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Review of 20 years of science and technology cooperation between China and IDRC

Department of International Cooperation
Ministry of Science and Technology

1999.10
Beijing

Contents

China-IDRC science and technology co-operation: An overview

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1 Background

The International Development Research Centre (IDRC) is a public corporation created by the Canadian government to help communities in the developing world find solutions to social, economic, and environmental problems through research. IDRC connects people, institutions, and ideas to ensure that the results of the research it supports and the knowledge that research generates, are shared equitably among all its partners, North and South. Since its foundation, IDRC has supported many research projects in developing countries all over the world and many of the researches have been very successful. IDRC has become a well-known and important development research organisation.

The science and technology cooperation between China and IDRC started in 1981 when an agreement of science and technology cooperation was signed. The Ministry of Science and Technology (MOST) (previously the State Science and Technology Commission) is responsible for the coordination and management of the IDRC supported projects in China. During the past 20 years, IDRC has supported about 150 collaborative research projects in China with a total funding of 25 million Canadian dollars. The researches in China supported by IDRC covered a wide range of scientific disciplines such as agriculture, forestry, health, environment, resources, information, economy and social development. IDRC projects in China also covered a wide range of geographic areas, from Shanghai, east of China to the Western China, Tibet and Xinjiang. The IDRC projects were in variety of ways such as collaborative researches, participation in international conferences, workshops, training courses etc. The benefits and outcomes of these collaborations are positive and obvious.

However, a complete assessment of the projects has never been done. Such an assessment would help both the MOST and the IDRC to improve their future cooperation, to help the MOST to improve its program delivery and project management efficiency, to develop its future science and technology cooperation with underdeveloped countries. To mark the 20 years of successful collaboration between the MOST and IDRC, an agreement was approached to carry out an review and assessment of all the IDRC projects conducted in China.

2 Aims of the review

The objectives of the assessment are several folds : 1) to summarise all IDRC projects in China conducted in the last 20 years, in order to find problems and lessons learned in the management and implementation of IDRC projects and this will be used as references by the MOST in designing and managing its future international science and technology cooperation; 2) to strengthen the information sharing and exchange among the host institutions of IDRC projects and project administration organisations. As a results of this goal, information on China-IDRC cooperation and projects will be launched at the web site of MOST; 3)to provide help for IDRC to develop its policy for future relation with China; 4) to help both sides to improve their efficiencies in future planning of research programs; 5) to provide experiences which can be helpful for China to develop overseas S&T development programs to the less developed countries.

3 Methodology of the assessment

The assessment will be carried out in a variety of ways. It is organised as a multiple level project review. The IDRC-China projects will be reviewed at project level, in which project leaders and team members will reassess their projects. Projects will also be assessed at institutional level, in which the projects will be categorised according to project fields which are usually managed by relevant institutions such as the Chinese Academy of forestry, Chinese Academy of Agricultural Sciences etc. At the sate (MOST) level, overall summarisation of the IDRC-China projects and general review will be conducted by the review team organised by the MOST which consists of expert and program officers. In parallel, IDRC is also setting up an review team, conducting assessments based on their knowledge, information and understanding. The two review teams will interact closely in all concerns of the assessment. Small sized workshops on exchange and discussion by key project leaders and staffs together with the IDRC review team will be held in several typical and representative institutions like the Chinese Academy of Forestry, Qinghua University etc. Further discussions will be made by visits to selected IDRC project sites in China in order to collect opinions of various project scientists and information on site. A visit to IDRC headquarters is planned to synthesise and finalise the final assessment report and to prepare for publication in both Chinese and English.

4 Expected outcomes of the assessment

The outcome of this assessment will be review papers by projects, host institutions, MOST review team and by the IDRC review team. These review papers are to be published in both Chinese and English. Meanwhile, information on IDRC-China projects will also be made available on the MOST web site. In such a way, the activities and achievements of the IDRC-China projects can be publicly accessed in China and abroad. A proposal for developing China's overseas science and technology development research with under-developed countries will also be prepared.

5 Summarised information on IDRC projects in China and statistics

5.1 Number of projects funded by IDRC in each year

Before the agreement of science and technology co-operation between IDRC and China signed in 1981, there was only one project of which the research relates to China and the implementation organisation was outside China. Since 1981 the number of projects funded by IDRC was steadily increased until 1986 in which the number of IDRC projects in China was peaked. Since then the number of projects subjected to decrease until to 1990, of which the number has been only 6, after that year there was a rise again of the project number, the number went to 13 in 1991. But after 1991, the number was going down again till the present (Fig. 1).

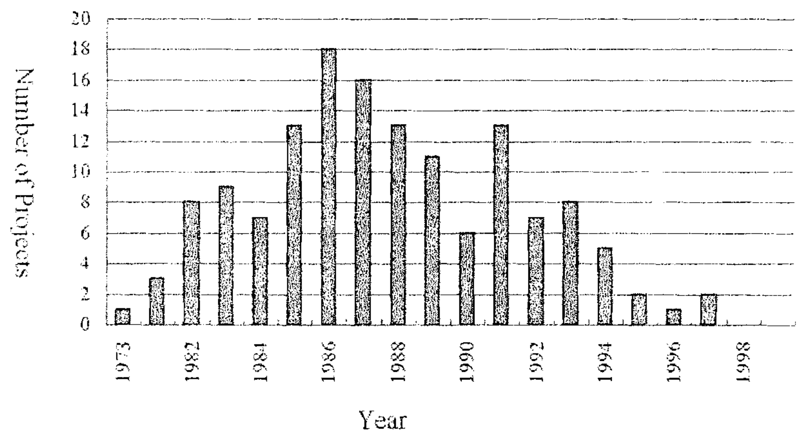

Figure 1, The number of projects granted by IDRC in China in each of the 20 years.

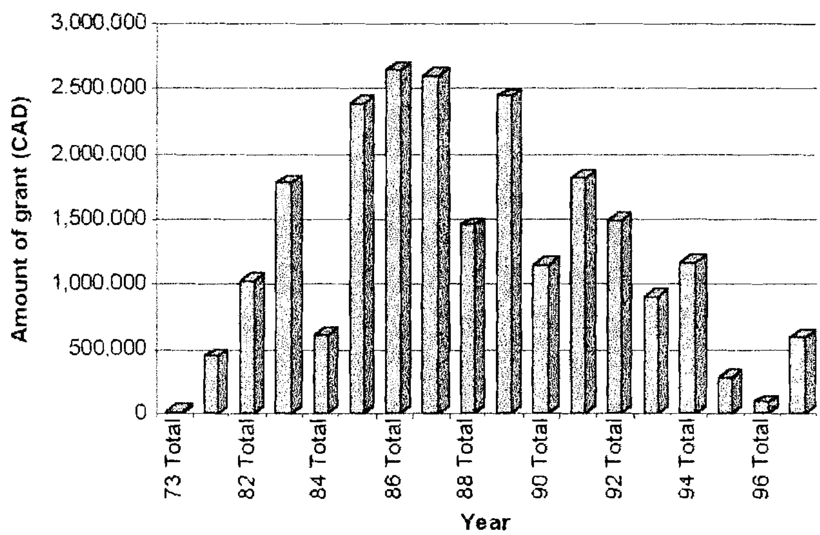

Figure 2, The yearly amount of IDRC fund granted to China

5.2 The yearly amount of fund granted by IDRC to China

The total funding of IDRC project in China in the past 20 years was estimated roughly close to 25 million Canadian Dollars. The amount granted in each of the years has generally followed a similar trend to that of the number of projects. The amount of fund increased from the early 80s with peaking in the mid 80s and since then decreased till present. There amount of project grant varied with small fluctuations from year to year under the general trend. The reason for these changes was not clear, but it may be probably affected by the IDRC overall R&D and finance policies.

Other reasons may be due to the IDRC staff changes in which personal research interests may have effects on approval of project proposals (Fig. 2).

5.3 Coverage of IDRC projects

IDRC projects in China covered a wide range of fields, such as, in order as the number of projects, social science and social development, agriculture, health, forestry, environment, information, resources, energy, engineering, earthquake and policy. The mostly supported fields are social sciences, agriculture, health, forestry and environment. This reflected in some extent that the priority of IDRC support was in the social development and human wellbeing (Fig. 3).

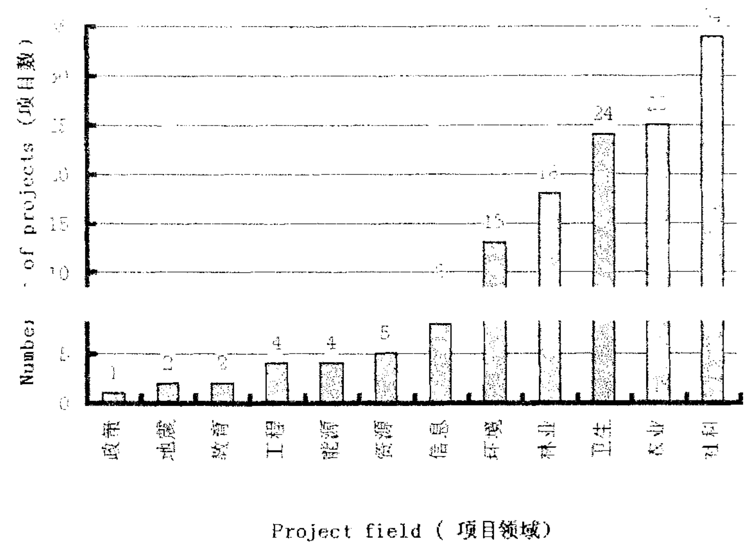

Figure 3, Number of projects granted by IDRC in each of the 20 years

5.4 Comparison of numbers of IDRC projects in various research fields

The number of IDRC projects in China (both implementing institution in China and in other country) totalled 151, of which 24% is in Social science and development, 18% is agricultural science, 17% of health care, 13% of forestry. Other fields are all under 10% (Fig. 4).

5.5 Geographic coverage of IDRC projects in China

IDRC projects in China covered a wide geographic area east from Shanghai to west China Tibet and Xsinjiang. About 24 provinces (or municipals) had been involved at least one of the IDRC projects. Some places had several or more IDRC projects. However, it showed that in the north-eastern China, Inner Mongolia and Linxia, no IDRC project have been supported there yet.

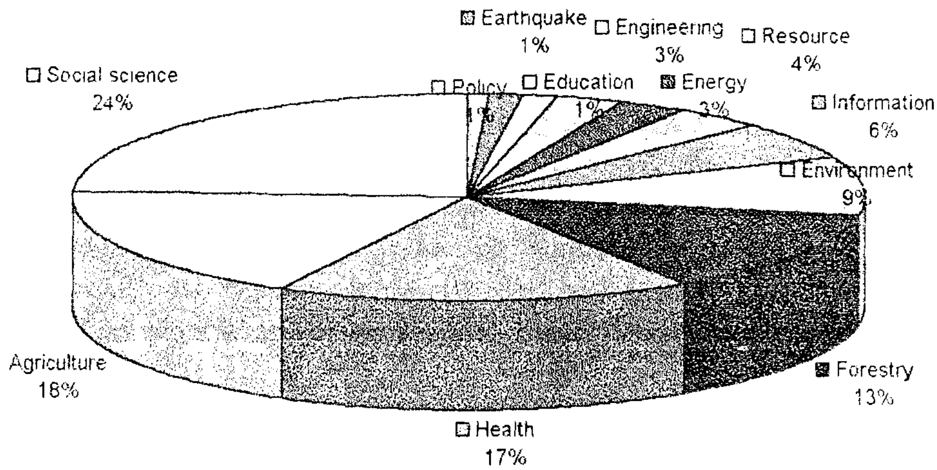

Figure 4, Proportion of project numbers in various fields

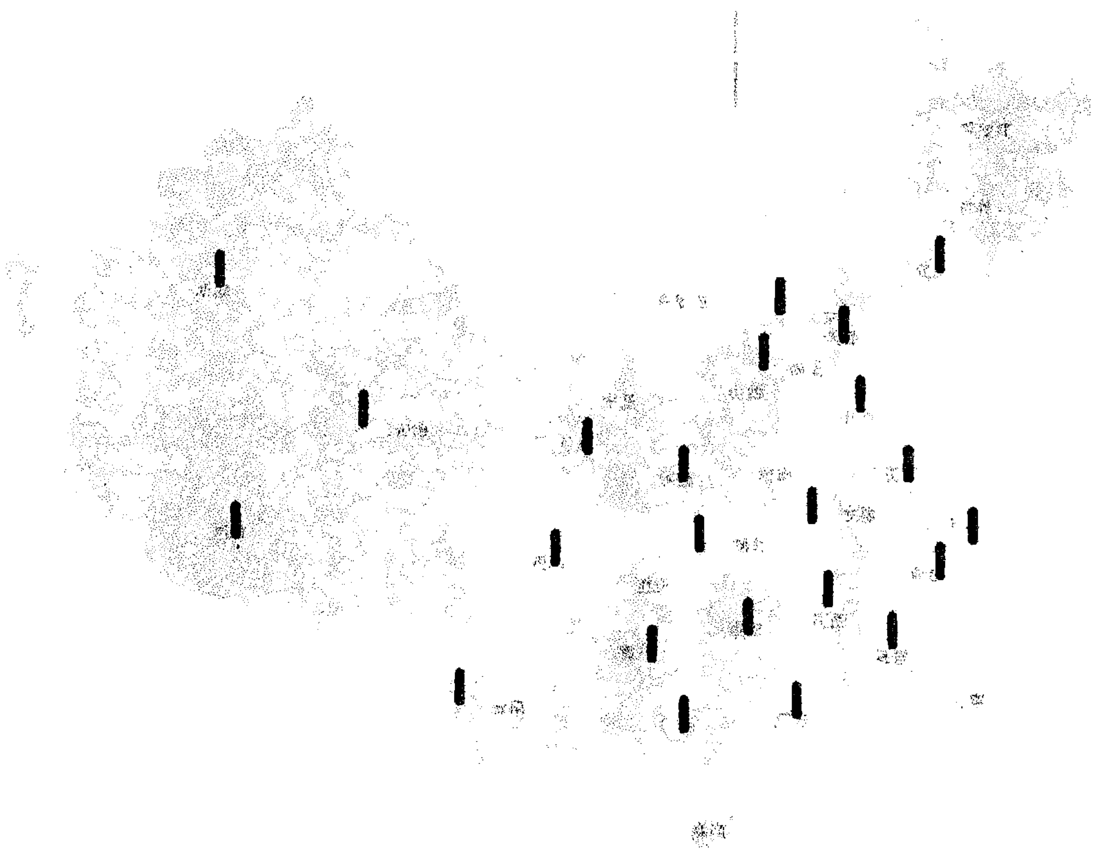

Figure 5, Geographic coverage of IDRC projects in China

6 Discussion

Many of the IDRC projects have achieved significant achievements, for example not to mention all, the Paulownia project conducted by the Chinese Academy of Forestry, the rapeseed project by the Chinese Academy of Agricultural Sciences and the Mountain area community based resource management project by the Guizhou Provincial Agricultural Academy have obtained high quality research results which have resulted in significant economic and social benefits by application of the research results.

It is evident that China-IDRC research collaboration have made obvious contribution to the progress of China's science and technology, capacity building of Chinese research institutions and scientists and the social and economic development in China. However, it also should be born in mind that we are not only to summarise our achievements and success, but also, as one the important task of the assessment, to identify imperfections and problems in any aspects of the planning and implementation of the projects. This will be of significant implications for improving our future collaborations.

With the rapid development of China's economy, international science and technology cooperation for China is being more important. China's science and technology may play more roles in supporting to under developed countries and the research collaboration may be expanded in future. How to make the program more efficient with benefits to bilateral interests of the co-operative countries, the IDRC case provides an excellent lesson.

International Scientific and Technological Cooperation at the Chinese Academy of Forestry

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1. The Present Status

1.1 Basic conditions

Up to the end of 1996, there were 248 institutions of forestry research and technical development in China, which are above the county level. There were 10,300 scientific and technological personnel in total. 2,400 research projects were conducted, 254 research results were registered, and 335 projects were awarded. 2,200 research papers were published, of which 131 papers were published in foreign journals.

The main research capabilities of China's forestry are distributed over such research institutions directly under the State Forestry Administration as the Chinese Academy of Forestry (CAF), and Beijing, Nanjing and the Northeast Forestry Universities as well as the provincial forestry research institutions.

CAF is a multi-discipline and comprehensive forestry research institution, which is directly subordinate to the State Forestry Administration. Its main tasks are set as follows: to be principally engaged in forest research of applied science while conducting its duly research of applied basic sciences, high and new technology, developmental research and research of soft sciences; to address the scientific and technological issues that bear overall, comprehensive, crucial and fundamental magnitudes as well as to serve the needs of forestry modernization. The main research areas include forest ecology environment, control of desertification, forest cultivation, forest resource information system and management, forest protection, agro-forestry, economic forests, flower, wood comprehensive utilization, cultivation and utilization of bamboo and rattan, chemical processing of forest products, wood pulp making, forestry economy and science and technological information, etc. There are 16 research institutes (centers) which are subordinate to CAF and distributed in 10 provinces, municipalities and autonomous regions, and they are undertaking important forestry research at state and other levels.

At present, the total staff and workers of CAF are 3700, of which the number of scientists and technicians is 1700 involved with 14 academic subjects of second level and more than150 specialties. There are 2 academicians of the Chinese Academy of Sciences, one academician of the Chinese Academy of Engineering, 138 research fellows, and more than 270 people with postdoctoral, doctoral and master degrees. CAF is entitled to the conferment of doctor degree in 5 subjects such as ecology, wood science etc. and to the conferment of master degree in 11 subjects, with 104 doctoral and master instructors. So far, 8 key ministerial laboratories, which are open to the public and 2 national research centers of forestry engineering technology, have been established. There are 4 national bases for forestry experiment with a total area of over 60,000ha, nearly 35,000ha. Of different kinds of experimental forests and demonstration forests have been planted. The library of CAF has collected more than 380,000 volumes of books and literature and subscribed over 1200 kinds Chinese and Foreign Journals. The 17 scientific and technological journals edited by the Academy and its research institutes are published regularly, enjoying a good reputation in the field of forestry research.

CAF is a principal implementing and organizing institution for the important forestry research projects. During the 9th Five-year plan, CAF undertakes 38% of the total national key forestry research projects, 40-50 research results are appraised while over 600 academic papers are published each year. By the end of 1997, CAF has totally gained 1007 scientific and technological results and published over 200 different kinds of monographs and translated books. Since 1978, 490 awards for different achievements have been obtained. Of all the 67 national awards, 42 awards are of the National Prizes of Scientific and Technological Advance including 1 special-class Prize and 3 First-class Prizes; 285 Prizes of Scientific and Technological Advance conferred by the Ministry of Forestry, of which there are 31 First – class Prizes. The pattern of the coordinated development has been formed among applied basic research, applied research and the research of high and new technology. The extension of scientific and technological results by CAF is increasingly strengthened. Over 60% scientific and technological results have been extended and applied to production. Since 1990, 161 research results from CAF have been listed in the state or sector extension plans. In 1993, CAF was endorsed as one of the first batches of research institutes with the right to conduct business operations with foreign countries.

CAF maintains exchange and cooperative relations in science and technology with research institutions of over 50 countries and international organizations. There are over 20 professionals holding important posts in international academic organizations. Each year, over 150 people are sent abroad for scientific and technical cooperation and exchanges and about 40 international cooperative projects are implemented.

Since 1980's, 110 cooperative projects have been implemented with total funds of more than 22 millions US dollars, which is equivalent to 40% of total scientific funds of CAF in the same period. In addition, more than 500 scientific researchers and managers are trained, and more than 34 times of international conferences, seminar and training courses are organized. Through international cooperation projects, seventeen great R&D achievements have been made, and many papers and treatises have been published.

The type of the international cooperative projects conducted by CAF can be classified into three types:

(1) purely financial aid projects, the foreign funder only provides fund without taking part in research activity. This kind of cooperation can be further classified into "Government Agreement Project " and " Free Application Project". The former refers to those projects based on agreements of scientific cooperation between governments or those projects financed by government organizations, while the latter refers to those projects based on free application of scientists and the contract with foreign funder and approved by the government;

(2) co-participating in cooperative projects, the foreign funder not only provides financial support but also takes part in research activity;

(3) other cooperative project, the international cooperative project or network that CAF takes part in as one partner but not the only beneficiary.

The cooperative projects conducted by CAF mainly comes from international organizations and developed countries including UNDP, FAO, ITTO, ACIAR, IDRC, ODA, International Foundation of Sweden, Forest Service of USDA, Life Wax Company of Japan, Korean Academy of Forestry, etc. The average duration for projects is about 3 years. However, some projects that focus on exotic tree species, cultivation and utility etc. last longer time, while other projects that focus on general survey and publication of research results etc are small in size and last shorter time.

1.2 Main Achievements

1.2.1 Research conditions greatly improved

Through international cooperative projects the research conditions at CAF have been improved. For example, the Wood Industry Institute of CAF has built a research center for comprehensive wood utilization and the National Center for testing and Monitoring Quality of Wood based Panels through UNDP projects. This improves not only research conditions at the institute but also the ability to supervise the quality of panel products from the industry. The Forest Products Chemical Processing Institute of CAF established labs for pulp and adhesive research through UNDP, IDRC and ACIAR projects.

1.2.2. A set of high level scientific research results achieved

Currently there are 25 achievements have been examined, among which 18 were awarded by the state /provincial governments for their contribution to the development of forestry in China.

For example, through IDRC project " Selection and Breeding of Super Clones of Paulownia", after eight years of survey and testing of 1100ha of experimental materials distributed in different climate zones, seven superior clones were selected from 1000 hybrid clones and 330 superior varieties distributed in more than 100 counties, achieved more than 30% higher of growth rate and awarded the first-class prize of science and technology advance of the Ministry of Forestry.

1.2.3 Personnel trained

Through international cooperative projects, quite a number of scientific and management personnel have been trained. For instance, in the fourteen IDRC projects, more than 120 scientists and managers attended lectures by foreign experts in training courses in China, 6 scientists got one year abroad training and 160 persons joined the international research survey and scientific seminar, 36 staff sent abroad for consulting services, 86 training courses were held in China and 5,600 persons were trained, 45 thousands of local technicians visited IDRC project demonstration sites, trained quite a number of local technicians and forest farmers. At the same time, quite a number of senior scientists and managers, including leaders at different levels at the CAF got training, some of them have already hold posts in the international organization, and become leading scientists of CAF.

1.2.4 Forest production and construction promoted

a) The application of scientific achievements improved

For example, the cultivation, breeding and processing of bamboo has become a leading industry in south mountain regions. Using the advanced technique of segment insertion of multiple varieties, CAF developed a GIS system and growth prediction system according pattern of growth, which can be used for decision making of exotic tree species planted in appropriate location. This method has become a powerful tool for deep understanding tree ecology and relevant research area, and has also been applied in study on climate change and breeding zone of tree species. Through the project " Study on symbiotic bacteria of Ecalyptus" conducted by the Institute of Tropic Forestry, CAF, a preliminary product-the TM series of bacterial chemicals, has been developed after seven years of technical studies of inoculation on different propagation materials such as seedlings and cuttings. The synthesis of Hebeloma bacterial root was developed for the first time in China. Quite a number of foreign experts were invited as cooperative project consultants, which helped a lot in successful implementing of the projects.

b) Introduced exotic tree species and established experimental bases for plantations

Through the cooperative projects, CAF introduced many superior exotic species, which greatly enriches the sources of tree species and provides new super planting materials to satisfy the requirement of appropriate species and provenance for plantations. Many experimental sites have been established. Since 1985, CAF has introduced eucalyptus resource from Australia, including 74 species, 388 provenances and 1301 families, established 130,700 ha of demonstration plantation sites and 7 million ha of fast-growing eucalyptus plantations; introduced species has bee introduced: 10 species, 102 provenances and 30 families of horsetail casuarina, and established 200,000 ha of demonstrate plantations in Guandong Province, etc. In addition, CAF has introduced seeds of bamboo and rattan from Asia countries.

c) Promoted commercialization of scientific achievements and the local economy

For example, finger jointing techniques developed from IDRC project " Wood utilization " by Institute of Wood Industry, CAF, have been applied to Gunhua forest farm, Congyang county, Hubei Province for making massons pine beam for trucks; the techniques for preserving fresh bamboo shoots developed from project "Comprehensive study of agroforestry in China" have been successfully applied in making tin products of fresh bamboo shoots products. Through ACIAR project "Study on cultivation of exotic eucalyptus" IN 1992- 1994, 70 ,000 km^2 of high-yield eucalyptus plantations have been established, greatly promoted the development of eucalyptus plantation in southern China

1.2.5 Gaining of international reputation

Successful implementation of international cooperative project greatly raises the reputation of CAF in the world. Since 1980's, CAF has cooperated with more than 50 countries in science and technology, and has established relationships with more than 40 international organizations and institutes. There are 15 people who have important posts in the international organizations. During the implementation of projects, CAF has organized successfully international conferences, training courses and seminars, including the 30th IUFRO Bureau Meeting, International Consultation of Bamboo Network, Asia Conference of Forest Genetic Improvement etc. Which were highly praised by conference attendees. Large number of scientists and managers attended international meetings and presented papers. With the achievements from international cooperative projects, CAF provided technical service to other developing countries, for example, our scientists were invited as consultants to Pakistan for Paulownia project, and to Malaysia for remote sensing project.

1.3 Main methods and experience

1.3.1 Chose project based on the actual situation of the country

a) Satisfying the need of rural development and social progress.Sustained management is the main topic for today's forestry. There are 300 thousands ha of tropic natural forests in the Hainan Province, which suffered from continued cutting, quality declined, species being imminent danger. Little progresses had been made since 1957 when the local government carried out a series of measures for finding a way for both economical and ecological benefits. Through ITTO project "Classified management for sustainable forestry in Hainan" implemented by CAF developed a sustainable management model, which could have 45 m3 /ha output while maintaining the stability and diversity of the tropical forest eco-system.

b) High priority to training activities. The following measures were taken for personnel training: giving lectures/advice for research / management by foreign consultants; (2) sending scientists/managers abroad for study tours /workshops & seminars/training , including advanced study for degree / as visiting scientists, etc.

1.3.2. Combining implementation of international cooperative research with national key projects

As the international cooperative projects were combined with key projects at state/ ministerial levels key scientific research projects, fundsand supports from different sources could be used. For example, ITTO project "Demonstration of sustainable utility of classification management of the tropical forest in Hainan Province, China" (phase one) implemented by Tropical Forestry Institute with input of 140,000 USD, was combined with the "Ninth-five year plan", After, it obtained 1.43 million yuan RMB at the first period, including 140 thousand US dollar from ITTO, got 1.9 million RMB from Hainan government and the investment from Forestry Ministry for 500 m^2 of labs, etc., resulting very smooth progress. The IDRC Paulownia project combined with the key project of Ministry of Forestry, established 8 experimental bases in 7 provinces, breeded out seven fine clones from 330 fine species in 200 counties and 1000 cross lines; trained more than 300 engineers from 200 counties of 13 provinces. Then these engineers trained about 30 thousand local researcher and parents, and planted 22 million seedlings of these fine clones.

1.3.3 Preparing proposals according to the key areas of the funder

It is important to have a clear understanding of the interests and key areas of the funder when applying for international cooperative research projects. For example, the " Fuel forest research" project proposed by Tropical Forestry Institute was soon put into implementation with IDRC's approval because of the energy shortage in the world and many countries were trying to exploit renewable energy resource at that time. CAF has very good relationships with IDRC. With the cooperation with IDRC, CAF implemented research on bamboo, Paulownia and cane projects in 1980s and multiple and netwok projects including agro-forestry, degraded land improvement research in 1990s.

1.3.4. Paying attention to demonstration and extension work

CAF encourages scientists paying more attention to demonstration and extension work so as to speed up the commercialization of research achievements to promote the development of forestry and local economy. 60% of research results from international cooperative research have been extended to the end users. For instance, the project "comprehensive research on agro-forestry in China/ plantation" by Research Institute of Forest Insects Resources in four years duration built 38.6ha high yield model stands and upgraded 1500 ha of wild stands in Sichuan, Yunnan, and Shanxi Province, held 23 workshops and trained more than 1500 local technicians.

1.3.5. Strengthening project management and services

a) Organizing a good project team.The Division of International Cooperation (DIC) of CAF is responsible for international cooperation at CAF. Once a contract of international cooperative project has been made, the DIC of CAF, will help to organize a project management team which is composed of scientists and managers. Attention has been made to ensure the stable of project staff to facilitate the successful implementation of projects.

b) Monitoring the whole process of project implementation. Rigorous rules and regulations and scientific management is the guarantee of successful implement of international cooperative project. CAF has strengthen management and made detailed rules to international cooperative projects, including project working plan, and implementation, project staff, fund, evaluation, and extension of project achievements, etc. Attention has been made to ensure all the project activities closely linked with project objectives. Project directors are asked to submit their progress report, annual report, and the final report of project in time and in good quality. Program officers from DIC visit project site whenever needed.

c) Offering good service to foreign partners. Understanding and friendship between partners is the base for a successful project. We always do our best to satisfy our foreign partner's needs for cooperative research, making them happy in China, and keeping them informed on the project progress. .

d) Always active in exploring new cooperative opportunities. CAF always encourage our scientists to be active in attending international conferences/workshops/seminars/training course to make friends and try to explore new opportunities for cooperative research. CAF has very good relations with UNDP, FAO, IDRC , ACIAR, ITTO and others and wish to further develop cooperation with them.

1.4. Existing problems

a) Lack of own funds

The international cooperation projects needed our own funds. But a few employs give little support or less. It not only affects the performance but also gives a bad impression. It is difficult to have others.

b) Lack of information on subjects and trends of international cooperation programs

The science and technology is developing so fast in the world. The climate of cooperation is very complicated. The competition is absolute, but cooperation is relative. The change and development of international relationships may affect to implement cooperation. Currently we rarely study the change of international climates, the trend of international science and technology, the popular topics of the international forestry research, and the fields and projects supported by international organizations and the leaders. Due to the situation that we can't get the information, we miss the fortunes.

c) Paid more attention to import rather than to export

It is popular to combine both technical and economic cooperation because they are mutually affected and promoted. The pure exchange of academy and techniques would not put cooperation further more. Many countries, especially the advanced countries and governments, had adjusted the cooperation policy. It demanded that the technical serve on the economic development and combine technical and economic cooperation. With the opening to the outside world, we have a chance to make an effort on the cooperation and exchange of technology. We change the mono technical exchange into the technical and economic trade. We would prefer to having both import and export cooperation. Meanwhile we would reduce the pure aid projects and increase the cooperation for both benefits. We will change the mono type of research into the comprehensive type combined with hotspot and popular topic in the world. Unfortunately our action is slower and looks weak and also low efficiency. We should change the situation to get the new feature. We should take advantage of the certificate for import and export approved by the government to enlarge the products export. We still serve on the technique requirement. Fortunately we begin to make a huge trade with the technical products. It doesn't mention the economic value and effect the others. We had been provided the aid cooperation projects in the past but we have to change because China has greatly changed.

d) Lack of the project efficiency and scale

Now the industrialization of science and technology is developing towards to be international, serious and large scale, otherwise it will not be suitable for the market and competition. From the record we find, we are lack of projects of efficiency and scale. A few projects are suited to domestic markets but lost the international markets. Even if in China, many projects are limited to cooperation on small scale, and not effective to promote development of forestry.

e) Lack of common standards in evaluating project achievements

This is a popular problem existing in the international cooperation of science and technology because there is quite different criteria among different countries in management of research results. It is not easy to manage because of many appraise standards used judge the projects. Now when an international cooperative project is finished, the collaborator's expert will assess the results. If it is up to the standard it should be passed. Unfortunately it can not get any kinds of rewards including the Chinese rewards.

2. Consideration on strategy and policy measures for international cooperative research

To further strengthen the R&D capability so as to promote the sustainable and appropriate development of science, economy and society by improving international cooperative research in China, recommendations are made on the strategies and policy measures for international cooperative research in China as the following:

2.1 To establish a better strategic pattern for international cooperation

More attention should be given not only to the inter-governmental cooperation and/or the cooperation with international organizations but also the non-governmental cooperation so as to increase opportunities and channels for international cooperative research.

2.2 To enhance the cooperation in key areas

According to the needs of forestry sustainable development and the key forestry engineering programs in China, key areas for international cooperation are identified as the following:

- Construction of ecological forestry engineering;
- Cultivation of timber plantations;
- Control and monitoring of disasters of forests;
- Efficient use of forest and bamboo resources.
- Control of desertification;
- Cultivation and processing of economical forests;
- Efficient use of non-wood resources;
- Management of agro-forests.

More emphasis should be given to the cooperative research on the development and application of biological techniques (gene transfer and fixation, molecule marking techniques), information network technique, remote sensing technique (monitoring and evaluation of forest resources and calamities) and nuclear technique etc.

2.3 To further improve the environment for international cooperation

- To build fist- level labs, research engineering centers, field experimental/monitoring stations, and to further establish international forestry research centers, technological development centers and training centers to facilitate international cooperative research and exchanges; to send promising young scientists abroad for high level cooperative research;

- To authorize more rights to research institutes/universities to facilitate international cooperation, including sign contracts on cooperative research and exchange visits with foreign partners if no government funding needed, and simply the procedures for scientists going abroad ;

- To establish foundations to support international cooperation projects.

- To put more emphasis on training of high level personnel for research and management for international cooperation research.

Final Report on *Paulownia* Project (China)
Project Phase 1 and 2 (1983 - 1990)

The Research Institute of forestry, CAF

1 Backgroud

Paulownia is one of the fastest growing tree species indigenous to China. It has a wide range of utilization - it can be processed into furniture, plywood and music instruments, etc; its leaves are high-quality feed for livestock husbandry; its flowers are rich resources of honey; and both of its leaves and flowers can be used for medicine. *Paulownia* is one of the best tree species for agroforestry. But the research in *paulownia* species, cultivation technologies, and utilization had been very poor for a long period of time. In 1982, the Chinese Academy of Forestry applied to the International Development and Research Center (IDRC) of Canada for research funds, and began the first phase of its *Paulownia* Research Project in 1983. In 1986, the second phase of this project began.

2 Main Objectives

2.1 Genetic Improvement of *Paulownia*

On the basis of the result of *paulownia* resources survey, scientists made provenance and plustree selection in the distribution zone, and breeded the supper clones through regional testing.

2.2 Synthetic Research on *Paulownia* Cultivation

On the basis of studying different appropriate ecological conditions for different *Paulownia* species, scientists made further researches in the silvicultural technologies of *Paulownia.*

2.3 Model Optimization of *Paulownia* Intercropping System

By making test for different models of *Paulownia* plantations which are of different density and different inter-cropped crops (testing objectives include: the microclimate, physiological changes of the intercropped crops, microbial communicties in the soil, soil chemistry, the annual increment and biomass of *Paulownia*, yield and quality of the intercropped crops), and evaluating the economic and ecological effects of different models, scientists selected the best models.

3 Expenses

IDRC Contribution:	Phase 1	356,000 CAD
	Phase 2	370,000 CAD

China's State Science and Technology Committee:

Phase 1	500,000 RMB
Phase 2	800,000 RMB

Local Government Contribution:

2,000,000 RMB (land contribution not included)

Chinese Academy of Forestry Contribution:

1,600,000 RMB (facilities and staff saleries)

4 Main Results

4.1 Genetic Improvement of *Paulownia*

4.1.1 Plus tree selection

Scientists chose 100 counties of which the geographic, climatic and vegetation features are typical in the 14 Provinces of *Paulownia* distribution for the plus tree selection. More than 500 technical staff participated in this research, after 6 month's of hard work, 10,000 plus trees was selected, among them 831 was finally selected.

4.1.2 Regional test of plus trees:

Scientists collected the root cuttings of the final selected plus trees, and began to make seedling and testing plantation measurement in six experiment stations that are respectively located in: Muzhou and Zizhong of Sichuan Province, Xingren of the Guizhou Province, Tongling of Anhui Province, and Yanzhou of Shandong Province, Minquan of Henan Province.

4.1.3 Interspecific crossing

More then 40 pairs of interspecific crossing were carried out. The first generation, after seedling selection, produced more than 1,000 superior individuals. These individuals was further proprogated, and tested in the above mentioned 6 experiment stations.

4.1.4 Trial plantation

In the above mentioned 6 experiment stations, scientists set up totally 212 ha of *Paulownia* clone and provenance trial plantations. Over 1,400 individuals have been tested.

4.1.5 Demonstration forests of Super Clones

After four years' testing and screening, about 30 best supper clones were selected. In order to adapt these clones, scientists set up demonstration forests, which the total area is 253 ha.

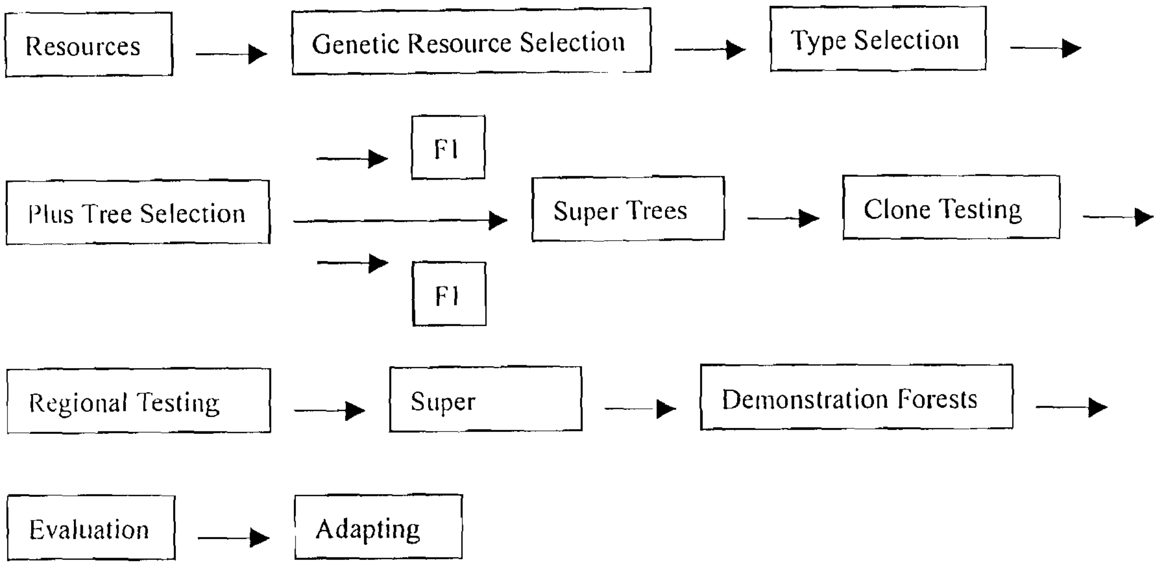
4.1.6 Superior clone identification

After 8 years' testing and screening, scientists concentrated on 7 superior clones that were selected out of over 1,400 individuals, they are C001, C020, C125, C161, CH001, CS001 and CH33. The above mentioned 7 clones grow 20 - 30% faster than local traditional species, the morbidity rate is 50% lower, and the trunk form was improved distinctively.

4.1.7 Conclusion

In the 14 years of hard work, the research in *Paulownia* Genetic Improvement has finished the following stages:

During this period, beside the local scientists and technical personnel in the above mentioned 6 experiment stations, other scientists from forestry research institutes of Anhui, Shaanxi, Jiangsu, Henan and Guizhou Provinces, and researchers from Henan Agricultural University. More than 120 people work on this subject from beginning to the end.



4.2 Research on Sets of Technologies for *Paulownia* Cultivation

4.2.1 High sturdy seedlings cultivation technologies

Before this research project was carried out, *Paulownia* root cuttings in nurseries usually need two years to reach the afforestation standards (height is over 3m, rhizome is above 4cm). After the technologies of high sturdy seedlings cultivation was developed, seedlings can reach the standard of out planting in one year, in the best testing nurseries, one year seedlings can reach the height of 4 - 5 meters, and the diameters of the stem can reach 6.2 cm, the highest seedling reaches 6.3 meters. The land was greatly saved. In the experimental area, this set of technologies extend at a rate of 200 ha per year.

4.2.2 Silvicultural technologies

Through comprehensive research, scientists identified the appropriate soil, ground water level, climate situation, and soil preparation and spacing for different species of *Paulownia*. Especially, scientists developed a set of new technologies for autumn afforestation, which has changed the traditional spring afforestation. Because this set of technologies can not only bring benefits to the growth of *Paulownia*, but also avoid damages to crops by spring afforestation, it has been widely adapted in production.

4.2.3 Other propagation technologies

Beside the above mentioned technologies of propagation by root cuttings, sturdy seedlings, this research project have successfully developed other propagation technologies, including propagation through tissue culture, seed, and short root.

4.2.4 Mixed forest of *Paulownia* and other tree species

This research experimented on many models of mixed forest of *Paulownia* and other tree species. The experiments on the models of *Paulownia* - Bamboo, *Paulownia* - Chinese fir, and *Paulownia* - tea were successful. These three models resulted in good economic returns and ecological effects, now has been widely adapted in production.

4.3 Integrated Evaluation and Model Optimization of *Paulownia* Intercropping System Research

4.3.1 Establishing experimental stations for *Paulownia* Intercropping system research

Since the spring of 1983, scientists have set up a experimental station in Tangshan County of Anhui Province, and began to intercrop *paulownia* with respectively cotton, wheat and maize, and at 6 different spacing, namely 5m×6m, 5m×10m, 5m×20m, 5m×30m, 5m×40m, 5m×50m, therefore there were 18 farm forestry models, three replications, all together 54 plots, 52 ha of experimental land. Scientists made comprehensive evaluation and model optimization of the *Paulownia*-crop intercropping (PCI), include evaluations of ecological effects (microclimate, solar radiation, energy balance and water utilization, soil features and nutrient utilization), biological effects (animal and microbial communities in the PCI system, growth, development and physiological changes of the intercropped crops and their quality and yield), economic effects (cost/benefit analysis of different lanting patterns). And social effects of the PCI systems, show that it is an efficient multiple function farming system suitable for development in this area.

4.3.2 Selection and optimization of PCI Models

Through the application of mathematical models for different PCI systems, the optimal level was reached based on scientific basis which helps in further developement of the PCI systems. Through ten years of comprehensive and large scale research, and the participation of more than 20 experts, this research achieved satisfactory results, the optimum PCI model was chosen - Model B. This model presents the highest land utilization ratio, the highest profit, and the highest yield in long term land management, and guarantees the production of crops. At the same time, this model can also increase the farmer's requirements for timber, fuel, feed and fertilizer. According to the result of calculating and comparing Model B with traditional models, the net present value, cost/benefit value and land expected value are increased respectively 70%, 42% and 70%.

4.3.3 Evaluation of research results

In the year 1990, the State Ministry of Forestry invited well-known experts to make evaluations for this project, the evaluation group universally believes that the result of this research project are of significant values for farm forestry production, the academic research was advanced in the international community.

5 Extension and Impacts

5.1 Extension of Superior *Paulownia* Clones

The selected 7 superior *Paulownia* Clones were heartedly welcomed by local farmers. Till 1992, the clones have been extended to 37,320,000 individuals in the whole country.

5.2 Extension of High Sturdy Seedlings Cultivation Technologies

In the 5 years from 1987 to 1991, the nurseries of high sturdy seedlings were extended to 10,000 ha in the scale of whole nation, which in average saved 5,000 ha of nurseries each year. These set of technologies has been used in agricultural production.

5.3 Extension of Afforestation Technologies in Autumn

From 1985 to 1990, this set of technologies had been adapted in Henan, Shangdong, Anhui and Shaanxi Provinces, etc. In Henan Province solely, more than 20 million *Paulownia* trees applied this set of technologies.

5.4 Extension of Optimal Models of *Paulownia*-crop Intercropping

From 1990 to 1991, this optimal Models of PCI had been extended to 40,000 ha in Anhui and

Henan Provinces.

5.5 Economic and Ecological Effects

According to the preliminary estimation in 1992, the comprehensive economic effects of this *Paulownia* Project had exceeded 1 billion Yuan (RMB). The result of this project was of significant for improving the ecological environment of China's agricultural areas, and the supply of fuels, timber, feed and fertilizers in rural areas; at least 1 million rural families was benefited from this project.

5.6 Extension in Foreign Countries

This research project had great international effects. Up to date, more than 20 nations have introduced and adapted *Paulownia* plantation, and receive seeds and root cuttings supplied by this project. Experts in this project was invited to provide consultancy for related institutions in India, Pakistan, USA, Thailand, Australia, Italy, Turkey and Malaysia, etc.

6 Rewards

6.1 Awards for Research Results of the Project

Several Subprojects received domestic rewards:

6.1.1 Selection of Superior *Paulownia* Clones - C020, C125 and CH33 was awarded First Prize by the State Ministry of Forestry in 1992, and Third Prize in national level in 1993.

6.1.2 Study on the Taxonomy, Distribution and Comprehensive Features of the *Paulownia* Genus was awarded Second Prize by the State Ministry of Forestry in 1989.

6.1.3 Comprehensive Evaluation and Optimization of *Paulownia*-crop Intercropping Models was awarded Second Prize by the State Ministry of Forestry in 1991.

6.1.4 *Paulownia*-cropping Intercropping Breeding Technology was awarded Third Prize by the State Ministry of Forestry in 1988.

6.1.5 Selection of Superior *Paulownia* Clones - CH001 and CS001 was awarded Second Prize in Shaanxi Province in 1987.

6.1.6 *Paulownia* Afforestaiton in Autumn was awarded Third Prize in Henan Province in 1989.

6.2 Awards for Individual

6.2.1 Prof. Zhu Zhaohua and Prof. Lu Xinyu, as members of the research group, were cited by the State Council in 1998.

6.2.2 Prof. Zhu Zhaohua and Prof. Xiong Yaoguo, as members of the research group, were awarded the title of "The Special Contribution Scientist of State" by the State Council in 1991.

6.2.3 Prof. Zhu Zhaohua, Project Leader, was awarded " Man of Trees" by the International Rechard St. Barbe Baker Foundation

6.2.4 Prof. Zhu Zhaohua, Project Leader, was rewarded by former Prime Minister of Canada for his contribution in leading this international cooperation project in 1995.

Report on the Farm Forestry Training Program in China

International Farm Forestry Training Center, CAF

1 Background

1.1 China is a developing country with populated population and limited land. The average arable land for each farmer is less than 0.1 Ha. In order to cater for the numerous demanding of increasing population for food, timber, and other basic needs, people indiscriminately exploit forests and other natural resources. This led to forests depletion, soil erosion and land degradation. In order to ameliorate effectively the ecological environment of agriculture, meet increasing demands for food, forest products, obtain higher biomass and economic returns from per unit area, agroforestry technology has been practiced in China for a long time.

1.2 China has a long history of agricultural research and development. As combination of traditional and update technological agroforestry system, various farm forestry models are being etensively developed in different regions of China. Some of these agroforestry models have been widely adapted and resulted in great benefit. The most famous ones are:

1.2.1 300 million ha. of farm land have been protected under shelterbelt forest system in China

1.2.2 1.8 million ha. farm land in North Center Plain have been intercepted with *paulownia* and 0.2 million ha. with date, 0.13 million ha with case trees and or shrubs and 0.26 million ha. with fruit trees.

1.2.3 Small wathershed control system in semiarid Loess Plateau.

1.2.4 Diversified slope farm forestry systems involved timber and cash tress as perennial component and agricultural crops, edible mushroom, husbandry and traditional medicinal herbs as under stories in subtropical hilly areas.

1.2.5 Multiple stories, high benefit combination of agro-forest-fish .

1.2.6 There are large scale of various farm forestry model in the tropical and south subtropical regions such as Rubber + Coffee + Tea; Rubber + Sugar cane + peanuts; Eucalyptus + pineapple.

All these above mentioned models are characterized with large scale, high economical and ecological benefits, reasonable structure, scientific design and matured technology. It would play an exemplary roles for other developing countries.

1.3 Since 1982, the projects, supported by IDRC, such as projects of bamboo (1982), Paulownia (1983), rattan (1985), fuelwood (1986), and wood utilization (1986) have already turned out excellent results. With the superior planting materials (paulownia, bamboo and rattan, tropical fuelwood species, etc.) developed by the projects, a lot of agroforestry model systems have been also developed. All the projects make the local people directly benefited from the research results. At the same time, the research results are also valuable to other developing countries.

1.4 Though China has achieved a great progress and rich experience in farm forestry, the international exchange is limited due to language barrier. International exchange and international farm forestry training center or courses therefore is necessary as a window for sharing experience with foreign countries especially developing countries.

1.5 Under the support of IDRC, CAF held the first International Farm Forestry Training Course during May 1 - 30, 1987. There were 27 participants from 10 countries in Asia. The training mainly gocused on the cultivation and utilization of paulownia and bamboo and agroforestry models. The first training course achieved fruitful success.

2 Objectives

2.1 To share the results and experience of farm forestry research and application in China. (Two training courses in China)

2.2 To increase the capacity of and get more opportunities for CAF in international exchange.

3 Expenses

The total budget of the project is 168,372 CAD

CAF administered: 105,008 CAD

IDRC administered: 63,364 CAD

4 Progress

4.1 Success of the three international training courses

8 - 28 September, 1991 International Farm Forestry Training Course (Warm Temperate Zone and Tropical Zone Farm Forestry Models)

6 - 26 September, 1992 International Farm Forestry Training Course (Warm Temperate Zone and Sub-tropical Zone Farm Forestry Models)

6 - 26 September, 1993 International Farm Forestry Training Course (Tropical Zone Farm Forestry Models)

Year	Number of Participants	Number of nations
1991	9	5
1992	23	13
1993	12	5

4.2 Training materials

4.2.1 Editing and printing the training materials in agroforestry Volumes 1, 2 and 3, totally 450 pages. 1500 sets were printed.

4.2.2 Publication of the book Agroforestry System in China (216 pages, 1991). 2000 copies were printed.

4.2.3 Training materials for each training course, totally 3 books, 580 pages, 100 copies were printed.

4.2.4 Video series on China Agroforestry Models, totally 8 parts, each part lasts 18 minutes, all together 144 minutes.

4.3 Facilities

A Toyot Station Wagon, 14 seats

A multisystem VCR monitor

A film projector

A electronic typewriter

The above mentioned facilities has contribute greatly to the promotion of the capacity of the training center.

4.4 Establishment of Permanent Farm Forestry Training Center

In 1991, at the approval of the Chinese Academy of Forestry and the financial support of IDRC, the International Farm Forestry Training Center was established. Since its establishment, the Center has accumulated rich experiences by carrying out a number of international and domestic training courses, and international cooperation programs, now has become well -known in the field of farm forestry to domestic and international communities.

5 Impact of the project

5.1 Success of a series of international training courses and workshops

After the success of the three international training courses in 1991, 1992 and 1993, the training center continued to receive supports from IDRC, especially supports from the State Ministry of Science and Technology (MOST, former State Committee of Science and Technology- SSTC), and continued to carry out various types of training courses and workshops.

Time	Name	Sponsor	Partici-pants	Nations
19-30 /09/94	Training Course on Farm Forestry and Agroforestry Technology Extension and marketing in Asia Pacific Region	INFORTRACE, IDRC, APAN, RECOFTC	29	12
7-20 /10/95	International Training Workshop on Popar and Paulownia Cultivation and Their Roles in Agroforestry	*INFORTRACE, SSTC, IDRC	31	14
16-30 /09/96	International Training Workshop on Tropical Farm Forestry and Multipurpose Tree Species	INFORTRACE, SSTC, IDRC	18	12
05-18 /09/97	International Training Workshop on NTFPs in Tropical Zone	*CAF, SSTC		
05/09/98	International Training Workshop on Genetic Resource and Cultivation of Paulonwia	*CAF, SSTC	9	8
29/03/99 - 02/04/99	Workshop on Model Forestry in China	MOST, CAF, IMFN, SSTC	45	4
11-23 /04/99	International Workshop on Bamboo and Rattan Biodiversity Conservation, Utilization and Technology Exchange	SSTC, INBAR, *CAF, MOST	31	18
1995 - 1999	Four Training Workshops on Land Utilization and Forest Environment with Cottbus University of Gemany	INFORTRACE, COTTBUS Univ.	Total:61	

Since 1994, besides the above mentioned 11 International Training Courses and Workshops, INFORTRACE, cooperating with Ford Foundation, Winrock International and IDRC, has also held two training courses on Forest Resource Management and Social Research, a training course on NTFPs and a training course on International Cooperation Program Management for related domestic scientists and administration officials. Famous foreign experts were invited to teach in these courses, the total number of participants is 125. These training courses played an important role in promoting the qualification of related Chinese experts and administration officials.

5.2 Training of High-qualified Teaching Force

Through the 9 years development, INFORTRACE has become an efficient, refined and opening training center. Permanent staff of the center was reduced from 9 to 4, yet, the international training activities continued to develop steadily. Beside the mayor experts of the Chinese Academy of Forestry, INFORTRACE has also integrated the training substances from Beijing Forestry University, Chinese Academy of Sciences, and the Chinese Academy of Social Science, therefore, the content of the training courses has been extended to a wider range than farm forestry. This has promoted the training standard to higher levels.

5.3 Consummation of the Training Materials

On the basis of IDRC training project, INFORTRACE made necessary further improvement of the training materials. Over 2,000 pages of training materials was edited, and the following books were published: Integrated Research in Farm Forestry (278 page, 1995), Participatory Forestry in China (308 pages, 1987), China's Mountain Area Forestry Development Forum (339 page, 1987), Non-timber Forest Product and Forest Biodiversity (350 pages, 1999).

6 Evaluation of INFORTRACE

In order to promote the training capacity and standard of INFORTRACE, participants of each training courses or workshop were asked to make secret evaluation on all aspects of the training courses and workshop, they had provided INFORTRACE with their valuable experiences and suggestions. The evaluation items include:

6.1 Training Objective

6.1.1 Objectives to attend this training workshop.

6.1.2 New knowledge achieved

6.1.3 Value of the course

6.1.4 Recommendation of the similar course to others

6.2 Presentations

6.2.1 Contents of the presentations

6.2.2 Sequence of the presentations

6.2.3 Techniques of presentation

6.3 Training materials and facilities

6.3.1 Necessity of the training materials

6.3.2 Conditions of the teaching facilities

6.4 Field Visit

6.4.1 Necessity of the field visit

6.4.2 Selected sites for field visit

6.5 The logistics

6.5.1 The accommodation

6.5.2 The Meals

6.5.3 Other services

7 **General Comment**

According to the result of the evaluation of training courses from 1991 to 1994, the average scores for each item is as the following:

Content	**Courses order**	**Training Techniques**	**Materials**	**Facilities**
85	85	88	88	86

Field Visit	**Selected Sites**	**Accommodation**	**Meals**	**Other services**
88	89	72	84	86

The average scores for each item of the evaluation of training courses from 1995 to 1999 is as the following:

Training Subject	**Theoretical Level**	**Practicality**	**Presentation**
97.2	83.3	93.3	85.6

Case Studies	**Facilities**	**Accommodation and meal**	**Transportation**
87.2	80.5	93	97.3

100% of the participants believes that the training courses are useful and helpful to their work and researches. The average rate of knowledge increase in the same academic field of each participant is 30%.

Because a great part of the participants of our training courses (except student training courses) are senior scientists or senior management officials - above 80% had got doctorate degree, 75% are senior researchers and management officials, including Vice Ministers, Director Generals of Forest Research Institutes and Director Generals of the National Forestry Institutes of other countries, we should deem that the increase of 30% in knowledge and the above high scoring indicate the result of the training courses is very excellent and fully satisfactory. Dr. Flore, Senior Program Officer of IDRC, who used to be responsible for IDRC training courses, told me that though he had supported more than 20 training projects, he had never seen participants expressed such high satisfaction.

BAMBOO (CHINA)

——Supported by International Development Research Centre of Canada (IDRC)

Fu Maoyi
The Research Institute of Subtropical Forestry
The Chinese Academy of Forestry

The project of Bamboo (China) is one of the earliest projects supported by International Development Research Centre of Canada (IDRC) after China implement the policy of economy reforming and opening to the world. It is also the first one taken on by the Chinese Academy of Forestry (CAF) supported. It is one test of comprehensive ability in organizing and participating in international academic exchanges and cooperation actives for our academy to carry out this project. The project was undertaken by the Research Institute of Subtropical Forestry CAF (RISF-CAF) in cooperation with the Research Institute of Wood Industry CAF, The Research Institute of Forestry Product and Chemistry Industry CAF. The project, including two phases of 3-year-term and one two-year postpone, began from April 1, 1982 and ended on July 31, 1990, lasting 8 years and 3 months. 492,200 CND Dollars of the total finance aid from IDRC was received during implementing this project.

1. Background

1) Bamboo Resource in China

China is one of the major bamboos growing countries in the world. It is rich in bamboo species resources. The known species are over 500, belonging to 39 genera. According to the meristematic propagation characteristics of bamboo rhizomes and the properties of their formation pattern, they can be put into three categories, namely monopodial-type (i.e. scattered type), sympodial-type(i.e. fascicular type), and mixed type. Most of the monopodial species belong to *Phyllostachys* genus. The area of *Phyllostachys pubescens*, a species originated from China and has been introduced to some countries, such as Japan, South Korea, and so on, is 2.8 million hectares, amounting to 70% of total area of China's bamboo stands. The yield of Moso bamboo is much higher than that of the others. Its annual output of high-yield stand is 27 tones of fresh weight of bamboo culm per hectare, which is much higher than that of the other forests. The bamboo stands received artificial care are often pure and extends to several square kilometers or some times even several dozens of square kilometers, covering a large area, where as the natural bamboo stands are usually mixed up with broad-leaved trees and coniferous trees. Sympodial-type has a greater variety of bamboo species than the monopodial-type. The major ones include *Bambusa*, *Neosinocalamus*, *Dendrocalamus*, and so on. Among the mixed type species, the major ones include *Pseudosasa*, *Pleioblastus*, and so on, in which one of species, *Pseudosasa amabilis (McClure) Keng f.*, is world famous. Its trade name for export is Zhengjiang bamboo. Which was ranked as the first class bamboo and "the angler's bamboo" in the United States and some other west countries

2) The Utilization of Bamboos in China

Bamboo is an important part of China's forestry production. We often use the term "bamboo and timber production" to refer to the production of forest products. The utilization of bamboos can be traced back to the primitive society, about 6,000 years ago. Bamboo implements are found in the recently discovered ruins of primitive commune in Hemudu of Yuyao County, Zhejiang Province. Needless to say, Bamboo utilization is far more extensive in modern times. For instance, in building industry, bamboo is used for scaffolding and for scaffold foot-board; in fishery, it is used for net-spreading support; in farming, it is used to make small farm tool handles; it is also used to make paper and pulp. Bamboo is woven into a great variety of household and farming utensils. Bamboo handcrafts are very common in China. It is carved or woven into various kinds of handcraft articles, and there are many kinds of bamboo shoot products and it is utilized in many ways as well. Bamboo helps to make the surrounding green, to make the air clean and to conserve water and soils. The beautiful landscape of the scenic spots in some of the rural and urban areas in the middle and south part of China is mainly formed by bamboo. Bamboo is good for making the soil more solid and for strengthening the dyke for it has twisted, gnarled and tangled roots. So it is often used to protect the banks of river from erosion or to conserve water in mountainous area. The small ones, which have exquisite shape and pattern, are used to make potted landscape (miniature trees and rockery). In short, Bamboo is closely linked with the daily life of the people in China. To some farmer, bamboo planting is their main farming and bamboo processing is their main industry. It is also the main income source of local economy in many mountainous areas.

3) Bamboo Cultivation Techniques in China

The recorded history of bamboo cultivation in China is very long and rich experience has been accumulated. Due to the great variety of species in a vast area, various techniques have been established. For example, there is a big difference between the cultivation techniques of monopodial species and that of sympodial species. The afforestation of the former is made through transplanting mother bamboo plants, while the latter is made through cuttings. The bamboo rhizome guiding technique can be used to quickly enlarge the forest area of monopodial species while the common method for enlarging the forest area of sympodial species is planting. There has been established a set of traditional techniques for cultivating bamboos that have an economic value. Taking *Ph. Pubescens* for example, through reserving and cultivating bamboo shoots to increase individual plants and to improve their quality; through clearing away weed, bushes to purity mixed forest; through loosening soil and fertilizer application to improve forest soil and its fertility so as to promote the growth and regeneration of bamboo rhizomes; through rational top-cutting to prevent snow-break and snow bent; through bamboo rhizome guiding to make the bamboo rhizomes extend towards the edge of the forest in order to enlarge the forest area; through rational felling to maintain the dominant young and adolescent age of the mother bamboo to promote the putting forth of the bamboo rhizomes and bamboo shoots; Disease and pest control is also a part of the cultivation techniques, and so is the integrated utilization of *Ph. Pubescens*. The cultivation techniques of other monopodial species are more or less the same.

4) Bamboo Research in China

i. Research on the management of bamboo: the main researches are concentrated on Moso bamboo, including afforestation, management, diseases and pests control, as well as basic theory of high-yield techniques of Moso bamboo.

ii. Researches on survey, collection and taxonomy of bamboo species: Emphasis has been put on the survey, collection and taxonomy of bamboo species in the Yangtze valley and the bamboo growing regions to the north of it. Since 1974, We have conducted successive surveys of bamboo species in Zhejiang Province, Fujian Province, Sichuan Province, Guizhou Province, Jiangxi Province, Hunan Province, Guangxi Autonomy Region, Beijing Municipality. Some species have been introduced into the Anji Botanical Garden of Bamboos built jointly by the Research Institute of Subtropical Forestry, CAF and Anji County Government. Apart from some of sympodial bamboo species which were introduced from the South and failed to survive under the cold winter, the rest is growing well. More than 100 species under 14 genera have been preserved and the area of the Botanical Garden of Bamboo has been enlarged to 13 hectares.

iii. Research on physical and chemical characteristics of bamboos: We have done researches on the determination of the physical properties of 30 species and cellulose content of 33 species off-and-on, and on determination of content of the fat, sugar and crude protein of bamboo shoots. We have also done some researches on the determination of the effect of the management measures on bamboo quality.

5) The Problems Existed in Bamboo Production and Problems Need to be Studied

More than 70% of the total area of Moso bamboo stands in China is low-yield bamboo stands with an annual output of bamboo culm of only 7 tones per hectare. At present, the total bamboo timber production can only meet half of the national demands. Some urgent technical problems for Moso bamboo stand cultivation, such as the soil management, fertilizer application techniques, the adjustment techniques of bamboo stand structure and the techniques for protecting and cultivating bamboo shoots, remain to be solved. Therefore, to work out technical measures for further increasing the output of Moso bamboo stand is an urgent necessity. The taxonomy and seed selection research work is in a bit of confusion. Different species with the same name and the same species with different names is a common phenomenon. Some species should be identified and determined whether they are new species or not. Except a few bamboo species, such as Moso bamboo, little research work was done on the biological characteristics, especially the resistance to cold, drought and diseases of most of the species, and their economic characteristics are little known. This hindered the exploration and utilization of these species. The physical and chemical properties of bamboo culm and the nutrients of bamboo shoots need to be studied in depth. Otherwise, the modification, chemical utilization and the evaluation of the economic characteristics of each species will be hindered. For this purpose, we raise some urgent problems closely related to bamboo production needed finance support in order to obtain research results in a short period of time, so that the bamboo farmers can apply them to promote production, thus to increase bamboo farmer's income and release the pressure on bamboo supply.

The details of research content of Bamboo (China) project as follow:

Phase I:

i) Survey, collection and taxonomy of bamboo species, the selection of cold-resistant bamboo species and establishment of Botanical Garden of Bamboo of Anji.

ii) Experiment on fertilization of Moso bamboo stands.

iii) Determination of the physical and chemical characteristics and the nutrient analysis of bamboo shoots of the major bamboo species in China

Phase II:

i) Establishment of Botanical Garden of Bamboo of Anji and studies on biological properties, including bamboo species introducing, studies on biological properties and cold-resistance of various bamboo species.

ii) Study on fertilization in Moso bamboo stands with different end uses and on nutrient cycling in ecosystem of Moso bamboo stands, including fertilization in Moso bamboo timber stands and bamboo shoots stands, nutrient cycling in ecosystem of Moso bamboo stands, effects on chemical-mechanical properties of bamboo culm and nutritional properties of bamboo shoots after fertilization.

iii) Bamboo preservation researches.

Postpone-term:

i) Economic analysis of fertilizing in Moso bamboo stands with different end uses

ii) Survey of sympodial bamboo resources in China

2. Execution of the Project

1) Financial situation (IDRC contribution)

IDRC funded 241,400 CND Dollars for the phase I, in which 186,706 CND Dollars were sent and spent in China. It was used for buying instruments and equipment, one vehicle, afforestation and land preparation, laboratory analyses, purchase fertilizers and insecticide, and so on. The expenses of project basically accordance with original budget.

IDRC funded 224,100 CND Dollars for the phase II, in which 179,100 CND Dollars were sent and spent in China. It was used for buying instruments and equipment, vehicle maintenance and buying a new vehicle, laboratory analyses, purchase fertilizers and insecticide, and so on. The expenses of project are a little over the original budget because of the RMB inflating and the raising of local travel fare.

IDRC funded 26,700CND Dollars for the postpone-term, which were sent and spent in China. It was used for field surveying, fertilizers and a symposium on sympodial bamboo.

2) Government investment

Chinese Government paid more attention to this project, and it invested 826,430 yuan(RMB) of total finance investment without including material object investment, for example, Lands, offices, and so on. In which, 206,800 Yuan (RMB) of budget has been planed to invest in phase I, but the actual expenses are more over the budget, up to 459,630 Yuan (RMB). The reason is that a new office building with 800m^2 area which spent 145,000 Yuan (RMB) and one bridge spent 90,000 Yuan (RMB) have been built in Botanical Garden of Bamboo of Anji. The most of overspend part comes from local government, and the rest comes RISF-CAF and Lingfengsi Forest Farm of Anji County. 171,800 Yuan (RMB) of budget has been planed to invest in phase II, but the actual expenses are up to 261,800 Yuan (RMB). The two-third of financial investment comes from allocation of CAF, the rest comes from forest department of local government of Fujian and Zhejiang. 105,000 Yuan (RMB) of budget has been invested in the postpone-term,

3) Instruments and equipment

Two vehicles, two microcomputers, one Canon duplicator, one Li-1600 stoma analysis, one low temperature incubator, one deep freezer (-45°C), one spectrophotometer, three sets of field shelters, one set of motor pump and accessories, four sets of microclimate instruments, and other small instruments and equipment, have been bought. All instruments and equipment have been used normally in the project duration. Moreover, they played an important role in this project, especially two vehicles brought successively provided convenience for field-trip. Up to the project end, most of big instruments can continually be used normally, which will be useful for research continually in future.

4) Training

The project leader of the Phase II, Prof. Fu Maoyi, supported by IDRC, took a refresher course in Toronto University, Canada. He majors in forest economy, trees genetic and breeding, and application of computer. The members of project group, Mr. Cheng Yanping, Mr. Xie Jinzhong, have been trained in English, application of computer respectively.

5) International exchanges actives

Totally, two groups including 5 members of project group in the phase I visited Japan, Singapore, and Thailand, India respectively, in the field of bamboo stands fertilizing, bamboo cultivation and utilization. The members of project group have also beard the preparatory work of "International Bamboo Workshop, Hangzhou, China" with more than 100 participants from 30 countries and international organizations in October 1985. Moreover, 2 members presented their papers in this workshop.

Totally, seven groups including 10 members of project group in the phase II visited Japan, Singapore, Thailand, India, Canada, Malaysia and Germany or attended related to international academic meetings respectively.

These actives promote exchanges and cooperation between China and other countries, expand impacts of our country bamboo research on the world, and make more opportunities for further international exchanges and cooperation.

6) Researcher team of project

Totally, 36 researchers were involved in this project, in which 20 staff from our institute. Most of researchers in the project are a young- or middle-aged technical backbone with medium or senior title of a professional post and higher theoretical level, and have an important influence in bamboo research aspect of China.

7) Achievement of the project

The project of Bamboo (China) through 8 years implement has successfully finished the research task and obtained noticeable achievement. The details of content of achievement as follow:

i) Totally, 138 bamboo species have been introduced into Anji bamboo Botanic Garden in past 6 years, except the 19 species dead by cold, and now 221 bamboo species are kept in the garden and the area were enlarged into 17 hectares. It has become one of the most important bases for bamboo research and education. It is decided to determine the cold-resistance of 64 bamboo species in the genus *Phyllostachys* by recovery method with conductivity measurement, and to select 30 economic species with high ability of cold-resistance for developing in North China depending on investigation of their situation of living through winter in North China. These 30 species mentioned above have been colonized into Beijing Botanic Garden, which promoted transplanting of parts of ornamental bamboo species from south to north. The biological properties of 30 fine economic bamboo species, including growth properties of shoot stage, morphology and germination of bamboo pollen, have been researched.

ii) The nutrient circle of ecosystem in Moso bamboo stands, including biomass of Moso bamboo stands, bamboo leaf litter and its decomposition, nutrient input from throughfall and loss from run-off, have been studied and the intensive techniques of Moso bamboo stands with different end uses, including properly dosage of fertilizer, fertilizing season and method, have been proposed. Namely, if it is adopted for Moso bamboo timber stands to fertilize 375kg·ha^{-1} compound fertilizer (NPKSi) in furrow in every early Spring, its culm yield and net income can be increased 46.9%, 832.2 Yuan·ha^{-1} respectively. If it is adopted for Moso bamboo shoot stands to fertilize 3,945kg·ha^{-1} compound fertilizer (NPK) twice every year — in early Spring and early Autumn — in furrow, each time 50% of total dosage respectively, its shoot yield and net income can be increased 20,000 kg·ha^{-1}, 7000Yuan·ha^{-1} respectively. If it is adopted for Moso bamboo pulp stands to fertilize 225kg·ha^{-1} compound fertilizer (NPK) in furrow in every early Spring, its culm yield can be increased more than 70%.

iii) The physical properties of seven bamboo species such as Moso bamboo, the chemical properties for paper-making of ten bamboo species such as Moso bamboo, *B. textilis*, and nutritive components of ten species such as Moso bamboo, *P. Iridescens*, *D. oldhami*, *D. latiforus*, *P. Praecox*, have been determined systematically. It has been proposed that the elder's culm properties is better than the young's, and culm properties of over 6 year old of Moso bamboo and over 2 year old of *B. pervariabillis* are stable, so it is proper for construction purpose to select the elder bamboo culm. It is better for pulp to select 1-3 year old bamboo culm and it also is reasonable for pulp-making and picking up furfural to consider the comprehensive utilization of bamboo culm. The bamboo shoots are rich in sugar content, rather high in protein content and edible cellulose, and have almost all amino acids needed by human being. In both monopodial and sympodial bamboo species, there are many kinds of edible shoots being ideal vegetables, which should be developed much.

iv) In the aspect of bamboo preservation research, observation on natural mould-resistance of bamboo timber of eleven bamboo species in various storing condition have been done. Moreover, treating methods for bamboo timber with different preservatives have been researched, and 2 good preservative medicaments, i.e. BBP, FACP, have been selected.

v) The resources of sympodial bamboo, nearly occupied one-fourth of total area of bamboo stands in China, have been pre-investigated, and literature on sympodial bamboo research also has been searched. Seven sympodial bamboo species, such as *D. brandisii*, *B. tulda*, *B. strictus*, *B. arundinacea*, have been introduced into Guangxi and Guangdong from India, and seven hectares area of nursery has been established

In addition, more than 30 papers have been published in international or domestic academic magazines or collections.

3. Evaluating the Effects of the Project on Research, Economy and Society

The project has not only come up to advanced world standards on academic levels, but also obtained noticeable achievement on effects of economy, ecology any society.

1) Transforming and application of research achievement of the project

Seven training courses of "Bamboo Cultivation and Utilization", supported the Chinese Ministry of Forestry and project of "Bamboo Technology Utilization in China" supported IDRC, have been held in several provinces of the main bamboo growing areas in South China, and totally several hundreds participants who are officers from basic unit of forestry technology popularizing and some bamboo farmers from the main bamboo growing areas have received technical training, which made it to be rapidly popularized and widely applied for achievement of bamboo stands intensive cultivation techniques with different end uses in several provinces of the main growing areas in South China, such as Zhejiang Province, Fujian Province, Jiangxi Province, Hunan Province, and Anhui Province, and up to now, more than 100 thousands hectares area of Moso bamboo stands have applied this techniques.

Anji Bamboo Botanic Garden, occupied the biggest area (17 ha), the most numerous bamboo species with monopodial-type and mixed type, established by this project, has not only conserved and developed bamboo plant genetic bank, but also raised several million bamboo seedlings of fine economic species, which have been introduced and planted in many places, and promoted fine bamboo shoot stands development of small-sized monopodial bamboo species.

2) Economic effects

More than ten thousand hectares areas of Moso bamboo trial stands and technical demonstrating stands have been established in the whole country, and 100 thousand hectares areas of bamboo stands applied this achievement. Net income of those bamboo stands has been increased by 410 million Yuan (RMB), and 21 million USD of exported value have been produced. Income produced directly by Anji Bamboo Botanic Garden providing various seedling of bamboo is over 3 million Yuans (RMB).

3) Ecological effects

Large-scale application of bamboo intensive cultivation techniques with different end uses can cause some ecological issues. For example, full-digging soil of bamboo stands and the mixed bamboo stands transforming into the pure bamboo stands will cause loss of water and erosion of soil, a large amount of fertilizing will cause water quality decreasing in the valley. However, up to now, some issues mentioned above have not appeared obviously in practice. So, The sustainable management techniques of Moso bamboo stands need further research in future.

Anji Bamboo Botanic Garden has become the biggest genetic bank of bamboo plants with monopodial-type and mixed type bamboo. Its establishment has promoted effectively preservation of resource of bamboo plant

4) Social effects

Two achievements, 《Study on Nutrient Circle of *Ph. pubescens* Stands and Its Utilization》, 《Anji Bamboo Botanic Garden》, have obtained the second class and the third class prize of state science and technology progress respectively. The project leader, Prof. Fu Maoyi, has been received by the national leaders, and the achievements have been reported by 《Guangming Daily》, 《Science and technology Daily》 and 《Forestry Newspaper》.

Project group has also organized 6 international bamboo training courses supported by the State Science and Technology Commission of China (SSTCC) and IDRC, and more 150 participants have received training. Over 20,000 persons including bamboo specialists, teachers and students, and managers have been received to visit various demonstrating bamboo stands. Anji Bamboo Botanic Garden has become an important place of research, education, and academic exchanges for internal and external specialists, guests, teachers and students of colleges, forestry researchers, and bamboo lover. Up to now, It has received several ten thousand visitors, in which foreign visitors have exceeded 100 times and several thousand persons.

All of that not only enlarges influence of our institute in internal and external, but also enlarges influence of IDRC in China.

Because the achievement has been popularized in vast poor mountainous areas, the thoughts of "science cultivation for bamboo" and " science management for bamboo" have rooted in the hearts of the people deeply, which extremely improved the raising the level of ideology and science in local society. Implement of the project has also brought out enormous economic effects, which accelerated the poverty alleviation of farmers.

5) Other effects

During the processing of project implement, the member of project group insisted on high quality and made strict demand on themselves, reasonably spent the finance, and made it to produce the largest benefits. It has been praised by consultants and finance evaluating group of IDRC, which made our institute to win good reputation. It is very useful for us to further strive for new project from this organization. For example, IDRC successively supported us to study on sympodial improvement, agroforestry models in subtropical hilly areas, bamboo shoots preserving, and so on.

6) personnel training

Through implement of this project, the quality of administrative personnel of our institute has been improved obviously. The backbone of bamboo researcher with high English level also has been trained. It is useful for us to further develop international cooperation and academic exchanges. The administrative personnel learned advanced regulatory regime from IDRC, reforming the traditional regulatory regime of our institute, which improved management level in research, finance and administration. The research primarily formed regorous scientific style. For example, the original administrative systems of RISF, by learned the advanced management means from IDRC, have been improved. Therefore, the survey designs, implement and investigation, statistics, and as well as reports of IDRC project had been carried out more careful and perfectly than that of national project. The serious scientific working attitude had been formed since then, instead of original casual working attitude and lack of planning designs which be described that the implementation of project were not consistent with their planning.

In addition, over 10 specialist had visited the Japan, Singapore, Thailand, India, Canada and so on for bamboo sector or meetings, and the International Bamboo Workshop, hold in Hangzhou, China, had been organized by our Institute in October 1985. These activities provided many opportunities to cooperate and exchange information and knowledge between researcher of RISF and related domestic and international specialist, and the extensive communication among them had been founded. And the researchers of RISF were promoted to learn the situation and the experience of bamboo production, research and utilization, and introduce the advanced technology of other countries, and their prospect broadened as well as confidence to applying the international joint project strengthened. For example, the researchers of RISF had successfully applied for the UNDP project about the photosynthesis mechanism of Moso bamboo, which was conducted by Shanghai Plants Physiology Research Institute, CAD.

By implementing this project, a large mount of scientific specialists, bamboo personnel for technological extension in the main Moso bamboo growing areas and special households of bamboo production have been trained, which made the technical extension network formed.

7) Technological innovations

i) Firstly to expound systemically the law of nutrient circle in ecological system of Moso bamboo stands, which provide the important theory basis for scientific management, reasonable fertilization and high yield.

ii) Firstly to put forward the best fertilizing way by economic analysis of means, time and dosage in Moso bamboo stands with different end uses

iii) To build biggest genetic species of monopodial-type and mixed type bamboo in China, named Anji Bamboo Botanic Garden, which promote effectively the conservation of bamboo resources in China.

iv) Firstly to select two useful preservatives of bamboo culms, which is benefits to preserving the bamboo products.

4. Suggestion and Evaluation of Project Administration of IDRC and The Chinese Ministry of Science and Technology

1) Selection of project tallying with national conditions

China, occupying 4 million hectares area of bamboo stands and annually producing 6~7 million tones of bamboo timber, is one of the main growing countries in the world. Moso bamboo is the most important native bamboo species with 2.8 million hectares area, in which area of low-yield bamboo stands occupies more than 70% of that. So, it is a task of top priority for bamboo research to probe the way to deal with applying intensive cultivation techniques of Moso bamboo stands and its theory. Besides, most of the low-yield bamboo stands are distributed in mountainous, semi-mountainous areas, some areas inhabited by the minority nationality with poor economy and lowly life standards. Therefore, the project of the intensive cultivation and utilization techniques of Moso bamboo stands has been placed on the first one and the most important one in forestry sector supported by IDRC, which is to tally with national conditions of our country and cherished desires of bamboo researchers

2) Financial Situation

The financial arrangement can basically satisfied with the progressing demand of project. Some advanced instruments have been provided in each phase of project, which is useful for project to raise research level and precision. The last one of allocation has been arranged after the final report finished, which is useful to improve quality of the project.

3) International cooperation and exchanges

Some activities of international exchanges have been arranged each phase by IDRC. Not only have some researchers of project group been arranged for visiting and training, but also some international consultants and specialists have to go abroad been arranged to experimental sites for inspecting and guiding. It is useful to raise the research level of project.

In short, under the auspices of the Department of International Cooperation, the Chinese Ministry of Science and Technology, and the Department of Science and Technology, The State Forestry Bureau, and under the coordinating and help of the Office of International Cooperation, the Chinese Academy of Forestry, the project of Bamboo(China) supported by IDRC and Chinese Government not only has obtained a distinguished achievements, and promoted the raising of bamboo research level of our country, but also the great progress on the aspects of research administration, personnel training and enlarging international cooperation and exchanges has been made.

BAMBOO TECHNOLOGY UTILIZATION (CHINA)

—— Supported by International Development Research Centre of Canada (IDRC)
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The Research Institute of Subtropical Forestry
The Chinese Academy of Forestry

The project of bamboo technology utilization (China) is a 3-year project supported by International Development Research Centre of Canada (IDRC) after the project of Bamboo (China), which has been implemented in previous six years. The project has been conducted by the Research Institute of Subtropical Forestry CAF (RISF-CAF) in coordination with the Experimental Centre of Subtropical Forestry CAF, Fujian Provincial Forestry Department, Forestry Bureau of Anji County, and Lingfengsi Farm of Anji County. The project began from May 1, 1989 and ended on December 31, 1992, lasting 3 years and 7 months. 56,100 CND Dollars of the total financial aid from IDRC have been received during the project period.

1. Background

.The two phases project of Bamboo (China) supported included by IDRC and Chinese Government has been implemented successively in six years. Although its four experimental sites have successively been set up in the main bamboo growing provinces, i.e. Zhejiang, Fujian, and Jiangxi, the areas of bamboo stands used in trials are only a small part of the total bamboo stands. At present, there are 2.8 million hectares of Moso bamboo in China, in which, intensive cultivation bamboo stands occupied 10~15% of the total and the middle one occupied 20~25%, while low-yield bamboo stands occupied around 65%. The increasing of annual output of Moso bamboo timber can not keep pace with the development of national economy. So, it is necessary to develop bamboo production and to improve the level of intensive cultivation. In order to popularize the achievements from the project of Bamboo (China) funded IDRC and the other ones in the main bamboo growing areas as soon as possible, to improve the technical level of bamboo cultivation, and to speed up the comprehensive utilization of bamboo, after several discussions with some officers of IDRC, it has been put forward that a plan for training technicians of forestry popularizing and setting up a series of demonstration bamboo stands applied the successful results obtained before.

2. Execution of the Project

1) 1) Financial situation (IDRC contribution)

The grant of 56,100 CND Dollars from IDRC has been received, in which 34,000 CND Dollars has been controlled by our academy, which equal to 124,070 Yuan (RMB). It was used for 3 training courses, printing training materials, travel fare of specialists and consultants, and making one video tape. The expenses of project basically accordance with original budget.

2) Government investment

Since the first training course on "bamboo cultivation and utilization" has been held in October 1987 in Fuzhou, Fujian Province, 18,972 hectare areas of bamboo demonstration stands have been set up, and 1.2 million Yuan (RMB) of local government investment have been attracted. In addition, several million Yuan funds invested by forestry farms and bamboo farmers themselves to the work.

3)Training

Three training courses on "bamboo cultivation and utilization" have successively been held in Fuzhou and Liancheng, Fujian Province, and Chenzhou, Hunan Province. Totally, 156 trainees, from Fujian, Jiangxi, Hunan, Sichuan, Guangdong, Zhejiang, and Beijing, were trained in those courses. Most of them are local managers engaged in bamboo cultivation of the main bamboo growing areas. By means of those training courses, they learned more knowledge about the techniques of bamboo intensive cultivation. It is very useful for them to involved in popularizing the techniques later. More than 120 technicians, from some main bamboo growing province, such as Zhejiang, Fujian, Jiangxi, and Hunan, have been organized to visit the demonstration bamboo stands in the Lingfengsi Forestry Farm, Anji County, Zhejiang Province. They exchanged the experience and techniques each other. The technical level of bamboo intensive cultivation in many regions has been raised remarkably by those activities.

In addition, in order to understand what have happened since three training courses held in 1988,1989,1990 respectively, a network of the technical popularization has been set up, and an investigation through a questionnaire on such training has been done in the former participants after each course.

4) Internal exchanges actives

During the implement of the project, 15 staffs including the project leader, co-leaders from extension sites and project consultants have respectively inspected the project work at sites in Fujian, Zhejiang, Hunan, and Jiangxi for 6 times. They, at the same time, visited several bamboo stand owners. Some problems met in practice have been resolved timely.

They also exchanged their experiences and lessons learned in the process of techniques extension each other so as to the project has been successfully implemented.

5) Researcher team of the project

Ten researchers of RISF-CAF have participated in this project. Through the implement of the project, the ability of personnel for rapidly transmitting research achievement into the productivity have been cultivated. Those technicians have not only high theoretical level but also rich in the practical experiences. They combined scientific research with production, resolved continually the problems existed in the process of technical extension, and became the main forces in the project.

6) Achievements of the project

Through more than three-year hard work, 18,792 hectare demonstration and dissemination plantations were established in Fujian, Zhejiang, Jiangxi, and Hunan provinces, and the net income from the stands increased to 39,723,500 Yuan(RMB). A text book and an illustrated pamphlet on Bamboo Cultivation and Utilization as teaching materials have been completed. One videotape supported by IDRC in China has been produced. Three training courses have been held and totally 156 people have received the training

3. Evaluating the Effects of the Project on Research, Economy and Society

Science and technology is the first productivity. By means of holding the training course and establishing demonstration bamboo stands jointly with the local governments, the researchers of the project have rapidly popularized the achievement of Bamboo project (China) in the main bamboo growing provinces in South China. It is welcomed by local forestry managers and farmers. Approximated 18,792 hectares demonstration and dissemination plantations were established. The bamboo stand area applied the techniques of intensive cultivation of bamboo amount to 72,000 hectares.

The implement of the project has also promoted the society development in the main bamboo growing areas in China. By means of establishing the experimental demonstration sites, the power of science and technology has been understood by farmers, so as to arouse their fervor of learning science. The thoughts of "science cultivation for bamboo" and " science management for bamboo" have rooted in the hearts of the people deeply, which extremely promoted the raising of the level of ideology and science in local society. Moreover, the implement of the project has brought out enormous economic effect, which accelerated the poverty alleviation of farmers.

In addition, the implement of the project has aroused farmers to invest in bamboo stands, which made many job opportunities, especially for women to get a job opportunity, and to raise their income situation and social position.

By implementing this project, not only have several dozens of research workers with high theoretical level and rich practical experiences been fostered, but also a large mount of backbone technicians of forestry for technological extension and special households of bamboo production have been trained, which made the technical extension network formed.

The IDRC-funded Fuelwood (China) Project: A General Review

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1. Background

The International Development Research Centre (IDRC) funded "Fuelwood (China) Project" was commenced in June 1986. It was the time that rural area of China had just experienced several years of 'economic systems reform' and agriculture got its right way of development. However, rural energy as one of the most important fundamentals for rural development was suffering from severe shortages. This problem was well recognised by the Government of China. Research on rural energy became one of the many national key research and development programs established by the State Science and Technology Commission (SSTC, now the Ministry of Science and Technology, MOST) during that time. IDRC is a funding agency who has been paying much attention in rural development. The common interest of IDRC and SSTC in rural development led to that the both sides established many scientific and technological co-operation agreements which proposed dozens of R & D projects in rural development be established with IDRC's financial supports. Logistically, the fuelwood research was placed in the list of such projects. The IDRC-funded fuelwood research (hereafter the Project) in China was implemented by the Research Institute of Tropical Forestry (RITF) of the Chinese Academy of Forestry (CAF). It was lasted for 8 years and divided into two phases. The first phase (June 1986 - May 1990) was an independent project entitled "Fuelwood (China) Project" (Centre file 3-P-85-0251) and focused on selection of tree species and development of cultivation techniques. The second phase (April 1990 - March 1994) became part of the IDRC-funded "Farm Forestry (China) Program" with emphasis on species improvement. Two large experimental bases, one in Qionghai county of Hainan Province and another in Huadu county of Guangdong Province were set up in the first phase, and one small experimental base was set up in Kaiping county of Guangdong Province in the second phase.

2 Project Implementation

2.1 Financial Implementation

2.1.1 China's contribution

The China's contribution into the Project mainly included the project staff's salaries and other welfare paid by the Government of China, the existed research equipment of the implementing institution and the research funds of the SSTC supported national key research projects during the 'Seventh Five-Year Plan' and those of the former Ministry of Forestry supported key research projects during the 'Eighth Five-Year Plan'.

2.1.2 Equipment and instruments

The equipment and instruments purchased with IDRC's funds included: one Toyota Landcruiser, one Cannon photocopier, one motorcycle, one refrigerator, two IBM compatible computers and some small lab instruments.

2.1.3 Personnel training

During the project period, four project staff members were supported to participate at six training courses. Three training courses for local forestry officers and technicians were organised by the Project during the first phase and the participants totalled about 200. The training activities of the second phase were jointly carried out by the staff members of the Project and those of the IDRC-funded 'Farm Forestry (China) Program'.

2.1.4 Visit, consultancy and technical exchange

The IDRC supported international visits by the project staff included: a scientific visit to the Philippines by one staff member, participation at the Winrock International and IDRC sponsored workshop on Multipurpose Tree Species and Their Use for Small Farms held in Bangkok, Thailand by the project leader, and participation at the International Symposium on Multipurpose Tree Species for Rural Livelihood held in Manila, the Philippines by two staff members.

The visitors that the Project received during the project period totalled some 30 people, including D. Weeb, Assistant Director for Forestry Science of IDRC, Dr. C. B. Sastry, Senior Program (Forestry) Officer of IDRC, Prof. Louis Zsuffa, the Project Consultant, Dr. Salleh Mohd. Nor., the former President of IUFRO, staff members of the IDRC-funded project 'Economics of fuelwood Production (Thailand)', and program officers or scientists from the World Bank, the Swedish University of Agricultural Sciences, CSIRO Division of Forestry, Winrock International, Argonne National laboratory (USA), and some program officers or scientists who visited to the 'Farm Forestry (China) Program'.

2.2 Project team

The project team consisted of eight people from RITF and the participating forestry bureaux. They are Mr. Zheng Haishui, the Project Leader, Mr. He Kejun, Mr. Cai Mantang, Mr. Huang Shineng and Mr. Lai Hanxing of the implementing institution and Mr. Li Kexiong, partner from the Forestry Bureau of Qionghai city, Hainan Province and Mr. Li Kezheng, partner from the Forestry Bureau of Huadu city, Guangdong Province.

2.3 Research achievements

Three research achievements were obtained during the project period and all were awarded by different authorities. The first achievement, based on the first-phase research results, "Studies on selection of fine and fast growing fuelwood species and their cultivation techniques in tropical China" was given the Third Class Award for Scientific and Technological Progress by the former Ministry of Forestry in 1990. The second research achievement, based on two-phase research results from Qionghai experimental base entitled "Selection of tree species and their cultivation techniques for short-rotation forest plantation development in Hainan Province", was given the Second Class Award for Scientific and Technological Progress by the government of Hainan Province in 1993. The third research achievement, based on the research results from Huadu experimental base entitled "Species selection and technology development for short-rotation energy and timber plantation management on poor hilly land", was given the Third Class Award for Scientific and Technological Progress by the government of Guangdong Province in 1996. In addition, a book written by the project staff members entiled "Cultivation techniques for short-rotation fuelwood and timber plantations" was published in 1990 and more than 40 papers were published.

3 Evaluation of scientific, economic and social effects of the project

3.1 Transfer and application of research achievements

As the multiple benefits of fuelwood plantation management were well considered before the project commencement, the tree species selected and the management techniques developed, especially those relating to intercropping with cash crops and cultivation of edible fungus as well as the establishment of chicken farms under forest canopy, by the Project were also suitable for short-rotation industrial plantation management, the research achievements of the project were immediately applied into the forestry production. It was estimated that the total area of forest plantations that were established under the guidance provided by the Project or with employment of the project's research results has reached some 75 500 hectares.

3.2 Economic benefits

It was estimated that a total of some one million CNY of incomes were generated by the local forest farms where the Project activities were conducted through intercropping with cash crops, cultivation of edible fungus and establishment of chicken farms. The 75 500 hectares of forest plantations, as mentioned in Section 3.1, are expected to produce about 113.3 million CYN of production values per year, with a net annual income of 28.2 million CNY.

3.3 Ecological benefits

As the use of multipurpose tree species, especially the nitrogen fixing ones and the management of diversified forest plantations had been the main concerns of the Project, the soil fertility of the planting sties shown significant improvements after plantation establishment. Meanwhile, the trial sites the Project used are those so-called difficult sites that local farmers did not want to use for any purposes at all. The sites in Huadu County are poor and heavily eroded and those in Qionghai are frequently damaged by typhoons. The success of the Project does provide a demonstrating example for the revegetation of degraded lands and the construction of shelter-forests in coastal areas in tropical China.

3.4 Social benefits

The training courses the Project offered to the local foresters, the diffusion of plantation technologies through on-farm training and dissemination of technical notes, and the establishment of demonstration plantations made the local foresters aware that the management of short-rotation fuelwood and timber plantations is beneficial. The reduction of employment pressures through their active participation in forest plantation establishment and the improvement of their knowledge in forest management are the main contributions of the Project to the society. Moreover, the book and some 40 published research papers or technical notes completed by the Project staff members are well recognised by the scientific community.

3.5 Human resources development

When the project commenced, there was only one person, Mr. Zheng Haishui, the Project Leader, who held a high professional rank as associate research professor among the project staff members. Others were research assistants, assistant engineers and technicians. At present, all of them have been promoted to held higher professional ranks. The Project Leader became a research professor, and all the others became associate research professors or senior engineers excepting one who was a technician at the beginning of the Project.

In addition, Mr. Cai Mantang obtained his Master Degree in farm forestry at Oxford University during the project period. Two staff members, Mr. Cai Mantang and Mr. Huang Shineng, are Ph.D. candidates of the Indian Council for Forestry Research in farm forestry and of at the Zhongshan University (Guangzhou) in plant ecology, respectively. One staff member, Mr. He Kejun, is studying towards the Master Degree in forest management at the South China Agricultural University (Guangzhou). Their abilities of opportunity-competition for continuing education are, at least in part, attributed to their experiences and knowledge gained through the implementation of the Project.

3.6 Scientific and technological invention

Through a variety of trials on different sites in different climate zones, a number of fine and fast-growing fuelwood species were screened out and their associated management technologies developed. The household-based and multi-purposed fuelwood plantation management system developed by the Project is a breakthrough in fuelwood research in China.

4 Comments on the project management by IDRC and the MOST of China

4.1 Application and approval of project proposals

The establishment of the project was corresponded to the development needs of China and to the hot-topics in the world forestry research. During the early 1980s, the world was suffered from 'energy crisis' and many countries, especially the developed countries started investigations on biomass-based renewable technologies. The research and development of short-rotation energy plantations of fast growing tree species was not only put by the MOST on its own funding list, but also treated as a priority area to seek for international financial assistance. With the MOST's help, the project proposed by CAF was immediately approved and financed by IDRC. It can be said that the process of application and approval of the Project was highly efficient.

4.2 Financial management

The IDRC-supported project funds had two parts: the IDRC managed funds and the CAF managed funds. The later usually account for two-third of the total project budget. In each project calendar year, IDRC sent its financial officers to CAF Headquarters and its program officers or project consultants to the project sites to make sure if the project funds were used exclusively for the project activities. The IDRC managed funds were used for supporting international travels by the project staff members or the project consultants, and for the international purchase of equipment and instruments for the projects. This management system ensured that all the project funds were used exclusively for the project activities.

4.3 International exchanges

It seemed less that the IDRC-supported international travels for training or/and workshop participation by the project staff members compared with the international visitors the Project received during the project period. Such international travels were, however, important for the researchers of China in the early stage that the country is "open to the outside world".

4.4 Information exchange and management

In each project calendar year, three Quarter Activity Letters, one Annual Report and one Financial Report were submitted to CAF and IDRC. A Project Completion Report was submitted to IDRC at the end of each phase of the Project. In addition, some technical progress reports were also submitted to the CAF, the project consultant and IDRC. The information exchange and management of the project was timely and efficient.

4.5 Project coordination

The project co-ordinating work by the MOST and IDRC was excellent.

5. Comparison of the IDRC-funded project and projects supported by other funding agencies

During the past 15 years, more then 15 projects funded by international agencies have been carried out by the RITF. The following comparison of differences in methods and procedures of funding is only made between the IDRC-funded projects and FAO, ACIAR and ITTO funded projects.

5.1 Priority areas and research fields funded

In general, the priority areas funded by the funding agencies are all corresponded to the priority areas in forestry research in China. However, the research fields funded are somewhat different as the funding agencies have their own objectives and mandates. For example, ITTO only considers projects that are hardwood related. ACIAR usually funds projects involving Australian tree species. Like IDRC, FAO funds projects in every fields of forestry research.

5.2 Project budget/funds (?)

It is difficult to compare the budget of projects funded by different funding agencies. Such difficulties in comparison are mainly attributed to the changes in foreign exchanges over time. For ACIAR-funded projects, in general, the RITF can only manage a small proportion (some 10% or less) of the total project budget. The budget of the IDRC-funded Fuelwood Project totalled 213400 Canadian Dollars, or 700-800 thousands CNY. It was a big-budgeted project during the mid-1980s and early 1990s in China.

5.3 Funding agencies' participation

FAO, ITTO and IDRC seem likely to participate only in the overall project management. ACIAR takes another way. The ACIAR-funded project activities are jointly implemented by Australian (ACIAR or CSIRO) scientists and Chinese scientists, and the proposals are usually formulated by Australian scientists. However, the ACIAR-funded projects provide the Chinese scientists with more opportunities in training and regional/internatioanl workshop participation.

5.4 Project duration

It seems to be the 'international rule' that the project duration usually lasts for 3-5 years.

5.5 The procedures of application, approval and implementation of projects

The procedures of application, approval and implementation of projects depend on the nature of the projects themselves; that is, the projects are bilateral or multilateral. The IDRC-funded and ACIAR-funded projects are the so-called 'bilateral projects'. If the proposed project activities are within the priority areas identified in the scientific and technological co-operation agreements established by both sides, the projects will be approved and financed.

In contrast, the multilateral projects, for example the ITTO-funded ones, are not easy to be approved and financed. The project proposals must be assessed for three times. Firstly, the project proposals must be assessed and recommended to the ITTO's permanent t committee concerned by the Expert Panel for technical appraisal. Secondly, the proposals must be assessed and recommended to the International Tropical Timber Council (hereafter the Council) by the permanent committee concerned. Finally, the proposals must be approved by the Council. That the proposals were approved by the Council does not mean that the projects will be financed. If there were no donors who want to fund the projects, the projects will be sunset ones after two or three Council session. However, after the projects are financed ITTO is the unique international organization that will transfer all the fresh money to the implementing agencies of the projects.

Our experiences indicate that there are no differences in procedures of project implementation and management for all the projects supported by international funding agencies.

General Report on Research on Rattan in China

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Abstract This general report gives a summary of the rattan studies made in China during 1985-1992 on investigation of resources and resources utilization, introduction and conservation of genetic materials, division of cultivation regions, and propagation techniques as well as strategies for managing high-yield plantations. The methods used are such as field survey and specimen collection, multiple site trials, fixed observation, and laboratory determination as well as establishment of extension and demonstration forests. Now more than 960 specimen have been collected and taxonomically classified. 40 species and 21 varieties representing 3 genera found in China, which take account of about 6.8% of the world total in species terms. They grow naturally in six vegetation zones in 11 provinces from southeastern coasts to southwestern mountains, with Hainan Island and Xishuangbanna as the two distribution centers. Moreover, rattan population distribution, the distribution dynamics, and the flora characteristics in different vegetation types are clarified. Microscopic structure and physical and chemical properties are also studied of 27 species and varieties. It is found that 14 species of VA mycorrhizal fungus species subordinate to 4 genera are infectious to rattan. Three gene pools, where biological and ecological observations are made, have been established with 49 species and 6 varieties introduced, of which 36 species and 5 varieties are successfully conserved. With aim to guiding the practices of rattan plantation, China's southern territory could be divided into four cultivation regions in respect to their suitability for rattan planting. Propagation techniques, both in sexual and vegetative ways, have been studied synthetically and in vitro stocks have been obtained in five species with a propagation coefficient 2.8×10^5 per year. Techniques for raising sound stocks on such aspects as mineral nutrition, light intensity, water and fertilizer supplying, and VA inoculation are summarized. The strategies for managing high-yield plantation on aspects as site conditions, tree selection for intercropping, pure plantation, density, group planting, control of diseases and pests, harvest age and interval, harvest methods, and tending are also included. The economic benefit of rattan plantation is analyzed. With *Daemonorops margaritae* as an example species, which could reach averagely more than 50 stems and 100 m in total stem length per clump, with 10 000 kg per ha in cane yield when 11 years old and result a net present value 16 785 yuan per ha, an internal rate of return 28.7%, and a benefit-cost ratio 4.8 during 25 years of rotation.

Key words Rattan; Resources investigation; Introduction; Propagation; cultivation; Cans properties

1 Introduction

Rattan is taxonomically subordinate to family Palmae and plays an important role in regional economic well-beings in tropics and southern sub-tropics with its multiplicity of utilization purposes. Rattan cane has advantageous properties for processing and is a good choice of raw material for making furniture, utensil and art-ware. Rattan fruit, seed and tender shoot could be used for food, medicine and decoration. Since the 1960s, the global rattan-related trade sum has amounted to 2 billion US dollars. In China, the annual rattan production value reaches up to several million RMB yuan and the annual foreign exchange near 100 million US dollars. Therefore, rattan is in South China one of the most important non-timber forest resources (next only to bamboo) and has a great contribution to local economy.

In China, rattan grows naturally and widely in tropical and southern subtropical natural forests ranging from southeastern coasts and islands to southwestern mountains, in which Hainan Island and Xishuangbanna are the two centers noted for richness in rattan resources and plenty in cane production. However, China is presently facing on such world-wide forestry problems as deterioration of tropical forests, reduction of wide life resources, shortness of rattan cane supply, and extinction of some rattan species. With consideration to conserve and make rational use of natural rattan resources as well as to develop rattan-related industry, it is increasingly recognized by the international society the importance and urgency to introduce superior species/varieties and expand rattan plantations. Since the mid-1960s, many countries, e. g. Malaysia, Indonesia, the Philippines, Thailand and India, have drawn rattan researches into their national scientific priority, some international organizations given a lot of financial and technological supports in this field, and great achievements been since made. In Malaysia, for example, rattan resources inventory has been made, propagation techniques for *Calamus manan*, *C. caesius* and *C. trachycoleus* have been successfully worked out, and tissue culture stocks of *C. manan* widely planted on slash of selected tropical rain forests at low elevation sites. Since 1978 three workshops on rattan researches have been hold and Rattan Information Center (RIC) and INBAR have been set up, which has accelerated greatly the development of rattan researches all over the world.

In China the history of rattan utilization could be in retrospect to more than 1000 years ago and that of rattan furniture industry to 150 years ago. However, rattan research remained empty until the 1960s. Later South China Botanical Institute and Kunming Botanical Institute of Academia Sinica, together with some other research organizations, have made some studies on taxonomic and cultivation aspects, which could be a reliable basis for further researches.

Rattan research history in Research Institute of Tropical Forestry, Chinese Academy of Forestry (RITF/CAF) could be divided into three stages. The first stage is between 1963 and 1972 during which the resources survey, fixed biological and ecological observation, and propagation were carried out at Jianfengling Mountain, Hainan Island. Unfortunately, the study was broken down since during the "Chinese cultural revolution". The second is from 1973 to 1984 when rattan propagation and cultivation was studied as an important objective with emphases on stock raising and cultivation trials, and the studies were initially made results. The third is during 1985 and 1992 when comprehensive studies were conducted with financial supports from The International Development Research Center (IDRC). An IDRC-funded project "Research on Rattan in China" and a key project of the Ministry of Forestry (MOF) " Cultivation techniques of commercial rattan species ", and a CAF-funded project "Pilot trial of *Calamus tetradactylus*" were undertaken In in this stage. The overall objective of the projects was to identify suitable rattan species of good quality and to develop technique for their large-scale cultivation in China. The research was focused on making rattan resources inventory in China, collecting genetic materials, clarifying the biological and ecological features, selecting superior species/varieties, optimizing cultivation techniques, expanding the plantation in South China, and improving the quantity and quality of rattan cane. Since 1985, multidisciplinary scientists from several institutes have been involved in related studies, and comprehensive results achieved. This general report is a summary on the studies made at the third stage.

Project Review of Bamboo Information Center

The Research Institute of Forestry Sci-Tech Information, CAF

1. Background

Bamboos are widely distributed in the tropical and subtropical areas of Asia and the Pacific, to some extent they occurs and South America. Because of their fast growth, easy propagation, soil binding properties, short rotation and long fibre of culms, bamboos are ideal plants for use in afforestation, soil conservation and social forestry programmes. Over 75 genera and 1250 species are reported to occur in the world. In Asian countries bamboos are valued as "poor man's timber", used widely for housing and making articles of daily use. In Europe they are considered as exotic plant species for house decoration and gardening. There are more than ten million hectares of bamboo forests in Southeast Asia. As a result of rapid decrease of tropical forests in recent decades much more attention has been paid to the cultivation and utilization of bamboo. Bamboo societies have been set up in America. Europe and in Asian countries. Hundreds of bamboo research papers are published annually, papers from some countries were concentrated on bamboo taxonomy and biology, those from other countries paid more attention to cultivation, those from third countries discussed mostly processing and utilization of bamboo. All the bamboo-related professionals wish to have a permanent institution for international exchange.

2. Process of the project

The project of Bamboo Information Center (BIC), undertaken by the Chinese Academy of Forestry (CAF) with the financial support from the International Development Research Centre (IDRC) of Canada, set up at the Institute of Scientech Information of Forestry (ISTIF), started work on 25 December 1987. The work of BIC was carried out in strict accordance with the Memorandum of Grant Conditions of the Project. The President of CAF and other leaders attached great importance to the fulfillment of this project, they helped the project team in many cases. Almost all the institutions concerned in bamboo research cultivation, farming and utilization in China expressed their desire to cooperate with BIC and receive its publications. A National Bamboo Information Network consisting of some 20 persons from all the bamboo producing provinces was formed at the beginning of work. Many institutions and individuals wrote from abroad to discuss information exchange and other sort of cooperation. The project members visited India, Thailand, the Philippines, Ethiopia, Cote d'Ivoire and Canada to study the information management experience and bamboo production status, or to demonstrate the objectives and activities of BIC. There are more than 800 domestic and foreign users from 25 countries and regions of Asia, North America, Oceania, Europe, Africa and Latin America on our mailing list.

- The expenses of the project totaled 74,910.17 RMB yuan in year 1 (ten percent excess over the estimate), 67,910.92 RMB yuan in year 2 (nine percent excess over the estimate), and 122,695.50 RMB yuan in year 3 (7.43 percent excess estimate). We don't think it does make any sense to sum three years' total expenses in term of RMB yuan. Because during this project of time RMB yuan devaluated rapidly. In mid year of 1987, when the project proposal for BIC was under discussion, we set annual inflation rate as 10%. In autumn of 1987, when the project proposal was put forward for approval, the exchange rate of Canadian dollar to Chinese yuan was 1:2.78, it was raised to 1:4.06 at the end of 1989, and to 1:4.48 in the second half of 1990 (the financial report for year 3 will be delivered separately by the Institution's financial officer. This period (25th Dec. 1987-25th Dec. 1990) witnessed a continuous and allround rise of price in Chinese continent. Take the year of 1990 for example, In this year the postage was raised by 150%, e. g. the inland postage of ordinary mail was raised from 0.08 to 0.20 RMB yuan. The honoraria rates were raised by 50%--100%, e.g. honorarium for translation of an abstract was raised from 15 to 25 RMB yuan that for compilation of an abstract from 5 to 10 RMB yuan. The railway tariff was raised by 20%. The civil air rates were by 80%. All these caused variances of actual expenses with budget.
- The financial used for collection of publications, edition, printing, visiting of the project members, equipments and so on. The equipments are: A microcomputer North Star NS1200 complete with 120 MB hard disk, IBM, with 3 terminals (each with 512 k, keyboard and monitor), provided by IDRC. And Hewlett Backard III. The necessary investments are: 330,640 RMB yuan in year 1, it includes sallery of the project members, equipment of the office and soon. The equipments are: A microcomputer IBM PC/XT with 10MB hard disk, 640K RAM, provided by ISTIF. A printer BROTHER M2024, provided by ISTIF, a Laserjet printer, Hewlett Packard series II, provided by ISTIF.
- According tot he project proposal, project leader and senior editor visited Thailand and Philippines. During the trip we visited the libraries of Thai Kasetsart University and Philippine University, studied their management practice. We also visited the International Buffalo Information Centre (IBIC), which was also supported by IDRC. Even the specialty of IBIC differs very much from that of BIC, it was of great interest to be acquainted with the experience of IBIc, because the work environments and problems of small scale information centres are all alike. At the beginning of the project, the project leader attended the STI Project Management held in Addis Ababa, Ethiopia. This meeting discussed key issues of project management under the following headings, management objectives and goal planning; personnel management and training; building and motivating a project team; financial management—budgeting and reporting; management of

capital equipment and physical resources; evaluation/control. Somme officials from the IDRC headquarters and an expert from the Manitoba Institute of Management gave interesting lectures. These lectures introduced a new way of thinking for Chinese. Most of Chinese project leaders perform their functions on the basis of personal experience or, sometime, by instinct. It is impossible to handle a modern scientific project successfully in such a way. Manitoba Institute worked out a series of methods for scientific analysis of working environment and conditions, and for the improvement of work style of project leaders. These methods benefited the BIC work significantly. In 1988, the project assistant took a training course at the Rattan Information Centre (RIC), Malaysia. The course lasted three weeks. She studied procedures and day to day operations of a small specialized information centre, including the management of correspondence, editing process of the publications, computer retrieval, literature classification, indexing and so on. As the RIC has worked for a long time, it has much good experience in information collection, consultation services and literature processing, it has made active contribution to rattan cultivation, production and rattan ware manufacturing. The professionals of the Center keep close contacts with rattan researchers, farmers and manufactures. Considering the specific field of activities of BIC, she visited bamboo herbariums, nurseries, experimental station and bamboo processing enterprises and got a general idea about bamboo cultivation and utilization in Malaysia. In order to extend the literature for the BIC, she collected many bamboo-related literature in Malaysia, which were very rare in China. The computer techniques in Singapore and Thailand. In Singapore, he watched how to use Micro CDS/ISIS and table publishing system—VENTURA. He visited libraries of the National University of Singapore, National Technical Institute and National Library of Singapore, watched their computer system and found it excellent. In addition, he discussed with Singapore librarians some questions about how to process Chinese words in computer. He gave them a Chinese operating system and a Chinese WS. It may be useful for them, because they have 20% of collections written in Chinese. In Thailand, he studied how to use CDS?ISIS in System Section of LRDC. The System Section helped users to set up their own databases. Any one, wishing to get up a new database, could contact the System Section and explain his requirements to this new database. And the analysts of the Section would use Micro CDS/ISIS to set up the system structure according to the requirements. They also teach users how to use the database. Users had not to know much about hardware and software. He though this was the normal relation between computer experts and other professionals. During the project, there were 3 training course and workshops organized by us, the participants were about 50. The translated abstracts were corrected by Professor A. N. Rao, he visited the BIC once a year for this purpose. It is evident that the arrangement of English translation was an important part of our work.

- IDRC officials and experts, they are : Mrs. Martha Stone, Dr. Cherla B. Sastry, Miss Maria Ng, Mr. Clive Wing visited the CAF, Miss Sheree W. Willis, A second secretary from the Embassy of the United States of America in Beijing, helped us to find important bamboo research papers and visited the BIC in order to get acquainted with our work.
- At the beginning of our work, we visited these consultants and listened to their suggestions concerning the activities of BIC. They provided us a name list of important bamboo experts, working in institutions of higher learning, research institutes, designing, we can contact experts of any discipline of bamboo sciences in case of need, such as bamboo classification, cultivation, protection, utilization etc. Some of our consultants made suggestions as now to select right papers for the Bamboo Abstracts. On order to carry out the work more successfully, we convened a workshop of bamboo abstract compilers in Nanjing in 1988. 10 persons attended the workshop. It was decided that all the bamboo and bamboo-related periodicals both in Chinese and in foreign languages should be scanned regularly for the selection of references for the Bamboo Abstracts. To distributed the periodicals for scanning and abstracting to attendants from different provinces and different institutions. Meanwhile we discussed the possible candidates for the members of the National Bamboo Information Network.
- The main task of BIC is to compile the Retrospective Catalogue of Chinese Bamboo Literature and the Current Bamboo Abstracts. We pay great attention to this work from the same commencement. It was not very difficult to compile the Chinese version of the publications, but the English version caused much difficulties. First of all, the translation of Chinese version into English was not of high quality, in general, Chinese professionals don't speak nor write English well because we didn't have much intercourse with foreigners. Some linguists do write English well, but they don't know botany nor forestry. Therefore, some of the translation couldn't be understood by foreigners. Professor A. N. Rao helped a lot in this respect. He visited BIC to edit and modify the English abstracts before they are published, thus ensured uniformity and quality of the English version. We had a face-to-face discussion during his stay in Beijing. We sat together by the word processor to correct all the mistakes and incorrectness directly on the screen, this we rasied the work efficiency, improved our mutual understanding and friendship. We are grateful to IDRC for sending us such a high qualified and friendly consultant. After our joint work we discovered that some of our colleagues translate pretty well, but others translate terribly. This helps us to select better ones for translation in

future. Typesetting of the English version is another difficulty. Because of the small impression of our publications, ordinary commercial printing houses don't accept our printing order as a rule, if they do, they set a very high price. We decided to print the publications in the printing house of the Institute of Scientech Information, but as the typesetters of this printing house were not qualified for setting English text, we had to type the matrices from computer, as our microcomputer didn't have all facilities for such work, we managed to order a Font Cartridge HP92286F TMS Proportional 2 from Hewlett-Packard to provide various fonts, such as in boldface, in italics, etc. After that we bought a commercial programme Wordstar 2000, which helped us run the font cartridge. In this way we succeeded to prepare matrices for our publications on Hewlett-Packard LaserJet Printer Series II, and then to print them on a mini-offset printer in our own printing house. But , unfortunately, the printing effect and the binding quality of the first publications were not good enough. It was necessary to choose another printing house. The Current Bamboo Abstracts are published twice a year, both English and Chinese versions contain 150 titles per issue. One hundred are taken from Chinese sources, and the other fifty from foreign sources. A Retrospective Catalogue of Chinese Bamboo Literature has been edited, its Chinese version contains 1200 items, and English version contains 600. All the items taken from Chinese bamboo literature were published from 1975 to 1986. If the financial resources permit, we shall compile Catalogue of Chinese bamboo literature published before 1975. All the items in the first issue of Current Bamboo Abstracts and the Retrospective Catalogue of Chinese Bamboo Literature were arranged in the order of Chinese classification system of bibliography, which differs from the international UDC system greatly. In order to fit the customs of foreign users, we decided to use the international system in the future. <Selected Papers of Chinese Bamboo Literature>, The project proposal of BIC stated that one hundred most important key documents that bench-mark the progress of bamboo research, development and utilization will be selected and published in the Selected Papers. Therefore most of the papers will be historical ones. We thought that the collection will be of great interest to domestic and foreign bamboo professionals. But our Indian colleagues told us that researchers are interested in contemporary research developments rather than historical papers. Because science and technology have been developing vertiginously rapidly in recent decades that bamboo research papers published many years ago remain historical documents, they lose their value in research reference. We reviewed this item, and decided to include important papers published in recent years. We selected 29 papers published after 1986 for the collection. As these recent papers are easily available in China, it does not make sense to publish a collection in Chinese. We made full text translation and set to publish a collection in English, as the editorial work was delayed due to some technical reason, this collection was published and distributed in the first quarter of 1992. Directory of Chinese Bamboo Processing Machines, published and distributed in 1991. In order to meet the demands in bamboo processing machines, some 60 enterprises are enganged in their manufacture, nearly 100 kinds of machines are being produced. <Compendium of Chinese Bamboo Species: An editorial team for the Compendium was formed. The team consisted of the project leader, the project assistant and nine bamboo experts from the Research Institute of Subtropical Forestry, the Chinese Academy of Forestry. Three meeting were held on the planning and progress of the work. Photos of some 250 species were taken and processed, written description of some 500 species was compiled. <Album "Substitute Bamboo for Wood in China">: a collection of 120 pictures on bamboo resources, plybamboo, bamboo paper-making, bamboo firewood, the environmental role of bamboo forest, bamboo food, handicrafts and bambooware. These pictures reflect the bamboo resources and bamboo timber utilization in Anhui, Beijing, Fujian, Guangdong, Guizhou, Hunan, Jiangsu and elsewhere. It was published in 1994. <Thesaurus of bamboo>: A Chinese-English thesaurus, including Latin species names, it was published in 1994. Data-base Complex—China Bamboo, there are 5 parts, it includes general situation, basic knowledge, bamboo industry, reference documents and bamboo literature. The general situation are up to date report on Chinese bamboo market, bamboo taxonomy, ecology, physiology, silviculture, protection, utilization and genetics and breeding. The basic knowledge has several sub-databases, they are bamboo species, bamboo insects, and bamboo resources. The bamboo industry are: raw bamboo market, shoot market, export and import market, processing machines, and so on. The reference documents are: on-going and completed research projects, related standards and bamboo-related patents.

3. Evaluation of social benefit

BIC serve personnel involved in: scientific research, teaching, management and planning, extension and production. Users are come from: central and local department of forestry, light industry (paper, arts and crafts, furniture), pharmaceuticals, building and construction, forestry and agricultural schools and colleges, wildlife protection agencies. Generally speaking, the teachers and students are more interested in bibliographical information, while the administrators, managers and planners are more interested in non-bibliographical information. Services: question and answer, literature search, document delivery upon request, mailing list distribution, translation upon request and SDI. On the other hand, BIC also make a role on bamboo civilization. As everybody know, China is a country of long history, it began agricultural production in ancient times. In the process of agricultural practice, China developed a kind of original, oriental culture. Three plant species contributed greatly to the formation and growth of Chinese culture, they were tea, mulberry and bamboo. But, they were not of the same importance, in comparison with bamboo, the role of tea and mulberry tree was not so great. The use of mulberry tree was limited in clothing and that of tea in drinking, while the use of bamboo could be found in all aspects of life. As early as in ancient times, our ancestors used bamboo widely, they made bamboo arrows and bows for fighting and hunting, bamboo tools for farming, bamboo huts for sheltering, bamboo caps and cloaks for wearing, they dug fresh bamboo shoots for food. Bamboo was a carrier of Chinese characters in ancient and mediaeval times before the invention of paper. Bamboo fibre was used for paper-making. Bamboo branches were cut for making brushes for writing. Bamboo was extremely important for Chinese people not only in their productive and battle, but also in their leisure time. Our ancestores made musical instruments of bamboo, such as bamboo flute and Chinese violin. Chinese orchestral instruments were actually bamboo instruments. Without bamboo there could not be Chinese national musical instruments. A kind of folk music is called plainly as "Southern String and Bamboo:. This wonderful plant was also widely accepted in gardening and housing. As bamboo served people for thousands of years our ancestors developed deep feelings for it. We found many pieces of literature and art praising and painting bamboo in museums and libraries. A famous scholar in Song Dynasty, Su Shi once said:" I would rather take a diet without meat, but there must be bamboo growing by my lodge, a diet without meat makes me lean, while a lodge without bamboo makes me vulgar." For Chinese people bamboo is a symbol of steadiness, honesty and modesty. Many intellectuals named their study, cottage, hall, pavilion or garden after bamboo. It is obvious that bamboo civilization is truly a civilization of significant contents. Bamboo goods used to be found in daily life of Chinese, especially rural people, but due to the development of manufacturing industry since 1950s many traditional bamboo goods have been replaced gradually by plastic and metal ones. This tendency affected the growth of bamboo industry to some extent. The importance of bamboo goods in people's life began less evident than dozens of years ago. However, thanks to the growing concern over environmental issues people change their taste in selecting daily necessities and bamboo goods regained favor among consumers. A kind of renewable resource, bamboo will not be exhausted under rational exploitation. Making a piece of bamboo-ware consumes less energy than that of plastic or metal ones, besides, bamboo goods do not cause environmental problems as plastic ones do.

Study on the utilization of biomass energy in small scale

-- Review for the IDRC Project

Institute of Chemical Processing and Utilization of Forest Products, CAF

1. BACKGROUD

The wood as a kind of renewable energy is been paid new attention, especially for developing countries that are realizing the industrialization and improving the people's living standards, it is impossible to rely only on the fossil energy. With the increase of population and the development of agricultural and forest by-products processing industry, the need for wood energy will increase quickly. If there is no appropriate measures to cope with such need, the limited forest resource will be depleted, which bring about the deterioration of the environment and bio-system. The measures should be the accelerating development of firewood plantation as well as enhancing the utilization efficiency of wood energy.

In China, the annual production of one-off energy is about 600 million tons of standard coal (not include the bio-mass energy), which is mainly used in the city and industry, and in forest and rural areas, the energy supply is poorly needed. At the same time, there is a lot of forest residue was cast off or burned with very low efficiency. Now we are developing the firewood with the aim of 10 to 20 million hectare of plantation, some will be used as domestic fuel, and the other will be converted into energy products.

According to the above situation, the Research Institute of Chemical Processing and Utilization of Forest Product of Chinese Academy of Forestry began to carry on the research and design of wood gasification technology and equipment, and mainly on the gasification furnace and the gas refining. Supported by the IDRC, from 1985, we launched the R&D on the utilization of forest residue as the domestic fuel, and completed four sub-projects.

2. IMPLEMENTATION

The IDRC supported project included four sub-projects, namely 1) Up-inhaling gasification furnace used as heating facility; 2) 1,500,000 kcal/h up-inhaling furnace; 3) Centralized gas supply in forest area; 4) Double furnaces gasification system.

Sub-project 1 was carried out in Bishui Forestry Center of Dailing Forestry Administration. There are three heating boilers which located in three different heating areas. In order to enhance the heat efficiency of the system, we designed to connect these areas through pipeline, and realized the centralized heat supply in the Center. The research results testified that this system is easily handled and run smoothly. It can use the branches with moisture below 50%, the general efficiency is from 59% to 78%.

Sub-project 2 was completed in Jianyang Textile Equipment Plant in Fujian Province. With the gas from up-inhaling furnace as fuel for boiler, the heat efficiency was improved to 63--71%. Compared with the direct burning of wood, the firewood was saved 33%, the energy utilization efficiency was improved 46%.

Sub-project 3 was implemented in Erdu Forestry Center in Shaowu City, Fujian Province.

The experimental scale is 100 dwellers, the supply capacity is 620 Nm^3 daily. This system can save the firewood about two thirds, the costing of wood gas is further cheaper than the price of coal gas in city.

In Sub-project 4, the system was combined with the up-inhaling furnace and down-inhaling furnace. It was testified that the combination excelled the single furnace system with both up-inhaling furnace of down-inhaling furnace.

IDRC supported 229,000 USD for the above projects, the fund from China was 288,684 RMB yuan. Three sets of sample equipment were installed, and a laboratory for wood gasification research was established, other instruments include one Z20-21 Oxygen detector, one RD-02 CO_2 detector, one Gas-Chromatograph, and some other instruments.

The project official had come to China for several times.

3. SCIENTIFIC, ECONOMIC AND SOCIAL EFFECTS

The IDRC project supported the establishment of three sample plants of wood energy utilization in different parts of China, which improved the introduction of wood gasification technology. Based on the technical achievements of this project, we developed the catalyzed gasification technology and the utilization of agricultural residues which is introducing in Jiangsu Province.

Wood gas as fuel for boilers can improve the heat efficiency of boilers, and the forest residue was fully utilized, the wood utilization efficiency enhanced, and the environmental pollution decreased.

The domestic wood gas system is beneficial for saving wood resources, and the price of wood gas is cheap. It is also healthier than burning wood directly, the people's living quality was improved.

UTILIZATION OF FIVELEAF GYNOSTEMMA-Project Review

Institute of Chemical Processing and Utilization of Forest Products, CAF

1. BACKGROUND

Gynostemma pentaphyllum Makino is a traditional plant of Curcurbitaceae family and is grown in forest areas in southern China. The plant is rich in triterpenoid saponins, which are similar to ginseng saponins in structure and possess a series of unique pharmaceutical qualities, such as reducing cholesterol and triglyciride levels in serum, fighting cancer, and preventing aging, ulcers and the side effects of glucocorticoid. In recent years in China, some products have been developed from this plant using wild resource, and the cultivation of this plant is now being studied. In order to utilize it with high-efficiency, the study on the selection of superior provenances with high gynosaponin content should be carried out. Gynostemma pentaphyllum also contains proteins, polysaccharides and mineral elements, so it should be comprehensively utilized, and the economic benefit of utilization would be further enhanced. Since this plant is usually grown in relatively poor forest and mountain areas, its cultivation and properly utilization is beneficial to local farmers.

2. IMPLEMENTATION

The implementation time of this project was from April 1, 1990 to March 31, 1994. IDRC had contributed 32580 Canadian dollars, mainly used in the materials, instrument, travel and labor cost. The Chinese Academy of Forestry supported 84600 RMB yuan, mainly used in salaries, instrument maintenance, water and electricity, communication and reports.

The instrument purchased by the support of this project included UV photometer, polarimeter and chromatograph column.

The research results from this project include:

1) Establishment of quantitative methods for analyzing the gynosaponin contents in Gynostemma pentaphyllum.

2) Isolation and identification of a new gypenoside, the structure of this compound was first reported in the world.

3) Twenty seven Gynostemma pentaphyllum samples were collected from around the China, two provenance with gynosaponin contents of more than 10% were selected out.

4) The laboratory and expanded experiment on extraction of valuable components from Gynostemma pentaphyllum were carried out, and the toxicity test for the gynostemma extract has been conducted.

5) The design of the pilot plant with annual capacity of 2t gynosaponins had been completed, the preliminary feasibility study was also completed.

3. Technical, Economic and Social Effect

The research results of this project provide the scientific basis for cultivation and introducing superior provenance of Gynostemma pentaphyllum. The new extraction technology was developed, and experimental product was manufactured. The extract was introduced into the healthy food and cosmetics. Now based on the research results of this project, we are engaging in the further developing of medicines with high added value, and expanding the application field of the extract. Three papers was published based on the research results.

The design of the pilot plant with annual capacity of 2t gynosaponins had been completed, the feasibility study showed that through purchasing the Gynostemma pentaphyllum, the plant would bring 1 million Yuan profit for local peasants.

Now in China, the utilization of Gynostemma pentaphyllum has developed into a kind of industry, it plays an important role for the economic development in the mountain areas, and for the income of people in poor areas.

SUGGESTED MAIN DIRECTIONS FOR COOPERATION WITH IDRC IN FUTURE

Accompanying the great progress of Chinese economy in the late twenty years, the ecosystem and environment are also deteriorated. Facing the new century, the scientific and technical development on Forest Chemical Industry should track on the motif of sustainable development. On the one hand we should aim at the economic development in the mountain and forest areas, develop the forest resource utilization technologies with high efficiency and introduce them into industry, so as to improve the income of people in the poor areas and enhance their life quality. On the other hand, we should also consider the potential influence of resource exploitation on ecosystem and environment, develop the environmentally benign technologies, and achieve the goal of sustainable development with the harmonization of the society, economy and nature.

Based on the above views, we proposed such main directions for future cooperation with IDRC as the below:

1. Extraction and Utilization of Natural Products

The application of natural products in medicine, health food, feed and cosmetics is paid more and more attention. The processing of natural products does not need the complex chemical synthetic steps, and the processing technology is harmless to the environment, so the natural products are seldom polluted by the heavy metals or organic pollutants, and they also cater the people's wish to be back to the nature.

Our Institute has done much research work in the field of natural bio-active products, namely the extraction of valuable components from plant resources such as ginkgo leaves, pine needles, *Gynostemma*, popular bark, *Adeaophora* and fig leaves, the extracts were used in the feed, health food and cosmetics. The utilization of natural products has developed into a kind of industry with apparent profit, and the economy in mountain and forest areas was improved based on this industry. But on the development of natural medicines with high value, we need further support.

2. Advanced Utilization of Renewable Forest Resources

To develop the new materials from renewable resources is very important for palliating the depletion of non-renewable resources, saving energy and protecting environment. As keeping on the research of the utilization and chemical modification of lignin, cellulose and semicellulose, we should emphasize the advanced processing and utilization of non wood forest products, use the natural organic materials from leaves, barks, fruits and wood secretions as raw materials, through chemical processing to prepare high-valued fine chemicals and functional materials. For example, we can prepare medicine intermediates and adhesives from plant tannin, and new polymer materials from modified rosin, and perfumes and chemical additives from turpentine. So that we can improve the utilization profits of non wood forest products, and expand the application fields of renewable resources.

3. Forest Products Biotechnology

The biotechnology will be the leading technology in the new century, the research and development of biotechnology in the forest industry should be supported. From the basic wood biodegradation mechanism, to the technical development of bio-conversion of wood and agricultural residues, and to the application of biotechnology in the pulping and papermaking and effluent treatment, a new research branch of forest science is emerging. That is the forest products biotechnology, which should be urgently strengthened in China.

4. Bio-mass Energy Conversion Technology

In order to realize the modernization and improve the people's living standard, it is impossible for the developing countries as China to rely only on fossil energy. The Bio-mass has great developing potential as a kind of renewable energy. Through chemical technology or biotechnology, the agricultural and forest residues can be converted into the energy for domestic and industrial use. And the bio-mass energy can play an important role in fulfilling the energy need in rural and forest areas, and is beneficial for reducing environmental pollution and enhancing the life quality of local people.

Introduction and Cultivation of Jojoba in Yunnan, China

Kunming Institute of Batany, Chinese Academy of Sciences

Background

Jojoba (*Simmondsia chinensis*) is native to the Southwest of U.S.A and Northwest of Mexico. It is distributed in the mountainous region of 23~35°N, 105~112°01'E, below 1500m of elevation and the area along the Pacific ocean, concentrating in the lowland of California, middle and south parts of Arizona and Texas of U.S.A., and north and southwest sections of Mexico.

The ecological environment in dry and hot regions of south and southwest China is similar to that of the native regions of Jojoba. A preliminary test on the introduction and cultivation shows that the region is suitable for the growth of Jojoba.

The planting of Jojoba will cut down the foreign exchange largely for the import of additives of lubricating oil of high quality and the liquid fat agent form abroad. At the same time the raw materials for producing higher lubricating oil and liquid fat agent for leather industry and the oil for industry and cosmetics will be supplied by us. As a result, the development of light and heavy industry and the chemical industry for daily use will be promoted greatly.

The success of the planting of Jojoba in China not only benefit China but also provide a direct experience for other countries where the ecological conditions are suitable for the growth of Jojoba.

Under aforementioned conditions, IDRC (International Development Research Center) subsidized "Jojoba (China)" from 1988 to 1991.

Implementation of item

- **Funds**

Form 1988 to 1991; IDRC provided $54980 CAD (¥187,853 RMB). Expenditure: a) Salaries & allowances: ¥64,412 RMB; b) Research expenses: ¥86,595 RMB; c) Equipment: ¥29,518 RMB; d) Local travel: ¥7,328 RMB.

The fund of approximate recipient contribution is ¥157,660 RMB. Expenditure: a) Wages & allowance: ¥84,480 RMB; b) Research expenses: ¥33,540 RMB; c) Equipment: ¥22,000 RMB; d) Local travel: ¥17,640 RMB.

- **Equipment**

In order to complete this item, we buy some equipment in the course of implementation of item, i.e. a) The meteorological instrument; b) The miniature tillage machinery; c) The sprayer; d) The high-lift pump; e) The cisterns; f) The super clean bench; g) The balances; h) The ovens; i) The tissue culture shelves; j) The shaker; k) The equipment of auto-adjust temperature and humidity; l) The Microscope; m) The hydrogen ion determination apparatus; n) The glass instrument; o) The counter and p) The camera.

- **Training course**

According to the results of investigated in dry and hot regions of Yunnan, we selected 6 planting plots for Jojoba provenance examination, the 6 planting plots are Yuanjiang, Pengpu, Taoyuan, Qina, Huaping, and Qiaojia. In order to let that the technicians and workers could know well the cultivation and management of Jojoba, we hold a training course in Qina planting plots in April 1989. There are 18 people attend this training course. We adopted the method that is integration of theory with practices. First, we introduced the introduction course, experiment and research, development and use of Jojoba in overseas; then, we explained the technique in cultivation, management and prevention and control of plant diseases and elimination pest etc. This is a most rewarding training course: a) knowing planting, development and use of Jojoba in overseas; b) we found many varieties of Jojoba that we introduced the commercial seed of the past; and male to female is high. We only did the provenance planting well can we did plant Jojoba in a large area in dry and hot regions of Yunnan; c) Through training, the students mastered the skill of sowing and growing seedlings, transplant and prevention and control of plant diseases and elimination pest. d) The important of observation and recording, and tabulations of observation in the cultivation experiment.

- **The exchange visits of expert**

According to the plan, from October 22 to November 11 1988, 2 experts of Kunming Institute of Botany, Mr. Guan Kaiyun and Mr. Zhu Yuanzhang investigated the native and cultivation regions of Jojoba in U.S.A. and Mexico. They keep informed on how the advanced cultivation techniques, development and use in U.S.A. and Mexico, and collected 25 fine varieties (including local provenance) and 45 technical data in this visit. Laying a foundation for provenance cultivation experiment and Jojoba variety development by selection in dry and hot regions of Yunnan.

Professor A.N.Rao, National University of Singapore, delegated to visit Qina Jojoba planting plot by IDRC in March 1991. He put forward a proposal about work of planting plot, and appraised based on facts.

- **Research group**

Since item implemented, a group of experts of seven (above college degree) of Kunming Institute of Botany, had been carrying out an experiment of Jojoba on the following aspects:

a) Study on the sowing of seed; b) The observation and research of biological character; c) Study on the clonal propagation; d) Experiment of ecological adaptation; e) Study on the prevention and control of plant diseases and elimination pest.

- **Achievements in Research**

a) Through observing the growth and development of fruit-bearing plants, and determining the oil content of seeds. Under same environmental condition, comparison of data form provenance showed no significant change in growth in height. But the significant correlation were found in oil content(47.8～57.0%).

b) Observing the male and female plants of provenance. We found a part of plants (3-years old) had bloomed and set fruits.

c) Along the success of introduction Jojoba provenance, it is very importance we prorate bred male and female seedlings. On the base of study on neutral propagation in 1989and 1990, the propagation by cutting was used. In April, we collected the cuttings (semi-hardwood) from the flowering males and females, the cuttings were immersed in 2000ppm ABT or NAA solution for 1 minute, then cutting were done in send and perlite mixed base. After 90 days, the rooting rate was 72%, and the transplant survival percent was 94%.

d) Study on the prevention and control of plant diseases and elimination pest. Studying of fix date (10 day) and fix plants (224 plants in 6 sample lands). In the dry season (November to May), the appearance of yellowing of plants is evident. The peak of diseases is from March to May. In the rainy season (June to October), the rate of diseases development and diseases are relatively stable. The main inducement of disease development is as follows: 1) Jojoba is a xerophyte, its root has strongest sucking force. When the moisture content is between 2.5%~10%, the main and lateral roots of plant growth well. If the moisture content is on high side, the growth of root will be restrained. 2) In Qina, the soil is sticky, and the content of stone is high; in the rainy season, the draining and aerating of soil are poor, the growth of main and lateral roots were controlled, the growth of plant is feeble and the diseases resistance of plant is weak. 3) Sampling from the roots of diseased plants, and isolating and cultivating with PDA and Agar culture mediums. In the pure pathogenic bacteria, the main pathogenic bacterium is Fusarium (*Fusarium spp.*). 4) After selecting agrochemical, we done the experiment of chemical content with 0.2% Bavistin solution (pouring) in Jojoba plantation. The result shows: the agrochemical can control the growth of Fusarium, and the development and death rates decline.

Appraising the result of Research, Economy and Society

The growth period of Jojoba was along time, it blossomed in third year after planting, and teemed with fruits in 7~10 years old. Because this item carried out just 3years, so we were difficult to appraise the result of economy, society and ecology.

Through cultivation research in 3 years, we saw Jojoba have relatively good adaptability in planting plots. We can full utilize the natural resources and exploit land resources in dry and hot regions of Yunnan. First, we introduce more fine varieties from abroad, and select good and high-yield verities are suited to local conditions. Then, we further explore the cultural techniques of high-yield in Yunnan. We will through productive growing Jojoba on a trial basis progressively expand the planting area. Making the plantation development Jojoba relatively good and quick in dry and hot regions of Yunnan.

Suggestion and Appraise on item management

The course of application and examination and approval of IDRC's item is simply, that item is advantageous to race against time, establish item as quickly as possible and develop item.

The distribution and use of the aid financially is rational.

Because the international exchange were relatively few in our works, we knew very few about the persons of the same trade or occupation. We hope you can promote the international exchange, especially, sending people to study and training is very impotent.

We hope the information management and exchange have improved to same extent. For example, we got very less information from IDRC and Science and Technology Deportment in the item implement, this state of affairs is unfavorable to development an international cooperation item. We hope from now on there will provide the new information about item betimes, so that we can always know the recent development in science and technology.

We gained same achievement in scientific research and won initial success in the past 3-years under aid financially by IDRC. As a long time item, the number of years set for a course of the aid financially that is too short. When IDRC supports the forestry and agriculture item, we hope have a long time in the future.

Review of IDRC Joint Research Program between University of Victoria and East China Normal University

Jin Yiming Qian Jingfang

With the fund supported by the International Development Research Center (IDRC),College of Educational Sciences in East China Normal University in China and College of Education in University of Victoria in Canada had conducted a seven-year joint research program which lasted from May of 1983 to May of 1990. The whole program was called "Education Research", who including two projects: "Education Research and Education Reform" & "Teaching Reform in High School".

I. Background of the Program

The program of joint research benefited from the reform and open-door policy of China. We believed that education research achievements acquired by any country would provide us with rich learning resources and wealth. That's why we made the choice of carrying out this program.

The program was the outcome of the friendship between the Chinese and Canadian people. With the financial aid given by IDRC who affiliated to the Parliament of Canada, we got substantial economic support to carry out the program.

The whole program was put into effect by ECNU and UVic. The two universities shared some common grounds in many aspects. The original goal of UVic was to train high school teachers. As the time went by, it gradually turned into a comprehensive university with high level of scientific research. However, it also took teacher training as its major task. The College of Education still maintains an important position in the university. ECNU is one of the key normal universities in China with a strong team of scientific research on education. The first College of Educational Sciences in the nation was set up there.

The common characteristics of the two universities could be obviously seen in developing scientific research on education and training high-quality secondary school teachers. That's why the leaders and experts in the two universities reached an agreement of collaboration. The intention of collaboration was first established in 1981, when Dr.H.E.Petch, the president of Uvic, visited ECNU.

It was in 1982 that the possibility of joint research was discussed by the representatives from both sides. The Cultural Counselor of Canadian Embassy in China and officials from IDRC played an active role in promoting the program. The former State Commission of Science also showed its great support to the program. The program was established formally at the end of 1982,and was carried out in May of 1983.

II. Practice of the Program

A. Settlement of the Research Contents and Anticipated Objectives

The whole program was conducted in two periods including three phases. The first period included the first phase (May,1983—May,1987) and the second phase (May,1987-May,1988). The second phase was for evaluation and adjustment. The second period was the third phase(May,1988-May,1990).

1. Settlement of the Research Contents

The contents of the first period of joint research were decided with two elements.

First, the program should meet the needs of ECNU. After several careful discussions, ECNU held that the program should benefit ECNU in two aspects --on the one hand, strengthening the disciplines of education with relatively good foundation so as to enable them to become the first class home and abroad; on the other hand, developing the disciplines of great importance in education development in China but very weak or even blank in ECNU. Through the joint research , ECNU anticipated the profit of learning materials accumulation, staff training, and the research method grasping. Therefore it might fill some blanks of educational research in China. With careful consideration, ECNU proposed some projects for selection.

Second, the program should be able to make use of the advantage of UVic. The projects ECNU chosen would better gain great help from the related experts in UVic. After exchange visits and discussions, seven collaborative areas were settled: Active Learning, Foreign Language Teaching, School Administration, Educational Evaluation, Computer Assisted Learning, Distance Education and Applied Psychology. Among them, School Administration, Educational Evaluation, Computer Assisted Learning, Distance Education were the new areas that ECNU planned to develop. In the second year of the first period (1984), Career Education in High School was added into the program. This research area might be new but needed necessary study in China.

Since educational administration reform being carried out in China from 1985 had made considerable headway for Chinese education, it could be obviously seen that teaching reform would also be important. Thus, the second period of the program was named as "Teaching Reform in High School". It was just the right time for us to do some research work in this area. The program included 5 subsidiary projects:

(1) Research on compiling learning materials for hihg school students(Subjects involved : English and mathematics)

(2) Research on teaching strategies for high school (Subjects involved : Geography, English, Chinese, etc.)

(3) Research on career education

(4) Research on educational evaluation and educational administration

(5) Research on distance education for training high school teachers

2. Anticipated objectives of the program

(1) Introduce reform in the areas of teaching materials, teaching methods and strategies in Chinese education by studying the learning materials and books offered by the experts from UVic and making use of educational research achievements of other countries. For instance, the research on the theory and experience of Active Learning did benefit in changing the teaching method of mechanically cramming students or the phenomenon of stuffing the students to gill. Meanwhile, the research on theory and practice of Evaluation would be a great help in making Chinese education be more systematic and scientific. At the same time, the research on the theory and practice of the career education would promote the work of career guidance in high

schools.

(2) Carry the reform forward in educational sciences in ECNU. On the one hand, already existing disciplines in ECNU, such as Theory on Instruction, Psychology and so on, would be pushed forward by the joint research; on the other hand, some new disciplines that China needed urgently, such as school administration, educational evaluation, computer assisted learning, career education and so on, would be set up in time. Therefor, it would be quite helpful in raising the level of teacher training in ECNU, so as to give impetus to the Chinese education reform indirectly.

(3) Raise education scientific research level of ECNU by exchanging visiting scholars, joint research and training of the young scholars.

B. Research Methods

The basic research methods being used in the whole program included documents and materials analysis, experiments, investigation, statistics, etc.

The research work was undertaken separately by the scholars in the two universities. But the connection was kept with each other. After a period (usually a year), experts would have a short-term visit to the other university to exchange experience and achievements and discuss some new problems.

The advantage of this research pattern reflected in four aspects. First, the researchers stayed at their own posts, so the teaching and administrative work they took on responsibility would not be influenced. Second, the researchers would not be separated themselves from their research collectives. Those who worked with them would have the chance to take part in the research work. Third, since the collaboration is a long term one, both sides might understand each other very well, and was in harmony with one another in the cooperation. Forth, comparative study on culture difference could be conducted. The same topic being studied by the scholars from two universities might not acquire exactly the same results and information, which would be helpful for them to explore the culture difference between the two counties.

C. Usage of IDRC Fund and Domestic Fund

1. Fund allocated by IDRC and distribution to the two Universities (unit: Canadian Dollar)

	Phase I	Phase II	Phase III	Total
Total	88,000	159,000	187,500	434,500
Canada	83,500	149,000	183,000	416,350
China	4,500	9,150	4,500	18,150

2. Usage of Fund

(1) The fund allocated to UVic being used by ECNU could be divided into three parts:① international travel, accommodation, living and traffic expenses being spent by the ECNU researchers who went to Uvic for academic visit, ② international travel , living and traffic expenses being used by the trainees,③ cost of buying a pickup camera, video equipment, books, and reading materials.

(2) The fund allocated to ECNU was spent in doing scientific research at home, servicing (printing, translation, etc.) and purchasing a duplicator. These expenses might make up about 55%, 52%, 36% respectively of the total fund which could be used by Uvic in the three phases.

(3) Another $2000 was subsidized by IDRC to support the publication of the research

outcome of the third phase.

3. Domestic Fund

In the whole program, ECNU spent about ￥80,000(not including salaries to the researchers) to be accessory money. It was mainly spent to subsidize the research expenses, to pay the expenses for the staff going abroad (including cost of passport, training, and dress), to pay the expenses being spent for the visitors from Uvic.

D. Instruments and Equipment

In the mid-term of 1980s,the tools used most for Chinese scientific research on education were still paper, pen, notebooks, etc. Supported by the fund given by the IDRC, ECNU could purchased some new instruments and equipment, including duplicator, printer, portable pickup camera, IBM-PCXT computer, software, VcRs/Monitors(3), Teledon, Decoder, etc. These instruments and equipment played an important role in doing the research work.

E. Staff Training and Exchanging of Expert Visitors

1.Number of trainees in the three phases:(unit: person/time)

	Two-month Training	Four-month Training	Eight-month Training	Master Degree Candidate
Phase I		4		2
Phase II		4		2
Phase III	4		3	1

2. Experts from ECNU visiting Canada:

Before the formal joint research 13

Phase I 7

Phase II 15

Phase III 9

3.Experts from UVic Visiting China

Phase I 13

Phase II 16

Phase III 18

(Phase III included those who came to China to attend International Conference on Teaching Reform in high School.)

F. Scientific Research Team

Because this program was the largest, longest, and fund-spent most one in ECNU among its international collaborative programs at that time, ECNU put into plenty of researchers to form the research team.

1. General Information of the Research Team

(1) Number of Researchers and Distribution of Professional Titles

total	High-ranking	Middle-ranking	Primary-ranking
45	12	18	15

(2)Disciplines Involved:

Fundamental Theory of Education, Psychology, Theory of Instruction, Foreign Language Teaching, Educational Technology, Educational Administration, Educational Evaluation, Adult Education, etc.

2. Management of Scientific Research Team

At the beginning of the implementation of "reform and open" policy, ECNU lacked the experience of organizing such a big international joint research program, so some measures might not conform with the regular rules in Phase I. With the help of Canadians and the experience gradually gained in Phase I, ECNU had built up a series of management files to make the program be carried out more properly.

The files included:

(1) Administrative duties of the Commission of Administration, the assistants who were in charge of coordination, and those who were in charge of subsidiary projects

(2) Evaluation requirements and outlines of the joint-research plan

(3) Suggestions for mid-term and final research reports

(4) Outlines of the reports on the visiting research

(5) Evaluation of the staff training

G. Research Outcomes

The main research outcomes manifested in three books:

1. Edward E. Owen: *Education in China,* University of Victoria, 1986.

2. Jing Yiming, Qian Jingfang(editors): *Education Research and Education Reform,* Press of East China Normal University,1990.

3. Jing Yiming, Qian Jingfang(editors): *Education Reform in High School,* Press of East China Normal University,1990.

Before the books being issued, some essays had been published on the professional journals home and abroad. For instance:

"The Space Concept of Chinese and Canadian Children" was published in Chinese language in *Reports on Psychology Science*, No.3, 1985, and was published in English Language in *Journal of Genetic Psychology*, No.4, 1986.

" The Grasp of Continuous Time Concept of Chinese and Canadian Children" was published in *Reports on Psychology Science*, No.2, 1986.

"Computer Optimal Choice of Satellite TV Receive System for Education" was published in *Journal of ECNU (Natural Science)*, No. 2,1985.

"Theory and Practice on Active Learning" was published in *Jiangxi Scientific Research on Education,* No.2, 1987.

"Vocational Orientation—Investigation of Several High Schools in Shanghai" was published on *Education and Profession,* No1, 1987.

Besides, some teaching materials, teaching software, video programs were made and published. For instance:

Step by Step, 4 Volumes, with tapes

Systemic Software for the 214 Course of Electronics

Software of CAD for Satellite TV Receive System and Microcomputer Research of Satellite Station

Five Video Programs of Active Learning in the Class of Geography
14-hour Asian-African Literature Video Programs for Distance Education

III. EVALUATION ON THE RESEARCH, ECONOMIC AND SOCIAL EFFECTS OF THE PROGRAM

We led an evaluating and adjusting stage during the first 2 phases of this program.

IDRC formed a special group of 4 scholars from CHINA and Canada in charge of evaluating the effects of the first 2 phases of this joint research. IDRC was satisfied with the effects of the program, and invited Doctor E. Owen and Professor Zhang Minlun to attend the correspondents conference held in Ottawa, Mar. 1988.

In evaluating the program, the special group invited experts and scholars of our country: Wang Cesan, Xiao Zongliu, Chu Peijun, Yang Jike, Xu Guozhang, Liu Fan, etc.to appraise 9 theses including "To Increase Schools' Efficiency—The Function of Educational Evaluation in China", "Children's Mastery of the Notion of Lasting Time in China and Canada", "Comparison on Issues of Primary & Secondary School Masters and Their Work between China & Canada", "Experimental Research on Active Teaching and its Initial Effect", "Application of Active Teaching in 'Transportation and Trade'", "Introduction and Comment on the Theory and Norm of Western Vocational Guidance", "An Instructive Trial – Report on the Comparative Experiment of 2 Teaching Approach in Correspondence Education", "Teaching English as a Foreign Language in the P.R.C.", "Educational Technology Research and Development in the P.R.C." etc. Most of the thesis were highly praised that they had some appreciative value to the education reform of our country, with some new ideas presented and new research methods adopted.

By the end of the phase III, "The International Seminar on the Reform of Secondary School Teaching" was held in East China Normal University. The 170 participants include research fellows from both sides, Chinese experts studying the reform of secondary school teaching, principals and teachers from the experimental schools which took part in the joint research, and educational researchers and secondary school masters from different provinces and cities. They appraised the cooperative research as of high quality with clear aim and correct choice. The aim is to promote the education reform. The programs are issues of current teaching reform in need of solving with high appreciative value. Every branch of the program contributed a lot to their own fields. They also found it necessary to improve teaching methods and to mobilize the students' initiative. The teaching materials of English and Geography are interesting, too. The teaching tapes of English can help to train students' listening and speaking ability, because they had reading materials of various kinds and with background sounds in them.

Educational management, educational evaluation and vocational guidance are fields recently rising in China and still short of systematic material and research experience. With the help of the foreign counterpart, ECNU could take the lead in the research and promote their development.

From the above general evaluation on the joint research program, we can see that our expected target has been basically met.

1. Promote the educational reform in China by spreading results of the cooperative research.

The results of our research have been widely spread through thesis, lectures, and various academic conferences. They played an active role in promoting the educational reform in China, especially the reform on the teaching of secondary school. Examples are as follows:

The result of the research on vocational guidance drew the attention of Wenhui Daily and was reported as a major issue worth of attention in the lead of Oct.31 1986. Chinese Vocational Education Agency, who had an excellent tradition in vocational Guidance, also opened a new volume on same issue in its periodical "Education and Vocation". Besides, they held a national seminar and invited experts of our university to introduce the research program. The Vocational Education Department of State Education Commission proposed that the research should be listed in "the 7th 5-year Plan" of the national educational research as a major program. The Basic Education Department proposed to introduce vocational guidance lesson in all junior high schools and entrusted us to draft the documents concerned. These, together greatly promote the practical and theoretical development of vocational guidance in Chinese secondary schools.

The research on "Active Learning: Teaching of Geography" and "Active learning: Teaching of English" were closely bound up with secondary school teachers from the very beginning. The process of the whole experimental research facilitated the transformation of teaching concept and the reform on teaching methods in these schools. They won the prizes in the subject teaching competition, and the teaching pictures made by them were highly prized at the professional conferences, too. Their students made progress in academic achievement and their learning interest increased.

2.Promote the reform on educational disciplines in ECNU by replenishing and renewing the content.

In mid-1980's, the teaching profession in China knew very little about the development of Western educational theory. Development of educational disciplines is tardy with limited newly-rising subjects and traditional subjects out of date. The cooperative research provided us with good opportunities of contacting with Western educational research staff. And through them we could collect materials on Western educational research. Our teachers could timely replenish their teaching with the newest research results. There are many examples. Such as they replenished the teaching material of Instruction Theory with experimental material and theoretical discussion of Active Learning; The teaching of "Psychological Linguistics" and "Linguistic Development" absorbed some latest materials and theories in content and adopted some methods of cross-culture and computer processing technology in scientific research. Another example is that we chose some research materials from the books offered by Canadian staff in the teaching of graduates in Educational Management. The other contribution is to promote the construction of new subjects, e.g. educational evaluation, computer-assisted instruction, vocational guidance etc.

All these together made ECNU take lead in some areas of educational subjects and spread its influence in the world of education in China.

Teachers' training is one of the main tasks of ECNU. The replenishment and renewal of educational subjects will be helpful in training of new teacher staff.

3. ECNU's capacity of educational research increased.

During the period of joint research, 44 experts in all visited Canada and undertook long-term joint research there together with Canadian experts. Uvic provided Master-degree training for 5 graduates and short-term training for 15 young teachers from ECNU. They received great deal of new knowledge and information there. This will play an active role in raising our capacity of scientific research.

IV. Reflections

The joint research between ECNU and UVic has lasted 7 years and has already made great outcome. The success has grown out of hard endeavor. We believe that it should be attributed to the correct approaches with which we treated the following relationships.

1. The relationship between Chinese education and foreign education.

Education belongs to social phenomena and is restricted by various social factors including politics, economy, culture, population, etc. Therefore, countries with different backgrounds will be different in the nature, aims, contents, and methods of their education. The domestic status in China and Canada are different from each other,. They have great difference in education, too. However, education in different countries also have some issues in common and some useful experience can be shared. Our joint research was undergoing on the basis of this understanding.

The joint research can help us draw lessons from foreign educational experience. But the fundamental aim is to construct our own education with Chinese characteristics. So we should focus our work on digesting, absorbing and creation instead of entire borrowing from foreign experience.

2. The relationship between Chinese experts and Canadian education

Experts from both countries jointly participated in each program with their own strong points. Canadian experts' strong point was their more knowledge on international educational theory and practice, while Chinese experts were more familiar with their country's situation. Both of them made up for each other's deficiencies and played an important role in promoting the development of Chinese educational theory.

Experts from both countries made great efforts in learning from each other's merits and making up for each other's deficiencies. During Chinese scholars' visiting in Canada, Canadian scholars arranged various activities for them to thoroughly learn foreign education by great deal of visits, interviews and extensive connections with people from various backgrounds. Similarly, during Canadian scholars' visiting in China, Chinese scholars invited them to introduce educational theory and practice of other countries. Besides, they also organized extensive visits to various types of school and offered them more information about the situation in China. Through a few years' efforts, scholars of ECNU have got thorough and profound knowledge about international educational theory and practice, and become accustomed to consider various educational issues from a wider view and boldly absorb helpful experience from foreign countries. While the scholars from Canada also have got more knowledge about the situation of China and can purposely provide some suggestions and strategies applicable for China.

Because we correctly treated the relationship between scholars from both countries, the joint research staff could cooperate together and support each other in good friendship.

3. The relationship between practice and theory

Foreign education have numerous schools of thought in theory and various styles in practice. The rightness of these theory need to be tested by practice. Especially their application to Chinese education must be taken serious.

Most of the joint research programs persisted in the principle of testing by experiment. The active teaching program was linked with some secondary schools in Shanghai from beginning to the end, where they undertook long-term experiments. At the beginning of programs on educational evaluation and vocational guidance, the investigation on its needs was made first, then we made plans and carried out experiments. Lastly, on basis of extensive experiments, we generalized concerned theory and presented it to the community step by step.

4. The stability and development of research team

The research team of this cooperative program was basically stable during the 8 years' research periods. Each branch program was under the cooperative charge by 2 experts, 1 from UVic, 1 from ECNU.

We highlighted the training of promising new staff during the joint research. With the financial aid from IDRC, some young teachers of ECNU had short-period study in UVic and then joined the collaborative research team. Therefore, although some Chinese and Canadian professors who first joined the collaborative research have already resigned, the program is still continuing and developing.

Through 7 years endeavor, each cooperative project has built up its own research team. This is a delightful phenomenon.

REVIEW ABOUT "BIOGAS REFRIGERATOR PRODUCTION TECHNOLOGY"

Xue Deqian
Beijing Solar Energy Research Institute

Biogas Refrigerator is powered by biogas as the main energy resources, which is based on the principle of refrigeration by diffusion-absorption. Refrigerant is NH_3 using water as the absorption medium. When the concentrated NH_3-H_2O solution is heated, the ammonia is released and then cooled in the condenser. The liquid ammonia diffuses in the evaporator. This diffusion is accelerated by the circulation of small quantities of hydrogen (or helium), which draws heat from the refrigerator. In the absorber the ammonia vapor is absorbed by the diluted NH_3-H_2O from generator through a thermaosiphon. The concentrated solution is kept in the storage tank. The refrigerator operates within the closed loop.

The Project "Biogas Refrigerator Production Technology" (91-0226) is following project of "Biogas Refrigerator" (85-1016), is also the second stage of "Biogas Refrigerator". It is a practical application phase which includes the establishment of a viable production technology for the manufacture of a biogas refrigerator, the development of production facilities, field test for trial-products, market investigation and promotion.

Under the guidance of State Science and Technology Commission of the People's Republic of China and supported financially by IDRC, Canada, the research team had successfully implemented stipulated tasks. In the course of the project Canadian Gas Research Institute had considerably cooperated with us in improvement and simplification of combustion and control system. Canadian combustion expert, Mr. John Overall visited China in May, 1993 for helping us in field test, program officer of IDRC Duly came to our institute and consumer field to instruct our work. We are deeply thankful for their help and support.

The research team started to work immediately as soon as the project "Biogas Refrigerator Production Technology" was approved by Canadian IDRC in April 1992. In 1993 and 1994 we had completed the small-batch production and field test. In order to reduce production cost and promote market we trial-produced small biogas freezers and propagandized these new products on newspapers, magazines, TV and broadcast etc. in 1995. All these did help us to transform research results into commodity and benefit peasants of China and other countries.

Our main activities are as follows:

REDESIGN AND DEVELOP THE PROTOTYPE OF THE BIOGAS REFRIGERATOR

At the beginning of the project, we had redesigned and developed the prototype of the biogas refrigerator. In terms of the users' requirement and reducing production cost, the original biogas refrigerator, developed in the first stage of the project "Biogas Refrigerator" should be modified. It took first three months for us to revise the original design.

The specifications of the biogas refrigerator and freezer:

a. The performance of the biogas refrigerator and freezer

We confirmed two biogas refrigerators as first generation products.

Number 1 is "XCD-150" biogas refrigerator.

Number 2 is "XD-65" biogas freezer.

The "XCD-150" refrigerator: Freezer capacity 21 liters, below −12℃

Refrigerator capacity 129 liters, 0 to 6℃

Total 150 liters

The "XD-65" freezer: Freezer capacity 65 liters, below -12 ℃

This feature and specifications will satisfy ordinary farmer family of 3-5 persons.

b. The biogas refrigerator is also to be powered by electricity when biogas is used up.

This design will provide reliability for usage. Our measuring results show that consumption is 1.0-1.4Nm3/day for "XCD-150" and "XD-65" and electricity consumption is 1.5 to 2.0 kwh/day, respectively. This power consumption could be reduced by means of enhancing coefficient of performance of the refrigerator core and increasing wall thickness of refrigerator insulation.

c. Simplify the combustion and control system

In the Biogas Refrigerator the automatic reignition system in original prototype is omitted for cost reduction. In normal operation there are very few times for ignition. We had developed manual and electronic ignition. When you adopt electronic ignition method, a small battery will be used and can last for more than half year. You can also use a match to ignite the biogas refrigerator without battery.

d. Design new cabinet of the biogas refrigerator

According to freezer and refrigerator capacities, the "XCD-150" biogas refrigerator was designed in double door type. The "XD-65" biogas freezer was designed in single door type.

SETTING UP OF MANUFACTURING REFRIGERATOR CORES AND CABINET PRODUCTION LINES

On basis of the new prototype, we looked for a few cooperative factories for trial-production and further, the batch-production with economic scale.

According to requirement of cooling unit production process, our cooperative factory, Qinhuangdao Household Electric Appliance Factory had provided necessary facilities such as three sets of tube benders, welding apparatus, tube washing apparatus etc. We designed and fabricated some special facilities and main equipment for manufacturing cooling units. QHEAF had the capacity of manufacturing 10,000 sets of the cooling units per year.

As to refrigerator cabinet, besides making full use of existed facilities, special moulds and a lot of subsidiary components for cabinets were designed and fabricated. The manufacturing cabinets were entrusted to Xinrong Refrigeration Equipment Factory in Sanhe county, Hebei province. This factory was a deep freezer manufacturer. We handed over them the refrigerator cabinet drawings and cooling units which were finished by QHEAF. Then, according to the contract, they would deliver the whole refrigerators on time. This factory had production capacity of more than 10,000 sets of refrigerator cabinet per year.

For components in combustion and control system we chose some factories to trial-produce at first. Then, on basis of the product quality and price we had confirmed a few factories which can provide mass-scale components.

Safety valves had been fabricated by Xinshi Household Gas Appliance Factory, Zhejiang Province. The performance was fine through one year's operation. They could be able to batch-produce for us. Electronic igniter was developed and fabricated by Beijing Public Service Research Institute. Fire indicator was batch-produced by Beijing Automatic Control Apparatus Factory.

The another cooperative factory was Guangxi Measuring Instrument Factory which was located in Nanning City, Guangxi Province, South China. They had plentiful experience in manufacturing absorption refrigerator. We considered there were potential market in South China. In order to reduce the transportation cost we entrusted them to manufacture biogas refrigerators. This factory could produce not only refrigerator cores but also refrigerator cabinets, which had about 200 employees.

LAY OUT PROCESSING DOCUMENT AND QUALITY INSPECTION CRITERIA

1. Cooling Unit Production

The performance of total refrigerator mainly depends on the quality of the cooling units. So at first, we worked out the cooling unit production requirements through many tests. Besides, general technology requirements which were expressed on the drawings, the key parameters have to be controlled, such as: vacuum degree inside the finished cooling unit, filling NH_3-H_2O solution, etc. The cooling unit could be installed into the refrigerator cabinet when the minimum temperature on the evaporator surface of the cooling unit has been lowered to -12°C and it has a certain length of frost such as 200-300 mm.

It is important to enhance the qualified rate and to reduce production cost, through limited production runs we discovered that main factors affecting qualified rate of products was as follows:

(1).Washing key parts such pump tube, condenser tube, evaporator tube, rich NH_3 solution tube etc. must be reached to be absolutely degreased.

(2)Strictly check the cooling unit dimensional conformance.

(3)It must make high pressure tests at 40 bar for cooling units. In this way it could guarantee the welding quality of cooling units.

(4)It has to ensure that the cooling unit is evacuated to required vacuum degree such as above 1×10^{-2} mm Hg.

(5)Correctly filling the volume of water-ammonia mixture and hydrogen(or helium) pressure to 22 bar.

Through these processing conditions the product qualified rate for batch production could be reached to 95% more. Therefore, it would possess the possibility of mass-batch production.

2. Refrigerator cabinet production

The requirements for biogas refrigerator cabinet production are almost alike as the compressor-refrigerator.

The thickness of wall for biogas refrigerator has to be larger than that for the compressor-refrigerator. The evaporator tube has to keep tightly close to the wall of freezer and cooling cabinet. Usually the special glue with good heat conductivity has to be used.

3. The combustion and control component production.

The safety and reliability of biogas refrigerators in operation is mainly determined by the combustion and control system. Biogas usually consists of methane (CH_4) and carbon dioxide (CO_2); The volume contents are CH_4: 50-70%, CO_2: 30-50%. Sometime, not only the proportion of these components is variable, but also the pressure is fluctuating. So the pressure regulator should be applied in the system. Ordinary pressure extent has to be controlled in the 50-100 mm H_2O column. The size of jet orifice diameter correspondingly should be about 0.8-0.85 mm. In this condition the burner of the combustion system could be operated efficiently.

FIELD TEST

Field test is important to convert the research result in the previous phase into the product for consumer so as to obtain socioeconomic benefit. From lab research to trial production many problems may be encountered. Meantime, it is an inspection for new product and first step of acquiring response from users.

We had used a advanced measuring method in the field test. At first, special measuring software could be set into Data-taker through micro-computer such as AST-286. Then the date-taker could be sent to test sites. No person needs to operate and manage. It could record test data about the biogas refrigerator.

We sent many biogas refrigerators to consumers in Beijing and other provinces such as Sichuan, Zhejiang, Shandong. In order to examine operation situation of the refrigerator easily, a choice of five focal sites was made. Now we introduce the status of five focal sites and response of using biogas refrigerator:

(1) Weigou Pig Farm in Beijing

There were more than 120 workers in the farm. About 20,000 pigs were fed. A large biogas plant could produce biogas of about 20m^3/day. It utilized the pig farm waste as raw material. Our refrigerator had been used for storage meat and other foods since September, 1992 in the kitchen of the canteen. The user was very satisfactory with the biogas refrigerator.

(2)Hugezhuang Village, Tong County

The biogas refrigerator in this village was powered by biogas from small pit. This was typical individual household biogas pit. It possessed 8 m^3 volume for producing about 3-3.5m^3/day of biogas. The biogas was used for cooking, lighting and operating the refrigerator each day. This family was located at suburban of Beijing about 50 km away and had 5-6 persons. The host had plentiful experience in using biogas.

We measured the biogas consumption of the refrigerator. It was about 1.3-1.4m^3/day in Summer months (July, August). So there was plenty of biogas for cooking and operating the refrigerator.

(3)Liuminying Village, Daxing County
This was a model of ecological village located in the South of Beijing City about 60 km away. There are more than 100 farmer families. A medium scale biogas plant had been built in the village as biogas plant field test. It could produce about 300m^3/day of biogas. The raw materials are provided by its breed chicken farm. The pipe line for transporting biogas was also built in the village and the secondary biogas engineering project will be started soon. So this was a model of modernization village for hundreds of millions of Chinese farmers.

(4) 41 Gwihuazhong street, Guanghan City in Sichuan Province
Waste materials in the town were fully utilized for improving environment and producing biogas. Here was a 50 m^3 of biogas plant built in underground. This plant utilized urban sewage and waste materials coming from a brewery and produces biogas. It didn't occupy urban construction field. On contrary, it could supply biogas for cooking. The biogas refrigerator field test functioned well.

(5) Yong Quan Shao Zhuang, Mianahu County in Sichuan Province
This was a village in South China, Sichuan Province. The biogas refrigerator was sent to a farmer's family with 4 persons. The farmer's name is Mi Yungui. He had two biogas pits with 6 m^3 volume each. The advantage of couple pits was without interruption supply biogas when replacing raw materials. This farmer breed 4-5 pigs and 7-8 chickens in his back yard. It was told that its cost for constructing two pits was only about 500 yuan RMB. The production biogas rate reached to 2.5-3.0 m3/day and it could resolve anxious problem of cooling and storage food and meat in Summer.

Some problems were discovered in field test. We had resolved in practical usage, For example: (1). Pressure fluctuation in the biogas pit made harmful affect on the combustion system of the biogas refrigerator. (2). There were some impurities such as sulphuric hydrogen (H_2S) etc. in the biogas. They seriously corroded the parts of combustion system. (3). Biogas yield rate was fluctuated upon ambient temperature, namely, the pit temperature. The refrigeration is more necessary in Summer months. Meanwhile biogas production rate is higher. Hence, South China is more suitable than North China in practical utilization of biogas refrigerator. In North China during Spring and Autumn it should keep the pit temperature at some level so that there is plenty of biogas for operating the refrigerator.

MARKET STUDY AND PROMOTION

In order to investigate biogas refrigerator market, the project researchers in BSERI traveled in

Beijing, Sichuan, Guangxi, Jiangsu, Zhejiang provinces etc. They brought with manual instructions and photographs of biogas refrigerators and directly visited farmers, village women and local cadres worked on rural energy source. Biogas utilization situation in many counties were recorded in detail. They mainly collected the material as following:

(1). The biogas pits or stations could provide how much of biogas each day. (2). The consumers would like which fashions of refrigerator type, which colors of the appearance and how much volume of freezing cabinet, etc. (3). How much income did local farmers have every year. The expenditure structure of farming families was how to arrange.

We had written many articles and reports on new product application to magazines, newspapers. Through various meetings, bulletins, special issues etc. this product had been propagated to all over China. Farmers in many areas began to know that biogas not only could be used to light or cook but also powered to the refrigerator operation. Many people called or wrote us for purchasing biogas refrigerators.

Through the market study on biogas refrigerators following conclusions can be drawn out:
1. Biogas refrigerators have a large potential market in China because of enormous amount of inhabitants utilizing biogas. The farmers' income is also increasing year by year. They considerably like and need the biogas refrigerator.

2. Biogas refrigerators market must be gradually developed. In the first two years only a few hundred sets could be sold in the high sale price. We think that the market of biogas refrigerator will grow up rapidly with demonstration and advertisement. It has three factors to speed up marketing promotion. The first is that the dramatic growth of Chinese economy will promote energy consumption growth, so it will cause serious lack of electricity in many areas. The second is that government and all people pay much attention to improving and protecting environment to establish ecological balance. The third is that the farmer's income enhances considerably year by year.

Biogas refrigerators must take up Chinese market even could be sold to South-East Asia such as Philippines, Thailand, Viet Nam etc. countries as long as it reaches large scale production, the production cost will be considerably reduced.

A review of the Environmental and Community Control of Dengue Fever in Hainan Island

Hainan Provincial Immunization Station

The memorandum of co-operation on the "Environmental and Community Control of Dengue Fever (DF)"was signed by Hainan province and IDRC in 1991. The program started in July,1991 and ended in June,1994. Through 3-year-practice, it had gained a marked effect. At present, the achievements of the program are being spread in the high-density-Aedes aegypte areas.

1. Background

In Oct.,1979, the DF caused by dengue virus 4 spread in the villages and towns along the coast in Danzhou city and this caused the pandemic of DF in Hainan. In 1980,there were 14 counties/cities had reported cases and the total cases were 440,063 and 65 people died. In order to find a way to control the DF spreading again, we tried to feed fish in water vats to control the reproducing of Aedes aegypti larvae. But the method had no effect, and the epidemic of DF appeared in Danzhou city again in Sep. 1985. We tried to gain the virus in time and confirmed it was dengue virus 2. At first, we planned to control the DF in Danzhou city, so in Feb.---May 1986, we sprayed pesticide to the houses of the residents once two weeks, and the reported cases were only 25 for each month. But when we stopped spraying in June1986, there were 356 reported cases, and the reported cases reached the peak in August 1986,and the number was 10,711. We did not get planned goal finally. At that time the main method was to spray pesticide. Its characteristic was: where there were cases, we sprayed with pesticide, and after the spraying, there was few case, but as the time past 2-3 weeks, the number of case rose up again. The result was that you sprayed ahead, the cases appeared behind. So this pandemic of DF ended two years later.

I realized that the method to control DF in Danzhou city was not good, but I had no ripe experience. So I could only learned some methods from books,and there were no other methods in the books at that time. But I thought that the main dissemination vector of DF was Aedes aegypti and it reproduced in the water vats and small water containers, if these water containers could be washed regularly, the DF should be controlled. Having this idea, I went to the Lingao county where the epidemic of DF was the most serious and I found a village called Baocai where the local leaders paid attention to the disease. The leaders organized the staff to spray pesticide in all the village at once, and at the same time we carried out health education about DF control to the residents and required the householders to wash the water vats every 3-5 days and put the small water containers upside down. Every village cadre took responsibility to several families and had a check every week. After two weeks, the density of the larvae (Breteau Index, BI) decreased from 89.9 to 5. We persisted in doing this work for 3 years and got good effects. The village had over 3,000 residents. When other villages around it had pandemic of DF, it just had 74 cases.

The Public Health Bureau of Guangdong province talked the program of DF control with IDRC in 1988,and they chose Hainan to be the testing ground. The official of IDRC required the delegate of Hainan should take part in the discussion. At the meeting, the delegate of Hainan raised a different view that to control the DF need the community administration and health education. The new idea was accepted by Dr. Panduka who was the high-ranking official of IDRC. Under this situation, the memorandum of "the Environmental and Community Control of Dengue Fever" was signed in 1991 by Hainan province and IDRC.

2. The situation of implementation.

A). To confirm the research area.

Dr. Panduka, the high –ranking official of IDRC, visited Hainan in the Spring of 1991 and walked over the most serious area of DF and talked to the grassroots cadres and the local people to find out how much the residents know about the DF. He finally decided to do the research work in 8 villages and towns which circle around Baimajin town. The area included 85 administrative villages,371 natural villages, 29,590 families and 178,373 people. The area covered 382.08 squire km. In the research area, we set up experimental area and comparative area. Between the two areas the distance on the sea level was 2 miles and the distance on the land was 10 km, and there were villages and towns along it. In the past two pandemic of DF, the research area was the first area to report the suspected cases. So the area was a natural and perfect research area.

The situation of the baseline investigation was that the knowledge level of residents was very low, the illiterate and half-illiterate people held 46.24% of the population of above 7 years old people; The B.I. of the larvae was 46.24 and only 7.13% of the residents knew about the DF.

B).The construction of the research team .

The core research team was composed of 20 people who were from the Institution of Health Education and Anti-epidemic Station of province/city. They were divided into the following groups: secretary of the program, health education, epidemiology, transmitting vectors, laboratory and spot managing. Among them there were 4 professors/associate professors and 5 middle-ranking people. They were under the guidance of the program director. During the research time there was 1 person died and 7 people leaving the program because of other work.

Besides the core team, there were a lot of grass-roots staff. There were 13people who were hygiene directors of village hospital being responsible for transmitting vectors surveillance, and 55 village leaders and 82 presidents of local schools for health education. Their work were checked by the core team once a month and evaluated once half a year. The situation were reported in the bulletin by the core team and the bulletin was distributed to the government, villages and towns and schools.

The core team was responsible for training, guiding, checking, evaluating and solving difficult problems on-the-spot. It was also responsible for the routine surveillance of mosquitoes, developments of DF and patients and observation of external ships.

C). The staff training.

The staff were divided into senior, middle and junior groups. The senior group was the core research team. The middle group was made up of hygiene doctors. The junior group was composed of village leaders. The method of training senior group was to combine the theory with practice. Learning in the practice and practice promote the understanding of theory. The group got together to study once half a year. Besides these, there were professors who were sent by IDRC to give lectures to the senior group, such as: Professor Manderson coming from Kunsland University of Australia came to Hainan three times to pass on health education; Dr. Suntharee coming from the virus department of the National Public Health Institution of Thailand came to teach us serological test of DF; Dr. Boondee coming from the Ministry of Public Health of Thailand taught us how to check the safety of the program.

The middle group was trained by the specialists in the senior group. The training contents included explaining the plan of the program, living history ,organisms' habits and reproducing environment of the Aedes aegypte and Aedes albopictus which are the main transmitting vectors of DF, and how to identify the adult mosquitoes and the larvae. In the first year, the group got together to study and conclude once a month; In the later two years, the group got together to study once half a year.

The training of the junior group was also taken by the senior group. The junior group was divided into several sub-groups according to the villages and towns. Once half a year, to train the village leaders and presidents of schools concentrately and distribute pamphlets of DF prevention to them and require them to grasp the "three remarks": (1) DF is spread by the bites of Aedes aegypte. (2) Aedes aegypte live in the water vats and small water containers, such as jars, tins and pots. (3) To wash the water vats once 3-5 days and put the water containers upside down or feed fish in the water vats can control the growth of the Aedes aegypte and this can prevent DF. Then the village leaders organized the village cadres to study and then the cadres took charge of every family and let everyone under his charge know the "three remarks". Besides these, there were also broadcast and large-character bulletin to propaganda. The students were taught in the school and required to educate their family members when they were at home. The work was checked once half a year.

D). The funds and materials.

The funds aided by IDRC were Ca$192,675 and supplied by the government of Hainan province were 480,000 yuan (RMB). The money aided by IDRC were mainly used to buy the necessary and supplementary equipments, such as ESPEC incubator, computer and vehicles and to pay the cost of visiting, communication and fragmentary material needed on-the-spot. The money supplied by the government of Hainan province were used to pay the cost of gasoline, eating and allowances.

E). The achievements of the program.

Through 3 years research, the knowledge level of the DF prevention in the residents had been risen. The percentage of knowing the "three remarks" in the village cadres rose from 12.06% (17/141) to 100.00% (162/162). The percentage in the students rose from 0 to 92.96% (317/341) and in the house women rose from 1.89% to 75.21% (710/944). And the behavior had changed. In the experimental area, the residents got used to wash the water vats every 3-5 days and the percentage of the small water containers upside down rose from 0 (1110 families were checked) to 52.53% (592/1127). The Breteau index decreased from 42.38 to 3.07, reaching the index to prevent DF spreading. The program had gained the expected goal. After the program, we kept on doing the routine surveillance of the research spot every year. Until now, 4 years went by, and the local residents remain the "three remarks" fresh in their memory and the Breteau index is still under 5. (The checking result of 1998 was 3.1). It showed that the achievements could last long time.

F). The visiting of specialists.

Mr. Duane J. Gubler who was the director of mosquito-borne virus department in CDC came to visit the program in 1992. We had the identity views of the cause, development, control and vanishing of DF. And IDRC also sent its director of the health ,society and environment department ---Dr. Gilles Forget and its high-ranking official of the occupational health and environmental toxicology department ---Dr. John Markham to Hainan to investigate the program and guide the work on-the-spot.

Under the support of IDRC, we organized 5 professional workers to visit Singapore and Malasia. In Singapore, the methods of controlling DF were to reduce the causes and health education. They used the pesticide to kill mosquitoes in some area only when they had to do. Their experience enlightened and benefited us.

3. The evaluation of the program.

A). The usage and transformation of the scientific achievements.

In 1996, after the program finished, its achievements were applied to 6 villages and towns of the following 6 cities/counties :Haikou, Shanya, Qionghai, Changjiang, Lingao and Danzhou. In the application, the result in the Haiwei town, Changjiang county was bad because of no support of the local leaders. Excerpt that, the results in other places were good. The percentage of knowing the "three remarks" was between 41.51% and 84.44% and the Breteau index was controlled at 5.66 to 6.67. Under this B.I, the DF will not spread in the area even though there are pandemic of DF in the places around it.

Some achievements of scientific research in preventive medicine field have only social benefits, so the operation was difficult if there is no investment of fund. The propaganda, health education, travelling allowance of staff and reward, all these are necessary and need money. But in the preventivè medicine field , the biggest contradictory in economic distribution is: when there are diseases, there is money, and there are more diseases and dead cases, there is more money.

When the program finished, we had 8 essays published in "Chinese Journal of Epidemiology", "Chinese Journal of Health Education", "Chinese Journal of Vector Biology and Control" and "Hainan Medicine". Mr. Duane J. Gubler, the director of the mosquito-borne virus department in CDC, published an essay named as "Community-Based Intergrated Control of Aedes aegypte" in "the American Journal of Tropical Medicine & Hygiene" (1994, No. 6) to introduce the program.

In Sep. 1993, I was invited to San Diego, U.S.A, to join "the First Meeting on the World Insect Biology & Control" and in Oct.1993, I took part in the Meeting on Australia Tropical Hygiene & Nutrition, and I got a chance to introduce the program on the meeting. In Aug. 1995, I was invited to Taiwan to introduce the program in the Institution of Preventive Medicine (Taibei) and Gaoxiong Medical University.

B). The social benefits of the program.

The program belongs to the preventive medicine research. Its benefits mainly reflect on the social benefits. Its economical benefits can't be valued by the usual method of input-output ratio. Between 1979 and 1989, there were two pandemics of DF in Hainan Island and there were 88,772 cases and 32 people died. The average course of the DF was 7 days. The loss of working time totaled 621,404 days. The average cost of curing and nutrition was every patient 300 yuan . So the total cost was 26,631,600 yuan, and this did not include other cost, such as transportation, allowance of the doctors and chemical for controlling the pandemic. From the beginning of the program to today, there are almost 9 years and the DF doesn't spread any more. From the facts I mentioned above, we can easily get the conclusion that the social and ecpnomical benefits of the program are countless.

C). The creation of the program.

(1).To create the new model of community administration, health education and environmental control to prevent the DF.

(2). The contents of the health education are "three remarks" : a. The DF is transmitted by the bites of Aedes aegypte. b). Aedes aegypte grow in the water vats and small water containers, such as jars, tins and pots. c). To wash the water vats every 3-5 days and put the water containers upside down or feed fish in the water vats can control the growth of Aedes aegypte and prevent the DF. The "three remarks" include the cause , development and control of the DF, and it is easy to understand and remember, and can be carried out completely.

(3). The method to control the DF is easy for the residents to grasp and manipulate.

(4). The method need no chemical and can not pollute the environment.

The Project Granted by IDRC
"Educational Strategy to Reduce Contraceptive Failure in Urban China"
Review and Reevaluation

Shanghai Luwan Women and Children Healthcare Center

We sent a proposal to IDRC in 1989. After inspection and investigation for project in Shanghai by a specialist who was sent by IDRC. We received IDRC approval on March. 1990. And started our research work on May 1990. The research was carried through for 3 years. According to the concern of Shanghai Municipal Family Planning Committee and Luwan District Government. And Also the help of Luwan District Family Planning Office. And Luwan Women's Association, the later 2 units were the co-operators of our research. Our Project was finished successfully on time at March 1993. The achievement was accomplished the original requirement of the project. . The project was introduced and communicated nationally an also abroad. We continuously educated the uneducated units of control Group after the project was finished. The education was also extended to the basic woman cadres and family Planning (EP) cadres of all the communities of Luwan District. In education, MCH knowledge was also added. Then the influence of our research was more extended and deepened. So the project. Obtained 3rd degree award of "Shanghai Major Scientific and Technical Progress Award of 1994". And "1st Degree award of Luwan District scientific and Technical Progress Award of 1995."

I. The Background

During the end of years of Eighties, the National Policy of FP had been implemented for 20 years, most childbearing aged women would follow the Policy. The contraceptive rate was high, then the birth rate and natural population increment rate in our country were decreased apparently in comparison to the years of seventies. As the implement of National FP Policy in Shanghai was excellent, so Shanghai's birth rate and natural population increment rate were usually the lowest among cities of nationwide. But the artificial abortion rate was very high. Although Shanghai municipal government had made great effort to elevate the efficiency of contraception by various methods through scientific research, but the abortion rate was continuously stepping up. It's well understood many complications and consequences are accompanied with abortions, some consequences may last throughout the life. If pregnant the possibility of prenatal and natal complication will be very common. So abortions not only jeopardize women' health, but also influence their work. Either family or society will endure much financial expenses. Therefore how to elevate the contraceptive efficiency and lower down abortion rate was a major problem concerned by officials of various level of government and all the persons worked for FP in Shanghai. We had preliminary surveyed for causes of abortion in Luwan District, which revealed that most abortions were caused by contraceptive failure, as most women lacked contraceptive knowledge, and couldn't select and manipulate the contraceptive methods appropriately and correctly. So we must educate them to increase their ability and efficiency of contraception. When one of our researchers studied in America 1987, Prof. Virginia C. Li of UCLA advised us to apply proposal to IDRC for research granting. Then under Prof. Li' recommendation, we formally sent the proposal "Educational Strategy to Reduce Contraceptive Failure in Urban China." to IDRC at 1989.

II. Implementation of Project Research

1. The expenses of Research Funds

After received the funds allocated from IDRC, we set an account in the bank special for the Project, managed by an appointed accountant. All the money received or expensed were recorded in a special book. The account of Project funds was separated from the funds of hospital. One of chief researchers was in charge of supervision and examination of funds expenses. All the expenses were strictly confined to the budget. According to the budget, our hospital had provided same amount of funds for research work.

The main expenses of research funds was detailed as follows:

(1). The expenses of pre- and post- educational surveys. The sample of survey was 1800 childbearing aged women (600 women each group), 510 husbands of experimental group 1, and 170 FP service providers of all the units of 3 groups. The main expenses for surveys included salaries and rewards of all the respondents; All the printings for survey; salaries and rewards of 20 interviewers who are Obs. doctors or senior midwives expert to FP service. Each survey was lasted for 6 months. Salaries and rewards of 2 experts for data computerization and expenses for statistical analysis managed by Shanghai Population Research Institute.

(2). The expenses of health education (HE): All the participating units were divided into 3 groups; in group 1 all the childbearing aged women and their husbands were educated; in group 2 only women were educated; in group 3 not educated for control. 170 FP providers of groups 1&2 were also educated. HE was lasted for 21 months (Jan. 1991 to Sept. 1992). There were 6,579 women educated, for 51,123 times in various forms of education. The fund was expended for HE, the salaries and rewards of all the acceptors of education; salaries and subsidies for traffic and meals of 10 Health Educators; the teaching materials we specially made including a set of videotapes of basic Knowledge of contraception, produced by Shanghai Movie production company, and copied 100 tapes for educated units and workshops. And we also wrote and published 10,000 sets of booklets. (5 booklets a set) of the same content for every education acceptor. All the health education was recorded on a special card, one card for each educated person; and salaries and subsidies of specialists for date computerization and statistical analysis.

(3). Salaries and entertainment of consultants

We invited 5 Chinese consultants for FP propaganda, HE and statistical analysis. And 2 foreign consultants invited by IDRC, Prof. Yuzuru .J. Takeshita and prof. virginia C. Li. They came to visit us separately once a year.

(4). Expenses of instruments and apparatus: we purchased computer and printing machine, duplicating machine, camera, projection machines, 2 sets of video and colored T.V and other apparatus needed for survey, education, date collection, computerization, and statistical analysis.

2. Training for project personnel

The training of Personnel was very important, it not only related to the success or failure of the project. and also influenced the extension of aftereffects of the research.

The methods of the training of personnel were follows:

(1). Various Kinds of personnel were trained successively according to theirs levels. At first, the project researchers were trained. We sent 2 senior visiting doctors to study in Michigan University of America, each for 6 months. One studied HE, and the other studied Survey and data analysis. Both of them came back on time and played important role in implementation of research. We invited 10 health educators. They were Obs. And Gyn. doctors and senior midwives with FP service experience. They attended lectures before work, studied the detailed Knowledge of reproductive physiology, principles and methods of contraception, and also the targets and significance of the Project. The chief researcher of the Project gave the lectures. In the course of HE in participate units, we trained chief FP service providers, the doctors of factory clinic at first. All the doctors responsible for FP service were collected. To attend lectures given also by chief of the project, taught them Knowledge of reproductive physiology, principles and methods of contraception. Technique of implementing HE. And also the target and significance of the Project. The health workers of all the units of educated groups who were in charge of FP service to the workers, were trained by the health educators of the Project, and doctors of factory clinics through various forms. The women workers of childbearing age were trained by health workers under the instruction of project educators, mostly in from of personal conversation. After 21 months of HE, there were 6,579 women were educated, for 51,123 times. Husbands of childbearing aged women of group 1 were educated by their wives and health workers of the workshop, following the contents of teaching materials.

(2) The training of personnel was formally and strictly.

Various kinds of personnel were trained separately according to their requirement. All the interviewers of pre- and post- educational survey were collected for 10 to14 days before work to study the book " Interviewer's Manual " published by Michigan University (1981), "Survey Research " written by Backstrom (1981). After they understood the technique and moral requirement of survey, they accomplished the survey successfully, and obtained praise from participating units and responders. As for the training of doctors of factory clinics, we hoped them to know well the contents of the teaching materials. An examination was taken place after each lecture, and instructed them personally if there was any difficulty in learning.

(3). Training of cadres was key problem of HE, as educating all the childbearing women was the main target of the Project, for this purpose training of basic cadres the health workers was apparently very important, because all the basic cadres are working or living intimately with women. They will be the important forces of HE in the units if they are well trained. They can educate women in form of converse no need to interrupt women's works. Then HE will be established continuously after the Project.

3. Exchange visits of Project experts.

Two foreign expert consultants of the Project, Prof. Virginia C. Li of Public Health College of UCLA of America, and Prof. Yuzuru J. Takeshita of Public Health College of Michigan University of America visited us in Shanghai every year separately for examination and instruction of our research works. They not only gave lectures to project personnel and other medical doctors of our hospital, but also gave lectures to chief FP officials of all the districts and counties of Shanghai, under the invitation of Shanghai Municipal FP committee.

We had entertained Prof. Sun Xiao Ming of Nanjing FP Research Institute, who was the chief researcher of another IDRC project for investigation of FP survey. We communicated and discussed what we learned from IDRC granted projects.

After the Project was finished, two chief researchers of the Project Prof. Zhou Mei-rong and Prof. Lu Shu-hua went to America to attend 121st and 122nd Annual Meetings of American Public Health Association (APHA), on Nov. 1993 and Nov. 1994. 4 papers were presented and communicated on these two Meetings, and obtained good evaluation.

4. The Research Personnel

All the researchers of the Project increased their ability and experience of implementing a research, after 3 years research work. The young doctors joined the Project increased their consciousness of scientific research and improved their technique to use computer and do statistical analysis. The person in charge of the Project, Prof. Zhou Mei-rong have retired, now she is the Honorary President of Luwan MCH Hospital. Recently she is carrying on a research granted by Research Department of Shanghai Municipal FP Committee. Chief researcher Prof. Lu Shu-hua, also retired recently serves as consultant of Luwan District Health Bureau. She joined the projects of" "Three Better Project", "Establishment of Baby Friendly District and City", and " Child protection and Development of National Program of Action (NPA)", and "Women's Protection and Development of NPA ". She obtained award of "Shanghai White Magnolia Award ". The researcher Wang Hai-yun, a young doctor was promoted to Vice-chief doctor after passed doctor promoting examination and evaluation held by Shanghai Municipal Health Bureau. After he studied in Michigan University for 6 months sent by the Project, he can use computer to manage data collection and statistical analysis by himself. He exerted important role in the Project research. Now, he is a member of 1st period of "Shanghai Officials Assist Xingjiang Team " for 3 years. In Xingjiang, he not only fulfils the duty of a clinic doctor, but also teaches Xingjiang young doctors voluntarily, and obtained high praise from local people and leaders. The researcher Wei Yao-ru, also a young doctor was promoted to Vice-chief doctor by Shanghai Municipal Health Bureau. After studied abroad for 6 months, she joined the Project to do HE and survey. Now she is the chief of doctors department of the hospital, Five Chinese famous experts were invited to be the consultants. Prof. Wu Jie-ping, a famous scholar of reproductive science was highly concerned to our research. Every time we met him in Beijing or in Shanghai. He heard our report about the progress of the Project with high interest. Usually he gave us encourage and said:" The Project of HE in FP sphere is a significant research, like a landmark. I hope you do it well". The other consultants were Prof. Zheng Huai-mei (Obs. and Gyn. of Shanghai Medical University), Prof. Zhang De-wei (Consultant of National FP Committee), Prof. Zhang Zhao-huan (Medical Statistician of Shanghai Medical University), and Dr. Jiang Yun-fen (Vice-chairman of Shanghai Sex Education Research Association and Expert of FP Propaganda). We reported to them the progress of our research and asked for their opinion and instruction 1 to 2 times a year. Prof. Liu Yong-liang, vice-chairman of Shanghai Municipal FP Committee, concerned and helped us very much. Before the Project finished he arranged to all the district and county FP officials to carry on the HE of FP, as one of the main program of their work. So the achievement of our research might be quickly popularized in Shanghai.

5. The Achievement of the Project

Our research is the precedent of HE in FP area. The main achievement of the research are as follows:

(1). HE increased women's knowledge of contraception, then enhanced their efficiency of contraception, as they can select method appropriate to themselves and manipulate correctly. Thus quite a number of abortions will be avoided, the abortion rate will be effectively cut down.

(2). If husbands are educated, they will be willing to participate contraception. With the co-operation of husband and wife, not only the contraceptive efficiency will be improved, also the communication between husband and wife will be much increased.

(3). An effective method of HE of FP was explored.

(4). After education the basic FP cadres' ability of FP service and applying HE for people are much increased. And their prestige and confidence in people will also be increased. They will be the basic force of undertaking any public health service in units or communities.

(5). A set of teaching material of popular science of contraception was provided, which was easily understand and well accepted by people.

Therefore, our Project was obtained 3rd degree award of " Shanghai Major Science and Technique Progress Award " of 1994. And 1st degree award of "Luwan District science and Technique Achievement Award " of 1995.

III. The Scientific, Economic, and Social Evaluation of the Project

1. The transformation and Utilization of Achievement of Scientific Research.

After the Project finished, the first thing we did was to educate the childbearing aged women and FP service providers of all the units of uneducated control group. At same time, we also educated the basic women cadres and FP service cadres of all the neighborhoods and communities in Luwan District with same teaching material. Let the scientific achievement of the Project popularized in Luwan District.

In the course research, Prof. Liu Yong-liang , the deputy director of Shanghai Municipal FP Committee visited us and highly evaluated the significance and practical value of our Project. He arranged us to introduce the achievement and experience of our research to the chief members of offices of all the districts and counties of Shanghai on a meeting, and announced that popular HE of FP was an important task of their daily work. Then our achievement of research was further extended all over Shanghai. Jia Ding County was the experimental unit in the rural area to test HE of FP. The success of the test was revealed that HE of FP can be carried out in farmers of rural area. Our achievement was published in newspapers of Beijing and Shanghai.

When the leaders of National FP Committee visited Shanghai, they inspected Luwan District and highly appraised the excellent FP service, especially the popular HE. They appointed Luwan District to be one of 5 "FP Nice Testified Model Point ". By efforts, Luwan District passed assessment examination, and highly praised by Chinese and foreign experts at 1998

We wrote 9 papers after Project finished, published in Chinese and foreign medical journals. 4 papers were presented on Annual Meetings of American Public Health Association, 3 papers were presented on National FP Science and Technique Progress Conference in Hohhot city, and 2nd International FP New Technique Conference in Beijing.

After the Project finished, we introduced the method and experience of popular HE into Maternal and Child's Health Care area, to unite FP and MCH care to increase the quality of population of newly born, and also protect women's and child's health. 1991 Luwan District was appointed as one of 28 "National Three Better Project (Better Birth, Better Growth, and Better education) experimental district". According to the contribution of the Project, Luwan District was awarded as advanced District of "National Three Better Project " by Women's and child's Work Committee of State Council at 1995, and also named as "National Model District" of "Women's Program" and "children's Program ". In the nationwide action of establishing " Baby Friendly District and City", Luwan District was first to be a "Baby Friendly District ", and gave important contribution to "Baby Friendly City " establishment in Shanghai. So FP service and MCH care in communities of Luwan District are usually advanced in Shanghai and also in the country. In 1998, Luwan District was also ahead in " National Community MCH Service Experimental District " movement run by MCH Department of National Health Ministry.

2. The Social and Economical Benefit of the Project.

The benefit of a project research are usually exposed in later years. Our Project has been finished for 6 years, through the review and re-evaluation of the Project, in relating to the progress and changes of FP in recent years, the significance and benefit of the Project are reflected as follows:

(1). Decrease the number of artificial abortions.

The total number of abortions of Luwan District in 1990, the year of the Project started, was 8,504 cases. And decreased to 5,869 cases in 1998, 30% abortions were avoided. The level of decrement of abortions is similar all over Shanghai that means huge amount of expenses for abortions was saved in Shanghai. Of course the causes of decrement of abortions are various. But from the data of our research, there were 263 cases of abortions in 1990 among the respondents of educated groups in pre-educational survey. After education, the number of abortions same groups of post-educational survey was 170 cases in 1992, showed 35% decrement. So we think HE is one of the main causes of abortion decrement in Shanghai. Abortion decrement not only saves economic expenses, but also protects women's health, which is more significant.

(2). Increase women's ability of contraception.

After educated, women's knowledge of contraception was much increased, their ability of selecting contraceptive method appropriate to themselves, and method manipulating were obviously improved. They could solve problems in contraceptive practice by themselves. If any trouble or annoyance encountered, they visited doctor or FP service provider for help spontaneously. Along with increase of contraceptive knowledge, their knowledge of reproduction were also much increased, which was very significant for launching MCH care movement in mass of people.

(3). Promoting husbands to participate contraception and enhance the intercommunication between husband and wife.

Post-educational survey showed that in experimental group 1, the group of both wife and husband were educated, after education husband not only supported his wife to adopt contraception, but also actively participated the contraception himself. So the abortion rate of group I was lowest in post-educational survey. Otherwise with husband's participation the intercommunication between husband and wife was apparently enhanced, not only in contraceptive practice, also in discussion for other family affairs, such as money expenses, child' education etc. In surveys women' answer to question "How about the intercommunication between you and your husband?" For contraception, intercommunication intimately before education occupied 33.3%, after education 42.7% ($p< 0.05$), for other family affairs before education 50.2%, after education increased to 83.3% ($p< 0.01$).

(4). Women cadres and FP cadres of basic level were educated.

In launching any work in the mass of people, the ability and efficiency of cadres of basic level is very important. The Project emphasized the education of cadres of basic level. After studied the knowledge and exercised HE practice in the masses, most cadres of basic level highly increased their work efficiency and confidence in women they served. In surveys women's evaluation to their FP providers in the basic department was that most providers increased their ability of FP service and their confidence in people was also much improved.

(5). A set of FP scientific popular booklets and videotapes were provide, which explain the profound knowledge in simple terms and welcomed by people. It is suitable for teaching material of HE of FP.

3. Training of Qualified Personnel.

Two young visiting doctors, who worked for the Project, were promoted to vice-chief doctors after passing through the doctor promoting examination held by Shanghai Municipal Health Bureau after the Project finished. One doctor got the post of chief person of department of doctors of Luwan District MCH hospital. She was appointed as a successor of backbone of scientific contingent of Luwan District. The other doctor was posted as Vice-president of Luwan District MCH Hospital, and President of Luwan District MCH Institute. He has been awarded twice as one of the "Ten Excellent Young Persons of Luwan District" of the years 1997 and 1998. He was also listed as " Excellent Reserve Forces of Shanghai Official Rank". Now he joined first period of "Shanghai Officials Assist Xinjiang Team " since 1997 for nearly 3 years, and obtained high praise from native people and officials.

4. New Idea in Science and Technique.

To utilize HE in FP area is a new idea and new trial in Shanghai and also in China. We have probed in Shanghai Medical Scientific and Technique Information Institute at 1994, realized no such kind of paper reported in national literatures. There were several papers found in foreign literature, but these papers discussed about HE in teenagers to prevent extramarital accidental pregnancy and STD. No paper dealt HE in married childbearing aged women.

IV. Evaluation and Suggestion for IDRC's and Chinese National Science and Technique Ministry's Administration of Project.

We have obtained great concern and help from IDRC and Chinese National Science and Technique Ministry. After we sent the proposal to IDRC through National Science and Technique Ministry, within a short time, Prof. Yuzuru J. Takeshita (Public Health College of

Michigan University), came to Shanghai, who was sent by IDRC, to inspect our research team and our hospital, and examined our application report, He gave us instruction and encourage. As we were informed the approval of IDRC through National Science and Technique Ministry, the Project fund was allocated a few days later. Then we could start research work on time. Every year, after we sent out Annual Technical Report and Financial Report we could quickly receive the fund of next year. So our research could be smoothly finished on time. As we usually received funds on time, there was no trouble in project expense.

For need of research, we changed the schedule, as we sent two persons for training abroad for 6 months in stead of one person for one year. For international exchange, two chief researchers went abroad after project finished, in stead of one person went abroad in 2nd research year. These changes were all approved by IDRC.

Both IDRC and National Science and Technique Ministry are very earnest in administration of project, funds were usually allocated on time, so there was no apparent barrier in the process of our research.

We thank two foreign consultants sent by IDRC, Prof. Y. J. Takeshita and Prof. V. C. Li. They worked earnestly and went to participated units and workshops to hold conference to discuss with women, cadres, and officials. They gave us many books and information materials. So their concern and help is one of important factors of success of our Project.

Review on the project "Biodiversity Conservation and Sustainable Development in Xishuangbanna Biosphere Reserve" funded by IDRC

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A multi-discipline project, focusing on the biodiversity conservation and sustainable development was carried out in past years, from October 1994 to March 1999. This project got the support mainly from The International Development Centre(IDRC) of Canada. The project title is Biodiversity Conservation and Sustainable Development in Xishuangbanna Biosphere Reserve. The location of the project is in China's Yunnan Province, Xishuangbanna Biosphere reserve, and mainly in Mengyang reserve, that is the largest reserve of five reserves in Xishuangbanna Biosphere Reserve.

Chinese Man And Biosphere Committee(C-MAB) Organized and coordinated the project. Institute of Ecology and Geobotany in Yunnan University (IEG) was responsible for and conducted whole research work. 12 researchers, including 3 professors, 5 associate professors and 4 lectures participated in the project. Among them five were females and seven males. Xishuangbanna Biosphere Reserve(XBR) provided with research area, provided field support, they got the training from the project and got the final research result. 10 men and 2 woman participated in the research and 8 of them got the training.

1. Background

Xishuangbanna, a Dai Nation Autonomous Prefecture, is located in southern part of China's Yunnan Province, neighboring from Laos and Burma. Xishuangbanna is located in humid tropical area, tropical rain forest is the major vegetation type. Because of the mountainous topography and crisscross of the different vegetation types, the biodiversity is rich here. Lancang-Mekong River flows through Xishuangbanna and connected the China with lower reaches countries as Burma and Thailand. There are thirteen different ethnic people lived here, many of them still remain the traditional living and producing habit, they make up the culture and social diversity. As it is far away from the center of China, the social and economic development in this area is not as fast as in other area of China.

Xishuangbanna Biosphere reserve, one of the first nature reserves established in China, situated in Xishuangbanna Prefecture within °10' - °24' latitude and 100°16'-101°50' longitude. The reserve is a comprehensive reserve set up primarily to preserve the tropical rain forest, monsoon rain forest and populations of rare and precious tropical wildlife. There are the most integrated tropical rain forest remaining in China and very rich diversity of plant and animal life in the reserve. With many local people live in the reserve, they established the relationship with the environment and influence the nature.

Funded by the International Development Research Centre (IDRC) of Canada, co-funded by the Yunnan Provincial Science and Technology Committee(STC), the project was carried out in Xishuangbanna Biosphere Reserve. Experts from Parks Canada joined in the project. Starting in October of 1994 and ended in October 1997 at first stage, through the research work of the project, new technologies have been used to improve the management of the reserve and to protect more effectively and practically the biodiversity. Research has also been conducted on the manner of natural resources use by local people and on sustainabl development of the area. With exploitation along with the Lancang/Mekong River and in Xishuangbanna, the conservation and management of the reserve might influence the economic development and natural resources use. This project provided with a basis and tool for evaluation, planning and prediction of local development and the effective use of natural resources.

With the first stage of the project finished and it was found that some research results of the project have not been practical used by the managers, such as the established GIS of the Xishuangbanna Biosphere Reserve was not used in the daily management of the reserve. Some plans proposed by the researchers were not recognized and to be used by the managers of the reserve. The project had also some shortage because of the time and fund limit, such as the distribution of some protected species was not very clear. The supplement project was carried out to help the project to be more effectively and make it to be used in practical. This supplement project was approved in the February of 1998 and the duration was one year.

2. Research Project Objectives

2.1 First stage

According to the project plan, there were four purposes of the project:

* To design a data base and establishment of GIS for the Xishuangbanna Biosphere Reserve, for the monitoring, management and effective conservation of local biological diversity. This is one of the important points of the project.
* To investigate, analyze, and summarize indigenous knowledge of natural resource use in the reserve, and to evaluate this knowledge to make plans for sustainable development by using GIS and other methods.
* To select and plan suitable sites for economic plants cultivation.
* To provide a basis and tool for evaluation, planning, and prediction of economic development and natural resources use which may influence the reserve conservation and management.

2.2 Objectives of the Supplement Project

Through the training course, workshop and publication, to dissemination the project results.

* To cooperated closely with the reserve managers to refine the first stage GIS models;
* To train the managers of the reserve for independently operating and maintaining the established GIS after the three years project.
* Through the training course to extend GIS application in management of various departments at different levels in this region and other regions.

* To recommend the research results of this project to the managers and decision makers of other nature reserves, especially those which are undertaking GIS projects within the China Biosphere Reserve Network.

3. The Main Activities And Results of the Project

3.1 A basic information database of the Xishuangbanna Biosphere Reserve was established, electronic maps by using collected data, information and existing maps are constructed. These data included the natural environment, social and economic conditions and the past research information.

3.2 A basic GIS and a Demonstration System for Xishuangbanna Biosphere Reserve was established. The GIS could be used by the Reserve to demonstrate the basic database and information of Xishuangbanna and also the reserve, to help the management for Mengyang reserve in the nature conservation and sustainable development, to make the development plan for the reserve and local people. The GIS was used in the project research and focus on the following subjects.

3.3 Amomum research

Amomum villosum(Latin name) is a kind of herb planted under the rain forest, its fruit is used as an important medicine and food. It is one of the very important economic plants for the local people. After field investigation, analysis and information collection, the distribution information of Amomum in the Mengyang reserve of Xishuangbanna was got. This information included the distribution area, sites, slope, direction of the slope, and growth conditions of Amomum, etc. As an important economic source for local people by planting the Amomum villosum, with increase of the market need and its value, the planting area was enlarged in these years. The economic analysis was made on Amomum plantation and the market evaluation for Amomum development, the influence of market fluctuation on Amomum plantation and plantation policies. Through research on the increasing growth conditions of Amomum and continuing field study, a suitability map of Amomum growth in Mengyang and a detailed explanation was obtained. On the basis of the above, GIS was used to analyze the influence of Amomum plantation on the rain forest, the relationship between Amomum plantation and biodiversity conservation, the relationship between distribution of villages and Amomum , the relation between Amomum productivity and variety, habitat and planting technique. The management and development plan on the Amomum was conducted; this was a synthesis plan in considering nature conservation, species structure, the best habitat of Amomum growth, economic benefit in the market and the local people's development.

3.4 Relation between traditional land and natural resource use and natural conservation and sustainable development. The management models and development of a land use plan in the Mengyang reserve.

3.4.1 Landscape map. By the overlay of different environmental factor's maps, three different natural landscape types have been classified. This is the basis for the land use plan and other plans connected with sustainable development and conservation of the Reserve.

3.4.2 The location of the villages in Mengyang and the changes from 50's to 90's.

Through this map it reflected the tendency of the village movement from 50' to 90'. The research shown the change was happened because of the political policy, disease control, economic development(especially the tropical crops plantation), transportation and communication need.

3.4.3 Land use models of the villages. Through the research of traditional land use and resources use of several minority villages in Mengyang, according to the relationship between population, economic and social development conditions and nature conservation, to evaluate the present patterns. Three major land use models were classified and in the village there were four different use models. The research shown that some models in the village was better for local sustainable development and was worth to be introduced to other part of Mengyang and Xishuangbanna.

3.4.4 Land use plan. On the basis of ecological landscape map, by using GIS to overlay distribution maps of rare and endangered species and present land use map. From the ecological map and the biological sensitivity map through the determination of different sensitivity standards, and also in considering the requirement in the division of reserve function areas, a division map of the reserve function area was obtained. Through this research and also considering the present distribution of villages and lands of the local people in the reserve, a land use plan of the reserve was made according to the relationship of biodiversity conservation and sustainable development.

3.4.5 Tradition and nature conservation. The evaluation of the relationship of traditional customs of local people and nature conservation, indigenous knowledge(IK) of some local people was made. Through the investigation and research of the productivity, life styles and traditional culture and customs, from the concept of a green culture to analyze and evaluate these forms and customs. The project was working to find a national root and tradition for local nature conservation and sustainable development, and the collision and change of modern social and economic environment to the minority nation's tradition. The research was made on Dai, Bulan and Jinuo people lived in Mengyang.

3.4.6 The influence of gender to the nature conservation. The research shown that the women would be more active in the nature conservation, but this activities were decided by the family and society position of the women, different ethnic people had some difference in this position and influence to the nature.

3.4.7 Population of the reserve and its relation with the nature conservation. Population increase in the reserve is the most serious problem to the nature conservation. The research has shown the reason of population increase, the relation of population and conservation and development, the proposal was provided to the reserve for the effective population control.

3.5 The distribution, population and management of the Asian elephant in Mengyang reserve of the Xishuangbanna Biosphere Reserve. The Asian elephant is one of the major protected wildlife in Xishuangbanna Biosphere Reserve. The largest population of the Asian elephant in China is in Mengyang reserve. The living conditions and activity pattern of the elephant is directly related to the conservation action and development of the Xishuangbanna Biosphere Reserve. Primary research on the distribution, population and basic activities of the elephant in Mengyang reserve have been made. The proposal for the managers of the reserve is made. This information would be the basis for the conservation and development strategy of the reserve by the use of GIS to analyze and make maps.

3.6 Joint research with the reserve managers to refine the former project results. The final report of the former project has been provided to the reserve managers of the Xishuangbanna Biosphere Reserve. But in the supplement project it was needed to help the managers to understand the results and use the results to the daily management work.

The supplement project has been conducted for the refining the project results according to the practical needs of the managers and the accurate date and information. Radar image date from Parks Canada has been used to check the high point of the former maps and some revised work has been done on the maps. The new established database has been used to refine the research, and some district and manager collaboratively management plan have been added to the project and help the managers of the reserve in the management. The final recommendation is conducted for two times and one time in Xishuangbanna in May and another time in Kunming in September for the staffs from Yunnan Forestry Department and the managers from Yunnan Province.

4. Training

From the start of the project, training is one of the major contents of the project. The training included different level and subjects.

4.1 GIS Training

GIS is an information system using computer and taking spatial data as a basis. Using GIS is the most important part of the research work of the project. Four researchers from the institute and two from the Reserve have been trained on the use and establishment of GIS. Two of them have got the higher training in Beijing of China. The GIS should be used not only by the researchers from IEG, but also shall be used by the staffs from the reserve. The staffs from XBR have been trained in the former project. Two training course in the GIS use in the nature reserves and the reserve management have been held separately in Kunming and Xishuangbanna.

4.2 Basic Computer Knowledge Training

With the development of nature conservation, computer is used more and more wider in Xishuangbanna. Seven staff of the reserve have been trained on the use of computer and also the basis of GIS in Yunnan University in the year of 1996. They have been working on the establishment of the database in Xishuangbanna.

4.3 The training course for local people.

By the use of the research result of the project, and also connected with the management work of the reserve. The training course was held in February of 1997 in Mengyang. The participators were villagers and managers from five reserves.

4.4 PRA Training

At the start of the project, an investigation method training course was held by IDRC in Guiyang of China. Three researchers from IEG and XBR were trained on the Rural Rapid Appraisal(PRA) and Rural Participating Appraisal(RPA), these methods were used in the project research.

5. Seminar/workshop

5.1 Organizing the seminar

From 1994 to 1998, total six formal seminars were held in the process of the project. An international seminar has been held in Jinghong in November 1997. The title of the seminar is "biodiversity Conservation and Sustainable Development in the Biosphere Reserve". Through this seminar, the researchers and conservation experts have exchanged and discussed the work and experiences in the biodiversity conservation and sustainable-development in the reserves. The project have been summed up and evaluated in this seminar. The participators more than 80, and more than 30 of them came from 5 different countries. The project result was reported in the meeting and got good appraise.

5.2 Atended meetings

The project provided the chance for the researchers and managers to learn and to exchange experiences in the relevant areas from home and abroad. From 1994 to 1998, more than 25 persons participated the domestic and international seminars in other province of China. Two of the researchers have brought the results of the project to participate the international workshops held outside of China.

A seminar for the result dissemination was held in Beijing in 1999. The participators were from many reserves of China who are interested in the GIS use for the management project and also from the MAB Chinese Committee, through these workshops, the influence of the project will be more wider not only in China, but also abroad.

6. Visit and receive foreign visitors

In the begin and in the process of the project, we received many international visitors, especially the experts and officials from IDRC. The former Chairmen of IDRC and Director of IDRC Singapore Office have visited Yunnan in 1994, and paid attention on this project. Dr. Stephen Tyler, the coordinator of the project from IDRC has paid great attention to the project and often provided with corresponding materials and information on the GIS use and indigenous knowledge research in other part of the world.

Two experts from Parks Canada(Dr. David Welch and Mr. Jean Poitevin) as the senior advisors of the project visited project three times differently from 1994 to 1997. Some important proposals for the project were made by them are very valuable and which were accepted in the research work.

The project has funded the Chinese experts visit to Canada, the visit was helpful to the success of the project. Project experts has visited Laos and Vietnam by the help of IDRC. They visited nature reserves and research agencies in these two countries, exchanged the experiences and ideas in the nature conservation. It would be help the project results to be known by these reserves as they locate same area and faces some similar problems.

7. Publishing research finding
With the completion of the project, the research findings have be published. Four research paper collections have been published. A special issue about the project research was published in the Journal China's Biosphere Reserve in September 1996 in Chinese with English title, A supplement issue in Acta Botanica Yunnanica was published in 1997 in Chinese with English abstract, A special issue for the project in Applying Ecology was published in October 1997 in Chinese with English abstract. A paper collection titled "Biodiversity Conservation and Sustainable Development in the Biosphere Reserves" was published in Kunming in December 1998. This is the final work of the project. More than 15 papers from former IDRC supported project were in the book. More than 30 research papers have been published in Chinese and English in different academic publications, journals or meeting reports, some of these papers are in English.

Multimedia Demonstration System of Xishuangbanna Biosphere Reserve and GIS. The practical used GIS, demonstration system and management system has been finished and provided to the managers of Xishuangbanna Biosphere Reserve. The managers and also the local people can use this system to demonstrate the general document, photos and moving pictures of the Xishuangbanna, including natural, social and economic information, which can be used directly in the management of the reserve. The former projects, from database, land use plan, settlement research, Amomum plantation, elephant research and others have been put into the system and can be demonstrated. The system is in multiple-media form and in a CD plate. The major menu of the system is in both English and Chinese.

8. Summarizing the Results of the Projects
8.1 The management of the Reserve have been improved by the use of GIS and from the results of the project. Some of the proposal and suggestions were accepted by the reserve in the management.

8.2 A GIS(hardware, software and staffs) for the Xishuangbanna Biosphere Reserve, focus on the Mengyang reserve was established for the demonstration and practical management;

8.3 The local villagers from the project have got the training, they could use the knowledge from the training course to the practice, such as the land use pattern, Amomum plantation, and these will help them to understand the effect and relation of nature conservation and sustainable development.

8.4 Researchers from IEG and XBR got the training in GIS and also in some new technology. That will help them in the research work. Through the project, one doctor and three masters have got the degree, four of the researchers have been promoted.

8.5 Equipment including hardware and software, such as the car, the digitizer, the ARC/Info and ARC/VIEW software are the basis for the IEG and XBR in the project and also in future research. A biodiversity protection information center in

Yunnan University has been established after the project, the ability to establish this center is relying on the project.

8.6 International connection was established and the experience from the project was got. This project as the start, the projects such as from UNESCO and from Provincial Government was approved.

9. Acknowledgment

The project speaks highly the support by Dr. David Welch and Mr. Jean Poitevin from Parks Canada. Especially in the first stage in the establishment of GIS, the tips from them were accepted and reference materials of GIS were useful for the researchers. Each time when they visited the project the report would be given for the project to consider the exacted problem and their experiences have helped the project a lot.

The success of the project is also du to the help of Dr. Stephen Tyler, the project official of IDRC, from begin to the end of the project, he provided with many useful help. The thanks is to Yunnan Science and Technology Committee, the committee provided the project with the fund from Chinese side. Thanks are to Mr. Zhang Hongqi from Ministry of Sciences and technology in Beijing.

I would like to thank Prof. Zhai Xianying, former secretary of C-MAB, she is the project leader and the person to proposal the project be caried out in Xishaungbanna Nature Reserve. Mr. Han Lianxian, the secretary of C-MAB, he is an excellent coordinator of the project. The thanks are to my colleagues in Institute of Ecology and Geobotany, Yunnan University, the managers from Xishuangbanna Nature Reserve. The hard work in the fields and in the door is the results of the project.

Report on the implementation of IDRC-supported Project

Xinjiang Science and Technology Commission

Project Background & Applicant Course

Tarim Basin is the important base for implementing the transforming strategy of dominant resources, of which the white resource is cotton and the black resource is crude oil. The Basin is 1050 thousand km^2. It has rich sunshine, heat, water, land, oil and gas resources. It is the reserve petroleum base, main cotton and other agricultural-products base of China in 21-century. But the ecological environment is very weak. The second largest desert is in it, and it makes 31% of the total area. The extreme dry climate, bad desert environment, unchecked reclamation and unreasonable utilization of water resource intensify the environment badness and desertification. Environmental protection is becoming the main constraining factor, which effects the sustainable development of local economy. The contradiction between rapid economic development and ecological environment protection shows in three aspects:

i. New trend of economic development in the Basin intensifies the pressure on water.

ii. In the whole Basin, it is lack of centralized and efficient water management system.

iii. The environmental protection of Tarim River Basin is increasingly severe.

The environmental problem of the Basin, especially the problem of desertification control and water management, is not only the key question of Xinjiang, but also draws the attention of foreign experts and international institutions. In 1992, the research group applied for the support of IDRC for the project of Tarim Basin environment protection.

On July 1992, the project official of Asian-Pacific area Dr. Stephen Tyler and Dr. Chi Chang of the Lethbridge Research Station of the Agriculture Department of Canada went to Xinjiang. During three weeks, they visited around the Basin, especially in Hetian City, Hejin and Weili County. After the visit, the two experts believe that the local key problem in the management and utilization of natural resources is lack of efficient management system and measures. It was the main factor causing the environment badness in the course of economic development. After that, according to their suggestion, the research group had a year's pre-feasible study. Four counties were selected as example.

On May 1993, the starting and discussion meeting of the project held in Urumqi. The technical counselor of Canadian Embassy in China and experts from Canada, Africa, Beijing and Xinjiang attended the meeting and pre-meeting trip to the project site. The leads of the Autonomous Region also took part in the meeting. All the participants agreed that the project is very important and has large-scale applied value. On November 1994, the project was approved by IDRC. Meanwhile, the Chinease Sci-Tech Committee and local government also gave great support to the project.

1 Project Content

During three years, the research group collected more than 1.5 million data and many historic materials and data in the four selected typical sites. They organized five times of large-scale field trips for foreign and local experts alongside the Basin. The total travelling distance reached 30 thousand kilometers. They investigated 360 households, held twelve special meetings and training. Beside this, the group did winter irrigation trial at the Tarim River.

The whole research covers four aspects:

i. Optimizing the configuration of natural resources

After comparing the three water regulation programs, the research group put forward the least cost water regulation program

ii. Creation of management system

By referring advanced foreign experiences, the new water management system suitable for local situation is formed. The renovation program of water price is designed by fully considering the bearing capacity of farmers.

iii. Efficient utilization of natural resources

The water-saving techniques with priority were listed after analyzing cost and benefits and local economic bearing capacity.

iv. Measures of desertifcation control

By analyzing the present situation, damage trend, the mode of desertification control was put forward.

2 Achievements & Effects

The people's government of the Autonomous Region paid great attention to the achievements of the project. Some of the achievements are applied directly. So in the letter giving to the headquarter by government, it is said that the support of IDRC to the project, has great effects on local economic development, especially on the efficient utilization of natural resources and protection of ecological environment. It gave scientific base for making strategy. The practical effect is far more than an important support on technology and engineering. In 1998, it is awarded the second prize of Science & Technology Progress by the government. It was utilized by many other international organizations, such as CIDA. The achievements includes:

i. The water regulation program gives scientific base for local government to solve the problem of water resources of Tarim River.

ii. The practical program of management system and water prize renovation is applied in the work of water price regulation by local government.

iii. The water-saving techniques and program gave scientific references for local farmers to utilize water-saving techniques.

iv. The new ideas of environment construction supplied practical and technical program for ecological environment protection and desertification control.

v. During the research period, thirteen theses were published. Three of them are exchanged in international scope and four of them are awarded prizes of different level.

The Chinese Agricultural Publisher formally published the research report. And all the achievements were made multi-media form and CD-ROM, and were communicated and extended by Internet and IDRC in the world.

3 Funds and Technical Support

IDRC support 180 thousand Canadian dollars for the project. The national Scientific & Technological Committee and the regional government give some amount of necessary funds. The total funds reaches 2.13 RMB Yuan, which is 333 thousand Canadian dollars. That guarantees the study of the project.

i. By training the group members of the project. The research method of IRP/DSM was applied in the study on water resources management for the first time in China. The marginal conception was used in the study of water price regulation for the first time in China. The two evaluating models of water-saving techniques and environment effects were developed by applying the theory and method of applied techno-economics and environmental economics to the study on water-saving techniques and techniques of desertification control for the first time in China.

ii. In the study, the field investigation, expert consultation, discussion and systematic analysis were combined together.

iii. Besides studying, the project also took great attentions to the personnel of production management and the strategies applying by the upper managers.

iv. According to the practical situation in Xinjiang, by regulating the ecological efficiency and the social efficiency, the researchers put forward three modes for desertification control.

v. By introducing the international experiences on water resources management, the new water resources management system and regulation program of water price were put forward also.

4 Comparing with Other International Cooperation Project

The Institute of Agricultural Sciences & Information is a special scientific institution, which is engaged in the study on agricultural resources and environment, rural economy, agricultural system engineering, agricultural information consultation, and agricultural market information. It took part in the cooperation project of IDRC, CIDA and UNDP, and also it has good relation with JICA, CIRAD (France) and Vrije University of the Netherlands. But it is believed that the project of IDRC has some specialties:

i. The project is selected strictly. To solve key problems is its target.

ii. Paying attention to the participation of local governmental officials and farmers.

iii. The support fund is based on guaranteeing the study of the project.

iv. The project combines study with the training of local technicians.

v. The project involves the experts of international, national and local origins.

vi. The project takes importance to field investigation and collection of local data and information.

After all, the project of IDRC is suitable for local needs. It can solve the key problems with high efficiency. Its achievements have great application value and effects on the development of local social economy.

A Review on "The Change of Urban Land Use and Spatial Patterns of Medium-Sized Cities in China" (A Joint Research Project funded by IDRC of Canada)

"The Change of Urban Land Use and Spatial Patterns of Medium-Sized Cities in China" research group

1. Background

In 1990, the dean of the Department of Geography of the University of Montreal, Prof. Peter Foggin came to the Department of Geography of Peking University for a one-year holiday. At that time he conferred with the dean Professor Hu Zhaoliang about applying for projects of IDRC along. After two year's efforts, the research project achieved ratification from Canadian and Chinese government. The dossier number is IDRC 91-1028, and Chinese National Science (foreign) sanction (92) 1854.

Initially, we had selected the following seven cities as samples: Xiainen, Wenzhou, Tai'an, Ma'anshan, Wuzhou, Yinchuan, Luzhou. Due to the limitation of time and funds, the actual work focused on Xiamen, Wenzhou and Ma'anshan.

We originally scheduled to fulfill the project in 24 months from 1991 to 1993. Since the sanction was obtained in late 1992, it was postponed for two years and was finished by the end of 1995. The results was published in October 1996.

2.The state of execution

The operation of the funds

The total amount of the project funds was 140 thousand Canadian dollars. Among it, 50100$ was allocated to Chinese side. All the funds were spent in researching.

Domestic complete set of funds

There were special domestic ftmds, however, the related cities such as Ma'anshan, Yinchuan, Wenzhou and so on also bore reception costs.

Equipment

During the process of research, we purchased French Spot satellite pictures (with a resolving power of IOX 10), two 386 computers, rent a no.0 drafting instrument. And we also used the equipment of the department.

Personnel training

This project achieved a lot in personnel training. It successfully trained: two doctors, one was Canadian, the other was Chinese; twelve masters, 4 were Canadian, 8 were Chinese. Most of the Chinese scholars went abroad to continue their study or work.

Exchange of experts

Two Canadian experts visited China:

(1) Prof. Peter Foggin investigated Xiainen, Wenzhou, Tai'an, Ma'anshan, Wuzhou, Yinchuan, Luzhou seven medium-sized cities respectively in 1992-1994.

(2) Prof. Claude Comtois (from the University of Montreal) led his students to investigate Ma'anshan in 1992.

Two Chinese experts visited Canadian:

Hu Zhaoliang and Sun Yinshe (from Peking University) investigated Montreal, Vancouver, Ottawa and several east U.S. cities.

Research staffs

The Chinese director of this project was Hu Zhaoliang, professor and dean of the Department of Geography of Peking University. The Canadian director was Peter Foggin, professor and dean of the Department of Geography of the University of Montreal.

Main technical director:

1.Wang Chao (Ph.D, Peking University and the University of Montreal)

2. Sun Yinshe (lecturer, Peking University)

3.Li B iao (lecturer, Peking University)

Cooperator:

1.Zhang Qin (section chief, the Planning Department of the Ministry of Construction)

2.Wang Yifang (bureau chief, urban planning bureau, Ma'anshan)

3.Shang Jianxin (capital planning committee)

4.Fan Zhaochang (city construction section, construction committee, Ningxia Autonomous Region)

Members:

Zhang Xiaodong, Chen Hong, Li Xinfeng, Zhang Zhiqiang, Li Xiangrong, Zeng Zanrong (masters, Peking University)

Consultants:

1.Qiu Weizhi (professor, Peking University)

2.Wang Enyong (professor, Peking University)

Research results

Two treatises:

1."Changing Spatial Patterns of Medium-Sized Cities in China (1980-1992)", China Environmental Science Press, 1996. 1 0.

2."Chinese Cities in the New Century", Taiwan Tangshan Press, 1996.12.

Seven thesis.

1. Hu Zhaoliang and Peter Foggin, "Gaige kaifang zhence yu chengshi fazhan" (The reform and open-door policy versus urban development). Urban Science. 1993, No.3: 33-37.
2. Hu Zhaoliang and Peter Foggin, "Chengshi xiandaihua sanyi" (Remarks on urban modernization). Guotu kaifa yu zhengzhi(Territorial Development and Management). 1993, No.3: 33-37.
3. Hu Zhaoliang and Wang Chao, "2020-Blueprint of China's Guangdong Megalopolis". Territorial Development and Management. 1993, No.4: 11-15
4. Hu Zhaoliang and Peter Foggin, "Daoqiang qianyuan . shangtian rudi . tianren heyi". Urban Science. 1993, No.5: 16-21.
5. S.Hu Zhaoliang and Peter Foggin, "Liangge tongji xilie zhongde chengshi renkou bijiao". Urban Problem. 1994, No. 1: 2-4.
6. Sun Yinshe, "Chengshi yingqu yu bianyuandai chengzhen fazhan". Urban Science. 1994, No.3: 42-46.
7. Hu Zhaoliang and Peter Foggin, "Beijign renkou de quanceng bianhua". Urban Problem. 1994, No.4: 42-45.

3. Evaluation of the scientific, economic and social benefits

The transformation and application of the scientific results

The results of this project can provide basis for urban planning and management, and enhance conciousness of them as well.

Social benefits

The main results were all published in English so it is easy for international comprehension of Chinese cities and convenient for exchanges between the Western and Eastern academia.

According to this project's results, Taiwan Tangshan press published "Chinese Cities in the New Century", which enhanced the understanding to the cities and the urban science in mainland of Taiwan academia.

Other benefits

The results were compiled into two textbooks, enriching the content of two courses-China Economic Geography and Urban Problems.

1. "China since open-door policy", China Environmental Science Press, 1996. Textbook for undergraduates.
2. "An outline of Chinese regional development", Peking University Press, 1999. Textbook for graduates.

Due to the substantial teaching content, Prof. Hu was chosen "the most popular teacher" in Peking University in 1998 by the students' union and was awarded Japanese Ahanzong excellent teacher praise.

Personnel training

This project achieved a lot in personnel training. It successfully trained two doctors and twelve masters. Among them, one doctor and four masters were Canadian. Most of the Chinese scholars went abroad to continue their study or work.

Meanwhile, there were four experts exchanging visits and improving understanding in each other.

After the project was finished, Canadian side sent students or students leaded by professors to
China for academic exchanges and investigations four times.

Scientific innovation

The major achievement of this project was to seek the circular changing law of urban spatial patterns in China since the reform and open-door policy. This law worked obviously not only in large cities but also in medium-sized cities.

4.Evaluation and suggestion in project management to IDRC and the Ministry of Science and Technology

The declaration and approval of the project

The period for Chinese side to examine and approve the project was too long, lasting one and a half years or so. This was one of the reasons for the project to postponed two years.

The operation of the funds

At that time there was a dual exchange rate in China, that means, the University paid RMB in official rate while we purchased computers in market rate. There was a two-fold disparity between them. At the same time, the University deducted 25% of the funds, so the project experienced serious deficit. In the end, appropriating funds from other projects fulfilled the project. Because of the long duration and the deficit, the final result appraisal and reward application both encountered much difficulty.

(The main members of this project are all overseas now. The Chinese director of this project, Prof. Hu Zhaollang, finishes this report. Address: Hu Zhaollang, The Department of Urban and Environmental Science, Peking University, Beijing 100871. Tel: 68032213)

IDRC in China

An assessment of 20 years of science and technology cooperation

Ministry of Science and Technology

June 2000

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China-IDRC science and technology cooperation: An overview

ZHENG Yongqi ZHAN Hongqi
Review team of IDRC projects in China, MOST

1 Background

The International Development Research Centre (IDRC) is a public corporation created by the Canadian government to help communities in the developing world find solutions to social, economic, and environmental problems through research. IDRC connects people, institutions, and ideas to ensure that the results of the research it supports and the knowledge that research generates, are shared equitably among all its partners, North and South. Since its foundation, IDRC has supported many research projects in developing countries all over the world and many of the researches have been very successful. IDRC has become a well-known and important development research organisation.

The science and technology cooperation between China and IDRC started in 1981 when an agreement of science and technology cooperation was signed. The Ministry of Science and Technology (MOST) (previously the State Science and Technology Commission) is responsible for the coordination and management of the IDRC supported projects in China. During the past 20 years, IDRC has supported about 150 collaborative research projects in China with a total funding of 25 million Canadian dollars. The researches in China supported by IDRC covered a wide range of scientific disciplines such as agriculture, forestry, health, environment, resources, information, economy and social development. IDRC projects in China also covered a wide range of geographic areas, from Shanghai, east of China to the Western China, Tibet and Xinjiang. The IDRC projects were in variety of ways such as collaborative researches, participation in international conferences, workshops, training courses etc. The benefits and outcomes of these collaborations are positive and obvious.

However, a complete assessment of the projects has never been done. Such an assessment would help both the MOST and the IDRC to improve their future cooperation, to help the MOST to improve its program delivery and project management efficiency, to develop its future science and technology cooperation with underdeveloped countries. To mark the 20 years of successful collaboration between the MOST and IDRC, an agreement was approached to carry out an review and assessment of all the IDRC projects conducted in China.

2 Aims of the review

The objectives of the assessment are several folds : 1) to summarise all IDRC projects in China conducted in the last 20 years, in order to find problems and lessons learned in the management and implementation of IDRC projects and this will be used as references by the MOST in designing and managing its future international science and technology cooperation; 2) to strengthen the information sharing and exchange among the host institutions of IDRC projects and project administration organisations. As a results of this goal, information on China-IDRC cooperation and projects will be launched at the web site of MOST; 3)to provide help for IDRC to develop its policy for future relation with China; 4) to help both sides to improve their efficiencies in future planning of research programs; 5) to provide experiences which can be helpful for China to develop overseas S&T development programs to the less developed countries.

3 Methodology of the assessment

The assessment will be carried out in a variety of ways. It is organised as a multiple level project review. The IDRC-China projects will be reviewed at project level, in which project leaders and team members will reassess their projects. Projects will also be assessed at institutional level, in which the projects will be categorised according to project fields which are usually managed by relevant institutions such as the Chinese Academy of forestry, Chinese Academy of Agricultural Sciences etc. At the sate (MOST) level, overall summarisation of the IDRC-China projects and general review will be conducted by the review team organised by the MOST which consists of expert and program officers. In parallel, IDRC is also setting up an review team, conducting assessments based on their knowledge, information and understanding. The two review teams will interact closely in all concerns of the assessment. Small sized workshops on exchange and discussion by key project leaders and staffs together with the IDRC review team will be held in several typical and representative institutions like the Chinese Academy of Forestry, Qinghua University etc. Further discussions will be made by visits to selected IDRC project sites in China in order to collect opinions of various project scientists and information on site. A visit to IDRC headquarters is planned to synthesise and finalise the final assessment report and to prepare for publication in both Chinese and English.

4 Expected outcomes of the assessment

The outcome of this assessment will be review papers by projects, host institutions, MOST review team and by the IDRC review team. These review papers are to be published in both Chinese and English. Meanwhile, information on IDRC-China projects will also be made available on the MOST web site. In such a way, the activities and achievements of the IDRC-China projects can be publicly accessed in China and abroad. A proposal for developing China抯 overseas science and technology development research with under-developed countries will also be prepared.

5 Summarised information on IDRC projects in China and statistics

5.1 Number of projects funded by IDRC in each year

Before the agreement of science and technology co-operation between IDRC and China signed in 1981, there was only one project of which the research relates to China and the implementation organisation was outside China. Since 1981 the number of projects funded by IDRC was steadily increased until 1986 in which the number of IDRC projects in China was peaked. Since then the number of projects subjected to decrease until to 1990, of which the number has been only 6, after that year there was a rise again of the project number, the number went to 13 in 1991. But after 1991, the number was going down again till the present (Fig. 1).

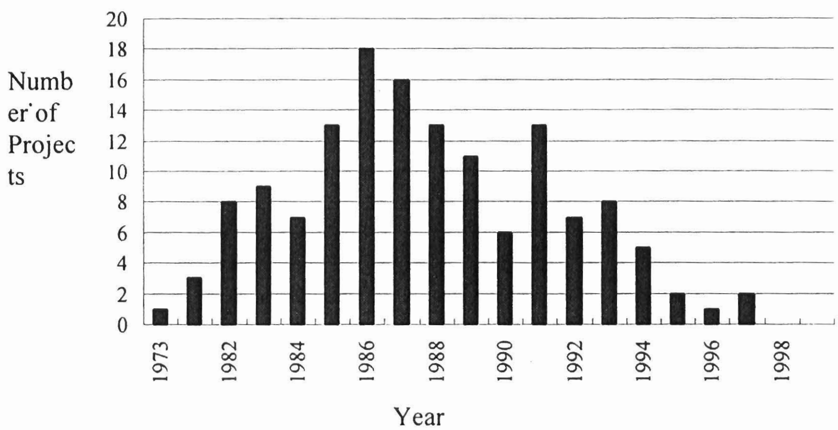


Figure 1, The number of projects granted by IDRC in China in each of the 20 years.

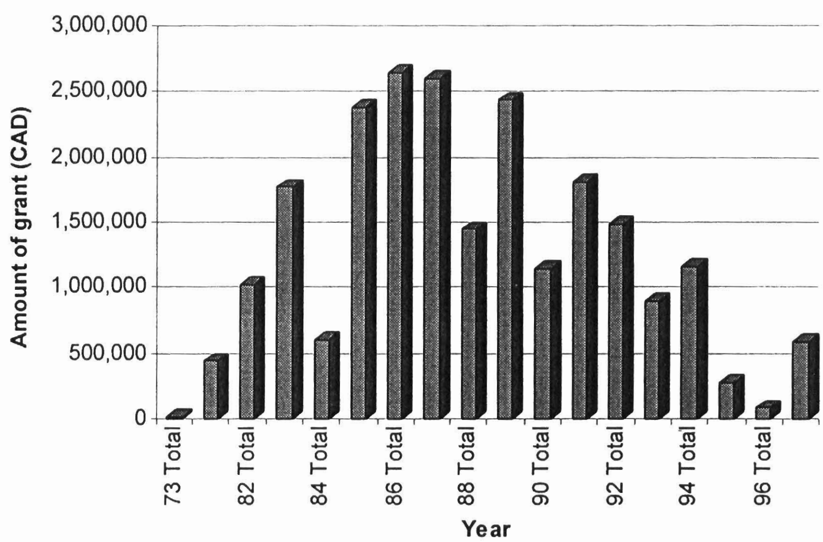


Figure 2, The yearly amount of IDRC fund granted to China

5.2 The yearly amount of fund granted by IDRC to China

The total funding of IDRC project in China in the past 20 years was estimated roughly close to 25 million Canadian Dollars. The amount granted in each of the years has generally followed a similar trend to that of the number of projects. The amount of fund increased from the early 80s with peaking in the mid 80s and since then decreased till present. There amount of project grant varied with small fluctuations from year to year under the general trend. The reason for these changes was not clear, but it may be probably affected by the IDRC overall R&D and finance policies. Other reasons may be due to the IDRC staff changes in which personal research interests may have effects on approval of project proposals (Fig. 2).

5.3 Coverage of IDRC projects

IDRC projects in China covered a wide range of fields, such as, in order as the number of projects, social science and social development, agriculture, health, forestry, environment, information, resources, energy, engineering, earthquake and policy. The mostly supported fields are social sciences, agriculture, health, forestry and environment. This reflected in some extent that the priority of IDRC support was in the social development and human wellbeing (Fig. 3).

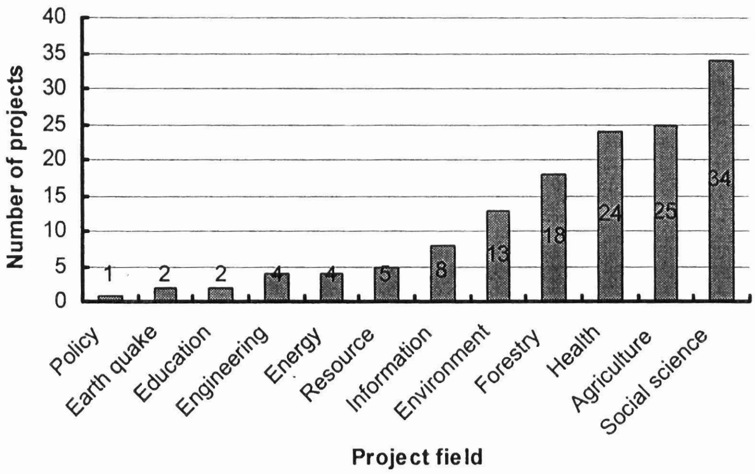


Figure 3, Number of projects granted by IDRC in each of the 20 years

5.4 Comparison of numbers of IDRC projects in various research fields

The number of IDRC projects in China (both implementing institution in China and in other country) totalled 151, of which 24% is in Social science and development, 18% is agricultural science, 17% of health care, 13% of forestry. Other fields are all under 10% (Fig. 4).

5.5 Geographic coverage of IDRC projects in China

IDRC projects in China covered a wide geographic area east from Shanghai to west China Tibet and Xsinjiang. About 24 provinces (or municipals) had been involved at least one of the IDRC projects. Some places had several or more IDRC projects. However, it showed that in the north-eastern China, Inner Mongolia and Linxia, no IDRC project have been supported there yet.

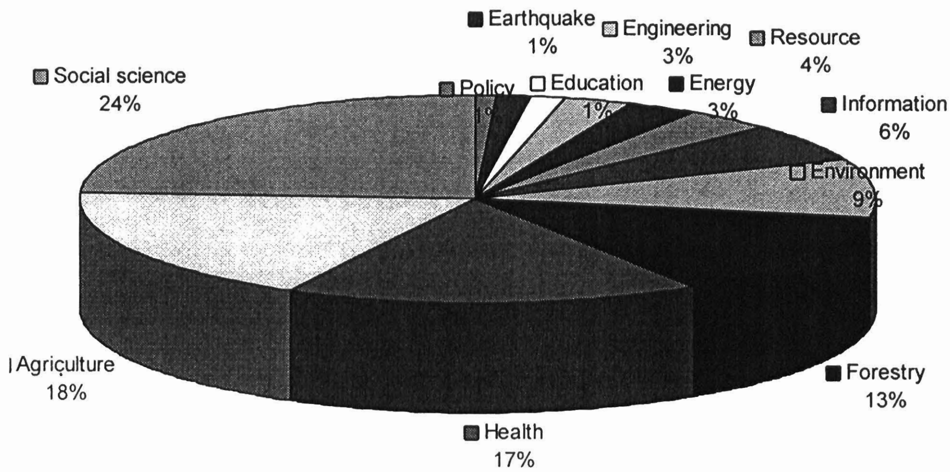


Figure 4, Proportion of project numbers in various fields

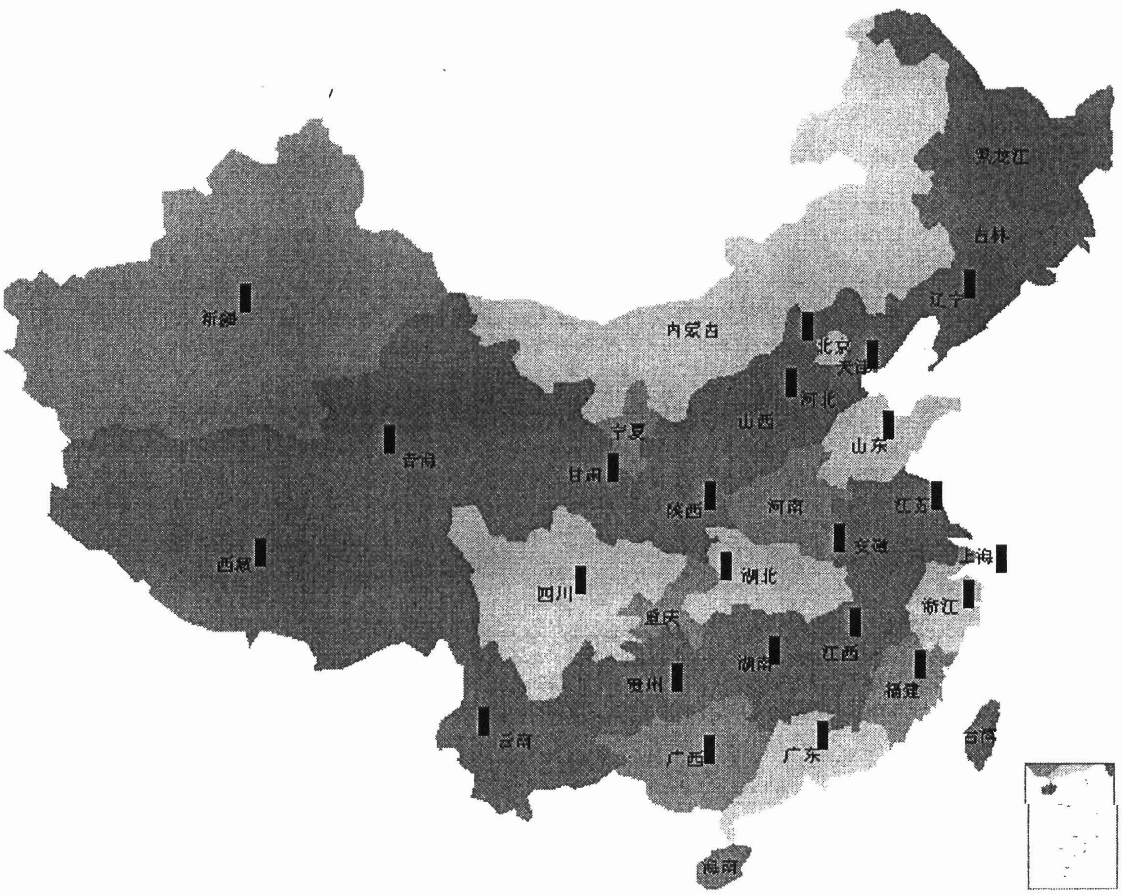


Figure 5, Geographic coverage of IDRC projects in China

6 Discussion

Many of the IDRC projects have achieved significant achievements, for example not to mention all, the Paulownia project conducted by the Chinese Academy of Forestry, the rapeseed project by the Chinese Academy of Agricultural Sciences and the Mountain area community based resource management project by the Guizhou Provincial Agricultural Academy have obtained high quality research results which have resulted in significant economic and social benefits by application of the research results.

It is evident that China-IDRC research collaboration have made obvious contribution to the progress of China's science and technology, capacity building of Chinese research institutions and scientists and the social and economic development in China. However, it also should be born in mind that we are not only to summarise our achievements and success, but also, as one the important task of the assessment, to identify imperfections and problems in any aspects of the planning and implementation of the projects. This will be of significant implications for improving our future collaborations.

With the rapid development of China's economy, international science and technology cooperation for China is being more important. China's science and technology may play more roles in supporting to under developed countries and the research collaboration may be expanded in future. How to make the program more efficient with benefits to bilateral interests of the co-operative countries, the IDRC case provides an excellent lesson.

Review, Prospects and Evaluation on the Cooperative Research between CAF and IDRC

Wang Meiyan
Chinese Academy of Forestry

The cooperation between CAF and IDRC began in 1982. Through the 18-year contacts, from mutual understanding to mutual trust, we have set up the close partnership and great success has been achieved, which has become the model for the technical cooperation between developed countries and developing countries. IDRC is the greatest cooperative research partner of the CAF. This paper has reviewed the history of 18 years for the cooperation and future cooperative plan in the new century has been made.

I. Review of the history

18 years have been passed since the cooperation between IDRC and CAF. In the past 18 years, 17 projects were funded by IDRC (See Table 1), and the total amount of funding is as much as CAN.D 4.5 million. More than 200 people have participated in the projects with over 40 sites which cover 16 provinces and regions, and International Network of Bamboo and Rattan (INBAR), the first international organization with its headquarters in China was established with the funding of IDRC.

Table 1. Main Projects cooperated with IDRC

FILE NUMBER	PROJECT	PERIOD	INSTITUTE
040186	CBRM—Reclaiming Degrading Land	1995-1997	RIF
810130	Bamboo(Phase 1)	1982-1985	RISF
810199	Wood Adhesive	1983-1986	RISI
820121	Paulownia	1982-1985	RIF
840273	Rattan	1985-1988	RITF
850023	Bamboo Breeding	1985-1988	RISF
850251	Fuel-wood	1986—1989	RITF
860164	Paulownia II	1985—1988	RIF
860098	Wood Utilization (Paulownia)	1987-1989	RIWF
860169	Farm Forestry Training Program	1990-1993	RIF
860264	Wood Gasification	1987-1990	RICPUFP
870329	Paulownia-dissemination of research results	1991-1994	RIF
870127	Bamboo Information Center	1987-1994	RISTIF
880100	Bamboo Technology Utilization	1989	RISF
890206	Farm Forestry	1990-1993	RIF
900074	Farm Forestry Training Program		RIF
910294	Farm Forestry Training Center	1991	RIF

II. Results of Cooperation

In the period of the cooperation, remarkable results have been achieved. With the joint efforts of the two sides, remarkable results have been achieved in the research work. The main results are as follows:

1. The research results have been awarded with many prizes of scientific and technological advance.

In the cooperative projects with IDRC, 3 sub-projects are awarded with prizes of the state level: The Rattan Research is awarded with the State-First-Class Prize of Scientific and Technological Advance, i.e. the Research of Nutrition Circulation Rule of Phyllostachys Forest and Its Application awarded with the State-Second-Class Prize of Scientific and Technological Advance; Research on breeding improved varieties of Paulownia CO20, C125 and P.tomentosa x P.fortuneiiNo.33 is awarded with State-Third-Class Prize of Natural Science; Glue manufacture with Sulfite Cellulose Liquor gets the State Patent . In addition, 16 sub-projects are awarded with Prizes of Scientific and Technological Advance of Provincial and Ministry Level. (See table 2)

Table 2. Prizes Awarded From the Cooperative Projects with IDRC

Awarded Project	Class of Prize	Year
Rattan Research	State-Forest-Class Prize of Scientific & Technological Advance First - Class Prize of scien-tech. Advance of Ministry of Forestry (MOF).	1996 1994
Technical Research on Introduction and Cultivation of Rattan in Guangxi	Third Class Prize of Scien-tech. Advance of Guangxi	1995
Research of Nutrition Circulation Rule of Phyllostachys Forest and Its Application	State Second - Class Prize of Scien-tech Advance Second - Class Prize of Scien-tech Advance of MOF	1996 1995
Research on Breeding Improved Paulownia Varieties Paulownia C020, C125 and P. tomentosa× P. Fortuneii No.33	State - Third - Class of Natural Science First Class Prize of Scien -tech. Advance of MOF	1995 1992
Research on Distribution and Comprehensive Characteristics of Paulownia Varieties.	Second - Class Prize of Scien - tech. Advance of MOF	1990
Optimized Model of Paulownia Intercroping with Agriculture Crops	Second - Class Prize of Science - tech. Advance of MOF	1992
Compatible Technology of High - Stalk and Robust Seedling of Paulownia	Third - Class Prize of Scien - tech. Advance of MOF	1990
Bamboo Species Garden Research on Selection of Fast - Growing and Good Tropical Tree Species for Fuelwood and Breeding Technology of Fuelwood Forest	Third - Class Prize of Scien - tech. Advance of MOF Third - Class Prize of Scien - tech. Advance of MOF	1985 1990
Research on Selection of Fuelwood and Timber Species of Short Rotation and Cultivation Technology in Hainan Province	Second - Class Prize of Science - tech. Advance of Hainan Province	1993
Research on Tropical Fuelwood Forest	Second - Class Prize of Scien - tech. Advance of MOF	1992
Selection of Fuelwood and Timber Species of Short Rotation and Cultivation Technology in Poor Hills	Second - Class Prize of Science - tech. Advance of Hainan Province	1995
Research on Finger - joint Technology with Masson Pine and Chinese Fir Thinnings	Third - Class Prize of Scien - tech. Advance of MOF	1995
Technology of Paulownia Planting in Autumn	Third - Class Prize of Scien - tech. Advance of Hainan Province	1978
Selection and Breeding of Good Paulownia Clones by Paulownia Crossing and Selection	Second - Class Prize of Scien - tech. Advance of ShanXi Province	1987
Glue manufacture with Sulfite Cellulose Liquor	State Patent	1987

2. more social, ecological and economic benefits are obtained.

2.1 Economic income is increased and ways for making foreign exchange are expanded.

Six thousand ha. of Rattan forest was cultivated and extended in the three years from 1993-1995 as a result of the Rattan Research Project. A total new output value of 36.29 million Yuan(RMB) and Profit and tax of 7.13 million yuan (RMB) were obtained only from harvest of rattan forest.

The result from the Project of "Research of Nutrition Circulation Rule of mao bamboo Forest and Its Application" was used and extended in 10000-mu mao bamboo forest and the net output value of 410 million yuan (RMB) was increased and a foreign exchange of US$ 21 million was made. 21 million of trees of good clones of Paulownia were totally extended and over 30% were increased for the average growth.

2.2 The ecological environment is improved and crop production is increased.
For example, due to the result of the Project of Paulownia Research, 120,000ha. of intercroping forest between Paulownia and agricultural crops was cultivated in Henan, Anhui and Shandong provinces from which the microclimate was improved and the production of agricultural crops was increased. Another example is the Project of Rattan Research. The space model of intercroping between forest and rattan is set up, with which not only the forest land fertility is maintained, thus, the growth and production of forest trees are not affected, but also the profits can be early obtained due to different harvesting season.

2.3 New ways for employment are created.
Through the Project of 'Research on Finger-joint Technology with Masson Pine and Chinese fir thinnings, a processing mill for producing wood products, such as wood pad for truck use with Masson pine thinnings was built in Guihua Forest Farm in Chong Yang, Hubei Province. The employment for a lot of young people in that area is solved. From the extension of the research result of 'Rattan Research project, chances were provided for the employment of 30000 people.

2.4 The crisis of energy resources is eased up to a certain extent from the development and use of wood wastes.
Through the Project of "Research on Finger-joint Technology with Masson Pine and Chinese Fir Thinnings, the problem of efficient use of plantation thinnings is solved and a lot of timber is saved for the country. Through the Project of 'wood Gasification', wood gas is produced with forest wastes, thus, the fuel problem is solved for the northeastern region of China. Through the Project of 'Selection of Good and Fast-growing Tropical Fuelwood Species and Research on Cultivation Technology for Fuelwood Forest, 9 suitable species with fast-growing and high-resistant characteristics were selected with which 60000ha. of fuelwood forest was established, which can provide 3 million ton fuelwood for 600,000 farmer households, thus, the terrible shortage of fuelwood energy in the tropical rural regions was eased up.

3. Different kinds of forestry staff are trained
3.1 Management staff are trained.
86 different kinds of training courses in the field of research management, financial management, extension research, social and economic research were held with the funding of IDRC and teaching by foreign experts and 5600 people have participated in the training courses. 120 of middle-level leading cadres of CAF participated in the training courses through which the business level of some cadres was improved after training and took up the leading post of finance and management.

3.2 A group of local technical backbones were fostered
Through the participation of IDRC projects some young people graduated from junior and middle school or workers of forest farms in the sites of the projects have mastered the basic experimental methods and operating measures, popularized science and technology, improved and enhanced the quality of business and become the nucleus of the local forestry technology and some of them have been promoted to senior engineers.

3.3 A group of forestry experts have been brought up

Through the long-term cooperation with IDRC, a group of excellent people who played the leading role for forestry research and experienced project managers for international cooperation have been brought up in the field of scientific research of China's forestry. Among the researchers who participated in the cooperative projects with IDRC, 6 of them have enjoyed the government allowances and most of the responsible people for the projects have been invited by other countries as technical consultants or taking up important posts in international organizations, especially, Mr. Zhu Zhaohua from the Chinese Academy of Forestry, was awarded with the prize of 'Man of Tree' by the Baker International Fund in 1985. He was the first prize winner since the establishment of the Fund in that year. He has not only won the honor for China, but also extracted the attention on China's forestry from the forestry colleagues of the world; During the 25-year anniversary of IDRC founding in 1995, Mr. Zhu Zhaohua was cited by Canadian Prime Minister for his great contribution to agroforestry.

4. The international exchanges and contacts for China's forestry have been promoted.

Through IDRC projects, 43 experts from the Chinese Academy of Forestry were sent to India, Indonesia, Pakistan, Thailand, Malaysia, Australia, USA and others for technical consultation and guidance on bamboo and Paulownia. Since 1982, IDRC has organized over 450 research people from developing countries to visit China's forestry research results of agroforestry, social forestry, bamboo and rattan cultivation and uses, processing of non-wood forest products, mushroom cultivation.

The Farm Forestry Training Center was established in CAF in 1991 with the funding of IDRC and 6 international agroforestry training courses and 3 bamboo training courses have been successful conducted and 230 senior forestry researchers and managers from developing countries were trained. These training courses are welcome by developing countries. Through IDRC projects, China has exchanged plant resources with developing countries. For example, we have provided seeds for Paulownia and bamboo for over 30 countries and introduced seeds of bamboo and rattan from other Asian countries so that the South-South Cooperation is promoted and the cooperative network taking Asia as the center has been formed.

III. Comparison of Management Characteristics of International Cooperative Projects of Different Sources

The Chinese Academy of Forestry has undertaken international cooperative projects of over a dozen of international organizations such as IDRC and etc., of which there are common points and unique features in the management of international organizations. In Table 3, the project management organs, project focuses, characteristics of project implementation and fund are listed, and the management features are as follows:

1. There is no fixed pattern for the specific management of international scien-tech cooperative projects. Different management measures are adopted respectively in accordance with the actual circumstances of project source, scale and etc.

2. Different international organizations and different countries have varied scope and intention in their search of international cooperation. The support focus of the International Development & Research Centre, Canada is on rural development and poverty alleviation, stressing the coverage scope and network of project contents; the Australian Centre for International Agricultural Research (ACIAR) concentrates on introduction of tree species and expansion of tree cultivation and plantation to increase tree productivity; the International Tropical Timber Organization (ITTO) has a clear aim, i.e. the protection of tropical forests.

3. ITTO's major projects have a large cooperative scale, extensive scope and involvement of different levels and establish leading and management organs of 3 levels i.e. the project

steering committee, project manager and project office; IDRC sets up a project management office in the implementation institution, which is endorsed with clear responsibilities and is easy for communications, guaranteeing the continuity of scientific research; For small cooperative projects that involves a single discipline, a project group is usually set up.

4. In the field of project monitoring and evaluation, all the international organizations pay great attention to the annual evaluation or interim evaluation. IDRC and CAF conduct regular monitoring on project implementation and formulate the rules that the project must submit the technical and financial reports periodically; UNDP conducts evaluation by 3 parties, interim evaluation and final evaluation, in addition to the progress report and final report required; The project management organ set up by ITTO guides the technical performance of the project, and requires the submission of project progress report every six month.

5. In the field of project fund management, IDRC attaches importance to the fund budget report, prompt allocation of the fund upon the receipt of technical and financial report. About 2/3 of project fund is administered by the Chinese side, which is spent and allocated according to the budget with certain flexibility; ACIAR project fund is basically administered by the Australian side; UNDP project fund is administered in a way of reimbursement system by FAO or the International Exchange Centre, the Ministry of Foreign Trade and Economic Cooperation except a small portion of fund retained by ITTO for the uses of project monitoring, evaluation and management, ITTO project allocates the majority of project fund to the project group, and the Chinese side enjoys a fairly large flexibility.

IV. INTERNATIONAL COOPERATION IN PROTECTION AND CONSTRUCTION OF ECOLOGICAL ENVIRONMENT IN WESTERN CHINA

In the process of the world economy integration, the international cooperation and exchanges will play a more important role. Especially, the forestry towards the 21st century is the hot spot and core for promoting the balance between environment and development. Strengthening international cooperation and exchange is important in forestry open-door to foreign countries. We would like to conduct wide cooperation and exchange in forestry with international organizations, friendly countries and non-governmental organizations on the basis of equality, mutual benefits and reciprocal favored treatment. The following are suggestions on the fields of cooperation for the development of the western region;

1. Establishment of the Forest Ecological Network System. This research has already formed a relatively scientific and sound framework, and has set up trial sites of different types. At present, it is urgently needed to set up more trial sites in the western region.

2. Protection of wetland. It covers the principles and methods for the use of wetland, dynamic monitoring of wetland environment, rehabilitation trials of seriously destroyed wetland, as well as formulation of laws on protection and use of wetland and its management regulations.

3. Combating desertification. This includes the construction of China Center of Research, Development and Training for Combating Desertification in Asia and Africa, and the UN Asia Center of Desertification Monitoring and Evaluation; As an Asia-Africa cooperative demonstration, one demonstration project is set up for Asia and Africa respectively to carry out comprehensive control and development of desertified land, and to research, extend and apply advanced and pragmatic techniques for combating desertification.

4. Biodiversity. It includes zoning of biodiversity protection in the western region, establishment of nature conservation network system and the establishment of information system on biodiversity in the western region of China; salvation, protecting and propagation of precious, rare and endangered species in the western region; Development and research on technology of sustainable use for biodiversity resources in the western region; Comprehensive research on social security system for biodiversity protection in the western

region; Establishment of demonstration sites for biodiversity protection in different areas of the western region.

5. Protection of natural forest resources. It includes the inventory of natural forest resource in the western region, caring of regenerated forest, the control of forest insect pests, diseases and rodents, and acid rain prevention in the western region.

6. New and high technology for forestry. It includes bio-technology, information network technology, and remote sensing technology.

7. A comprehensive research with the involvement of multiple departments and multiple disciplines on the protection and construction of the ecological environment in the western region.

TABLE 3 COMPARATIVE MANAGEMENT FEATURES OF INTERNATIONAL COOPERATIVE PROJECTS FROM DIFFERENT SOURCES

SOURCE OF PROJECT	PROJECT EXAMPLES	ADMINISTRATIVE ORGANIZATION	STRESS OF SETTING UP PROJECT	FEATURES OF PROJECT IMPLEMENT	Fund MANAGEMENT
IDRC Input CAD 4480,000	Paulownia (1992-1990) Farm Forestry (1990-1993); CBRM- Reclaiming Degrading Land (1995-1997)	Setting up the Project Administrative Office in CAF Appointing a Coordinator for Projects	Mainly stress on single technique during 70-80s and on comprehensiveness and network during the 90s; The Projects are compatible with the National Key Projects The national demands are combined with the international key research	Chinese side plays a leading role on research method, personnel arrangement, selection of sites and instrument purchasing; Submit quarterly and annual technical reports and financial statements on time. Officers or representatives of the IDRC visit the project site 1or 2 times a year	IDRC pays attention to the financial statements and CAF has the initiative on using and distributing funds. IDRC financial officer reviews accounts once a year and reasons should be given for overspending or surplus.
ACIAR Input US$ 3291,000	Introduction and Cultivation Experiments for Australian Broadleaved Tree Species (1985-1993); Australian Acacias for Sustainable Development in Chnia, Vietnam and Australia (1994-1997)	The Executing Agencies are responsible for implementing the Project CAF is responsible for management, inspection and supervision of projects.	1 The main purpose for this project is to introduce the Australian broad - leaved trees for research. 2 The basis of cooperation with Australia is the Cooperative Agreement signed in 1984	The research content is discussed and decided by the two sides. Australian side provides seeds, equipment and so on; Submit progress report every 6 month and annual report once a year.	The Australia side who provides equipment, traveling fund for research activities manages the fund. The fund is used under the control of the Australian Side and relevant compatible fund should by provided by the project implement institution Senior consultation meeting is held every 3 years by the two sides
UNDP Input US$900,000	Capacity Building, Research and Extension for Sustainable Forest Management	The Executing Agencies are responsible for implementing the Projects;	The project is compatible with the National key project; Under the guidance of the foreign and National expert;	Tripartite evaluation by China, UNDP and Administrative Agencies once a year. Submit progress report every	The fund is managed by the Administrative Agency of the Ministry of Foreign Trade and Economic Cooperation, expenses account submission rendered

	(1997—2000)	CAF is responsible for management, inspection and supervision of projects.	the task assigned in the Agreement is accomplished.	3 month. At the end of the second year and the end of the last year the project will be evaluated	
ITTO Input US$2497,500	A Demonstration Programme of Sustainable Utilization of Tropical Forests by Means of Differentiated Management in Hainan Island, China (1993-1998)	Project Steering Committee; Leading Group of China; Projects Director of the State; Project Administrative Office	Protection and sustainable management is the aim; This project is implemented by the CAF and ITTO Secretariat participates in the policy decision	The project is supervised by the Project Steering Committee Submit bi-annual progress reports before 31 Match and 30 Sept. Each year. At least two meetings must be held once a year by the project steering committee to discuss the progress of project.	ITTO gives the total fund to China Project Administrative office, of which 20% is reserved; (10% is for project management for institutions at all level and the Administrative office); Forestry Department of Hainan Province compatible fund for the project; Detail rules and regulations for finance and fund for the project is formulized

Final Report on *Paulownia* Project (China)
Project Phase 1 and 2 (1983 - 1990)

The Research Institute of forestry, CAF

1 Backgroud

Paulownia is one of the fastest growing tree species indigenous to China. It has a wide range of utilization - it can be processed into furniture, plywood and music instruments, etc; its leaves are high-quality feed for livestock husbandry; its flowers are rich resources of honey; and both of its leaves and flowers can be used for medicine. *Paulownia* is one of the best tree species for agroforestry. But the research in *paulownia* species, cultivation technologies, and utilization had been very poor for a long period of time. In 1982, the Chinese Academy of Forestry applied to the International Development and Research Center (IDRC) of Canada for research funds, and began the first phase of its *Paulownia* Research Project in 1983. In 1986, the second phase of this project began.

2 Main Objectives

2.1 Genetic Improvement of *Paulownia*

On the basis of the result of *paulownia* resources survey, scientists made provenance and plustree selection in the distribution zone, and breeded the supper clones through regional testing.

2.2 Synthetic Research on *Paulownia* Cultivation

On the basis of studying different appropriate ecological conditions for different *Paulownia* species, scientists made further researches in the silvicultural technologies of *Paulownia.*

2.3 Model Optimization of *Paulownia* Intercropping System

By making test for different models of *Paulownia* plantations which are of different density and different inter-cropped crops (testing objectives include: the microclimate, physiological changes of the intercropped crops, microbial communicties in the soil, soil chemistry, the annual increment and biomass of *Paulownia*, yield and quality of the intercropped crops), and evaluating the economic and ecological effects of different models, scientists selected the best models.

3 Expenses

IDRC Contribution: Phase 1 356,000 CAD
Phase 2 370,000 CAD

China's State Science and Technology Committee:
Phase 1 500,000 RMB
Phase 2 800,000 RMB

Local Government Contribution:
2,000,000 RMB (land contribution not included)

Chinese Academy of Forestry Contribution:

1,600,000 RMB (facilities and staff saleries)

4 Main Results

4.1 Genetic Improvement of *Paulownia*

4.1.1 Plus tree selection

Scientists chose 100 counties of which the geographic, climatic and vegetation features are typical in the 14 Provinces of *Paulownia* distribution for the plus tree selection. More than 500 technical staff participated in this research, after 6 month's of hard work, 10,000 plus trees was selected, among them 831 was finally selected.

4.1.2 Regional test of plus trees:

Scientists collected the root cuttings of the final selected plus trees, and began to make seedling and testing plantation measurement in six experiment stations that are respectively located in: Muzhou and Zizhong of Sichuan Province, Xingren of the Guizhou Province, Tongling of Anhui Province, and Yanzhou of Shandong Province, Minquan of Henan Province.

4.1.3 Interspecific crossing

More then 40 pairs of interspecific crossing were carried out. The first generation, after seedling selection, produced more than 1,000 superior individuals. These individuals was further proprogated, and tested in the above mentioned 6 experiment stations.

4.1.4 Trial plantation

In the above mentioned 6 experiment stations, scientists set up totally 212 ha of *Paulownia* clone and provenance trial plantations. Over 1,400 individuals have been tested.

4.1.5 Demonstration forests of Super Clones

After four years' testing and screening, about 30 best supper clones were selected. In order to adapt these clones, scientists set up demonstration forests, which the total area is 253 ha.

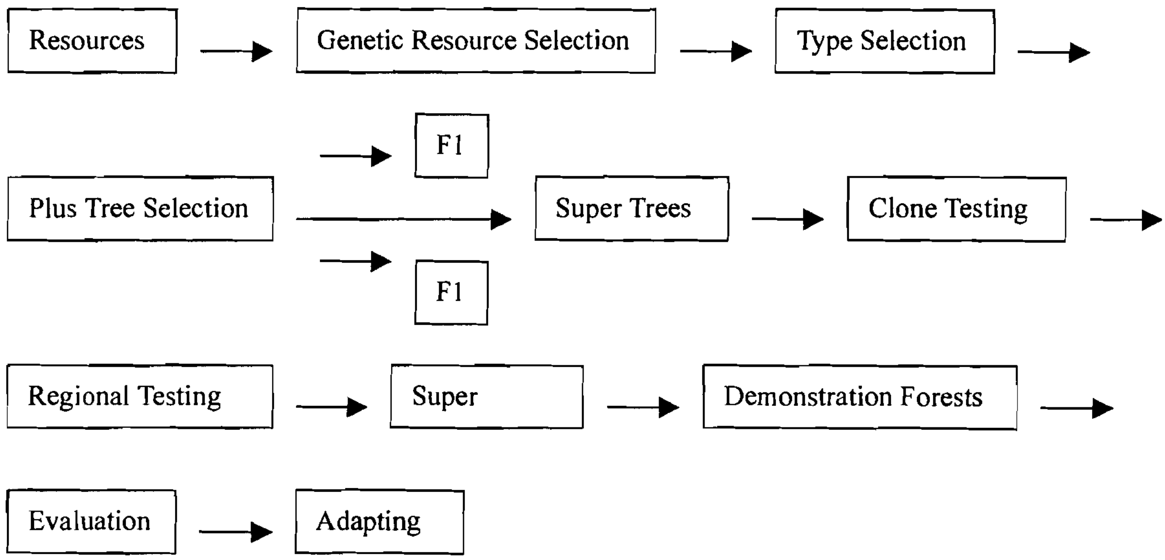
4.1.6 Superior clone identification

After 8 years' testing and screening, scientists concentrated on 7 superior clones that were selected out of over 1,400 individuals, they are C001, C020, C125, C161, CH001, CS001 and CH33. The above mentioned 7 clones grow 20 - 30% faster than local traditional species, the morbidity rate is 50% lower, and the trunk form was improved distinctively.

4.1.7 Conclusion

In the 14 years of hard work, the research in *Paulownia* Genetic Improvement has finished the following stages:

During this period, beside the local scientists and technical personnel in the above mentioned 6 experiment stations, other scientists from forestry research institutes of Anhui, Shaanxi, Jiangsu, Henan and Guizhou Provinces, and researchers from Henan Agricultural University. More than 120 people work on this subject from beginning to the end.



4.2 Research on Sets of Technologies for *Paulownia* Cultivation

4.2.1 High sturdy seedlings cultivation technologies

Before this research project was carried out, *Paulownia* root cuttings in nurseries usually need two years to reach the afforestation standards (height is over 3m, rhizome is above 4cm). After the technologies of high sturdy seedlings cultivation was developed, seedlings can reach the standard of out planting in one year, in the best testing nurseries, one year seedlings can reach the height of 4 - 5 meters, and the diameters of the stem can reach 6.2 cm, the highest seedling reaches 6.3 meters. The land was greatly saved. In the experimental area, this set of technologies extend at a rate of 200 ha per year.

4.2.2 Silvicultural technologies

Through comprehensive research, scientists identified the appropriate soil, ground water level, climate situation, and soil preparation and spacing for different species of *Paulownia.* Especially, scientists developed a set of new technologies for autumn afforestation, which has changed the traditional spring afforestation. Because this set of technologies can not only bring benefits to the growth of *Paulownia,* but also avoid damages to crops by spring afforestation, it has been widely adapted in production.

4.2.3 Other propagation technologies

Beside the above mentioned technologies of propagation by root cuttings, sturdy seedlings, this research project have successfully developed other propagation technologies, including propagation through tissue culture, seed, and short root.

4.2.4 Mixed forest of *Paulownia* and other tree species

This research experimented on many models of mixed forest of *Paulownia* and other tree species. The experiments on the models of *Paulownia* - Bamboo, *Paulownia* - Chinese fir, and *Paulownia* - tea were successful. These three models resulted in good economic returns and ecological effects, now has been widely adapted in production.

4.3 Integrated Evaluation and Model Optimization of *Paulownia* Intercropping System Research

4.3.1 Establishing experimental stations for *Paulownia* Intercropping system research

Since the spring of 1983, scientists have set up a experimental station in Tangshan County of Anhui Province, and began to intercrop *paulownia* with respectively cotton, wheat and maize, and at 6 different spacing, namely 5m×6m, 5m×10m, 5m×20m, 5m×30m, 5m ×40m, 5m×50m, therefore there were 18 farm forestry models, three replications, all together 54 plots, 52 ha of experimental land. Scientists made comprehensive evaluation and model optimization of the *Paulownia*-crop intercropping (PCI), include evaluations of ecological effects (microclimate, solar radiation, energy balance and water utilization, soil features and nutrient utilization), biological effects (animal and microbial communities in the PCI system, growth, development and physiological changes of the intercropped crops and their quality and yield), economic effects (cost/benefit analysis of different lanting patterns). And social effects of the PCI systems, show that it is an efficient multiple function farming system suitable for development in this area.

4.3.2 Selection and optimization of PCI Models

Through the application of mathematical models for different PCI systems, the optimal level was reached based on scientific basis which helps in further developement of the PCI systems. Through ten years of comprehensive and large scale research, and the participation of more than 20 experts, this research achieved satisfactory results, the optimum PCI model was chosen - Model B. This model presents the highest land utilization ratio, the highest profit, and the highest yield in long term land management, and guarantees the production of crops. At the same time, this model can also increase the farmer's requirements for timber, fuel, feed and fertilizer. According to the result of calculating and comparing Model B with traditional models, the net present value, cost/benefit value and land expected value are increased respectively 70%, 42% and 70%.

4.3.3 Evaluation of research results

In the year 1990, the State Ministry of Forestry invited well-known experts to make evaluations for this project, the evaluation group universally believes that the result of this research project are of significant values for farm forestry production, the academic research was advanced in the international community.

5 Extension and Impacts

5.1 Extension of Superior *Paulownia* Clones

The selected 7 superior *Paulownia* Clones were heartedly welcomed by local farmers. Till 1992, the clones have been extended to 37,320,000 individuals in the whole country.

5.2 Extension of High Sturdy Seedlings Cultivation Technologies

In the 5 years from 1987 to 1991, the nurseries of high sturdy seedlings were extended to 10,000 ha in the scale of whole nation, which in average saved 5,000 ha of nurseries each year. These set of technologies has been used in agricultural production.

5.3 Extension of Afforestation Technologies in Autumn

From 1985 to 1990, this set of technologies had been adapted in Henan, Shangdong, Anhui and Shaanxi Provinces, etc. In Henan Province solely, more than 20 million *Paulownia* trees applied this set of technologies.

5.4 Extension of Optimal Models of *Paulownia*-crop Intercropping

From 1990 to 1991, this optimal Models of PCI had been extended to 40,000 ha in Anhui and

Henan Provinces.

5.5 Economic and Ecological Effects

According to the preliminary estimation in 1992, the comprehensive economic effects of this *Paulownia* Project had exceeded 1 billion Yuan (RMB). The result of this project was of significant for improving the ecological environment of China's agricultural areas, and the supply of fuels, timber, feed and fertilizers in rural areas; at least 1 million rural families was benefited from this project.

5.6 Extension in Foreign Countries

This research project had great international effects. Up to date, more than 20 nations have introduced and adapted *Paulownia* plantation, and receive seeds and root cuttings supplied by this project. Experts in this project was invited to provide consultancy for related institutions in India, Pakistan, USA, Thailand, Australia, Italy, Turkey and Malaysia, etc.

6 Rewards

6.1 Awards for Research Results of the Project

Several Subprojects received domestic rewards:

6.1.1 Selection of Superior *Paulownia* Clones - C020, C125 and CH33 was awarded First Prize by the State Ministry of Forestry in 1992, and Third Prize in national level in 1993.

6.1.2 Study on the Taxonomy, Distribution and Comprehensive Features of the *Paulownia* Genus was awarded Second Prize by the State Ministry of Forestry in 1989.

6.1.3 Comprehensive Evaluation and Optimization of *Paulownia*-crop Intercropping Models was awarded Second Prize by the State Ministry of Forestry in 1991.

6.1.4 *Paulownia*-cropping Intercropping Breeding Technology was awarded Third Prize by the State Ministry of Forestry in 1988.

6.1.5 Selection of Superior *Paulownia* Clones - CH001 and CS001 was awarded Second Prize in Shaanxi Province in 1987.

6.1.6 *Paulownia* Afforestaiton in Autumn was awarded Third Prize in Henan Province in 1989.

6.2 Awards for Individual

6.2.1 Prof. Zhu Zhaohua and Prof. Lu Xinyu, as members of the research group, were cited by the State Council in 1998.

6.2.2 Prof. Zhu Zhaohua and Prof. Xiong Yaoguo, as members of the research group, were awarded the title of "The Special Contribution Scientist of State" by the State Council in 1991.

6.2.3 Prof. Zhu Zhaohua, Project Leader, was awarded " Man of Trees" by the International Rechard St. Barbe Baker Foundation

6.2.4 Prof. Zhu Zhaohua, Project Leader, was rewarded by former Prime Minister of Canada for his contribution in leading this international cooperation project in 1995.

Report on the Farm Forestry Training Program in China

International Farm Forestry Training Center
Chinese Acacmy of Forestry

1 Background

1.1 China is a developing country with populated population and limited land. The average arable land for each farmer is less than 0.1 Ha. In order to cater for the numerous demanding of increasing population for food, timber, and other basic needs, people indiscriminately exploit forests and other natural resources. This led to forests depletion, soil erosion and land degradation. In order to ameliorate effectively the ecological environment of agriculture, meet increasing demands for food, forest products, obtain higher biomass and economic returns from per unit area, agroforestry technology has been practiced in China for a long time.

1.2 China has a long history of agricultural research and development. As combination of traditional and update technological agroforestry system, various farm forestry models are being etensively developed in different regions of China. Some of these agroforestry models have been widely adapted and resulted in great benefit. The most famous ones are:

1.2.1 300 million ha. of farm land have been protected under shelterbelt forest system in China

1.2.2 1.8 million ha. farm land in North Center Plain have been intercepted with *paulownia* and 0.2 million ha. with date, 0.13 million ha with case trees and or shrubs and 0.26 million ha. with fruit trees.

1.2.3 Small wathershed control system in semiarid Loess Plateau.

1.2.4 Diversified slope farm forestry systems involved timber and cash tress as perennial component and agricultural crops, edible mushroom, husbandry and traditional medicinal herbs as under stories in subtropical hilly areas.

1.2.5 Multiple stories, high benefit combination of agro-forest-fish .

1.2.6 There are large scale of various farm forestry model in the tropical and south sub-tropical regions such as Rubber + Coffee + Tea; Rubber + Sugar cane + peanuts; Eucalyptus + pineapple.

All these above mentioned models are characterized with large scale, high economical and ecological benefits, reasonable structure, scientific design and matured technology. It would play an exemplary roles for other developing countries.

1.3 Since 1982, the projects, supported by IDRC, such as projects of bamboo (1982), Paulownia (1983), rattan (1985), fuelwood (1986), and wood utilization (1986) have already turned out excellent results. With the superior planting materials (paulownia, bamboo and rattan, tropical fuelwood species, etc.) developed by the projects, a lot of agroforestry model systems have been also developed. All the projects make the local people directly benefited from the research results. At the same time, the research results are also valuable to other developing countries.

1.4 Though China has achieved a great progress and rich experience in farm forestry, the international exchange is limited due to language barrier. International exchange and international farm forestry training center or courses therefore is necessary as a window for sharing experience with foreign countries especially developing countries.

1.5 Under the support of IDRC, CAF held the first International Farm Forestry Training Course during May 1 - 30, 1987. There were 27 participants from 10 countries in Asia. The training mainly gocused on the cultivation and utilization of paulownia and bamboo and agroforestry models. The first training course achieved fruitful success.

2 Objectives

2.1 To share the results and experience of farm forestry research and application in China. (Two training courses in China)

2.2 To increase the capacity of and get more opportunities for CAF in international exchange.

3 Expenses

The total budget of the project is 168,372 CAD
CAF administered: 105,008 CAD
IDRC administered: 63,364 CAD

4 Progress

4.1 Success of the three international training courses

8 - 28 September, 1991 International Farm Forestry Training Course (Warm Temperate Zone and Tropical Zone Farm Forestry Models)

6 - 26 September, 1992 International Farm Forestry Training Course (Warm Temperate Zone and Sub-tropical Zone Farm Forestry Models)

6 - 26 September, 1993 International Farm Forestry Training Course (Tropical Zone Farm Forestry Models)

Year	Number of Participants	Number of nations
1991	9	5
1992	23	13
1993	12	5

4.2 Training materials

4.2.1 Editing and printing the training materials in agroforestry Volumes 1, 2 and 3, totally 450 pages. 1500 sets were printed.

4.2.2 Publication of the book Agroforestry System in China (216 pages, 1991). 2000 copies were printed.

4.2.3 Training materials for each training course, totally 3 books, 580 pages, 100 copies were printed.

4.2.4 Video series on China Agroforestry Models, totally 8 parts, each part lasts 18 minutes, all together 144 minutes.

4.3 Facilities

A Toyot Station Wagon, 14 seats

A multisystem VCR monitor

A film projector

A electronic typewriter

The above mentioned facilities has contribute greatly to the promotion of the capacity of the training center.

4.4 Establishment of Permanent Farm Forestry Training Center

In 1991, at the approval of the Chinese Academy of Forestry and the financial support of IDRC, the International Farm Forestry Training Center was established. Since its establishment, the Center has accumulated rich experiences by carrying out a number of international and domestic training courses, and international cooperation programs, now has become well -known in the field of farm forestry to domestic and international communities.

5 Impact of the project

5.1 Success of a series of international training courses and workshops

After the success of the three international training courses in 1991, 1992 and 1993, the training center continued to receive supports from IDRC, especially supports from the State Ministry of Science and Technology (MOST, former State Committee of Science and Technology- SSTC), and continued to carry out various types of training courses and workshops.

Time	Name	Sponsor	Partici-pants	Natio n s
19-30 /09/94	Training Course on Farm Forestry and Agroforestry Technology Extension and marketing in Asia Pacific Region	INFORTRACE, IDRC, APAN, RECOFTC	29	12
7-20 /10/95	International Training Workshop on Popar and Paulownia Cultivation and Their Roles in Agroforestry	*INFORTRAC E, SSTC, IDRC	31	14
16-30 /09/96	International Training Workshop on Tropical Farm Forestry and Multipurpose Tree Species	INFORTRACE, SSTC, IDRC	18	12
05-18 /09/97	International Training Workshop on NTFPs in Tropical Zone	*CAF, SSTC		
05/09/98	International Training Workshop on Genetic Resource and Cultivation of Paulonwia	*CAF, SSTC	9	8
29/03/99 - 02/04/99	Workshop on Model Forestry in China	MOST, CAF, IMFN, SSTC	45	4
11-23 /04/99	International Workshop on Bamboo and Rattan Biodiversity Conservation, Utilization and Technology Exchange	SSTC, INBAR, *CAF, MOST	31	18
1995 - 1999	Four Training Workshops on Land Utilization and Forest Environment with Cottbus University of Gemany	INFORTRACE, COTTBUS Univ.	Total:6 1	

Since 1994, besides the above mentioned 11 International Training Courses and Workshops, INFORTRACE, cooperating with Ford Foundation, Winrock International and IDRC, has also held two training courses on Forest Resource Management and Social Research, a training course on NTFPs and a training course on International Cooperation Program Management for related domestic scientists and administration officials. Famous foreign experts were invited to teach in these courses, the total number of participants is 125. These training courses played an important role in promoting the qualification of related Chinese experts and administration officials.

5.2 Training of High-qualified Teaching Force

Through the 9 years development, INFORTRACE has become an efficient, refined and opening training center. Permanent staff of the center was reduced from 9 to 4, yet, the international training activities continued to develop steadily. Beside the mayor experts of the Chinese Academy of Forestry, INFORTRACE has also integrated the training substances from Beijing Forestry University, Chinese Academy of Sciences, and the Chinese Academy of Social Science, therefore, the content of the training courses has been extended to a wider range than farm forestry. This has promoted the training standard to higher levels.

5.3 Consummation of the Training Materials

On the basis of IDRC training project, INFORTRACE made necessary further improvement of the training materials. Over 2,000 pages of training materials was edited, and the following books were published: Integrated Research in Farm Forestry (278 page, 1995), Participatory Forestry in China (308 pages, 1987), China's Mountain Area Forestry Development Forum (339 page, 1987), Non-timber Forest Product and Forest Biodiversity (350 pages, 1999).

6 Evaluation of INFORTRACE

In order to promote the training capacity and standard of INFORTRACE, participants of each training courses or workshop were asked to make secret evaluation on all aspects of the training courses and workshop, they had provided INFORTRACE with their valuable experiences and suggestions. The evaluation items include:

6.1 Training Objective

6.1.1 Objectives to attend this training workshop.

6.1.2 New knowledge achieved

6.1.3 Value of the course

6.1.4 Recommendation of the similar course to others

6.2 Presentations

6.2.1 Contents of the presentations

6.2.2 Sequence of the presentations

6.2.3 Techniques of presentation

6.3 Training materials and facilities

6.3.1 Necessity of the training materials

6.3.2 Conditions of the teaching facilities

6.4 Field Visit

6.4.1 Necessity of the field visit

6.4.2 Selected sites for field visit

6.5 The logistics

6.5.1 The accommodation

6.5.2 The Meals

6.5.3 Other services

7 General Comment

According to the result of the evaluation of training courses from 1991 to 1994, the average scores for each item is as the following:

Content	Courses order	Training Techniques	Materials	Facilities
85	85	88	88	86

Field Visit	Selected Sites	Accommodation	Meals	Other services
88	89	72	84	86

The average scores for each item of the evaluation of training courses from 1995 to 1999 is as the following:

Training Subject	Theoretical Level	Practicality	Presentation
97.2	83.3	93.3	85.6

Case Studies	Facilities	Accommodation and meal	Transportation
87.2	80.5	93	97.3

100% of the participants believes that the training courses are useful and helpful to their work and researches. The average rate of knowledge increase in the same academic field of each participant is 30%.

Because a great part of the participants of our training courses (except student training courses) are senior scientists or senior management officials - above 80% had got doctorate degree, 75% are senior researchers and management officials, including Vice Ministers, Director Generals of Forest Research Institutes and Director Generals of the National Forestry Institutes of other countries, we should deem that the increase of 30% in knowledge and the above high scoring indicate the result of the training courses is very excellent and fully satisfactory. Dr. Flore, Senior Program Officer of IDRC, who used to be responsible for IDRC training courses, told me that though he had supported more than 20 training projects, he had never seen participants expressed such high satisfaction.

BAMBOO (CHINA)

—— Supported by International Development Research Centre of Canada (IDRC)

Fu Maoyi
Research Institute of Subtropical Forestry
Chinese Academy of Forestry

The project of Bamboo (China) is one of the earliest projects supported by International Development Research Centre of Canada (IDRC) after China implement the policy of economy reforming and opening to the world. It is also the first one taken on by the Chinese Academy of Forestry (CAF) supported. It is one test of comprehensive ability in organizing and participating in international academic exchanges and cooperation actives for our academy to carry out this project. The project was undertaken by the Research Institute of Subtropical Forestry CAF (RISF-CAF) in cooperation with the Research Institute of Wood Industry CAF, The Research Institute of Forestry Product and Chemistry Industry CAF. The project, including two phases of 3-year-term and one two-year postpone, began from April 1, 1982 and ended on July 31, 1990, lasting 8 years and 3 months. 492,200 CND Dollars of the total finance aid from IDRC was received during implementing this project.

1. Background

1) Bamboo Resource in China

China is one of the major bamboos growing countries in the world. It is rich in bamboo species resources. The known species are over 500, belonging to 39 genera. According to the meristematic propagation characteristics of bamboo rhizomes and the properties of their formation pattern, they can be put into three categories, namely monopodial-type (i.e. scattered type), sympodial-type(i.e. fascicular type), and mixed type. Most of the monopodial species belong to *Phyllostachys* genus. The area of *Phyllostachys pubescens*, a species originated from China and has been introduced to some countries, such as Japan, South Korea, and so on, is 2.8 million hectares, amounting to 70% of total area of China's bamboo stands. The yield of Moso bamboo is much higher than that of the others. Its annual output of high-yield stand is 27 tones of fresh weight of bamboo culm per hectare, which is much higher than that of the other forests. The bamboo stands received artificial care are often pure and extends to several square kilometers or some times even several dozens of square kilometers, covering a large area, where as the natural bamboo stands are usually mixed up with broad-leaved trees and coniferous trees. Sympodial-type has a greater variety of bamboo species than the monopodial-type. The major ones include *Bambusa*, *Neosinocalamus*, *Dendrocalamus*, and so on. Among the mixed type species, the major ones include *Pseudosasa*, *Pleioblastus*, and so on, in which one of species, *Pseudosasa amabilis (McClure) Keng f.*, is world famous. Its trade name for export is Zhengjiang bamboo. Which was ranked as the first class bamboo and "the angler's bamboo" in the United States and some other west countries

2) The Utilization of Bamboos in China

Bamboo is an important part of China's forestry production. We often use the term "bamboo and timber production" to refer to the production of forest products. The utilization of bamboos can be traced back to the primitive society, about 6,000 years ago. Bamboo implements are found in the recently discovered ruins of primitive commune in Hemudu of Yuyao County, Zhejiang Province. Needless to say, Bamboo utilization is far more extensive in modern times. For instance, in building industry, bamboo is used for scaffolding and for scaffold foot-board; in fishery, it is used for net-spreading support; in farming, it is used to make small farm tool handles; it is also used to make paper and pulp. Bamboo is woven into a great variety of household and farming utensils. Bamboo handcrafts are very common in China. It is carved or woven into various kinds of handcraft articles, and there are many kinds of bamboo shoot products and it is utilized in many ways as well. Bamboo helps to make the surrounding green, to make the air clean and to conserve water and soils. The beautiful landscape of the scenic spots in some of the rural and urban areas in the middle and south part of China is mainly formed by bamboo. Bamboo is good for making the soil more solid and for strengthening the dyke for it has twisted, gnarled and tangled roots. So it is often used to protect the banks of river from erosion or to conserve water in mountainous area. The small ones, which have exquisite shape and pattern, are used to make potted landscape (miniature trees and rockery). In short, Bamboo is closely linked with the daily life of the people in China. To some farmer, bamboo planting is their main farming and bamboo processing is their main industry. It is also the main income source of local economy in many mountainous areas.

3) Bamboo Cultivation Techniques in China

The recorded history of bamboo cultivation in China is very long and rich experience has been accumulated. Due to the great variety of species in a vast area, various techniques have been established. For example, there is a big difference between the cultivation techniques of monopodial species and that of sympodial species. The afforestation of the former is made through transplanting mother bamboo plants, while the latter is made through cuttings. The bamboo rhizome guiding technique can be used to quickly enlarge the forest area of monopodial species while the common method for enlarging the forest area of sympodial species is planting. There has been established a set of traditional techniques for cultivating bamboos that have an economic value. Taking *Ph. Pubescens* for example, through reserving and cultivating bamboo shoots to increase individual plants and to improve their quality; through clearing away weed, bushes to purity mixed forest; through loosening soil and fertilizer application to improve forest soil and its fertility so as to promote the growth and regeneration of bamboo rhizomes; through rational top-cutting to prevent snow-break and snow bent; through bamboo rhizome guiding to make the bamboo rhizomes extend towards the edge of the forest in order to enlarge the forest area; through rational felling to maintain the dominant young and adolescent age of the mother bamboo to promote the putting forth of the bamboo rhizomes and bamboo shoots; Disease and pest control is also a part of the cultivation techniques, and so is the integrated utilization of *Ph. Pubescens*. The cultivation techniques of other monopodial species are more or less the same.

4) Bamboo Research in China

i. Research on the management of bamboo: the main researches are concentrated on Moso bamboo, including afforestation, management, diseases and pests control, as well as basic theory of high-yield techniques of Moso bamboo.

ii. Researches on survey, collection and taxonomy of bamboo species: Emphasis has been put on the survey, collection and taxonomy of bamboo species in the Yangtze valley and the bamboo growing regions to the north of it. Since 1974, We have conducted successive surveys of bamboo species in Zhejiang Province, Fujian Province, Sichuan Province, Guizhou Province, Jiangxi Province, Hunan Province, Guangxi Autonomy Region, Beijing Municipality. Some species have been introduced into the Anji Botanical Garden of Bamboos built jointly by the Research Institute of Subtropical Forestry, CAF and Anji County Government. Apart from some of sympodial bamboo species which were introduced from the South and failed to survive under the cold winter, the rest is growing well. More than 100 species under 14 genera have been preserved and the area of the Botanical Garden of Bamboo has been enlarged to 13 hectares.

iii. Research on physical and chemical characteristics of bamboos: We have done researches on the determination of the physical properties of 30 species and cellulose content of 33 species off-and-on, and on determination of content of the fat, sugar and crude protein of bamboo shoots. We have also done some researches on the determination of the effect of the management measures on bamboo quality.

5) The Problems Existed in Bamboo Production and Problems Need to be Studied

More than 70% of the total area of Moso bamboo stands in China is low-yield bamboo stands with an annual output of bamboo culm of only 7 tones per hectare. At present, the total bamboo timber production can only meet half of the national demands. Some urgent technical problems for Moso bamboo stand cultivation, such as the soil management, fertilizer application techniques, the adjustment techniques of bamboo stand structure and the techniques for protecting and cultivating bamboo shoots, remain to be solved. Therefore, to work out technical measures for further increasing the output of Moso bamboo stand is an urgent necessity. The taxonomy and seed selection research work is in a bit of confusion. Different species with the same name and the same species with different names is a common phenomenon. Some species should be identified and determined whether they are new species or not. Except a few bamboo species, such as Moso bamboo, little research work was done on the biological characteristics, especially the resistance to cold, drought and diseases of most of the species, and their economic characteristics are little known. This hindered the exploration and utilization of these species. The physical and chemical properties of bamboo culm and the nutrients of bamboo shoots need to be studied in depth. Otherwise, the modification, chemical utilization and the evaluation of the economic characteristics of each species will be hindered. For this purpose, we raise some urgent problems closely related to bamboo production needed finance support in order to obtain research results in a short period of time, so that the bamboo farmers can apply them to promote production, thus to increase bamboo farmer's income and release the pressure on bamboo supply.

The details of research content of Bamboo (China) project as follow:

Phase I:

i) Survey, collection and taxonomy of bamboo species, the selection of cold-resistant bamboo species and establishment of Botanical Garden of Bamboo of Anji.

ii) Experiment on fertilization of Moso bamboo stands.

iii) Determination of the physical and chemical characteristics and the nutrient analysis of bamboo shoots of the major bamboo species in China

Phase II:

i) Establishment of Botanical Garden of Bamboo of Anji and studies on biological properties, including bamboo species introducing, studies on biological properties and cold-resistance of various bamboo species.

ii) Study on fertilization in Moso bamboo stands with different end uses and on nutrient cycling in ecosystem of Moso bamboo stands, including fertilization in Moso bamboo timber stands and bamboo shoots stands, nutrient cycling in ecosystem of Moso bamboo stands, effects on chemical-mechanical properties of bamboo culm and nutritional properties of bamboo shoots after fertilization.

iii) Bamboo preservation researches.

Postpone-term:

i) Economic analysis of fertilizing in Moso bamboo stands with different end uses

ii) Survey of sympodial bamboo resources in China

2. Execution of the Project

1) Financial situation (IDRC contribution)

IDRC funded 241,400 CND Dollars for the phase I, in which 186,706 CND Dollars were sent and spent in China. It was used for buying instruments and equipment, one vehicle, afforestation and land preparation, laboratory analyses, purchase fertilizers and insecticide, and so on. The expenses of project basically accordance with original budget.

IDRC funded 224,100 CND Dollars for the phase II, in which 179,100 CND Dollars were sent and spent in China. It was used for buying instruments and equipment, vehicle maintenance and buying a new vehicle, laboratory analyses, purchase fertilizers and insecticide, and so on. The expenses of project are a little over the original budget because of the RMB inflating and the raising of local travel fare.

IDRC funded 26,700CND Dollars for the postpone-term, which were sent and spent in China. It was used for field surveying, fertilizers and a symposium on sympodial bamboo.

2) Government investment

Chinese Government paid more attention to this project, and it invested 826,430 yuan(RMB) of total finance investment without including material object investment, for example, Lands, offices, and so on. In which, 206,800 Yuan (RMB) of budget has been planed to invest in phase I, but the actual expenses are more over the budget, up to 459,630 Yuan (RMB). The reason is that a new office building with 800m^2 area which spent 145,000 Yuan (RMB) and one bridge spent 90,000 Yuan (RMB) have been built in Botanical Garden of Bamboo of Anji. The most of overspend part comes from local government, and the rest comes RISF-CAF and Lingfengsi Forest Farm of Anji County. 171,800 Yuan (RMB) of budget has been planed to invest in phase II, but the actual expenses are up to 261,800 Yuan (RMB). The two-third of financial investment comes from allocation of CAF, the rest comes from forest department of local government of Fujian and Zhejiang. 105,000 Yuan (RMB) of budget has been invested in the postpone-term,

3) Instruments and equipment

Two vehicles, two microcomputers, one Canon duplicator, one Li-1600 stoma analysis, one low temperature incubator, one deep freezer (-45°C), one spectrophotometer, three sets of field shelters, one set of motor pump and accessories, four sets of microclimate instruments, and other small instruments and equipment, have been bought. All instruments and equipment have been used normally in the project duration. Moreover, they played an important role in this project, especially two vehicles brought successively provided convenience for field-trip. Up to the project end, most of big instruments can continually be used normally, which will be useful for research continually in future.

4) Training

The project leader of the Phase II, Prof. Fu Maoyi, supported by IDRC, took a refresher course in Toronto University, Canada. He majors in forest economy, trees genetic and breeding, and application of computer. The members of project group, Mr. Cheng Yanping, Mr. Xie Jinzhong, have been trained in English, application of computer respectively.

5) International exchanges actives

Totally, two groups including 5 members of project group in the phase I visited Japan, Singapore, and Thailand, India respectively, in the field of bamboo stands fertilizing, bamboo cultivation and utilization. The members of project group have also beard the preparatory work of “International Bamboo Workshop, Hangzhou, China” with more than 100 participants from 30 countries and international organizations in October 1985. Moreover, 2 members presented their papers in this workshop.

Totally, seven groups including 10 members of project group in the phase II visited Japan, Singapore, Thailand, India, Canada, Malaysia and Germany or attended related to international academic meetings respectively.

These actives promote exchanges and cooperation between China and other countries, expand impacts of our country bamboo research on the world, and make more opportunities for further international exchanges and cooperation.

6) Researcher team of project

Totally, 36 researchers were involved in this project, in which 20 staff from our institute. Most of researchers in the project are a young- or middle-aged technical backbone with medium or senior title of a professional post and higher theoretical level, and have an important influence in bamboo research aspect of China.

7) Achievement of the project

The project of Bamboo (China) through 8 years implement has successfully finished the research task and obtained noticeable achievement. The details of content of achievement as follow:

i) Totally, 138 bamboo species have been introduced into Anji bamboo Botanic Garden in past 6 years, except the 19 species dead by cold, and now 221 bamboo species are kept in the garden and the area were enlarged into 17 hectares. It has become one of the most important bases for bamboo research and education. It is decided to determine the cold-resistance of 64 bamboo species in the genus *Phyllostachys* by recovery method with conductivity measurement, and to select 30 economic species with high ability of cold-resistance for developing in North China depending on investigation of their situation of living through winter in North China. These 30 species mentioned above have been colonized into Beijing Botanic Garden, which promoted transplanting of parts of ornamental bamboo species from south to north. The biological properties of 30 fine economic bamboo species, including growth properties of shoot stage, morphology and germination of bamboo pollen, have been researched.

ii) The nutrient circle of ecosystem in Moso bamboo stands, including biomass of Moso bamboo stands, bamboo leaf litter and its decomposition, nutrient input from throughfall and loss from run-off, have been studied and the intensive techniques of Moso bamboo stands with different end uses, including properly dosage of fertilizer, fertilizing season and method, have been proposed. Namely, if it is adopted for Moso bamboo timber stands to fertilize 375kg·ha^{-1} compound fertilizer (NPKSi) in furrow in every early Spring, its culm yield and net income can be increased 46.9%, 832.2 Yuan·ha^{-1} respectively. If it is adopted for Moso bamboo shoot stands to fertilize 3,945kg·ha^{-1} compound fertilizer (NPK) twice every year — in early Spring and early Autumn — in furrow, each time 50% of total dosage respectively, its shoot yield and net income can be increased 20,000 kg·ha^{-1}, 7000Yuan·ha^{-1} respectively. If it is adopted for Moso bamboo pulp stands to fertilize 225kg·ha^{-1} compound fertilizer (NPK) in furrow in every early Spring, its culm yield can be increased more than 70%.

iii) The physical properties of seven bamboo species such as Moso bamboo, the chemical properties for paper-making of ten bamboo species such as Moso bamboo, *B. textilis*, and nutritive components of ten species such as Moso bamboo, *P. Iridescens*, *D. oldhami*, *D. latiforus*, *P. Praecox*, have been determined systematically. It has been proposed that the elder's culm properties is better than the young's, and culm properties of over 6 year old of Moso bamboo and over 2 year old of *B. pervariabillis* are stable, so it is proper for construction purpose to select the elder bamboo culm. It is better for pulp to select 1-3 year old bamboo culm and it also is reasonable for pulp-making and picking up furfural to consider the comprehensive utilization of bamboo culm. The bamboo shoots are rich in sugar content, rather high in protein content and edible cellulose, and have almost all amino acids needed by human being. In both monopodial and sympodial bamboo species, there are many kinds of edible shoots being ideal vegetables, which should be developed much.

iv) In the aspect of bamboo preservation research, observation on natural mould-resistance of bamboo timber of eleven bamboo species in various storing condition have been done. Moreover, treating methods for bamboo timber with different preservatives have been researched, and 2 good preservative medicaments, i.e. BBP, FACP, have been selected.

v) The resources of sympodial bamboo, nearly occupied one-fourth of total area of bamboo stands in China, have been pre-investigated, and literature on sympodial bamboo research also has been searched. Seven sympodial bamboo species, such as *D. brandisii*, *B. tulda*, *B. strictus*, *B. arundinacea*, have been introduced into Guangxi and Guangdong from India, and seven hectares area of nursery has been established

In addition, more than 30 papers have been published in international or domestic academic magazines or collections.

3. Evaluating the Effects of the Project on Research, Economy and Society

The project has not only come up to advanced world standards on academic levels, but also obtained noticeable achievement on effects of economy, ecology any society.

1) Transforming and application of research achievement of the project

Seven training courses of "Bamboo Cultivation and Utilization", supported the Chinese Ministry of Forestry and project of "Bamboo Technology Utilization in China" supported IDRC, have been held in several provinces of the main bamboo growing areas in South China, and totally several hundreds participants who are officers from basic unit of forestry technology popularizing and some bamboo farmers from the main bamboo growing areas have received technical training, which made it to be rapidly popularized and widely applied for achievement of bamboo stands intensive cultivation techniques with different end uses in several provinces of the main growing areas in South China, such as Zhejiang Province, Fujian Province, Jiangxi Province, Hunan Province, and Anhui Province, and up to now, more than 100 thousands hectares area of Moso bamboo stands have applied this techniques.

Anji Bamboo Botanic Garden, occupied the biggest area (17 ha), the most numerous bamboo species with monopodial-type and mixed type, established by this project, has not only conserved and developed bamboo plant genetic bank, but also raised several million bamboo seedlings of fine economic species, which have been introduced and planted in many places, and promoted fine bamboo shoot stands development of small-sized monopodial bamboo species.

2) Economic effects

More than ten thousand hectares areas of Moso bamboo trial stands and technical demonstrating stands have been established in the whole country, and 100 thousand hectares areas of bamboo stands applied this achievement. Net income of those bamboo stands has been increased by 410 million Yuan (RMB), and 21 million USD of exported value have been produced. Income produced directly by Anji Bamboo Botanic Garden providing various seedling of bamboo is over 3 million Yuans (RMB).

3) Ecological effects

Large-scale application of bamboo intensive cultivation techniques with different end uses can cause some ecological issues. For example, full-digging soil of bamboo stands and the mixed bamboo stands transforming into the pure bamboo stands will cause loss of water and erosion of soil, a large amount of fertilizing will cause water quality decreasing in the valley. However, up to now, some issues mentioned above have not appeared obviously in practice. So, The sustainable management techniques of Moso bamboo stands need further research in future.

Anji Bamboo Botanic Garden has become the biggest genetic bank of bamboo plants with monopodial-type and mixed type bamboo. Its establishment has promoted effectively preservation of resource of bamboo plant

4) Social effects

Two achievements, 《Study on Nutrient Circle of *Ph. pubescens* Stands and Its Utilization》, 《Anji Bamboo Botanic Garden》, have obtained the second class and the third class prize of state science and technology progress respectively. The project leader, Prof. Fu Maoyi, has been received by the national leaders, and the achievements have been reported by 《Guangming Daily》, 《Science and technology Daily》 and 《Forestry Newspaper》.

Project group has also organized 6 international bamboo training courses supported by the State Science and Technology Commission of China (SSTCC) and IDRC, and more 150 participants have received training. Over 20,000 persons including bamboo specialists, teachers and students, and managers have been received to visit various demonstrating bamboo stands. Anji Bamboo Botanic Garden has become an important place of research, education, and academic exchanges for internal and external specialists, guests, teachers and students of colleges, forestry researchers, and bamboo lover. Up to now, It has received several ten thousand visitors, in which foreign visitors have exceeded 100 times and several thousand persons.

All of that not only enlarges influence of our institute in internal and external, but also enlarges influence of IDRC in China.

Because the achievement has been popularized in vast poor mountainous areas, the thoughts of "science cultivation for bamboo" and " science management for bamboo" have rooted in the hearts of the people deeply, which extremely improved the raising the level of ideology and science in local society. Implement of the project has also brought out enormous economic effects, which accelerated the poverty alleviation of farmers.

5) Other effects

During the processing of project implement, the member of project group insisted on high quality and made strict demand on themselves, reasonably spent the finance, and made it to produce the largest benefits. It has been praised by consultants and finance evaluating group of IDRC, which made our institute to win good reputation. It is very useful for us to further strive for new project from this organization. For example, IDRC successively supported us to study on sympodial improvement, agroforestry models in subtropical hilly areas, bamboo shoots preserving, and so on.

6) personnel training

Through implement of this project, the quality of administrative personnel of our institute has been improved obviously. The backbone of bamboo researcher with high English level also has been trained. It is useful for us to further develop international cooperation and academic exchanges. The administrative personnel learned advanced regulatory regime from IDRC, reforming the traditional regulatory regime of our institute, which improved management level in research, finance and administration. The research primarily formed regorous scientific style. For example, the original administrative systems of RISF, by learned the advanced management means from IDRC, have been improved. Therefore, the survey designs, implement and investigation, statistics, and as well as reports of IDRC project had been carried out more careful and perfectly than that of national project. The serious scientific working attitude had been formed since then, instead of original casual working attitude and lack of planning designs which be described that the implementation of project were not consistent with their planning.

In addition, over 10 specialist had visited the Japan, Singapore, Thailand, India, Canada and so on for bamboo sector or meetings, and the International Bamboo Workshop, hold in Hangzhou, China, had been organized by our Institute in October 1985. These activities provided many opportunities to cooperate and exchange information and knowledge between researcher of RISF and related domestic and international specialist, and the extensive communication among them had been founded. And the researchers of RISF were promoted to learn the situation and the experience of bamboo production, research and utilization, and introduce the advanced technology of other countries, and their prospect broadened as well as confidence to applying the international joint project strengthened. For example, the researchers of RISF had successfully applied for the UNDP project about the photosynthesis mechanism of Moso bamboo, which was conducted by Shanghai Plants Physiology Research Institute, CAD.

By implementing this project, a large mount of scientific specialists, bamboo personnel for technological extension in the main Moso bamboo growing areas and special households of bamboo production have been trained, which made the technical extension network formed.

7) Technological innovations

i) Firstly to expound systemically the law of nutrient circle in ecological system of Moso bamboo stands, which provide the important theory basis for scientific management, reasonable fertilization and high yield.

ii) Firstly to put forward the best fertilizing way by economic analysis of means, time and dosage in Moso bamboo stands with different end uses

iii) To build biggest genetic species of monopodial-type and mixed type bamboo in China, named Anji Bamboo Botanic Garden, which promote effectively the conservation of bamboo resources in China.

iv) Firstly to select two useful preservatives of bamboo culms, which is benefits to preserving the bamboo products.

4. Suggestion and Evaluation of Project Administration of IDRC and The Chinese Ministry of Science and Technology

1) Selection of project tallying with national conditions

China, occupying 4 million hectares area of bamboo stands and annually producing 6~7 million tones of bamboo timber, is one of the main growing countries in the world. Moso bamboo is the most important native bamboo species with 2.8 million hectares area, in which area of low-yield bamboo stands occupies more than 70% of that. So, it is a task of top priority for bamboo research to probe the way to deal with applying intensive cultivation techniques of Moso bamboo stands and its theory. Besides, most of the low-yield bamboo stands are distributed in mountainous, semi-mountainous areas, some areas inhabited by the minority nationality with poor economy and lowly life standards. Therefore, the project of the intensive cultivation and utilization techniques of Moso bamboo stands has been placed on the first one and the most important one in forestry sector supported by IDRC, which is to tally with national conditions of our country and cherished desires of bamboo researchers

2) Financial Situation

The financial arrangement can basically satisfied with the progressing demand of project. Some advanced instruments have been provided in each phase of project, which is useful for project to raise research level and precision. The last one of allocation has been arranged after the final report finished, which is useful to improve quality of the project.

3) International cooperation and exchanges

Some activities of international exchanges have been arranged each phase by IDRC. Not only have some researchers of project group been arranged for visiting and training, but also some international consultants and specialists have to go abroad been arranged to experimental sites for inspecting and guiding. It is useful to raise the research level of project.

In short, under the auspices of the Department of International Cooperation, the Chinese Ministry of Science and Technology, and the Department of Science and Technology, The State Forestry Bureau, and under the coordinating and help of the Office of International Cooperation, the Chinese Academy of Forestry, the project of Bamboo(China) supported by IDRC and Chinese Government not only has obtained a distinguished achievements, and promoted the raising of bamboo research level of our country, but also the great progress on the aspects of research administration, personnel training and enlarging international cooperation and exchanges has been made.

BAMBOO TECHNOLOGY UTILIZATION (CHINA)

—— Supported by International Development Research Centre of Canada (IDRC)

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The project of bamboo technology utilization (China) is a 3-year project supported by International Development Research Centre of Canada (IDRC) after the project of Bamboo (China), which has been implemented in previous six years. The project has been conducted by the Research Institute of Subtropical Forestry CAF (RISF-CAF) in coordination with the Experimental Centre of Subtropical Forestry CAF, Fujian Provincial Forestry Department, Forestry Bureau of Anji County, and Lingfengsi Farm of Anji County. The project began from May 1, 1989 and ended on December 31, 1992, lasting 3 years and 7 months. 56,100 CND Dollars of the total financial aid from IDRC have been received during the project period.

1. Background

The two phases project of Bamboo (China) supported included by IDRC and Chinese Government has been implemented successively in six years. Although its four experimental sites have successively been set up in the main bamboo growing provinces, i.e. Zhejiang, Fujian, and Jiangxi, the areas of bamboo stands used in trials are only a small part of the total bamboo stands. At present, there are 2.8 million hectares of Moso bamboo in China, in which, intensive cultivation bamboo stands occupied 10~15% of the total and the middle one occupied 20~25%, while low-yield bamboo stands occupied around 65%. The increasing of annual output of Moso bamboo timber can not keep pace with the development of national economy. So, it is necessary to develop bamboo production and to improve the level of intensive cultivation. In order to popularize the achievements from the project of Bamboo (China) funded IDRC and the other ones in the main bamboo growing areas as soon as possible, to improve the technical level of bamboo cultivation, and to speed up the comprehensive utilization of bamboo, after several discussions with some officers of IDRC, it has been put forward that a plan for training technicians of forestry popularizing and setting up a series of demonstration bamboo stands applied the successful results obtained before.

2. Execution of the Project

1) 1) Financial situation (IDRC contribution)

The grant of 56,100 CND Dollars from IDRC has been received, in which 34,000 CND Dollars has been controlled by our academy, which equal to 124,070 Yuan (RMB). It was used for 3 training courses, printing training materials, travel fare of specialists and consultants, and making one video tape. The expenses of project basically accordance with original budget.

2) Government investment

Since the first training course on "bamboo cultivation and utilization" has been held in October 1987 in Fuzhou, Fujian Province, 18,972 hectare areas of bamboo demonstration stands have been set up, and 1.2 million Yuan (RMB) of local government investment have been attracted. In addition, several million Yuan funds invested by forestry farms and bamboo farmers themselves to the work.

3)Training

Three training courses on "bamboo cultivation and utilization" have successively been held in Fuzhou and Liancheng, Fujian Province, and Chenzhou, Hunan Province. Totally, 156 trainees, from Fujian, Jiangxi, Hunan, Sichuan, Guangdong, Zhejiang, and Beijing, were trained in those courses. Most of them are local managers engaged in bamboo cultivation of the main bamboo growing areas. By means of those training courses, they learned more knowledge about the techniques of bamboo intensive cultivation. It is very useful for them to involved in popularizing the techniques later. More than 120 technicians, from some main bamboo growing province, such as Zhejiang, Fujian, Jiangxi, and Hunan, have been organized to visit the demonstration bamboo stands in the Lingfengsi Forestry Farm, Anji County, Zhejiang Province. They exchanged the experience and techniques each other. The technical level of bamboo intensive cultivation in many regions has been raised remarkably by those activities.

In addition, in order to understand what have happened since three training courses held in 1988,1989,1990 respectively, a network of the technical popularization has been set up, and an investigation through a questionnaire on such training has been done in the former participants after each course.

4) Internal exchanges actives

During the implement of the project, 15 staffs including the project leader, co-leaders from extension sites and project consultants have respectively inspected the project work at sites in Fujian, Zhejiang, Hunan, and Jiangxi for 6 times. They, at the same time, visited several bamboo stand owners. Some problems met in practice have been resolved timely.

They also exchanged their experiences and lessons learned in the process of techniques extension each other so as to the project has been successfully implemented.

5) Researcher team of the project

Ten researchers of RISF-CAF have participated in this project. Through the implement of the project, the ability of personnel for rapidly transmitting research achievement into the productivity have been cultivated. Those technicians have not only high theoretical level but also rich in the practical experiences. They combined scientific research with production, resolved continually the problems existed in the process of technical extension, and became the main forces in the project.

6) Achievements of the project

Through more than three-year hard work, 18,792 hectare demonstration and dissemination plantations were established in Fujian, Zhejiang, Jiangxi, and Hunan provinces, and the net income from the stands increased to 39,723,500 Yuan(RMB). A text book and an illustrated pamphlet on Bamboo Cultivation and Utilization as teaching materials have been completed. One videotape supported by IDRC in China has been produced. Three training courses have been held and totally 156 people have received the training

3. Evaluating the Effects of the Project on Research, Economy and Society

Science and technology is the first productivity. By means of holding the training course and establishing demonstration bamboo stands jointly with the local governments, the researchers of the project have rapidly popularized the achievement of Bamboo project (China) in the main bamboo growing provinces in South China. It is welcomed by local forestry managers and farmers. Approximated 18,792 hectares demonstration and dissemination plantations were established. The bamboo stand area applied the techniques of intensive cultivation of bamboo amount to 72,000 hectares.

The implement of the project has also promoted the society development in the main bamboo growing areas in China. By means of establishing the experimental demonstration sites, the power of science and technology has been understood by farmers, so as to arouse their fervor of learning science. The thoughts of "science cultivation for bamboo" and " science management for bamboo" have rooted in the hearts of the people deeply, which extremely promoted the raising of the level of ideology and science in local society. Moreover, the implement of the project has brought out enormous economic effect, which accelerated the poverty alleviation of farmers.

In addition, the implement of the project has aroused farmers to invest in bamboo stands, which made many job opportunities, especially for women to get a job opportunity, and to raise their income situation and social position.

By implementing this project, not only have several dozens of research workers with high theoretical level and rich practical experiences been fostered, but also a large mount of backbone technicians of forestry for technological extension and special households of bamboo production have been trained, which made the technical extension network formed.

Project Review of Bamboo Information Center

The Research Institute of Forestry Sci-Tech Information, CAF

1. Background

Bamboos are widely distributed in the tropical and subtropical areas of Asia and the Pacific, to some extent they occurs and South America. Because of their fast growth, easy propagation, soil binding properties, short rotation and long fibre of culms, bamboos are ideal plants for use in afforestation, soil conservation and social forestry programmes. Over 75 genera and 1250 species are reported to occur in the world. In Asian countries bamboos are valued as "poor man's timber", used widely for housing and making articles of daily use. In Europe they are considered as exotic plant species for house decoration and gardening. There are more than ten million hectares of bamboo forests in Southeast Asia. As a result of rapid decrease of tropical forests in recent decades much more attention has been paid to the cultivation and utilization of bamboo. Bamboo societies have been set up in America. Europe and in Asian countries. Hundreds of bamboo research papers are published annually, papers from some countries were concentrated on bamboo taxonomy and biology, those from other countries paid more attention to cultivation, those from third countries discussed mostly processing and utilization of bamboo. All the bamboo-related professionals wish to have a permanent institution for international exchange.

2. Process of the project

The project of Bamboo Information Center (BIC), undertaken by the Chinese Academy of Forestry (CAF) with the financial support from the International Development Research Centre (IDRC) of Canada, set up at the Institute of Scientech Information of Forestry (ISTIF), started work on 25 December 1987. The work of BIC was carried out in strict accordance with the Memorandum of Grant Conditions of the Project. The President of CAF and other leaders attached great importance to the fulfillment of this project, they helped the project team in many cases. Almost all the institutions concerned in bamboo research cultivation, farming and utilization in China expressed their desire to cooperate with BIC and receive its publications. A National Bamboo Information Network consisting of some 20 persons from all the bamboo producing provinces was formed at the beginning of work. Many institutions and individuals wrote from abroad to discuss information exchange and other sort of cooperation. The project members visited India, Thailand, the Philippines, Ethiopia, Cote d'Ivoire and Canada to study the information management experience and bamboo production status, or to demonstrate the objectives and activities of BIC. There are more than 800 domestic and foreign users from 25 countries and regions of Asia, North America, Oceania, Europe, Africa and Latin America on our mailing list.

- The expenses of the project totaled 74,910.17 RMB yuan in year 1 (ten percent excess over the estimate), 67,910.92 RMB yuan in year 2 (nine percent excess over the estimate), and 122,695.50 RMB yuan in year 3 (7.43 percent excess estimate). We don't think it does make any sense to sum three years' total expenses in term of RMB yuan. Because during this project of time RMB yuan devaluated rapidly. In mid year of 1987, when the project proposal for BIC was under discussion, we set annual inflation rate as 10%. In autumn of 1987, when the project proposal was put forward for approval, the exchange rate of Canadian dollar to Chinese yuan was 1:2.78, it was raised to 1:4.06 at the end of 1989,and to 1:4.48 in the second half of 1990 (the financial report for year 3 will be delivered separately by the

Institution's financial officer. This period (25th Dec.1987-25th Dec.1990) witnessed a continuous and allround rise of price in Chinese continent. Take the year of 1990 for example, In this year the postage was raised by 150%, e. g. the inland postage of ordinary mail was raised from 0.08 to 0.20 RMB yuan. The honoraria rates were raised by 50%--100%, e.g. honorarium for translation of an abstract was raised from 15 to 25 RMB yuan that for compilation of an abstract from 5 to 10 RMB yuan. The railway tariff was raised by 20%. The civil air rates were by 80%. All these caused variances of actual expenses with budget.

- The financial used for collection of publications, edition, printing, visiting of the project members, equipments and so on. The equipments are: A microcomputer North Star NS1200 complete with 120 MB hard disk, IBM, with 3 terminals (each with 512 k, keyboard and monitor), provided by IDRC. And Hewlett Backard III. The necessary investments are: 330,640 RMB yuan in year 1, it includes sallery of the project members, equipment of the office and soon. The equipments are: A microcomputer IBM PC/XT with 10MB hard disk, 640K RAM, provided by ISTIF. A printer BROTHER M2024, provided by ISTIF, a Laserjet printer, Hewlett Packard series II, provided by ISTIF.
- According tot he project proposal, project leader and senior editor visited Thailand and Philippines. During the trip we visited the libraries of Thai Kasetsart University and Philippine University, studied their management practice. We also visited the International Buffalo Information Centre (IBIC), which was also supported by IDRC. Even the specialty of IBIC differs very much from that of BIC, it was of great interest to be acquainted with the experience of IBIc, because the work environments and problems of small scale information centres are all alike. At the beginning of the project, the project leader attended the STI Project Management held in Addis Ababa, Ethiopia. This meeting discussed key issues of project management under the following headings, management objectives and goal planning; personnel management and training; building and motivating a project team; financial management—budgeting and reporting; management of capital equipment and physical resources; evaluation/control. Somme officials from the IDRC headquarters and an expert from the Manitoba Institute of Management gave interesting lectures. These lectures introduced a new way of thinking for Chinese. Most of Chinese project leaders perform their functions on the basis of personal experience or, sometime, by instinct. It is impossible to handle a modern scientific project successfully in such a way. Manitoba Institute worked out a series of methods for scientific analysis of working environment and conditions, and for the improvement of work style of project leaders. These methods benefited the BIC work significantly. In 1988, the project assistant took a training course at the Rattan Information Centre (RIC), Malaysia. The course lasted three weeks. She studied procedures and day to day operations of a small specialized information centre, including the management of correspondence, editing process of the publications, computer retrieval, literature classification, indexing and so on. As the RIC has worked for a long time, it has much good experience in information collection, consultation services and literature processing, it has made active contribution to rattan cultivation, production and rattan ware manufacturing. The professionals of the Center keep close contacts with rattan researchers, farmers and manufactures. Considering the specific field of activities of BIC, she visited bamboo herbariums, nurseries, experimental station and bamboo processing enterprises and got a general idea about bamboo cultivation and utilization in Malaysia. In order to extend the literature for the BIC, she collected many bamboo-related literature in Malaysia, which were very rare in China. The computer techniques in Singapore and Thailand. In Singapore,

he watched how to use Micro CDS/ISIS and table publishing system—VENTURA. He visited libraries of the National University of Singapore, National Technical Institute and National Library of Singapore, watched their computer system and found it excellent. In addition, he discussed with Singapore librarians some questions about how to process Chinese words in computer. He gave them a Chinese operating system and a Chinese WS. It may be useful for them, because they have 20% of collections written in Chinese. In Thailand, he studied how to use CDS?ISIS in System Section of LRDC. The System Section helped users to set up their own databases. Any one, wishing to get up a new database, could contact the System Section and explain his requirements to this new database. And the analysts of the Section would use Micro CDS/ISIS to set up the system structure according to the requirements. They also teach users how to use the database. Users had not to know much about hardware and software. He though this was the normal relation between computer experts and other professionals. During the project, there were 3 training course and workshops organized by us, the participants were about 50. The translated abstracts were corrected by Professor A. N. Rao, he visited the BIC once a year for this purpose. It is evident that the arrangement of English translation was an important part of our work.

- IDRC officials and experts, they are : Mrs. Martha Stone, Dr. Cherla B. Sastry, Miss Maria Ng, Mr. Clive Wing visited the CAF, Miss Sheree W. Willis, A second secretary from the Embassy of the United States of America in Beijing, helped us to find important bamboo research papers and visited the BIC in order to get acquainted with our work.
- At the beginning of our work, we visited these consultants and listened to their suggestions concerning the activities of BIC. They provided us a name list of important bamboo experts, working in institutions of higher learning, research institutes, designing, we can contact experts of any discipline of bamboo sciences in case of need, such as bamboo classification, cultivation, protection, utilization etc. Some of our consultants made suggestions as now to select right papers for the Bamboo Abstracts. On order to carry out the work more successfully, we convened a workshop of bamboo abstract compilers in Nanjing in 1988. 10 persons attended the workshop. It was decided that all the bamboo and bamboo-related periodicals both in Chinese and in foreign languages should be scanned regularly for the selection of references for the Bamboo Abstracts. To distributed the periodicals for scanning and abstracting to attendants from different provinces and different institutions. Meanwhile we discussed the possible candidates for the members of the National Bamboo Information Network.
- The main task of BIC is to compile the Retrospective Catalogue of Chinese Bamboo Literature and the Current Bamboo Abstracts. We pay great attention to this work from the same commencement. It was not very difficult to compile the Chinese version of the publications, but the English version caused much difficulties. First of all, the translation of Chinese version into English was not of high quality, in general, Chinese professionals don't speak nor write English well because we didn't have much intercourse with foreigners. Some linguists do write English well, but they don't know botany nor forestry. Therefore, some of the translation couldn't be understood by foreigners. Professor A. N. Rao helped a lot in this respect. He visited BIC to edit and modify the English abstracts before they are published, thus ensured uniformity and quality of the English version. We had a face-to-face discussion during his stay in Beijing. We sat together by the word processor to correct all the mistakes and incorrectness directly on the screen, this we rasied the work efficiency, improved our mutual understanding and friendship. We are grateful to IDRC for sending us such a high qualified and friendly

consultant. After our joint work we discovered that some of our colleagues translate pretty well, but others translate terribly. This helps us to select better ones for translation in future. Typesetting of the English version is another difficulty. Because of the small impression of our publications, ordinary commercial printing houses don't accept our printing order as a rule, if they do, they set a very high price. We decided to print the publications in the printing house of the Institute of Scientech Information, but as the typesetters of this printing house were not qualified for setting English text, we had to type the matrices from computer, as our microcomputer didn't have all facilities for such work, we managed to order a Font Cartridge HP92286F TMS Proportional 2 from Hewlett-Packard to provide various fonts, such as in boldface, in italics, etc. After that we bought a commercial programme Wordstar 2000, which helped us run the font cartridge. In this way we succeeded to prepare matrices for our publications on Hewlett-Packard LaserJet Printer Series II, and then to print them on a mini-offset printer in our own printing house. But , unfortunately, the printing effect and the binding quality of the first publications were not good enough. It was necessary to choose another printing house. The Current Bamboo Abstracts are published twice a year, both English and Chinese versions contain 150 titles per issue. One hundred are taken from Chinese sources, and the other fifty from foreign sources. A Retrospective Catalogue of Chinese Bamboo Literature has been edited, its Chinese version contains 1200 items, and English version contains 600. All the items taken from Chinese bamboo literature were published from 1975 to 1986. If the financial resources permit, we shall compile Catalogue of Chinese bamboo literature published before 1975. All the items in the first issue of Current Bamboo Abstracts and the Retrospective Catalogue of Chinese Bamboo Literature were arranged in the order of Chinese classification system of bibliography, which differs from the international UDC system greatly. In order to fit the customs of foreign users, we decided to use the international system in the future. <Selected Papers of Chinese Bamboo Literature>, The project proposal of BIC stated that one hundred most important key documents that bench-mark the progress of bamboo research, development and utilization will be selected and published in the Selected Papers. Therefore most of the papers will be historical ones. We thought that the collection will be of great interest to domestic and foreign bamboo professionals. But our Indian colleagues told us that researchers are interested in contemporary research developments rather than historical papers. Because science and technology have been developing vertiginously rapidly in recent decades that bamboo research papers published many years ago remain historical documents, they lose their value in research reference. We reviewed this item, and decided to include important papers published in recent years. We selected 29 papers published after 1986 for the collection. As these recent papers are easily available in China, it does not make sense to publish a collection in Chinese. We made full text translation and set to publish a collection in English, as the editorial work was delayed due to some technical reason, this collection was published and distributed in the first quarter of 1992. Directory of Chinese Bamboo Processing Machines, published and distributed in 1991. In order to meet the demands in bamboo processing machines, some 60 enterprises are enganged in their manufacture, nearly 100 kinds of machines are being produced. <Compendium of Chinese Bamboo Species: An editorial team for the Compendium was formed. The team consisted of the project leader, the project assistant and nine bamboo experts from the Research Institute of Subtropical Forestry, the Chinese Academy of Forestry. Three meeting were held on the planning and progress of the work. Photos of some 250 species were taken and processed, written

description of some 500 species was compiled. <Album "Substitute Bamboo for Wood in China">: a collection of 120 pictures on bamboo resources, plybamboo, bamboo paper-making, bamboo firewood, the environmental role of bamboo forest, bamboo food, handicrafts and bambooware. These pictures reflect the bamboo resources and bamboo timber utilization in Anhui, Beijing, Fujian, Guangdong, Guizhou, Hunan, Jiangsu and elsewhere. It was published in 1994. <Thesaurus of bamboo>: A Chinese-English thesaurus, including Latin species names, it was published in 1994. Data-base Complex—China Bamboo, there are 5 parts, it includes general situation, basic knowledge, bamboo industry, reference documents and bamboo literature. The general situation are up to date report on Chinese bamboo market, bamboo taxonomy, ecology, physiology, silviculture, protection, utilization and genetics and breeding. The basic knowledge has several sub-databases, they are bamboo species, bamboo insects, and bamboo resources. The bamboo industry are: raw bamboo market, shoot market, export and import market, processing machines, and so on. The reference documents are: on-going and completed research projects, related standards and bamboo-related patents.

3. Evaluation of social benefit

BIC serve personnel involved in: scientific research, teaching, management and planning, extension and production. Users are come from: central and local department of forestry, light industry (paper, arts and crafts, furniture), pharmaceuticals, building and construction, forestry and agricultural schools and colleges, wildlife protection agencies. Generally speaking, the teachers and students are more interested in bibliographical information, while the administrators, managers and planners are more interested in non-bibliographical information. Services: question and answer, literature search, document delivery upon request, mailing list distribution, translation upon request and SDI. On the other hand, BIC also make a role on bamboo civilization. As everybody know, China is a country of long history, it began agricultural production in ancient times. In the process of agricultural practice, China developed a kind of original, oriental culture. Three plant species contributed greatly to the formation and growth of Chinese culture, they were tea, mulberry and bamboo. But, they were not of the same importance, in comparison with bamboo, the role of tea and mulberry tree was not so great. The use of mulberry tree was limited in clothing and that of tea in drinking, while the use of bamboo could be found in all aspects of life. As early as in ancient times, our ancestors used bamboo widely, they made bamboo arrows and bows for fighting and hunting, bamboo tools for farming, bamboo huts for sheltering, bamboo caps and cloaks for wearing, they dug fresh bamboo shoots for food. Bamboo was a carrier of Chinese characters in ancient and mediaeval times before the invention of paper. Bamboo fibre was used for paper-making. Bamboo branches were cut for making brushes for writing. Bamboo was extremely important for Chinese people not only in their productive and battle, but also in their leisure time. Our ancestores made musical instruments of bamboo, such as bamboo flute and Chinese violin. Chinese orchestral instruments were actually bamboo instruments. Without bamboo there could not be Chinese national musical instruments. A kind of folk music is called plainly as "Southern String and Bamboo:. This wonderful plant was also widely accepted in gardening and housing. As bamboo served people for thousands of years our ancestors developed deep feelings for it. We found many pieces of literature and art praising and painting bamboo in museums and libraries. A famous scholar in Song Dynasty, Su Shi once said:" I would rather take a diet without meat, but there must be bamboo growing by my lodge, a diet without meat makes me lean, while a lodge without bamboo makes me vulgar." For Chinese people bamboo is a symbol of steadiness, honesty and modesty. Many intellectuals named their study, cottage, hall, pavilion or garden after bamboo. It is obvious that bamboo civilization is truly a civilization of significant contents. Bamboo goods used to be found in daily life of Chinese, especially rural people, but due to the development of manufacturing industry since 1950s many traditional bamboo goods have been replaced gradually by plastic and metal ones. This tendency affected the growth of bamboo industry to some extent. The importance of bamboo goods in people's life began less evident than dozens of years ago. However, thanks to the growing concern over environmental issues people change their taste in selecting daily necessities and bamboo goods regained favor among consumers. A kind of renewable resource, bamboo will not be exhausted under rational exploitation. Making a piece of bamboo-ware consumes less energy than that of plastic or metal ones, besides, bamboo goods do not cause environmental problems as plastic ones do.

REVIEW OF IDRC PROJECT " WOOD UTILIZATION "

Research Institute of Wood Industry
Chinese Academy of forestry

1. Project Background

China is a less forested country as well as a developing country, which is confronted with a sharp contradiction of timber supply and demand. The solution to China's problem of short supply of timber lies in enlarging resource and economizing on consumption i.e. large scale establishment of fast growing plantations to expand forest resource, and the development of rational and comprehensive use of timber to augment the utilization rate of forest resource. According to a primitive estimate in mid-1980s, in China there were 71 million hectares of juvenile and middle aged forest, which would turn out 7 million m^3 of thinnings yearly. And the amount of thinnings will be increased continuously along with the expansion of afforestation. The development of method for processing thinnings is one of the ways to alleviate the contradiction between timber supply and demand, and is of far-reaching significance.

Traditional processing methods are difficult to treat the thinnings as most of which are small in diameter, short and crooked. Up to mid-1980s, finger jointing was only used in treating the residues of timber processing, it is a blank in research for finger joint to deal with small diameter timber of thinnings. This project was the first one for finger joint targeting at thinnings, while the production enterprises in China were eager to apply the successful result of the research in the production. Meanwhile the project met one of the requirements of the priorities of the Spark Program initiated by State Science and Technology Commission (SSTC): Development of rural residential building, building materials and the production techniques of interior decoration materials; Cultivation of fast growing trees and comprehensive utilization techniques of forest products.

2. Project Implementation

- Fund Expenditure

The total IDRC budget for this project was 168,900 Canadian dollars, the actual allocated amount was 155,500, and the remaining balance of 13,400 was kept by IDRC.

In the four years of project implementation (including one extended year), the total fund transferred from IDRC was an equivalent of RMB 216,350 yuan, which was administered by the recipient institution and spent on the following six parts: 1) Research expense: purchase of raw materials (timber, chemicals etc.), experimental devices, apparatuses, cutting tools, pilot production, labour wages. 2) Travel expense. 3) Project appraisal meeting. 4) conduction of training course. 5) printing the research report. 6) salaries of researchers doing economic study.

About 85,000 Canadian dollars under IDRC control was mainly used in inviting foreign consultants, purchasing foreign instruments, and short term training of researchers.

- Counterpart Fund

The total of counterpart fund for this project was 44,520 yuan, and was mainly spent on the salaries of researchers, on the purchase of some chemicals, office articles and on telecommunications.

- Instruments and Equipment

In the project implementation period between 1987 – 1990, the instruments and equipment purchased or built by IDRC supported fund are as follows:

Serial No.	Name	Amount
1	Top-load Electronic Balance	2
2	Abi Light Reflector	1
3	Gel Chromatographic Column	4
4	Super Constant Temperature Water Bather	2
5	Constant Temperature Water Vat	1
6	Rotary Viscosity Meter	2
7	Surface Thermometer	1
8	Portable pH Meter	1
9	Wood Moisture Meter	2
10	Finger Jointer	2
11	Finger Dryer	1
12	Thermometer with Digital Auto Printer	1
13	Vacuum Pressure Immersion Device	1 set
14	Circular Saw	1
15	Thicknesser	1
16	Finger Milling Cutter	6 sets
17	Knife Grinder	1
18	Dust Collector	2

- Personnel Training

The following activities were funded by IDRC:

1) From June 7 to June 28, 1987, Mr. Zhu Huanming and Mr. Luo Wenshi had a short-term training in Canada on wood finger jointing and wood adhesives. The purpose was to study the production technology and equipment for finger jointing; categories, uses and formations of wood adhesives for finger jointing, and the precautions; quality testing methods for finger jointed wood The three week training met the above three targets, which has proved to be quite useful to the research work of the project and the extension and application of the research result in the late period.

2) In July 1989, Mr. Zhu Huanming went to the finger jointed timber factory on Guihua Farm Chongyang County, Hubei Province and gave lectures on finger jointing techniques for thinnings, on finger jointing quality control, and related test knowledge, which promoted the improvement of the quality of finger jointed timber products of the factory.

3) In December 1990, a technical training course was held in Beijing on finger jointing for thinnings. The course covered wood defects, wood preservation and preservative treatment, wood adhesives and finger jointing process. It also offered demonstrative operations of preservative treatment, adhesive application and finger jointing process. The course enabled the participants to have acquired a basic command of finger jointing

chemicals; The project has passed the test of production and proved the analysis of the economic and social benefits generated by the finger jointed products in the actual production practices.

3) Finger jointed timber for structural purpose has been developed out of thinning timber, such as pad timber of truck and bottom board of truck loading platform, which enables thinning timber to substitute timber in load-bearing structure.

The successful implementation of the project has met good comments from IDRC and caught attention from other developing countries. Issue 1 of Vol.20 Of the journal " Reports" run by IDRC contained an article, written by senior editor Mr. Zhao Qinghua who has made an interview with the project leader Mr. Zhu Huanming, entitled " Fingering a Solution to China's Dwindling Forests", which dealt with the research result of the project and its application situation. On December 14, 1994 and May 1, 1995 respectively IDRC Office in South Asia wrote to the Chinese Academy of Forestry requesting the academy to sign a new memorandum of understanding so as to endorse IDRC to put the research result into commercialization in India and other developing countries. Related people from Cameroon, Jordan, Kenya etc. showed interests in their letters hoping to get the technical material of the project.

The project was selected in the Circular on Extension of 100 Research Achievements by the Ministry of Forestry in 1994, and again it was enlisted in the Recommended Projects for Concentrated Extension of National Scientific and Technological Achievements in 1995 by the State Science and Technology Commission.

4. Comments and Suggestions on the Project Management of IDRC and Ministry of Science and Technology

- Project Application and Approval

IDRC and the Ministry of Science and Technology (previously SSTC) take a very serious and strict attitude towards the project application and approval. What impress us much are: Each item of expense must be calculated and examined in detail. After the approval of the project, each item of expense is earmarked for specific activity, which could not be diverted to other purpose while it enjoys a ±10% flexibility; 2) The allocation of next year's fund could only be made when the progress report for the previous year is submitted and considered as satisfactory; 3) The financial officials often come to the recipient institutions for financial auditing, which is a good practice for supervision.

In order to help the project leaders and financial personnel know and manage well the fund use, IDRC and the Ministry of Science and Technology jointly sponsored a project management course in the autumn of 1988, which pulled together all the IDRC project leaders in China for several days learning and exchanging among themselves. It was an effective way.

- International Exchange

IDRC pays a great attention to international exchange, and adopt different kinds of ways to accomplish it. For example, the regular journal of " Reports " run by IDRC headquarters introduces the results, progresses and experiences that IDRC projects has achieved in various countries; experienced specialists are selected and sent to guide the IDRC projects; Different scales and forms of training courses and workshops are held; The project leaders of recipient countries are supported to attend international professional seminars. In addition, some monographs on certain projects are compiled and circulated, producing a good effect.

- Project Coordination

During the process of project implementation, there are a lot of things to be coordinated, e.g. invitation of foreign technical consultant, the visit of foreign consultant, study tour abroad by project staff, training, attending international workshop, purchase of foreign instruments and equipment, experiment goods, adjustment of implementation plan, adjustment of some expenses, which are varied in scope and great in work load. IDRC and the Ministry of Science and Technology have given an excellent performance in project coordination, of which the conscientious, timely and considerate work are quite impressive. The project leader has had many contacts with IDRC Office in Singapore in the project implementation, there are many cases showing this, but it is omitted here because of space limit.

Review of IDRC Project Integrated Technical and Socioeconomic Approaches to Reclaiming Degraded Forest Lands

Chinese Academy of Forestry

1. Background Information of the Project

"Integrated Technical and Socioeconomic Approaches to Reclaiming Degraded Forest Lands" (Reclaiming Degraded Forest Lands) was a joint project of the Chinese Academy of Forestry (CAF), the International Development Research Center (IDRC) of Canada and the Center for International Forestry Research (CIFOR).

Before this project, CAF has a long history of cooperation with IDRC in the field of forestry research and development, and great progresses were achieved. In terms of the fields of cooperation between CAF and IDRC, IDRC-supported forestry projects in China went through the following stages. In early 1980s, IDRC started to fund forestry research project in CAF. The funded projects focused on technical solutions of various forestry issues, including research on single group of tree species or forest type (such as paulownia, bamboo, fuelwood plantations etc.) or single forest technologies (such as wood gasification, finger-joint technology for use of small logs etc.). All these research contributed to provide solutions on various technical problems in forestry sector including cultivation and management of forest resources and improvement of forest resource uses, so as to increase the value of forest resources. Like other sectors, more and more "no-technical solution" problems appeared in forestry as the evolution of China's economic reform. Under this situation, IDRC-supported forestry project started to address some of the non-technical problems, including socioeconomic and policy issues in forestry development. From the later 1980s to mid-1990s, IDRC and CAF expended the fields of cooperation. The first initiative was to carry out economic evaluation of various technical research results, and economists jointed the technical research team. This was the first initiative of multidisciplinary research in forestry in China. During this period, training was concerned with great emphasis to meet the increasing demands for multidisciplinary research. Further development of the initiative was the dialogue between IDRC and CAF to formulate an integrated and multidisciplinary forestry research project in China, that developed into a project "Integrated Farm Forestry Research in China" in 1990. In this first true multidisciplinary research project, socioeconomic and nutrient experts joined the project along with the technical experts for an integrated research and evaluation of different farm forestry models in different regions of China. This was probably the first multidisciplinary forest research project in China. However, objectives of the project were still "technology-orientated," i.e. the purpose of introducing socioeconomic and nutrient experts into the project was to carry out socioeconomic evaluation of various farm forestry technologies, and the socioeconomic and nutrient experts didn't participate in the process of determination of project objectives.

In the first two stages of cooperation between IDRC and CAF, from the first stage's technical research to the second stage's integrated research, training continued being an important component in most projects and research capacity was much improved. It was that when the direction of forestry research, as part of natural resource management research, changed from technology-orientated research to community/ people-orientated research. IDRC launched a new project initiative in Community-Based Natural Resource Management (CBNRM). At the same time, new problems emerged in China's forestry economic reform and there was a need for new approaches to solve the newly emerged forestry problems. The project "Reclaiming Degraded Forest Lands" was launched after negotiation among CAF, IDRC and CIFOR to address the new forestry development issues in China.

The project was carried out in four core research sites; they are Zhejiang, Hunan, Guangxi and Yunnan. The research sites represented a matrix of variables in economic development level (Better economic condition in Zhejiang, middle level in Hunan and Guangxi, and poor area in Yunnan) and forest type (economic plantations/bamboo in Zhejiang, timber forests in Hunan, fuelwood forest in Guangxi and protective forest in Yunnan). In each of the research sites, an integrated/multidisciplinary research team was organized composing of scientists, grassroots level government officials and farmers. The project developed and used an integrated participatory approach - diagnosis, design and delivery (Tri-D) in the whole process of research. Through 3 years research, great progresses were achieved in providing integrated solutions for rehabilitation of degraded forestlands under different biophysical conditions and varying socioeconomic context. At the same time, it is also analyzed and assessed the characteristics and patterns of participation of farmers, scientists and grassroots governments, that provided good information for future economic policy formulation to promote rehabilitation of degraded forestlands.

2. Project Implementation

The project was managed and coordinated by the International Farm Forestry Training Center (INFORTRACE) of the CAF. The major collaborative institutions were: 1) The Research Institute of Tropical Forestry, CAF (Guangxi site); 2) The Research Institute of Resource Insects (Yunnan site); 3) Central-South Forestry College (Hunan Site) and 4) Zhejiang Forestry College (Zhejiang Site). Besides the 4 core research sites, technical researches were also carried out on special technologies in reclaiming degraded forestlands, including site management of multiple generations of eucalyptus and Chinese fir plantations, resource investigation and cultivation of hardwood species, etc. This project also set up small research grants to train young scientists. Agreements were signed between INFORTRACE and individual research teams (core sites as well as technical research teams) to set up the detailed research contents and budget allocation for each research team.

- ***Use of funds:*** This project had two external sources of funding, 254,195CAD from IDRC and 180,000 USD from CIFOR. All the research funds were managed by the Financial Division of CAF, and funds were released to research partners on time. Project management regulations, including financial management, were set up in references with IDRC's project management rules.
- ***Local contribution*** The main part of the local contribution to this project was salaries paid to the scientists' time working in this project and research facilities. This project didn't account any problem due to the problem of local contribution.
- ***Equipment and instruments:*** This project imported a vehicle and bought some computers and accessories. All the equipment and instruments were used solely for the project related activities.
- ***Training:*** Before the project commenced, a 4-week training course on social sciences in natural resource management were held for the project in Kunming, Yunnan Province in July of 1995. Resources persons were invited from US and Canada for this training. Core research teams were trained in this field. This training was funded from external source (Ford Foundation). In December 1995, a training workshop was organized in Guangzhou to discuss the research methodologies. Researchers from the 4 core sites participated in this one-week workshop. In addition, principle researchers of this project participated in international workshops with support from IDRC.
- ***Visits of experts:*** During the execution of the project, IDRC program officers and CIFOR research officers visited the project sites several times to discuss the progress of the project, and guidelines were provided on various matters of the project activities.
- ***Research Team:*** The research team is composed with a group of scientists from different disciplinary including natural sciences, social science and economics. Besides the multidisciplinary scientist team, local farmers and grassroots governments participated in the project team as well, that ensured the quality of the participatory nature of the research.
- ***Scientific Results:*** This project used a multidisciplinary research method that is quite different with the conventional forestry research approach. A complete framework of research method was developed for natural resource management research, i.e. Diagnosis, Design and Delivery (Tri-D). The key principles used in Tri-D can be summarized as follows:
    1) Participation: It emphasized the participation of farmers, grassroots governments and scientists, and multiple parties' participation is the key for success of this research method. In the circumstance of farmer-centered participatory research, governments provided policy backstop and played important role in setting up long term development plan, while the scientists acted as a good bridge between farmers and government besides their active role in providing technical support.
    2) Bottom-up and on-farm experimentation: The project set up research priorities after participatory diagnosis of potentials and constraints in natural resource

management, that ensured a bottom-up problem-solving process. At the same time, experimentations were carried out on-farm that shortened the time from research results to extension of the results.

3) Multiple options and integrated approach in "design": In conventional natural science research, the objective is to seek for a 'optimal solution." In natural resource management, multiple options are always needed to suit changing conditions. The outputs from participatory design of this project were set of options provided for choosing by individual households. At the same time, the provided options were an integrated package rather than a single technology, it included technical solutions with necessary policy, information and institutional support means.
4) Combination of research and extension: This project made extension an integral part of the research to ensure quick transfer of research results for good economic and social benefits. At the same time, research on extension process granted quick information feedback to benefit the further research.

Research results of this project were partially published. Zhejiang Provincial Education Commission and Department of Forestry organized an evaluation meeting for the research work of Zhejiang site and the work was highly appraised.

3. Evaluation of scientific, economic and social benefits

- ***Transfer and use of research results:*** As this project employed a research method that combined research and extension and on-farm experimentation, research results, ranging from technical solutions to socioeconomic approaches, were quickly transferred to communities. Successful introduction of neem into the hot and dry areas of the Jinshajiang River reaches, for instance, led a quick development of neem cultivation in this area. The provincial government also made great efforts, including allocating special research funds to promote the development of the species. Meanwhile, the on-farm experimentation played an important demonstration role for the local farmers.
- ***Economic benefit:*** It is difficult to estimate the direct economic benefit produced from this project. After implementation of the project, the income of the research sites were increased at different levels with successful installation of some technical solutions, and improvement of community organization and institutional arrangement. Hunan research site provided training on grafting for citrus regeneration that helped the local farmers in improving their citrus orchards and good economic returns were and will be generated. As most of the forest operations need longer time to generate economic return, the economic benefits of the project will be realized in a longer period of time. Besides the direct economic benefit, the research sites played a role as demonstration for the surrounding areas and indirectly benefit are also expected.

- ***Ecological Benefit:*** Sustainable development of communities is always the ultimate objective of the project. To reach this ultimate objective, balancing among economic benefit, social benefit and ecological benefit was taken as important concept in the whole project course. In Yunnan research site, one of the major problems was no suitable species for afforestation in the hot and dry area. Because of this reason, the ecological environment was badly degraded. After successful introduction of neem for this area, farmers started cultivation this species with great enthusiasm, that will contribute to the improvement of the local ecological environment. Another village of the research sites in Yunnan is located at upper mountainous area where farming on steep slope were causing big erosion problem. With help of the research team, the local farmers are improving their slope farming system.
- ***Social benefit:*** Through the practice of participation of multiple parties, each party benefited from this joint efforts in natural resource management. Even the patterns of cooperation and contribution from each party vary from case to case, this approach will benefit the community natural resource management for a long run, and may also influence in future policy formulation. In this project, participation of women was also encouraged and every efforts were made to increase the accessibility to women of information and other resources.
- ***Other benefit:*** Besides the benefits described above, this project contributed to the research and development of natural resource management in terms of participatory research methodologies. In each annual project meeting, experts and governmental officials invited to the meetings showed great interests to the integrated research methods, that will influence further development of research methods and policy making in natural resource management.
- ***Training:*** The training courses of the project trained the core research staff in research methods, concepts in participatory resource management and application of social science tools in natural resource management in particular. The project also set a small research grants opening for young scientists to provide on-site training for both the project management and research capacity of young scientists. Through all these training, the research capacity of the team was much improved. The research team in Zhejiang Forestry College, for instance, played an important role in the school's recent restructuring, and most of the team members were promoted into middle level managers of various departments of the school. The project also provided training for farmer technicians.
- ***Scientific innovation:*** This project introduced social science methods and combined with technical research for integrated approach in rehabilitation of degraded forestlands. The methodological framework of Tri-D is suitable for a wide range of research in sustainable natural resource management.

4. Assessments and Suggestion to the Project Management of IDRC and the Ministry of Science and Technology

- ***Procedures of project application and approval:*** IDRC and the Ministry of Science and Technology have a complete set of procedures for project application process and approval procedure, that provides the applicants a great convenience when apply for research grants from IDRC. In addition, IDRC's program officers are always responsive in discussion of project proposals and monitoring project progress of implementation. CAF has long history in collaboration with IDRC and the Ministry of Forestry and familiar with all the procedures, so has no problems in terms submission of proposal and facilitate approval process. It is recommended to IDRC and the Ministry of Science and Technology to publish guidelines about applying IDRC grants, preferably in local language, and distributes the guidelines to a wide range of audience.
- ***Use of funds:*** Most of the IDRC-funded projects are solely implemented by research organizations in recipient countries. The recipients are the main player in determining research fields, defining objectives and scopes, and budgeting available funds etc., that ensured efficient use of project funds. In addition, IDRC has good monitoring mechanism, and helps the recipients very much for a rational use of all project funds.
- ***International exchange:*** IDRC takes great concerns in promoting international exchange of all funded projects. If needed and condition permits, IDRC provides possibilities to all the projects with opportunities to engage in international exchange through project budget or specially allocated funding sources. The major type of activities including sending consultants to project sites, participation of project staff in international workshops, training and any other relevant international exchange.
- ***Information management and sharing:*** IDRC and the Ministry of Science and Technology emphasize the importance of information exchange through good information management systems including project reports and other types of outputs and distribute the information through their network system. The Ministry of Science and Technology also has special project monitoring mechanism and collect and distribute project outputs via different information exchange channels.
- ***Project coordination:*** Coordination of IDRC-funded projects is normally carried through communications among project leaders and program officers of IDRC. With matured project management regulations and skillful personnel, the communications are conducted smoothly.

5. Comparison of IDRC-funded projects with other international organizations

Besides implementation of IDRC funded projects, the executive organization also has experiences working with other international organizations such as Ford Foundation, UNESCO.

The following comments are made based on those experiences and understanding of the author about the operations of other internationally funded projects..

In aspect of identification of research directions, IDRC has a wider and flexible cooperation fields. Another important advantage of IDRC-funded projects is the recipient has more freedom in choosing project topics that ensures the funded project can address the local problems. As IDRC mainly funds research project and the scale of funding is still quite adequate, but the scale is reduced recently. IDRC itself doesn't directly involve in research activity but technical supports are always provided when needed through sending consultants to project, training of project staff etc. Normally IDRC funded projects last for about 3 years that is similar to most of the international organizations. For a forest project, 3 years is normally not enough. So it is very important for IDRC to assess the continuality of the funded project.

General Report on Research on Rattan in China

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Abstract This general report gives a summary of the rattan studies made in China during 1985-1992 on investigation of resources and resources utilization, introduction and conservation of genetic materials, division of cultivation regions, and propagation techniques as well as strategies for managing high-yield plantations. The methods used are such as field survey and specimen collection, multiple site trials, fixed observation, and laboratory determination as well as establishment of extension and demonstration forests. Now more than 960 specimen have been collected and taxonomically classified. 40 species and 21 varieties representing 3 genera found in China, which take account of about 6.8% of the world total in species terms. They grow naturally in six vegetation zones in 11 provinces from southeastern coasts to southwestern mountains, with Hainan Island and Xishuangbanna as the two distribution centers. Moreover, rattan population distribution, the distribution dynamics, and the flora characteristics in different vegetation types are clarified. Microscopic structure and physical and chemical properties are also studied of 27 species and varieties. It is found that 14 species of VA mycorrhizal fungus species subordinate to 4 genera are infectious to rattan. Three gene pools, where biological and ecological observations are made, have been established with 49 species and 6 varieties introduced, of which 36 species and 5 varieties are successfully conserved. With aim to guiding the practices of rattan plantation, China's southern territory could be divided into four cultivation regions in respect to their suitability for rattan planting. Propagation techniques, both in sexual and vegetative ways, have been studied synthetically and in vitro stocks have been obtained in five species with a propagation coefficient 2.8×10^5 per year. Techniques for raising sound stocks on such aspects as mineral nutrition, light intensity, water and fertilizer supplying, and VA inoculation are summarized. The strategies for managing high-yield plantation on aspects as site conditions, tree selection for intercropping, pure plantation, density, group planting, control of diseases and pests, harvest age and interval, harvest methods, and tending are also included. The economic benefit of rattan plantation is analyzed. With *Daemonorops margaritae* as an example species, which could reach averagely more than 50 stems and 100 m in total stem length per clump, with 10 000 kg per ha in cane yield when 11 years old and result a net present value 16 785 Yuan per ha, an internal rate of return 28.7%, and a benefit-cost ratio 4.8 during 25 years of rotation.

Key words Rattan; Resources investigation; Introduction; Propagation; cultivation; Cans properties

1 Introduction

Rattan is taxonomically subordinate to family Palmae and plays an important role in regional economic well-beings in tropics and southern sub-tropics with its multiplicity of utilization purposes. Rattan cane has advantageous properties for processing and is a good choice of raw material for making furniture, utensil and art-ware. Rattan fruit, seed and tender shoot could be used for food, medicine and decoration. Since the 1960s, the global rattan-related trade sum has amounted to 2 billion US dollars. In China, the annual rattan production value reaches up to several million RMB yuan and the annual foreign exchange near 100 million US dollars. Therefore, rattan is in South China one of the most important non-timber forest resources (next only to bamboo) and has a great contribution to local economy.

In China, rattan grows naturally and widely in tropical and southern subtropical natural forests ranging from southeastern coasts and islands to southwestern mountains, in which Hainan Island and Xishuangbanna are the two centers noted for richness in rattan resources and plenty in cane production. However, China is presently facing on such world-wide forestry problems as deterioration of tropical forests, reduction of wide life resources, shortness of rattan cane supply, and extinction of some rattan species. With consideration to conserve and make rational use of natural rattan resources as well as to develop rattan-related industry, it is increasingly recognized by the international society the importance and urgency to introduce superior species/varieties and expand rattan plantations. Since the mid-1960s, many countries, e. g. Malaysia, Indonesia, the Philippines, Thailand and India, have drawn rattan researches into their national scientific priority, some international organizations given a lot of financial and technological supports in this field, and great achievements been since made. In Malaysia, for example, rattan resources inventory has been made, propagation techniques for *Calamus manan*, *C. caesius* and *C. trachycoleus* have been successfully worked out, and tissue culture stocks of *C. manan* widely planted on slash of selected tropical rain forests at low elevation sites. Since 1978 three workshops on rattan researches have been hold and Rattan Information Center (RIC) and INBAR have been set up, which has accelerated greatly the development of rattan researches all over the world.

In China the history of rattan utilization could be in retrospect to more than 1000 years ago and that of rattan furniture industry to 150 years ago. However, rattan research remained empty until the 1960s. Later South China Botanical Institute and Kunming Botanical Institute of Academia Sinica, together with some other research organizations, have made some studies on taxonomic and cultivation aspects, which could be a reliable basis for further researches.

Rattan research history in Research Institute of Tropical Forestry, Chinese Academy of Forestry (RITF/CAF) could be divided into three stages. The first stage is between 1963 and 1972 during which the resources survey, fixed biological and ecological observation, and propagation were carried out at Jianfengling Mountain, Hainan Island. Unfortunately, the study was broken down since during the "Chinese cultural revolution". The second is from 1973 to 1984 when rattan propagation and cultivation was studied as an important objective with emphases on stock raising and cultivation trials, and the studies were initially made results. The third is during 1985 and 1992 when comprehensive studies were conducted with financial supports from The International Development Research Center (IDRC). An IDRC-funded project "Research on Rattan in China" and a key project of the Ministry of Forestry (MOF) " Cultivation techniques of commercial rattan species ", and a CAF-funded project "Pilot trial of *Calamus tetradactylus*" were undertaken In in this stage. The overall objective of the projects was to identify suitable rattan species of good quality and to develop technique for their large-scale cultivation in China. The research was focused on making rattan resources inventory in China, collecting genetic materials, clarifying the biological and ecological features, selecting superior species/varieties, optimizing cultivation techniques, expanding the plantation in South China, and improving the quantity and quality of rattan cane. Since 1985, multidisciplinary scientists from several institutes have been involved in related studies, and comprehensive results achieved. This general report is a summary on the studies made at the third stage.

2 Methods

2.1 Resources survey and utilization

2.1.1 Resources survey The resources survey was made with both census and sample methods. The natural rattan distribution area was investigated, specimen were collected, and the locality, land-form, altitude, soil type and major mixed plants of the site where specimen grew were recorded. Then the specimen were taxonomically classified, and the geographical distribution of each species or variety was analyzed. The vegetation types were investigated in the long-term sample plots and the temporary sample plots where vegetation was protected well and rattan species abound. Finally, the dominant populations and the relationship between populations as well as between population and environment were analyzed.

2.1.2 Cane properties The species used for cane property analyses include *Demonorops margaritae*, *C. tetradactylus* and the like 25 species. Size and density of vascular bundle as well as fiber proportion were measured with section-cutting method. Anatomic structure, such as length, width and fiber length of vessel elements in metaxylem, was measured with Jeffrey's decomposition method. As to physical strength properties, specific gravity of cellular wall was measured with a bottle method, specific gravity of periphery with maximum moisture method, and tensile strength of cane periphery with textile and paper tensile testing machines. Lignin content was measured with the state standard method.

2.1.3 Utilization of shoot The model species are *Daemonorops margaritae* and *C. simplicifolius*. The nutrients measured are protein, fat, fiber, ash, vitamins, and amino acids.

2.1.4 Investigation of mycorrhizal fungi (VA) Small roots of *D. margaritae* and *C. simplicifolius* as well as the soil around were sampled from different types of natural forest and plantation in provinces Guangdong, Guangxi and Hainan. The mycorrhizal fungi were isolated and incubated, and the spores screened with a wet sieve and observed with a microscope. In this way, the fungi were taxonomically classified and dominant species were identified. Additionally, the rate and degree of infection of VA to rattan under natural conditions were studied.

2.2 Collection and domestication of genetic materials

When resources survey was made, seed and/or seedlings of wild rattan were collected. Some foreign species were introduced with seed exchange method. Three gene pools were set up, where phenological and biological characteristics and growth dynamics could be studied. Superior rattan species were selected out and extended in large plantation establishment.

2.3 Division of cultivation regions

The natural distribution area of rattan is exclusively fallen in China's southern and southwestern 11 provinces. With the six major climatic indices, namely, annual mean temperature, annual rainfall, 15°C-above accumulated temperature, January mean temperature, 25mm-below rainfall months, and annual frost days, which were provided by 256 meteorological stations, the area was cluster analyzed and pre-divided. In combination with the regional performance of four promising species *D. margaritae*, *C. tetradactylus*, *C. simplicifolius*, and *C. dioicus*, the area was formally divided into 4 suitability-varying regions, for which suitable species and practical planting techniques were proposed.

2.4 Propagation

2.4.1 Seed propagation With requirement of "Technological Standard for Forest Seed Testing", the seeds of all species collected were sampled for testing the purity, superiority degree, gravity per 1 000 grains, moisture content, and germination rate. Seed storage experiments were made with a split-plot design, of which seed was designed in different temperature and moisture treatments. The moisture content and germination rate were determined at a fixed interval of time. Germination acceleration experiments were made with a random block design.

2.4.2 Tissue culture *D. margaritae*, *C. simplicifolius*, *C. tetradactylus*, *C. egregius* and *C. dioicus* were employed for tissue culture studies with basic MS medium. Explant selection, callus induction, bud induction,and root induction were included in this ground. Microscopic observation of multi-bud stock was made also.

2.4.3 nursery techniques The aspects in this context include physiology of mineral nutrition, techniques for sound stock raising, fertilization, and inoculation with VA mycorrhizal fungi. Such designs as comparison, random blocks, split plots, and orthogonal type were adopted for the experiments .

2.5 Cultivation and management techniques

2.5.1Cultivation techniques The species tested were *D. margaritae*, *C. tetradactylus*, and *C. simplicifolius*. planting trials were conducted in several places of Hainan, Guangdong, Guangxi and Fujian provinces for testing varios planting patterns of intercropping rattan species with tree species. Group planting, planting spacing,, fertilizing as well as control of diseases and pests were studied with the designs of comparison, random blocks, split plots.

2.5.2 plantation Management techniques Harvest age, harvest methods, harvest interval and rotation of rattan plantations were studied. Economic Beneficial analysis was made.

2.5.3 Beneficial analysis Data of growth and harvest quantum were recorded on the rattan trials established in Guangdong and Guangxi, and were further combined with the data of market situation for beneficial analysis. Three dynamic indices, namely, net present value, ratio of net present value, and internal rate of return, and two static indices, namely, benefit/cost ratio and period of investment return, were employed to evaluate the economic benefit of rattan plantation management.

4 Conclusion

Resources of rattan in China have been surveyed, and 960 specimen collected to establish the largest rattan specimen pool in the country. It is identified that there are 40 species and 21 varieties of 3 genera of rattan in China, which have a natural distribution from the southeastern coasts to the southwestern mountains, covering 6 vegetation zones in 11 provinces. In such vegetation types as tropical rain forest, tropical mountainous rain forest, tropical evergreen monsoon forest, and subtropical evergreen broad-leaved forest, rattan population density is high. For example, tropical mountainous rain forest carries 7 rattan species with a total density 5 690 rattan clumps per ha, and tropical evergreen monsoon forest does 6 species with a total density 1 450-2 380 clumps per ha. Rattan cane anatomical structure as well as physical and chemical properties have been determined for the first time of 27 species of 3 genera, which helps divide the commercial cane into five grades. Analysis on nutrient elements and their content in shoot of two major species indicates that rattan shoot is rich in nutrients and the total content of 17 amino acids reaches up to 13.14%. It is also clarified that there are 14 VA mycorrhizal species of 4 genera infectious to rattan.

Three gene pools have been set up with a total area 3.3 ha where 49 species and 6 varieties of 3 genera have been collected and 36 species and 5 varieties conserved successfully, including 30 species and 5 varieties of *Calamus*, 5 species of *Daemonorops*, and 1 species of *Plectocomia*, of which 16 species have born seed. The growth, sucker sprout, adaptability (temperature, water, soil, and light), flower and seed-bearing characteristics have been studied also. *D. margaritae*, *C. tetradactylus*, *C. simplicifolius* and *C. dioicus* are selected to be expanded in southern China, and *C. egregius*, *C. flagellum*, *C. nambariensis* var. *xishuangbannaensis*, *C. yunnanensis*, *C. distichus* var. *shangsiensis*, *D. jenkinsiana*, and *C. caesius* to be further studied..

Division of regions suitable for rattan planting has been made. Four regions could be divided and the species suitable for each region and the planting techniques have been proposed.

Seed examination, seed storage and germination acceleration have been studied of 41 species and varieties, and a series of practical techniques have been summarized and widely applied in stock raising practices. In vitro stocks have been obtained with tissue culture method in five species, namely *C. simplicifolius*, *D. margaritae*, *C. tetradactylus*, *C. egregius*, and *C. dioicus*. The propagation coefficient of tissue culture amounts to 2.8×10^5 per year.

Mineral nutrition of stock has been studied with solution incubation methods for three species, namely, *D. margaritae*, *C. tetradactylus* and *C. simplicifolius*. Techniques for raising sound stocks have been summarized. The 41 species and varieties tested could divided into three types according to their growth speed. In addition, the corresponding methods for raising different type of stock and for field planting have been worked out, which could be a guidance to normal practices.

On basis of division of cultivation regions, selection of tree species intercropped, plant density, group planting, grading of stocks, and fertilization of juvenile plantation have been studied with *D. margaritae*, *C. tetradactylus*, *C. simplicifolius*, and *C. dioicus* as the main objectives. Totally 51.1 ha trials, 55 ha extension forests, and 1 200 ha demonstration plantations have been established. Meanwhile, above ground biomass and nutrient accumulation as well as cane growth models in different tree-rattan mixtures have been studied. Moreover, economic benefit of *D. margaritae*, *C. tetradactylus* and *C. simplicifolius* plantations have been analyzed with data of cane harvest and market situation. *D. margaritae* is the most promising species for plantation establishment, and the other two the next. In 25 years of rotation, the three species could result a net present value up to 3 495 yuan, 4 658 yuan, and 16 785 yuan per ha respectively, an internal rate of return 25.95%, 21.20%, and 28.71% respectively, a benefit-cost ratio 1.71, 2.13, and 4.77 respectively, but an investment return period only 5.5 years, 10.3 years, and 10.2 years respectively.

Rattan related studies have a relatively short history. Researchers involved in this field are in short. Plantation starts just recently. In addition, rattan grows in clump with sharp thorns and has a habitat of winding and climbing, which makes field investigation very difficult. Though some achievements have been made through years of efforts and such experiments as density, group planting, and rattan-tree intercropping are being carried out and will be summarized in future, many theoretical and applied problems are urgently needed to be studied in future, eg. community structure in plantation, interaction between rattan and tree interplanted, mechanisms of sucker sprout, propagation techniques and the like. Moreover, extension of the results achieved to the forestry practices should be made to meet the increasing demands for cane raw material in both quality and quantity terms.

The IDRC-funded Fuelwood (China) Project: A General Review

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1. Background

The International Development Research Centre (IDRC) funded "Fuelwood (China) Project" was commenced in June 1986. It was the time that rural area of China had just experienced several years of 'economic systems reform' and agriculture got its right way of development. However, rural energy as one of the most important fundamentals for rural development was suffering from severe shortages. This problem was well recognised by the Government of China. Research on rural energy became one of the many national key research and development programs established by the State Science and Technology Commission (SSTC, now the Ministry of Science and Technology, MOST) during that time. IDRC is a funding agency who has been paying much attention in rural development. The common interest of IDRC and SSTC in rural development led to that the both sides established many scientific and technological co-operation agreements which proposed dozens of R & D projects in rural development be established with IDRC's financial supports. Logistically, the fuelwood research was placed in the list of such projects. The IDRC-funded fuelwood research (hereafter the Project) in China was implemented by the Research Institute of Tropical Forestry (RITF) of the Chinese Academy of Forestry (CAF). It was lasted for 8 years and divided into two phases. The first phase (June 1986 - May 1990) was an independent project entitled "Fuelwood (China) Project" (Centre file 3-P-85-0251) and focused on selection of tree species and development of cultivation techniques. The second phase (April 1990 - March 1994) became part of the IDRC-funded "Farm Forestry (China) Program" with emphasis on species improvement. Two large experimental bases, one in Qionghai county of Hainan Province and another in Huadu county of Guangdong Province were set up in the first phase, and one small experimental base was set up in Kaiping county of Guangdong Province in the second phase.

2 Project Implementation

2.1 Financial Implementation

2.1.1 China's contribution

The China's contribution into the Project mainly included the project staff's salaries and other welfare paid by the Government of China, the existed research equipment of the implementing institution and the research funds of the SSTC supported national key research projects during the 'Seventh Five-Year Plan' and those of the former Ministry of Forestry supported key research projects during the 'Eighth Five-Year Plan'.

2.1.2 Equipment and instruments

The equipment and instruments purchased with IDRC's funds included: one Toyota Landcruiser, one Cannon photocopier, one motorcycle, one refrigerator, two IBM compatible computers and some small lab instruments.

2.1.3 Personnel training

During the project period, four project staff members were supported to participate at six training courses. Three training courses for local forestry officers and technicians were organised by the Project during the first phase and the participants totalled about 200. The training activities of the second phase were jointly carried out by the staff members of the Project and those of the IDRC-funded 'Farm Forestry (China) Program'.

2.1.4 Visit, consultancy and technical exchange

The IDRC supported international visits by the project staff included: a scientific visit to the Philippines by one staff member, participation at the Winrock International and IDRC sponsored workshop on Multipurpose Tree Species and Their Use for Small Farms held in Bangkok, Thailand by the project leader, and participation at the International Symposium on Multipurpose Tree Species for Rural Livelihood held in Manila, the Philippines by two staff members.

The visitors that the Project received during the project period totalled some 30 people, including D. Weeb, Assistant Director for Forestry Science of IDRC, Dr. C. B. Sastry, Senior Program (Forestry) Officer of IDRC, Prof. Louis Zsuffa, the Project Consultant, Dr. Salleh Mohd. Nor., the former President of IUFRO, staff members of the IDRC-funded project 'Economics of fuelwood Production (Thailand)', and program officers or scientists from the World Bank, the Swedish University of Agricultural Sciences, CSIRO Division of Forestry, Winrock International, Argonne National laboratory (USA), and some program officers or scientists who visited to the 'Farm Forestry (China) Program'.

2.2 Project team

The project team consisted of eight people from RITF and the participating forestry bureaux. They are Mr. Zheng Haishui, the Project Leader, Mr. He Kejun, Mr. Cai Mantang, Mr. Huang Shineng and Mr. Lai Hanxing of the implementing institution and Mr. Li Kexiong, partner from the Forestry Bureau of Qionghai city, Hainan Province and Mr. Li Kezheng, partner from the Forestry Bureau of Huadu city, Guangdong Province.

2.3 Research achievements

Three research achievements were obtained during the project period and all were awarded by different authqrities. The first achievement, based on the first-phase research results, "Studies on selection of fine and fast growing fuelwood species and their cultivation techniques in tropical China" was given the Third Class Award for Scientific and Technological Progress by the former Ministry of Forestry in 1990. The second research achievement, based on two-phase research results from Qionghai experimental base entitled "Selection of tree species and their cultivation techniques for short-rotation forest plantation development in Hainan Province", was given the Second Class Award for Scientific and

Technological Progress by the government of Hainan Province in 1993. The third research achievement, based on the research results from Huadu experimental base entitled "Species selection and technology development for short-rotation energy and timber plantation management on poor hilly land", was given the Third Class Award for Scientific and Technological Progress by the government of Guangdong Province in 1996. In addition, a book written by the project staff members entiled "Cultivation techniques for short-rotation fuelwood and timber plantations" was published in 1990 and more than 40 papers were published.

3 Evaluation of scientific, economic and social effects of the project

3.1 Transfer and application of research achievements

As the multiple benefits of fuelwood plantation management were well considered before the project commencement, the tree species selected and the management techniques developed, especially those relating to intercropping with cash crops and cultivation of edible fungus as well as the establishment of chicken farms under forest canopy, by the Project were also suitable for short-rotation industrial plantation management, the research achievements of the project were immediately applied into the forestry production. It was estimated that the total area of forest plantations that were established under the guidance provided by the Project or with employment of the project's research results has reached some 75 500 hectares.

3.2 Economic benefits

It was estimated that a total of some one million CNY of incomes were generated by the local forest farms where the Project activities were conducted through intercropping with cash crops, cultivation of edible fungus and establishment of chicken farms. The 75 500 hectares of forest plantations, as mentioned in Section 3.1, are expected to produce about 113.3 million CYN of production values per year, with a net annual income of 28.2 million CNY.

3.3 Ecological benefits

As the use of multipurpose tree species, especially the nitrogen fixing ones and the management of diversified forest plantations had been the main concerns of the Project, the soil fertility of the planting sties shown significant improvements after plantation establishment. Meanwhile, the trial sites the Project used are those so-called difficult sites that local farmers did not want to use for any purposes at all. The sites in Huadu County are poor and heavily eroded and those in Qionghai are frequently damaged by typhoons. The success of the Project does provide a demonstrating example for the revegetation of degraded lands and the construction of shelter-forests in coastal areas in tropical China.

3.4 Social benefits

The training courses the Project offered to the local foresters, the diffusion of plantation technologies through on-farm training and dissemination of technical notes, and the establishment of demonstration plantations made the local foresters aware that the management of short-rotation fuelwood and timber plantations is beneficial. The reduction of employment pressures through their active participation in forest plantation establishment and the improvement of their knowledge in forest management are the main contributions of the Project to the society. Moreover, the book and some 40 published research papers or technical notes completed by the Project staff members are well recognised by the scientific community.

3.5 Human resources development

When the project commenced, there was only one person, Mr. Zheng Haishui, the Project Leader, who held a high professional rank as associate research professor among the project staff members. Others were research assistants, assistant engineers and technicians. At present, all of them have been promoted to held higher professional ranks. The Project Leader became a research professor, and all the others became associate research professors or senior engineers excepting one who was a technician at the beginning of the Project.

In addition, Mr. Cai Mantang obtained his Master Degree in farm forestry at Oxford University during the project period. Two staff members, Mr. Cai Mantang and Mr. Huang Shineng, are Ph.D. candidates of the Indian Council for Forestry Research in farm forestry and of at the Zhongshan University (Guangzhou) in plant ecology, respectively. One staff member, Mr. He Kejun, is studying towards the Master Degree in forest management at the South China Agricultural University (Guangzhou). Their abilities of opportunity-competition for continuing education are, at least in part, attributed to their experiences and knowledge gained through the implementation of the Project.

3.6 Scientific and technological invention

Through a variety of trials on different sites in different climate zones, a number of fine and fast-growing fuelwood species were screened out and their associated management technologies developed. The household-based and multi-purposed fuelwood plantation management system developed by the Project is a breakthrough in fuelwood research in China.

4 Comments on the project management by IDRC and the MOST of China

4.1 Application and approval of project proposals

The establishment of the project was corresponded to the development needs of China and to the hot-topics in the world forestry research. During the early 1980s, the world was suffered from 'energy crisis' and many countries, especially the developed countries started investigations on biomass-based renewable technologies. The research and development of short-rotation energy plantations of fast growing tree species was not only put by the MOST on its own funding list, but also treated as a priority area to seek for international financial assistance. With the MOST's help, the project proposed by CAF was immediately approved and financed by IDRC. It can be said that the process of application and approval of the Project was highly efficient.

4.2 Financial management

The IDRC-supported project funds had two parts: the IDRC managed funds and the CAF managed funds. The later usually account for two-third of the total project budget. In each project calendar year, IDRC sent its financial officers to CAF Headquarters and its program officers or project consultants to the project sites to make sure if the project funds were used exclusively for the project activities. The IDRC managed funds were used for supporting international travels by the project staff members or the project consultants, and for the international purchase of equipment and instruments for the projects. This management system ensured that all the project funds were used exclusively for the project activities.

4.3 International exchanges

It seemed less that the IDRC-supported international travels for training or/and workshop participation by the project staff members compared with the international visitors the Project received during the project period. Such international travels were, however, important for the researchers of China in the early stage that the country is "open to the outside world".

4.4 Information exchange and management

In each project calendar year, three Quarter Activity Letters, one Annual Report and one Financial Report were submitted to CAF and IDRC. A Project Completion Report was submitted to IDRC at the end of each phase of the Project. In addition, some technical progress reports were also submitted to the CAF, the project consultant and IDRC. The information exchange and management of the project was timely and efficient.

4.5 Project coordination

The project co-ordinating work by the MOST and IDRC was excellent.

5. Comparison of the IDRC-funded project and projects supported by other funding agencies

During the past 15 years, more then 15 projects funded by international agencies have been carried out by the RITF. The following comparison of differences in methods and procedures of funding is only made between the IDRC-funded projects and FAO, ACIAR and ITTO funded projects.

5.1 Priority areas and research fields funded

In general, the priority areas funded by the funding agencies are all corresponded to the priority areas in forestry research in China. However, the research fields funded are somewhat different as the funding agencies have their own objectives and mandates. For example, ITTO only considers projects that are hardwood related. ACIAR usually funds projects involving Australian tree species. Like IDRC, FAO funds projects in every fields of forestry research.

5.2 Project budget/funds (?)

It is difficult to compare the budget of projects funded by different funding agencies. Such difficulties in comparison are mainly attributed to the changes in foreign exchanges over time. For ACIAR-funded projects, in general, the RITF can only manage a small proportion (some 10% or less) of the total project budget.

The budget of the IDRC-funded Fuelwood Project totalled 213400 Canadian Dollars, or 700-800 thousands CNY. It was a big-budgeted project during the mid-1980s and early 1990s in China.

5.3 Funding agencies' participation

FAO, ITTO and IDRC seem likely to participate only in the overall project management. ACIAR takes another way. The ACIAR-funded project activities are jointly implemented by Australian (ACIAR or CSIRO) scientists and Chinese scientists, and the proposals are usually formulated by Australian scientists. However, the ACIAR-funded projects provide the Chinese scientists with more opportunities in training and regional/internatioanl workshop participation.

5.4 Project duration

It seems to be the 'international rule' that the project duration usually lasts for 3-5 years.

5.5 The procedures of application, approval and implementation of projects

The procedures of application, approval and implementation of projects depend on the nature of the projects themselves; that is, the projects are bilateral or multilateral. The IDRC-funded and ACIAR-funded projects are the so-called 'bilateral projects'. If the proposed project activities are within the priority areas identified in the scientific and technological co-operation agreements established by both sides, the projects will be approved and financed.

In contrast, the multilateral projects, for example the ITTO-funded ones, are not easy to be approved and financed. The project proposals must be assessed for three times. Firstly, the project proposals must be assessed and recommended to the ITTO's permanent t committee concerned by the Expert Panel for technical appraisal. Secondly, the proposals must be assessed and recommended to the International Tropical Timber Council (hereafter the Council) by the permanent committee concerned. Finally, the proposals must be approved by the Council. That the proposals were approved by the Council does not mean that the projects will be financed. If there were no donors who want to fund the projects, the projects will be sunset ones after two or three Council session. However, after the projects are financed ITTO is the unique international organization that will transfer all the fresh money to the implementing agencies of the projects.

Our experiences indicate that there are no differences in procedures of project implementation and management for all the projects supported by international funding agencies.

UTILIZATION OF FIVELEAF GYNOSTEMMA-Project Review

Institute of Chemical Processing and Utilization of Forest Products
Chinese Academy of Forestry

1. BACKGROUND

Gynostemma pentaphyllum Makino is a traditional plant of Curcurbitaceae family and is grown in forest areas in southern China. The plant is rich in triterpenoid saponins, which are similar to ginseng saponins in structure and possess a series of unique pharmaceutical qualities, such as reducing cholesterol and triglyciride levels in serum, fighting cancer, and preventing aging, ulcers and the side effects of glucocorticoid. In recent years in China, some products have been developed from this plant using wild resource, and the cultivation of this plant is now being studied. In order to utilize it with high-efficiency, the study on the selection of superior provenances with high gynosaponin content should be carried out. Gynostemma pentaphyllum also contains proteins, polysaccharides and mineral elements, so it should be comprehensively utilized, and the economic benefit of utilization would be further enhanced. Since this plant is usually grown in relatively poor forest and mountain areas, its cultivation and properly utilization is beneficial to local farmers.

2. IMPLEMENTATION

The implementation time of this project was from April 1, 1990 to March 31, 1994. IDRC had contributed 32580 Canadian dollars, mainly used in the materials, instrument, travel and labor cost. The Chinese Academy of Forestry supported 84600 RMB yuan, mainly used in salaries, instrument maintenance, water and electricity, communication and reports.

The instrument purchased by the support of this project included UV photometer, polarimeter and chromatograph column.

The research results from this project include:

1) Establishment of quantitative methods for analyzing the gynosaponin contents in Gynostemma pentaphyllum.

2) Isolation and identification of a new gypenoside, the structure of this compound was first reported in the world.

3) Twenty seven Gynostemma pentaphyllum samples were collected from around the China, two provenance with gynosaponin contents of more than 10% were selected out.

4) The laboratory and expanded experiment on extraction of valuable components from Gynostemma pentaphyllum were carried out, and the toxicity test for the gynostemma extract has been conducted.

5) The design of the pilot plant with annual capacity of 2t gynosaponins had been completed, the preliminary feasibility study was also completed.

3. Technical, Economic and Social Effect

The research results of this project provide the scientific basis for cultivation and introducing superior provenance of Gynostemma pentaphyllum. The new extraction technology was developed, and experimental product was manufactured. The extract was introduced into the healthy food and cosmetics. Now based on the research results of this project, we are engaging in the further developing of medicines with high added value, and expanding the application field of the extract. Three papers was published based on the research results.

The design of the pilot plant with annual capacity of 2t gynosaponins had been completed, the feasibility study showed that through purchasing the Gynostemma pentaphyllum, the plant would bring 1 million Yuan profit for local peasants.

Now in China, the utilization of Gynostemma pentaphyllum has developed into a kind of industry, it plays an important role for the economic development in the mountain areas, and for the income of people in poor areas.

SUGGESTED MAIN DIRECTIONS FOR COOPERATION WITH IDRC IN FUTURE

Accompanying the great progress of Chinese economy in the late twenty years, the ecosystem and environment are also deteriorated. Facing the new century, the scientific and technical development on Forest Chemical Industry should track on the motif of sustainable development. On the one hand we should aim at the economic development in the mountain and forest areas, develop the forest resource utilization technologies with high efficiency and introduce them into industry, so as to improve the income of people in the poor areas and enhance their life quality. On the other hand, we should also consider the potential influence of resource exploitation on ecosystem and environment, develop the environmentally benign technologies, and achieve the goal of sustainable development with the harmonization of the society, economy and nature.

Based on the above views, we proposed such main directions for future cooperation with IDRC as the below:

1. Extraction and Utilization of Natural Products

The application of natural products in medicine, health food, feed and cosmetics is paid more and more attention. The processing of natural products does not need the complex chemical synthetic steps, and the processing technology is harmless to the environment, so the natural products are seldom polluted by the heavy metals or organic pollutants, and they also cater the people's wish to be back to the nature.

Our Institute has done much research work in the field of natural bio-active products, namely the extraction of valuable components from plant resources such as ginkgo leaves, pine needles, *Gynostemma,* popular bark, *Adeaophora* and fig leaves, the extracts were used in the feed, health food and cosmetics. The utilization of natural products has developed into a kind of industry with apparent profit, and the economy in mountain and forest areas was improved based on this industry. But on the development of natural medicines with high value, we need further support.

2. Advanced Utilization of Renewable Forest Resources

To develop the new materials from renewable resources is very important for palliating the depletion of non-renewable resources, saving energy and protecting environment. As keeping on the research of the utilization and chemical modification of lignin, cellulose and semicellulose, we should emphasize the advanced processing and utilization of non wood forest products, use the natural organic materials from leaves, barks, fruits and wood secretions as raw materials, through chemical processing to prepare high-valued fine chemicals and functional materials. For example, we can prepare medicine intermediates and adhesives from plant tannin, and new polymer materials from modified rosin, and perfumes and chemical additives from turpentine. So that we can improve the utilization profits of non wood forest products, and expand the application fields of renewable resources.

3. Forest Products Biotechnology

The biotechnology will be the leading technology in the new century, the research and development of biotechnology in the forest industry should be supported. From the basic wood biodegradation mechanism, to the technical development of bio-conversion of wood and agricultural residues, and to the application of biotechnology in the pulping and papermaking and effluent treatment, a new research branch of forest science is emerging. That is the forest products biotechnology, which should be urgently strengthened in China.

4. Bio-mass Energy Conversion Technology

In order to realize the modernization and improve the people's living standard, it is impossible for the developing countries as China to rely only on fossil energy. The Bio-mass has great developing potential as a kind of renewable energy. Through chemical technology or biotechnology, the agricultural and forest residues can be converted into the energy for domestic and industrial use. And the bio-mass energy can play an important role in fulfilling the energy need in rural and forest areas, and is beneficial for reducing environmental pollution and enhancing the life quality of local people.

Study on the utilization of biomass energy in small scale -- Review for the IDRC Project

Institute of Chemical Processing and Utilization of Forest Products
Chinese Academy of Forestry

1. BACKGROUD

The wood as a kind of renewable energy is been paid new attention, especially for developing countries that are realizing the industrialization and improving the people's living standards, it is impossible to rely only on the fossil energy. With the increase of population and the development of agricultural and forest by-products processing industry, the need for wood energy will increase quickly. If there is no appropriate measures to cope with such need, the limited forest resource will be depleted, which bring about the deterioration of the environment and bio-system. The measures should be the accelerating development of firewood plantation as well as enhancing the utilization efficiency of wood energy.

In China, the annual production of one-off energy is about 600 million tons of standard coal (not include the bio-mass energy), which is mainly used in the city and industry, and in forest and rural areas, the energy supply is poorly needed. At the same time, there is a lot of forest residue was cast off or burned with very low efficiency. Now we are developing the firewood with the aim of 10 to 20 million hectare of plantation, some will be used as domestic fuel, and the other will be converted into energy products.

According to the above situation, the Research Institute of Chemical Processing and Utilization of Forest Product of Chinese Academy of Forestry began to carry on the research and design of wood gasification technology and equipment, and mainly on the gasification furnace and the gas refining. Supported by the IDRC, from 1985, we launched the R&D on the utilization of forest residue as the domestic fuel, and completed four sub-projects.

2. IMPLEMENTATION

The IDRC supported project included four sub-projects, namely 1) Up-inhaling gasification furnace used as heating facility; 2) 1,500,000 kcal/h up-inhaling furnace; 3) Centralized gas supply in forest area; 4) Double furnaces gasification system.

Sub-project 1 was carried out in Bishui Forestry Center of Dailing Forestry Administration. There are three heating boilers which located in three different heating areas. In order to enhance the heat efficiency of the system, we designed to connect these areas through pipeline, and realized the centralized heat supply in the Center. The research results testified that this system is easily handled and run smoothly. It can use the branches with moisture below 50%, the general efficiency is from 59% to 78%.

Sub-project 2 was completed in Jianyang Textile Equipment Plant in Fujian Province. With the gas from up-inhaling furnace as fuel for boiler, the heat efficiency was improved to 63--71%. Compared with the direct burning of wood, the firewood was saved 33%, the energy utilization efficiency was improved 46%.

Sub-project 3 was implemented in Erdu Forestry Center in Shaowu City, Fujian Province. The experimental scale is 100 dwellers, the supply capacity is 620 Nm^3 daily. This system can save the firewood about two thirds, the costing of wood gas is further cheaper than the price of coal gas in city.

In Sub-project 4, the system was combined with the up-inhaling furnace and down-inhaling furnace. It was testified that the combination excelled the single furnace system with both up-inhaling furnace of down-inhaling furnace.

IDRC supported 229,000 USD for the above projects, the fund from China was 288,684 RMB yuan. Three sets of sample equipment were installed, and a laboratory for wood gasification research was established, other instruments include one Z20-21 Oxygen detector, one RD-02 CO_2 detector, one Gas-Chromatograph, and some other instruments.

The project official had come to China for several times.

3. SCIENTIFIC, ECONOMIC AND SOCIAL EFFECTS

The IDRC project supported the establishment of three sample plants of wood energy utilization in different parts of China, which improved the introduction of wood gasification technology. Based on the technical achievements of this project, we developed the catalyzed gasification technology and the utilization of agricultural residues which is introducing in Jiangsu Province.

Wood gas as fuel for boilers can improve the heat efficiency of boilers, and the forest residue was fully utilized, the wood utilization efficiency enhanced, and the environmental pollution decreased.

The domestic wood gas system is beneficial for saving wood resources, and the price of wood gas is cheap. It is also healthier than burning wood directly, the people's living quality was improved.

Introduction and Cultivation of Jojoba in Yunnan, China

Kunming Institute of Batany, Chinese Academy of Sciences

Background

Jojoba (*Simmondsia chinensis*) is native to the Southwest of U.S.A and Northwest of Mexico. It is distributed in the mountainous region of 23~35°N, 105~112°01'E, below 1500m of elevation and the area along the Pacific ocean, concentrating in the lowland of California, middle and south parts of Arizona and Texas of U.S.A., and north and southwest sections of Mexico.

The ecological environment in dry and hot regions of south and southwest China is similar to that of the native regions of Jojoba. A preliminary test on the introduction and cultivation shows that the region is suitable for the growth of Jojoba.

The planting of Jojoba will cut down the foreign exchange largely for the import of additives of lubricating oil of high quality and the liquid fat agent form abroad. At the same time the raw materials for producing higher lubricating oil and liquid fat agent for leather industry and the oil for industry and cosmetics will be supplied by us. As a result, the development of light and heavy industry and the chemical industry for daily use will be promoted greatly.

The success of the planting of Jojoba in China not only benefit China but also provide a direct experience for other countries where the ecological conditions are suitable for the growth of Jojoba.

Under aforementioned conditions, IDRC (International Development Research Center) subsidized "Jojoba (China)" from 1988 to 1991.

Implementation of item

- **Funds**

Form 1988 to 1991; IDRC provided $54980 CAD (¥187,853 RMB). Expenditure: a) Salaries & allowances: ¥64,412 RMB; b) Research expenses: ¥86,595 RMB; c) Equipment: ¥29,518 RMB; d) Local travel: ¥7,328 RMB.

The fund of approximate recipient contribution is ¥157,660 RMB. Expenditure: a) Wages & allowance: ¥84,480 RMB; b) Research expenses: ¥33,540 RMB; c) Equipment: ¥22,000 RMB; d) Local travel: ¥17,640 RMB.

- **Equipment**

In order to complete this item, we buy some equipment in the course of implementation of item, i.e. a) The meteorological instrument; b) The miniature tillage machinery; c) The sprayer; d) The high-lift pump; e) The cisterns; f) The super clean bench; g) The balances; h) The ovens; i) The tissue culture shelves; j) The shaker; k) The equipment of auto-adjust temperature and humidity; l) The Microscope; m) The hydrogen ion determination apparatus; n) The glass instrument; o) The counter and p) The camera.

- **Training course**

  According to the results of investigated in dry and hot regions of Yunnan, we selected 6 planting plots for Jojoba provenance examination, the 6 planting plots are Yuanjiang, Pengpu, Taoyuan, Qina, Huaping, and Qiaojia. In order to let that the technicians and workers could know well the cultivation and management of Jojoba, we hold a training course in Qina planting plots in April 1989. There are 18 people attend this training course. We adopted the method that is integration of theory with practices. First, we introduced the introduction course, experiment and research, development and use of Jojoba in overseas; then, we explained the technique in cultivation, management and prevention and control of plant diseases and elimination pest etc. This is a most rewarding training course: a) knowing planting, development and use of Jojoba in overseas; b) we found many varieties of Jojoba that we introduced the commercial seed of the past; and male to female is high. We only did the provenance planting well can we did plant Jojoba in a large area in dry and hot regions of Yunnan; c) Through training, the students mastered the skill of sowing and growing seedlings, transplant and prevention and control of plant diseases and elimination pest. d) The important of observation and recording, and tabulations of observation in the cultivation experiment.

- **The exchange visits of expert**

According to the plan, from October 22 to November 11 1988, 2 experts of Kunming Institute of Botany, Mr. Guan Kaiyun and Mr. Zhu Yuanzhang investigated the native and cultivation regions of Jojoba in U.S.A. and Mexico. They keep informed on how the advanced cultivation techniques, development and use in U.S.A. and Mexico, and collected 25 fine varieties (including local provenance) and 45 technical data in this visit. Laying a foundation for provenance cultivation experiment and Jojoba variety development by selection in dry and hot regions of Yunnan.

Professor A.N.Rao, National University of Singapore, delegated to visit Qina Jojoba planting plot by IDRC in March 1991. He put forward a proposal about work of planting plot, and appraised based on facts.

- **Research group**

Since item implemented, a group of experts of seven (above college degree) of Kunming Institute of Botany, had been carrying out an experiment of Jojoba on the following aspects:

a) Study on the sowing of seed; b) The observation and research of biological character; c) Study on the clonal propagation; d) Experiment of ecological adaptation; e) Study on the prevention and control of plant diseases and elimination pest.

- **Achievements in Research**

a) Through observing the growth and development of fruit-bearing plants, and determining the oil content of seeds. Under same environmental condition, comparison of data form provenance showed no significant change in growth in height. But the significant correlation were found in oil content(47.8～57.0%).

b) Observing the male and female plants of provenance. We found a part of plants (3-years old) had bloomed and set fruits.

c) Along the success of introduction Jojoba provenance, it is very importance we prorate bred male and female seedlings. On the base of study on neutral propagation in 1989and 1990, the propagation by cutting was used. In April, we collected the cuttings (semi-hardwood) from the flowering males and females, the cuttings were immersed in 2000ppm ABT or NAA solution for 1 minute, then cutting were done in send and perlite mixed base. After 90 days, the rooting rate was 72%, and the transplant survival percent was 94%.

d) Study on the prevention and control of plant diseases and elimination pest. Studying of fix date (10 day) and fix plants (224 plants in 6 sample lands). In the dry season (November to May), the appearance of yellowing of plants is evident. The peak of diseases is from March to May. In the rainy season (June to October), the rate of diseases development and diseases are relatively stable. The main inducement of disease development is as follows: 1) Jojoba is a xerophyte, its root has strongest sucking force. When the moisture content is between 2.5%~10%, the main and lateral roots of plant growth well. If the moisture content is on high side, the growth of root will be restrained. 2) In Qina, the soil is sticky, and the content of stone is high; in the rainy season, the draining and aerating of soil are poor, the growth of main and lateral roots were controlled, the growth of plant is feeble and the diseases resistance of plant is weak. 3) Sampling from the roots of diseased plants, and isolating and cultivating with PDA and Agar culture mediums. In the pure pathogenic bacteria, the main pathogenic bacterium is Fusarium (*Fusarium spp.*). 4) After selecting agrochemical, we done the experiment of chemical content with 0.2% Bavistin solution (pouring) in Jojoba plantation. The result shows: the agrochemical can control the growth of Fusarium, and the development and death rates decline.

Appraising the result of Research, Economy and Society

The growth period of Jojoba was along time, it blossomed in third year after planting, and teemed with fruits in 7~10 years old. Because this item carried out just 3years, so we were difficult to appraise the result of economy, society and ecology.

Through cultivation research in 3 years, we saw Jojoba have relatively good adaptability in planting plots. We can full utilize the natural resources and exploit land resources in dry and hot regions of Yunnan. First, we introduce more fine varieties from abroad, and select good and high-yield verities are suited to local conditions. Then, we further explore the cultural techniques of high-yield in Yunnan. We will through productive growing Jojoba on a trial basis progressively expand the planting area. Making the plantation development Jojoba relatively good and quick in dry and hot regions of Yunnan.

Suggestion and Appraise on item management

The course of application and examination and approval of IDRC's item is simply, that item is advantageous to race against time, establish item as quickly as possible and develop item.

The distribution and use of the aid financially is rational.

Because the international exchange were relatively few in our works, we knew very few about the persons of the same trade or occupation. We hope you can promote the international exchange, especially, sending people to study and training is very impotent.

We hope the information management and exchange have improved to same extent. For example, we got very less information from IDRC and Science and Technology Deportment in the item implement, this state of affairs is unfavorable to development an international cooperation item. We hope from now on there will provide the new information about item betimes, so that we can always know the recent development in science and technology.

We gained same achievement in scientific research and won initial success in the past 3-years under aid financially by IDRC. As a long time item, the number of years set for a course of the aid financially that is too short. When IDRC supports the forestry and agriculture item, we hope have a long time in the future.

REVIEW OF IDRC PROJECT OF CHINA AGRICULTURAL INFORMATION SERVICE

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I. Project Background and Objective

1.1 Project Background

Entrusted by the Ministry of Agriculture, the Research Institute of Scientific and Technological Information, on behalf of China, officially entered the International Agricultural Scientific and Technological Information System (AGRIS) of the Food and Agriculture Organization (FAO), the United Nations in 1983. According to the requirement of AGRIS work, it is necessary for each of the member states to set up a national center in its own country.

The realization of agricultural modernization is one of China's grand goals of four modernizations, while an advanced agricultural scientific and technological information service would stimulate the progress of agricultural production and scientific development, and accelerate the process of agricultural modernization.

Neither in the quantity and quality, nor in the means and methods, the agricultural scientific and technological information work in China is advanced with the facts that China had not yet established agricultural scientific and technological information database of her own, the computer retrieval was yet a blank of the agricultural documentation and literature in Chinese. That was not equal to the status possessed by China's agriculture in the world.

Setting up the AGRIS national center in China would strengthen and improve the agricultural scientific and technological information system, give an impetus to the modernization of the agricultural scientech information work, standardize and normalize the work of the existing agricultural scientech information network, so that it would play a better role in the agricultural production and scientific research in China.

On May 7, 1986, the Chinese Academy of Agricultural Sciences (CAAS) signed the memorandum of understanding with the International Development and Research Center (IDRC) for the grant project of China Agricultural Information Service, in which it is stated that in the four years period IDRC provide 358,000 Canadian dollars, and CAAS will invest 8.23 million RMB yuan as counterpart fund. Under the joint efforts from the two parties, the project has made smooth progress and obtained the expected objective.

1.2 Project Objective

1.2.1 Specific Objectives

(1) To set up the AGRIS national center, which will develop the ability of conveying Chinese agricultural scientific and technological information to AGRIS, and the ability of using the different products of AGRIS;

(2) Through training, a team for computer retrieval shall be established with the command of computer input/output techniques, and a computer retrieval network shall be formed;

(3) To set up the Chinese agricultural scientific and technological database, which will be integrated with AGRIS literature magnetic tapes to offer all the agricultural professionals in China computer retrieval and designated subject services;

(4) To carry out experimental research on the technique of computer input/output of Chinese agricultural literature for the realization of AGRIS products in Chinese;

(5) To form training capability for the sake of providing professional training on agricultural scientech information service to the other developing countries;

(6) To identify, collect and process systematically valuable agricultural documents generated in China; to make an effective participation of the activities of AGRIS for the mutual benefits among international community, and the guarantee of a rapid and effective information dissemination to users.

To set up the AGRIS national center in China which would be in charge of the national coordination of the work concerned: in the 7 great regions, 7 regional centers will be established respectively to identify, collect and process local agricultural information; to upgrade the facilities and resource conditions of the national and regional centers, to strengthen their processing and use capabilities of agricultural information; to conduct training on AGRIS methodology and information for information professionals.

1.2.2 Project Products

Chinese abstracts of Chinese and foreign agricultural literature; Index of Chinese agricultural literature; summary of special agricultural subject; project publicity brochure.

1.2.3 Project Service

Users' training; AGRIS and CABI magnetic tape special subject service; document dissemination (printed version and microfilm version) and information consulting service; translation service; AGRIS input and transfer to the AGRIS coordination center.

2. Project Implementation

The Research Institute of Information, the Chinese Academy of Agricultural Sciences (presently the scientech Documentation and Information Center, CAAS) has certain professionals, equipment and housing facilities, which would set up the system of computerized input of literature to AGRIS, organize the technical study tours to AGRIS headquarters and related regional and national centers, to learn the experience in setting up national centers. It would hold training on computerized retrieval, organize the input of agricultural literature, and extend the technical team. Regional AGRIS centers would be set up in the agricultural research and education institutions in the provinces concerned. The working staff would be recruited and the equipment installed. Domestic and foreign specialists would be invited to conduct research on input and output of Chinese literature.

2.1 Results of Project Implementation

2.1.1 Establishment of China AGRIS National Center and 7 Regional Centers

On the basis of investigation and argumentation, China AGRIS national center has been set up in the Scientific and Technological Documentation and Information Center, the Chinese Academy of Agricultural Science. At the same time regional centers have been set up in the information institutes of the provincial academy of agriculture of Hebei, Liaoning, Jiangsu, Hubei, Guangdong, Shaanxi, Sichuan, representing respectively of the regions of North China, Northeast, East China, Central China, South China, Northwest and Southwest. The tasks, responsibilities, work divisions and coordination methods have been formulated for the national center and 7 regional centers. It was agreed that a technical consultative meeting be held each year alternatively in the national center and 7 regional centers in a cycle of eight years. Starting since 1987, 4 meetings were held with the attendance of project leaders from the national and regional centers, in which current year's work was finalized and coordinated, and technical discussion was conducted. With the support from IDRC, the facilities and conditions have been improved and the qualifications of the personnel have been heightened. At present, there are over 70 people with high, middle and primary professional titles in the national center, and 5 – 7 professionals in each of the regional centers engaged in the work of China AGRIS system, constituting a basic technical team that is working efficiently.

2.1.2 Reinforcement of Dissemination of Agricultural Documents and Information

In accordance with the fixed objective of the project, the Scientech Documentation and Information Center of the Chinese Academy of Agricultural Sciences have initiated the serial publication of abstracts on foreign agriculture, i.e. the 6 volumes on crop genetic breeding, agricultural entomology, soil and fertilizer, animal husbandry, veterinary medicine, and biotechnology bulletin; the abstract series on Chinese agriculture cover food and economic crops, horticulture, plant protection, soil and fertilizer, animal husbandry, and veterinary medicine; the index series on domestic and foreign agricultural literature include Catalogue of Foreign Scientific and Technological Literature — Agriculture, and Catalogue of Chinese Agricultural Scientific and Technological Literature. Meanwhile the publication of Information Research on Agriculture and Animal Husbandry etc. was started, focusing on summary review of agriculture. Each year a total of around 90,000 pieces of information messages on domestic and foreign agricultural science was published and disseminated, consisting of more than 20,000 pieces of abstracts, about 70,000 pieces of titles, and nearly 100 summaries and reviews, which played a vital role in augmenting the use rate of agricultural scientific literature.

2.1.3 Electronic Computer System Basically Taking Shape

Of the IDRC grant, over 60% was consumed on equipping computer system in the national center and 7 regional centers. The national center was equipped with the small main computer of HP3000, Chinese and English workstations, 55 MB Winchester, 404-MB magnetic tape drive, 571 MB magnetic tape handling unit, Chinese and English printers and MINISIS software. These were delivered, installed, adjusted and put into operation from the late half of 1987. In the late half of 1988, an IBM PS/250 computer and CDS/ICIS software in Chinese was supplied by IDRC to the national center and each of the 7 regional centers, and was installed, adjusted and put into operation, including training. At the same time, in light of actual needs, the national center further purchased HP300/70 small main computer and related peripheral devices, thus making the basic shape of the electronic computer processing system in the national and regional centers. Since then a series of training activities was followed and the computer processing of agricultural information and literature was carried out in a planned, systematic and organized way. By the end of 1988, the input to AGRIS was started in the form of disk. The building of Chinese agricultural literature database was started in 1989.

2.1.4 The Resource Share of Chinese Agricultural Information and Literature Promoted

The national center and 7 regional centers regularly convey information on Chinese agricultural science and technology, in a coordinated and planned way, to the database of international agriculture of AGRIS and CABI. In the past few years, the input amount to AGRIS and CABI respectively are: 714 pcs and 800 pcs in 1985; up to 4500 pcs and 800 pcs in 1989; up to 6000 pcs to AGRIS in 1990. Comparing 1988 against 1985, the input amount to AGRIS was increased by nearly five times, but the quality desired to be improved. Being put into the database of AGRIS and CABI, the selected Chinese agricultural documents and information was quickly disseminated to different countries and regions in the world, many users wrote letters for reading and copying the materials. Meanwhile the tapes of CABI as well as tapes of AGRINDEX of AGRIS were used in the national and regional centers, and were popular with user and were given high remarks. At present, the constant users of CABI are as much as over 270 while the users of AGRIS exceeded 100.

2.1.5 The Building of Agricultural Literature Database Accelerated

Because of equipment and personnel conditions basically available, the building of agricultural literature database was started quickly. Under the unified guidance and clear division of work, in addition to the task for AGRIS input, the regional centers screen and select local agricultural literature generated from its own region respectively, using the same standards, make the selected into disk, submit to the national center for examination to control the quality, then input to the HP3000 main computer for building the database. Up to the present, the database of Chinese agricultural literature and information contains more than 400,000 pcs (titles), the database of research achievements of agriculture, animal husbandry and fishery contains over 5,000 pcs (documents), the database of Chinese agricultural literature abstracts, the databases of CABI and AGRIS are all established. These databases are available for user service, and are on experiment of distant online retrieval, the performance is good and users are satisfied.

2.2 Fund Expenditure

(1) The conduction of AGRIS literature online retrieval service and thematic information service, about 50,000 Canadian dollars per year;

(2) For the input to AGRIS, 5 microcomputers purchased, the total cost is 70,000 Canadian dollars;

(3) 1 set of microfilm duplicating unit purchased, including cameras, automatic developing and printing machine, microfilm duplicator, microfilm reading devices, which will offer service in copying the microfilm of Chinese publications when it is needed. The total cost is 60,000 Canadian dollars;

(4) According to demand, the related AGRIS literature is translated and published in

Chinese, yearly expenditure is 20,000 Canadian dollars;

(5) Professional study tour, 5 man/times, the total cost is 50,000 Canadian dollars;

(6) Professional training; twice in a year, the cost is 60,000 Canadian dollars;

(7) Invitation of domestic and foreign consultants on computer hardware and software, the cost is 50,000 Canadian dollars;

(8) Facilities purchased for conduction of international training course, the cost is 50,000 Canadian dollars.

2.3 Domestic Counterpart Fund

For the smooth implementation of the project, the Chinese Academy of Agricultural Science allocated a counterpart fund of 8.23 million RMB yuan, which is a great support to the project, guaranteeing the project accomplished excellently in time.

2.4 Instruments and Equipment

For the realization of the project objective, the small main computers of HP3000/37 and HP300/70 were purchased for the AGRIS national center, one micro-computer was purchased for each of the regional centers in North China, Northeast, East China, Central China, South China, Northwest and Southwest.

2.5 Personnel Training

In the period of the project implementation, China AGRIS national center held 22 training courses or workshops, the trainees and participants accumulated is 593 man/times, the details are as follows:

Contents of Training Courses or Workshop Names	Trainee No.	Time	Location
1. Training course on AGRIS Methodology	2	198703-04	Manila
2. Training on Input Method	12	198703-04	Beijing
3. Training on AGRIS	1	198712	Rome
4. AGRIS database structure and treatment method	1	198708	Vienna
5. Workshop on AGRIS input method	10	198712	Beijing
6.Training on computer and AGRIS data pre-treatment	19	198807	Beijing
7. Senior Course on MINISIS database management	4	198812	Beijing
8. Senior Course on MINISIS database management	1	198809	Ottawa
9. China AGRIS national center technical discussion and training	25	198811	Hebei
10. Workshop on literature subject indexing	40	198809	Beijing
11. Workshop on micro-computer based database of agricultural literature	43	198809	Beijing
12. Workshop on agricultural literature management and	49	198708	Liaoning

retrieval service			
13. Seminar on pre-treatment of agricultural literature database	25	198910	Hangzhou
14. Workshop on editing of foreign agro-scientech journals	29	198709	Harbin
15. Young Editors Seminar	33	198811	Hangzhou
16. Training course and workshop on building of agro-information computer retrieval system	52	198702-03	Shaanxi
17. Agro-information users training and workshop	40	198909	Jilin
18. Primary training on MINISIS database management system	32	198911	Beijing
19. Agro-information retrieval and users training course	50	198609	Beijing
20. Agro-information retrieval and users training course	41	198709	Beijing
21. Agro-information retrieval and users training course	32	198810	Beijing
22. Agro-information retrieval and users training course	50	198909	Beijing
Total	**593**		

2.6 Specialist Visits

In the process of the project implementation, the project staff attended twice AGRIS technical consultation meetings (the Fifth Technical Consultation of AGRIS and the Sixth Technical Consultation of AGRIS), attended thrice the annual meeting of MINISIS user group. The staff also took part in the seminar on strategy of agro-information development sponsored by the international agricultural librarians and document workers association, and the international seminar on plant protection information run by CABI. At the same time visits were made to IDRC Asia Office, AGRIS Asia Center (AIBA). These international meetings and visits enabled the project staff to know the development situation and trend of foreign agro-science and technology information, to get acquaintance with new friends and exchange experience, which produced a good effect in improving China's agro-information work, and promoted international exchange and cooperation.

In February 1989, Ellen Ruggrok, the senior program analyzer of IDRC Information Science Division, came twice to the office of system data treatment, the national center, to solve the problem of AGRIS tape format conversion. The settlement of the problem let the center use quickly AGRIS tapes to provide the users in the country with the retrieval service and special subject service of AGRIS database.

2.7 Research Team

The project implementation has brought up a strong team for pre-treatment, and hardware and software in China. Starting from December 1986, a series of technical training were conducted both at home and abroad on AGRIS methodology, software application of MINISIS, CDS/ISIS, DBASE as well as HP3000 and computer operation, Chinese input, literature classification and indexing for the building of database. 17 domestic training courses were held with a total attendance of 588 people. So far in the national and regional centers, a strong technical team has taken shape consisting of over 100 professionals engaged in hardware/software development and literature pre-treatment. The team is composed of 28 senior staff, 46 middle ranked staff, 49 primary ranked staff, and 13 auxiliary staff. During the time, the provincial institutes of agricultural information and colleges and institute of agriculture as well as research institutes have also employed and brought up their own professionals for agricultural information service. Now this team is reinforcing its technical force through training, apprenticeship and teaching in work, and working hard to fulfill the tasks assigned and coordinated by the national center.

2.8 Scientific Achievement

The implementation of the project has integrated into one line the Chinese database, editing, composing and printing in publishing the scientific literature. The computer based line of database building, editing, composing and printing has come true for the 6 periodical journals such China Agricultural Abstracts, of which a series of program software have been developed, including:

1. Streamlining program for computerized database building and editing/composing;
2. Streamlining program for editing of subject classification database. It uses WORD STAR software to input, then treats with program conversion. The word interrelationship of the descriptive words of " use ", " substitute ", " division ", and " reference " will be generated automatically, then the document will be conveyed to Micro CDS/ISIS software for sequencing;
3. Entry start/forming program for subject indexing. 9 function symbols are adopted to control distribution of the retrieval points and logic relation of descriptive words for guaranteeing the quality of entry index and raising the efficiency of labeling, which standardizes and automates the formation of entry index;
4. Computerized editing and control program for document sequential number. The sequential number of entry will be controlled automatically and the computerized sequencing achieved greatly increases work efficiency and accuracy. (see paper by Wang Huaihui).

3. Evaluation of the project scientific, economic and social effects

In the process of the project implementation, the objectives set for the project, with the common efforts and close cooperation, have been reached and fulfilled far beyond what were originally designed, e.g. the computer system of the national center was HP300/37 as its main computer. However in consideration of the work requirement, China raised fund by herself to add a main computer of HP3000/70 and etc.; the entry amount of the database of Chinese agricultural literature information exceeds the originally planned amount by several times; the amount of document input to AGRIS also surpasses what was planned in the forth year by 4,000 entries; the information amount of domestic and foreign agricultural literature that is disseminated annually by the national center to the whole country are more than the originally planned 50,000 entries by 80%. In summary the project has made smooth progress, successfully accomplished the original design concept. Its success is due to the correct guiding ideology, and the concentrated use of limited fund in the construction of the national center whereas the regional centers are organized to form a strong source of radiation for gradual spreading its influence. The result out of the 1st phase implementation of the project shall produce a far-reaching effect. It is because of:

3.1 A Tentative Analysis of Project Implementation

The result out of the 1st phase implementation of the project shall produce a far-reaching effect. It is because of:

3.1.1 The construction of the national center is already on certain scale, which could effectively organize and coordinate the agricultural information work in the country. The information products and technical scale of the center could not only tender service to information users in the country, but also plays a demonstration and leading role in the national agricultural information system. The setting up of the 7 regional centers have made the national center full-fledged. In the construction of the national agricultural information network, the national center serves as the main body while the 7 regional centers act as the key ones among the agricultural information institutions above provincial level. Along with the improvement of the equipment, the network as a whole will generate an ever increasing benefit in the strive for computerized offline and online retrieval of Chinese agricultural information literature.

3.1.2 As the 1st phase of the endeavor, the project has started dredging the channel to input Chinese agricultural literature in a planned way to the international agricultural database of AGRIS and CABI, at the same time it has created the condition to introduce to China the information products of AGRIS and CABI. Actually it has already begun dredging the channel for resource share of the database of international agricultural literature. As the majority of the countries that could not directly use Chinese literature may use the English title list and abstracts of the database of international agricultural literature. The project supported by IDRC as the 1st phase has made a good start in exploiting the information resource of Chinese agricultural literature. Based on this, the resource share of Chinese agricultural literature shall be extended step by step in the future.

3.1.3 The techniques initiated for building the database of Chinese agricultural literature, covering its pre-treatment and standard, Chinese keyword and indexing for agriculture, and the development of software etc. shall render experience for the building of database by the agricultural information and literature institutions above provincial level. Furthermore, as the national and regional centers advance, they shall tackle new problems, sum up experience all the time, circulate technical bulletin periodically to the agricultural information institutions throughout the country, and conduct technical training, so that the technical system for computerized retrieval of agricultural literature shall be updated continuously in the country.

3.1.4 In the national center and 7 regional centers, there is already a technical team of nearly 100 specialists engaged in pre-treatment and hardware/software, which is not only committed to the fulfillment of the tasks assigned by the national and regional centers, but also serves as a sowing machine in spreading the techniques to different places, in extending and enlarging the team. This shall surely produce a more and more great influence in the national agricultural information construction.

3.2 Agricultural Scientech Information Playing a Vital and Indispensable Role in Promotion of Agricultural development in China

China is a country with a population of 1.2 billion while her agricultural population accounts for over 80%. The agricultural harvest produces directly an impact on the pace of the development of the national economy. The flourish or sluggishness of China's economy is almost always a reflection of the agricultural production of the current or previous year. More population and less arable land per capita are a sharp contradiction for Chinese agriculture. Where is the way out? On the one hand, the way out is to carry out family planning for the control of population, on the other hand it is to rely on policy, on science and technology, and on input. From the long run, science/technology and input are fundamental, and science/technology possesses the greatest potential in particular. In the light of rapid development of science and technology of the present world, the radical solution to the problem of agricultural that has the bearing on the rise and fall of a country lies in invigorating agriculture by science and education, which is already put on the agenda as more important than it was never before.

The agricultural productivity must be increased, and efforts should be exerted in raising crop unit yield and effective use of agricultural resources. In certain high yielding areas, the yield per hectare is already as much as 15 tons, it would be rather difficult to further increase crop unit yield if there is no technical breakthrough. The development of science and technology could not be taken apart from scientific and technological information. In the world about 250,000 pieces of agricultural information are generated each year. In the past ten years, 25,000 important achievements of agricultural science and technology have been accumulated while about 40,000 pieces of agricultural literature and information are newly generated. This constitutes a tremendous potential productivity. The key for converting the potential productivity into actual productivity is to timely convey advanced and appropriate techniques and information to millions of farmers and thousands of scientists and technicians. The project of agricultural information service established and supported by IDRC since 1985 has met the need of Chinese agricultural development, and has made a prominent achievement.

China is a huge market for agricultural information, which currently owns as much as several million information users, whereas potential users are dozens of millions. The direct information of audio-visual materials is most popular with information users at the levels below county while written information market is also more and more flourishing. The journal of Agricultural Science and Technology once had the highest subscription amount of 470,000, and the Farmers' Abstracts had 1.2 million subscriptions. Electronic information products are much welcomed among scientists, researchers and teachers of the institutions above provincial level. Therefore supporting the development of Chinese agricultural information is bound to stimulate the prosperity of Chinese agricultural information market and to yield greater social and economic benefits.

REVIEW OF IDRC PROJECT OF TEA INFORMATION SERVICE

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I. The National of the Project

1. The Role of Tea Information in Scientific Advance of Tea in China

China is the home of tea, of which the southwest is the original place. The history of growing, making and drinking tea by Chinese people date back to over 3,000 years. Tea trees in other countries in the world are all originated from China either directly or indirectly. Tea is not only a traditional beverage product popular with Chinese people, but is also one of traditional Chinese export commodities. Tea at that time was one of important agricultural export products. Over 1,000 years ago, Lu Yu, a scholar of the Tang Dynasty wrote the book of On Tea, which is recognized as the 1st monograph on tea in the world. In history, the tea, tea technique, tea culture and tea books of China have made tremendous contribution to the dissemination and development of tea in the world.

After the year of 1949, along with the constant development of tea production in China, the tea scientech level and its information in China have also made great development and improvement. Till the end of 1980s, in China there were 1 national level research institute of tea (Research Institute of Tea, CAAS), 10 research institutes at provincial level, 9 research institutes at prefecture level, and there was tea specialty in 11 institutes of high agricultural education. All the research institutes and tea specialties of education institutions are attached with a tea information service unit, which are engaged in the collection, analysis and research of books, materials and information on tea, serve in the different forms of compiling journals, textbooks, training materials and audio-visual products, providing all round service, either paid or free, to tea production enterprises, institutions of research and education. For example, the work of tea scientech information in the Research Institute of Tea, CAAS has obtained apparent social and economic benefits in the fields of tea research and production service. Here are a few cases of the sort: (1) In the making of black tea, China used to adopt the natural withering in house, which took a long time for withering while fresh tea leaves tended to pile up and deteriorate. And usually the withering floor space took up about 60% of the total workshop floor space. In order to solve the problem, researchers acquired certain information in the book of Tea Manufacture from the book collection of the institute, and worked out a withering trough which was of simple structure, high efficiency, cheap and suitable for the application in large, medium and small black tea primary producers. The withering trough was quickly extended in the black tea producing areas in the country, which effectively promoted the development of black tea production in China. (2) The analysis of chemical residue is a technique of ultra-micro analysis, which is a difficult job. To work out an analysis method of a new agricultural chemical requires a long time and large amount of financial and material resources. The researchers of the institute found in the book of Residue Review that the method of using an enzyme in mouse liver to test the residue amount of organic phosphate was simple and reliable with high accuracy. After improvement, the method was applied to test tea leaves in combination with thin layer chromatography, which yielded an accuracy 100 – 1000 times higher than that of the previous method. This research result was accorded the Award of Agricultural Scientific and Technological Achievement by Zhejiang Province, and was adopted by many organizations. (3) In the research of comprehensive utilization of tea seed, researchers sought a great deal of literature of China, India, Sri Lanka, the Soviet Union and countries of the eastern Africa, then set the advanced level at home and abroad as the starting point. After 10 years of research, 4 new products were developed such as tea saponin, of which teaseed oil was awarded second prize for technical improvement by the former Ministry of Agriculture, Animal Husbandry and Fishery, TS – 80 emulsifier was given a third prize for invention by the State Science and Technological Convention. All those techniques have been extended and applied in production and obtained apparent social and economic benefits. The technique of teaseed oil alone could generate a value around 20 million yuan.

2. Relationship Between Tea Information and Extension of Tea Techniques

Tea producing areas are widely distributed in China, ranking the 1st in the tea growing acreage in the world. Nearly 1000 counties of the 16 provinces (and autonomous regions) are producing tea, where there are over 1 million hectares of tea plantations with a yearly production of more than 500,000 tons. Especially since 1979, the continuous deepening of the reform of China's economic system has brought about fundamental changes in tea production. The management system has been shifting from the state-run and collective-run to private individual run, whereas the unified purchase and distribution of the traditional planned economy has been giving way to the competitive sales of the market economy, the demand and supply of tea has been turning from seller's market to buyer's market, and the tea production has been changing from the sales according to production to the production according to sales. All the changes have broken the past production patterns, resulting in the emergence of a great number of individual tea dealers, specialized tea households. It is estimated at that time in the country there were 1 million households engaged in tea production, of which the production accounted for 70% of the national total. The present tea farmers are different from what they used to be, who are not only engaged in tea leaf production, but also do tea processing and sales. They desire scientech knowledge as well as market information, and their eagerness for acquisition of scientech knowledge is more imperative than ever before. When the then technical extension system was considered, the tea farmers might acquire technical service provided by the government technical extension system, information departments of research institutions. The ways for acquisition of techniques included attendance of technical meetings, receiving short term training, subscription of professional journals and documents. For the wide spread individual tea farmers, the most effective way to obtain techniques was through technical journals and technical materials, which was just the kind of information products the tea information departments were specially responsible for the production. So the tea information service is closely associated with the extension and application of tea techniques, and has made great contribution in the extension and application of tea techniques. Taking for example, the techniques in the 1980s such as the Integrated Production Technique of Different Teas, the Technique for Quality Improvement of Broken Black Tea, the Special Fertilizer for Tea Trees as well as the Techniques for Superior Tea Production, were all extended and applied widely through periodicals and journals on tea.

3. Information Service of Research Institute of Tea, CAAS

Under the Research Institute of Tea, CAAS, there was then a research division of tea information, which consisted of the literature group, editing group and information research group. There are book storerooms, reading rooms and reference materials rooms. The library contains a total of more than 20,000 books, over 500 periodicals and journals, over 7,000 technical materials as well as audio-visual materials, microfilm documents and a lot of statistical materials on tea production and sales.

In the field of tea information service, towards different readers, are published the technical periodical of Chinese Tea, the academic journal of Tea Science, the information publication of Foreign Agronomy – Tea, the retrieval journal of Tea Abstracts, and the information paper of News on Tea. Meanwhile efforts are exerted to provide audio-visual service, and open new service areas, achieving an excellent publicity effect. Information technical training courses had been conducted several times with a total participation of nearly 100 trainees, which brought up local tea information workers. Twice the national tea information work meeting was sponsored, in which a coordination group was formed with the institute as the leader. In the strive of 3 years, the Joint List of National Tea Scientech Literature was compiled and published, which had a collection of 25,000 literature titles running from 1949 to 1982. All this demonstrated that the Research Institute of Tea, CAAS had laid a good foundation for the development of tea information service.

It is shown from above, tea information service in China has an important bearing on tea research and extension of tea techniques, and the Research Institute of Tea, CAAS possesses the capability to conduct tea information service. But the work then could not meet the demand put by research and production, the existing problems mainly were: (1) A sound retrieval system of tea scientific literature had not been set up, incurring a low use of literature. It took a long time for scientists to search the literature and even failed sometimes. (2) along with the progress of the state Spark Program, the demand on tea information by tea farmers was increasing all the time. In nearly 1,000 tea producing counties necessary techniques and information were not yet available. While the information techniques, personnel and means of service in the institute then all lagged behind the development, which could not satisfy the need of users. In order to adapt to the new changes of the social development, and to offer thousands of tea farmers an effective service of tea information, the project of Tea Information Service was carried out by the Research Institute of Tea, CAAS and IDRC, Canada.

II. Project Period and Objective

1. Project Period: June 1988 - May 1991.
2. Project Objective

(1) To offer Chinese tea farmers and tea specialized households training on pragmatic techniques of tea growing and processing with conscientiously designed written and audio/visual materials.

(2) To strengthen the work of the scientists of the institute working on the tea demonstration sites at county level through enlarging the contents of tea growing and processing in the information service.

(3) To remold the information processing organ of the Research Institute of Tea, and improve the qualifications of information staff, so as to upgrade the information service to small scale tea producers.

(4) To provide AGRIS, the international information agency, with important tea literature through China AGRIS national center.

(5) To strengthen the contacts with foreign tea scientists and information workers, to promote the exchange of experience.

III. Project Implementation

1. Fund Expenditure In the 3 years of the project implementation, IDRC provided a fund of 203,255 Canadian dollars, while the counterpart fund from the Research Institute of Tea, CAAS was 800,000 RMB yuan. The fund was spent on the publishing and distribution of publications, purchase of software and equipment, training of information workers at home and abroad, tea farmers training courses, research visit abroad by project leader, the making of audio-visual products, personnel salaries, telecommunication and office goods.

2. Instruments and Equipment The project purchased 1 IBM286 and 1 IBM386 computers, 2 Epson printers, 1 NP-4540 Cannon copying machine. These facilities were relatively advanced at the time, and also were the earliest advanced equipment purchase by the Research Institute of Tea, CAAS,

3. Personnel Training

(1) September 9 to November 10,1988, 2 persons attended the Training Course on Computer run by the Scientech Documentation and Information Center, CAAS.

(2) May 7 to July 28, 1989, 2 persons took part in the Training Course on Information New Techniques and Computerized Library Service in the Asia Institute of Technology, Bangkok, Thailand.

(3) January to February 1990, 1 person attended the Training Course on Information Regeneration, in the Asia Institute of Technology, Bangkok, Thailand.

(4) November 12 to December 15, 1990, 1 person took part in the Training Course on Automation of Library and Information Center in University of Science and Technology, Malaysia.

(5) December 3 to 21, 1990, 1 person attended the Training Course on Abstract and Indexing in Philippines.

4. Research visit

The project leader and project manager visited Malaysia and Indonesia in the period of March 4 – 17, 1989, and also reported the progress of the project 1st year's implementation to IDRC Singapore Office. In the period of April 7 to 24, 1990, visit was made to the tea production organizations and research institutions of Sri Lanka and Turkey, at the same time a report was made to the IDRC Singapore Office on the project 2nd year's implementation.

5. Scientech Results

(1) During the project implementation, 9 information products were produced.

- Tea Science, academic journal, semi-annually, the total distribution amount of 6,000 researcher paper.

4.2 Research facilities

A batch of equipments were provided by IDRC during the three years of the project:

Olympus microscope	8 sets
Microscopic photography facility	2 sets
Canon NP—3025copying machine	1 set
Electrical typewriter	2 sets
Conviron E—7plant growth chamber	5 sets
IPM P—TX computer	1 set

These machines were distributed to institutions involved in the project.

4.3 IDRC funding

IDRC provided provide a total funding of 253,000 CAD for the project. 147,000 CAD of them were delivered to the Institute of Biological Control for research expenses, material, labor, experimental facility, training, meetings, transport and documents, and 106,000 CAD were managed by IDRC for research equipment, Chinese visits, international conference and books and journals.

4.4 Dissemination of research results

A number of achievements were obtained during the three years. 20 papers were published in various journals and about 60 reports were presented at number of academic meetings. The book "research and application of redeye bees in China" written by project manager, Professor Bao Jianzhong was published in both Chinese and English. A video tape on "Factorized production of redeye bees" was also made.

Review of IDRC supported project "Farming system" (1984-1993)

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Chinese Academy of Agricultural Sciences

1 Project backgroud

Improvement of grain production is always the priority of agriculture in China. Farming system reform has drawn attention from the government. In the past three decades, through continued efforts, the farming systems have changed substantially, the north margin of biannual rice farming system extended from latitude of 28 degree to 31-32 degree. Alternative rice and wheat system extended from the Yangtze River area to the northern margin of the North Plain (latitude of 40). The total area of rice in 1976 was 36.217 million ha and the total rice production were 0.126 billion tons, were 1.4 and 2.6 time of those in 1949. Since the late 1970s, rice farming system in China entered a adjusting and consolidating period, the cultivation index of arable land in some of the developed areas started to decrease, however, due to the farmers' enthusiasm aroused by reform of economic policies, the total rice production was actually increased rather than an expected decrease. The total rice production was 0.178 billion tons. Total grain production was 0.4 billion tons, averaging at 400 kg per capita, the shortage of warm dress and food supply was solved.

In March 1980 a workshop on farming system was held in the International Rice Research Institute, which was participated by researchers from relevant Asian countries and researchers and extension personnel of the IRRI. The workshop discussed the multiple cycle of cropping, improvement of rice production and strategies to stand against challenges of population expansion. A report "Rice farming system and development in China" was presented by Chinese Scientists. The report drew the interests of the participants, particularly the coordinator, D.V.R. Carengcl, of Asian Cropping System Network (ACSN) who proposed China to join the ACSN. Approved by the Ministry of Agriculture, Farm Husbandry and Fishery, China joined the ACSN in 1981.

In 1982, Senior program officers Dr Benta and Dr Cerengal of IDRC Asia Regional Office visited Jiangshu and Hunan provinces to study their rice farming system and reform. After the visit, they exchanged ideas with Chinese counterparts and agreed to make an application for support to IDRC. The application was approved and the project started in March 1984. With coordination by the Insititute of Agricultural Cops, CAAS, a research network consisting of 8 research institutes of Guangdong, Hunan, Zhejiang, Sichuan, Beijing provincial agricultural academies. During 1984-1985, experiments were established in various places in Guandong Xinhui (N22° 32'), Hunan Changsha (N27°51'), Zhejiang Shaoxing (N30°01'), Sichuan Guanghan (N13°58'), Beijing Tongxian (N39°35'), Liaonin Liaoyang (41°11'). The first phase of the project was for 3 years (1984-1986). It was actually delayed to March 1988 and followed by the second phase (1988-1991) study. The research network for the second phase study expanded to include Institutes of Agricultural Crops, Agriculture Economics, Soil Fertility and Agricultural Meteorology of CAAS, and 13 research institutes of provincial agricultural academies of Guangdong, Hunan, Zhejiang, Sichuan, Shanghai, Jiangshu, Beijing, Liaonin provinces. 20 institutes in total were involved in the project. During the second phase of the project all the experiments sites (except the on in Guangdong Xinhui) were changed to places where the production was at medium or low level.

2 Project implementation

2.1 Objectives

The long-term objective of the project was to establish highly productive, stable, efficient and beneficial rice cropping systems suitable for local ecological conditions and economic development in China. While improving the grain production, the project aimed at expanding number of agricultural products and improving the ration of output to input per unit area, hence improving the economic benefit. The specific objectives included: to completely evaluate existing rice cropping systems to analyze their production, ecological and economic benefits; to develop rice-rice, rice-oil, rice-feed, rice-by products cropping systems in order to meet the diverse market needs, improve income and maintain and improve soil fertility; to improve cultivation technologies which are the key component of cropping system in order to improve the annual total production; to develop integrated rice-husbandry, rice-fish systems to promote the development of by products and to establish a balanced ecological chain, hence improving economic benefits; to develop research methodologies for studies on cropping system by combining experiences of other Asian countries with experiences obtained within China; to improve research capacity by international academic exchanges including international training and conferences.

2.2 Major research projects

1) Evaluation of existing cropping system. Permanent observation stations were established to study the productivity and stability as well as their influences on soil fertility under different cropping systems in the major rice producing regions in Guangdong, Hunan and Sichuan provinces, respectively with existing 8, 12 and 8 local cropping systems, including fertilizer-rice-rice, wheat-rice-rice, oil-rice-rice, idle-rice-rice, fertilizer-rice, oil-rice, wheat-rice. The experiments were observed for 5-8 consecutive years under the same culture system.
2) Development of new cropping system, involving Guangdong, Hunan, Zhejiang, Beijing and Sichuan.
3) Series of cultivation technologies. These included variety trials, high temperature resistant hybrid rice development, direct seeding, dry rice cropping, fertilization etc.
4) Integration of agriculture with husbandry. Studies on rice-pig, rice-cattle systems in different regions.
5) Combination of rice with fish. In Hunan Huaihua and Jiangshu Yixing, studies on systems integrating rice cropping with fish raising.
6) Assessment of economic benefits of cropping systems and research methodology.

2.3 Project Funding

The project was in IDRC priority area and fit the realities of agriculture development in China. The state Science and Technology Commission, Ministry of Agriculture and Provincial and local governments attached great importance to the project. The total investment for the 2 phases was 4.5 06 million Yuan RMB of which about 2.4 million RMB (489,620 CAD) was provided by IDRC, accounting for 52.8%. The rest invested by the CAAS and other collaborators was about 2.127 million RMB accounting for 47.2%. Of the IDRC fund of 849,620 CAD, 306,800 was managed by IDRC and used for international conferences, international study tours, overseas short training course, MS student training, visiting scholars, consultancy and equipment, 542,820 CAD was managed by the CAAS and used for experiment subsidy for the farmers, domestic training courses, domestic study tours, domestic training, travel of the coordinators and equipment. Funding provided by collaborators were mainly used for salaries, labor wages, experimental material, technical training, workshops, study tours, experiment facilities etc. IDRC provided one 286 and 486 computer each, one 24 pin dot printer, one laser printer, one fax machine, two copying machine and one projector.

2.4 International Exchange

During the 8 year from 1984-1991, with support by IDRC, 27 researchers were sent overseas to attend the short training courses (1 – 5 months) held by IRRI including training courses on "Methodology for cropping system research", "Arid crop improvement", "GIS application in agriculture" etc. Although some of the training could not be directly applied in operational practices, majority of trained researchers became the core research power of the project. Due to funding constraints, the number of researchers trained overseas could not meet the real demands for training. It was decided to conduct domestic training courses by inviting scientists from IRRI to give lectures together with other Chinese experts. 7 training courses such as "Methodology of cropping system studies", "Computer application in cropping system studies", "Dry cropping of rice" and "water and labor saving rice cropping" etc. were held and 356 persons form collaborative research institutes were trained.

111 researchers from Asian Cropping System Network member countries, IRRI, CIMMYT, ICLARM, IITA, IIRR visited the project at various times. Two working meetings of the Asian Cropping System Network were held in China in 1983 and 1994 respectively, a total of 11 Chinese researchers made presentations at the meetings and received wide interests by participants of the meetings. An IDRC senior officer once praised that the project had a multidisciplinary research team and attached importance to the transfer of research results to productivity and that the project researchers had a good team work, good collaboration among institutes within the academy, between the academy and the provincial academies, and good collaboration with local units at the experiment sites. The project was also praised by the coordinator of the Asian Cropping System Network, pointing out that the project first paid attention to "sustainable agriculture development" and start to conduct studies on this issue. In May 1990, a joint delegation of IRRI and CIMMYT visited China's rice-wheat cropping system and was deeply impressed. CIMMYT Asian representative Dr. Hobbs decided to organize a visit by researchers of the South Asia Rice-Wheat Program member countries of India, Pakistan, Bangladesh, Nepal in the harvesting season, November 1991 to learn Chinese Rice-Wheat cropping technology. The delegation of 8 researchers visited Jiangshu, Zhejiang and was deeply impressed. They indicated intention to explore opportunities for future cooperation. A tractor and its related tools were purchased by Nepal during the visit.

45 persons/times of the project researchers joined the working group meetings from the 12^{th} to 22^{nd} of Asian Cropping System Network, international study tours and relevant international workshops organized by the Network. 49 researcher papers were published in journals or presented in international conferences. In 1987 and 1988, 3 visiting scholars were sent to IRRI to conduct one-year collaborative studies on hybrid rice, multiple harvesting, and green fertilizer.

Through the 10 years of international academic exchanges, close cooperative relationships with world counterparts, particularly the neighboring Asian countries were established, strengthening the understanding and friendships among scientists, so that they could help and learn from each other, making progress together.

2.5 Research Team

At the start of the project in 1984, there were only 13 researchers working on the project, of which 4 were senior researchers, only agronomy was involved in the study. Up to 1988 when the second phase started, the team expanded to 55 researchers, the project involved 9 research fields of agronomy, agriculture economy, agriculture ecology, agriculture meteorology, agriculture mechanics, soil fertilizer, pasturage, feed and aquaculture. There were 19 senior researchers working on the project. In 1993 when the project completed, there were 10 research professors and 10 associate research professors. Zhou Liuyan and Tan Zhonghe were promoted to president and vice president of Liaonin and Sichuan provincial agriculture academies respectively. Ying Jifeng from Chinese Rice Institute and Wang Guofa from Zhejiang Provincial Agriculture Academy studied for master degree in Chiangmai University, Thailand and got excellent accomplishments. The project established a multidisciplinary research team of good combination of scientists at various levels.

3 Main research results and their application

The project has achieved a number of achievements:

3.1 Evaluation and utilization of existing rice cropping system

It was determined that wheat-rice-rice, horsebean-rice-rice (Guangdong), greenfertilizer-rice-rice, rapeseed-rice-rice (Hunan), barley-rice-rice (Zhejiang), wheat-rice, rapeseed-rice (Sichuan) were good cropping system for the local conditions. These cropping systems were good for grain production. The annual unit grain production for these systems were the most productive during the whole experiment duration with stable production and high production value and net benefit. With the same fertilization, the contents of soil organic matters, the whole nitrogen and whole phosphate did not decrease but increase for these cropping systems. A striking results was found from the 6 year of stationed observations. Although the wheat-rice-rice system was generally considered a soil degrading triple harvesting system, with the wheat and rice residues returned to the soil and application of 1000 kg/Mu organic fertilizer (Pig manure), the content of soil organic matters increased from 1.84% prior to the experiment (1979) to 3.01% when the experiment completed (1985), whereas content of organic matters for the greenfertilizer-rice-rice system increased from 1.84% to 2.52%.

Similar results did apply to the contents of whole nitrogen and phosphate. Non-treatment experiment in 1986 further proved that the triple-harvesting system had better supply of three key soil elements and higher rice production compared with the greenfertilizer-rice-rice system. This provided reliable evidence for multiple harvesting systems in China.

Research results indicated that shift culture of rice with dry cultivating crops of mealie, soybean, peanuts and the like could significantly improve soil penetration, reduce the content of deoxidizing matters, improve the output/input ratio of nitrogen fertilizers and cost effectiveness. Experiments in Guangdong made integrated comparisons of different cropping systems for 3 years of shifting cultivation, the grain-oil crop-potato system ranked first, the grain-oil crops-beans-green fertilizer system ranked second, and the grain-beans-green fertilizer ranked third. The system of wheat-rice-rice ranked the top in production, soil fertility and nutrition balance, but due to the low effectiveness of investment, labor and energy, its integrated evaluation was ranked forth. The same results were also obtained in Sichuan. These results indicate the need to change the single grain cropping system. Experiments at different altitudes in Hunan showed that at 560 meter of altitude, the per-unit production was lower of main greenfertilizer-rice-rice cropping system in the province than rapeseed-rice, horsebean-rice, horsebean+mealie-rice and patato-rice systems. Therefore, the cropping system should fit the local ecological and environmental conditions.

3.2 Development and application of new cropping system

In Hunan there was lack of animal feed, the annual consumption of rice for pig feed was 1.5 million tons. The output/input ratio and benefit were low. The Use mealie as pig feed was successful. Two new cropping systems of mealie-rice and mealie+horsebean-rice were developed. In 1985 the systems were extended to a total area of 254 ha in Changsha, Wugang, Hengyang counties, average production was 443 kg/Mu for mealie, 438 kg/Mu for rice totaling at 881 kg. It was 15.5% higher than the rice-rice system as control. In 1986, total extension area in the province was 2930 with an average production of 891 kg. In Guangdong, a new cropping system of vegetable-rice-rice was developed to make use of the wintertime. Zhejiang developed a new barley/watermelon+mealie-rice system based on the system of barley/watermelon-rice to improve the grain production. Experiment showed that inter cropping with 800-1000 individuals of mealie could increase the mealie production by 95.4 kg without obvious effects on watermelon production. During 1988-1990, extension of the system reached 15,000 ha, increasing the mealie production by more than 20,000 tons. Sichuan expanded the existing wheat-rice and rapeseed-rice systems to a triple harvesting system of wheat-rice-sweet potatoes in order to make use of the 60 days interval between the rice and wheat. Up to 1987, the area of this cropping system reached 27,000 ha, bringing a increase of benefit of 37 million RMB. The wheat-rice-sweet potatoes later improved as wheat-rice-short life cycle crops (vegetables, greenfertilizer, mealie) and rapeseed-rice-short life cycle crops (vegetable, mealie). Experiment results indicated that the Shandong cabbage had the highest production and benefit and the next were potato, early cabbage, radish and lettuce. The greenfertilizer had the lowest benefit. These crop systems were extended to 135,000 ha in 1990, but their production was still unstable.

The common feature of the cropping system research in the north was that they aimed at water saving, less labor demanding and high production. During 1984-1987, encouraged by the State Agriculture Technology Extension Administration, the dry rice cropping system was employed with a total area of 0.48 million ha and rice production of 2.52 million tons, contributing substantially to the rice development in north China. Experiments in Tongxian county of Beijing suburb showed that the wheat-rice system had the highest average (over 4 years) annual production (10.3 ton/ha), barley-rice system with 8.4 ton/ha, rapeseed-rice with 7.5 ton/ha, greenfertilizer (pea) -rice system and greenfertilizer (rapeseed)-rice system had the lowest average annual production respectively of 4.6 and 4.4 ton/ha. However, all of the above 5 systems resulted in decrease of contents of organic matters, whole nitrogen and whole phosphate in the soil after 3 consecutive years of cropping. During the second phase of the project, Beijing succeeded in introduction of rye, hence developed a new rye-rice cropping system. Average production of rye and rice with the system during 1985-1988 was 24.6-35.4 ton/ha and 4.8-6.7 ton/ha respectively. This system provided new opportunity for integrating agriculture with by-products and promoting milking industry. This also provided new technology to solved the soil degradation problem caused by dual harvestings of dry cultivated rice.

Dry rice cropping and ground covered rice cropping was successful in Liaonin, with evident water conserving effects and economic benefits. The area of dry rice cropping was 25,600 ha in 1989 with an average production of 354 kg, saving 400 m^3 of water compared with water raised rice. There was 30,000 ha of ground covered rice cropping in Lioanin and Jilin during 1987-1990. The average production was 473 kg, increasing production by 59.6% compared with previous mealie production. The effects of increasing production were even evident in even colder regions.

Hunan started to test dry rice cropping in rain-fed fields. Results indicated that hybrid rice was more adaptable to dry cropping than the usual rice and more productive. Earlier seeding and ground covering promote early flowering, reducing effects of summer drought. Unit area production increases with amount of fertilization. Effects of pre-fertilization were larger than post-fertilization. A set of rain-fed dry cropping technologies with Hunan characteristics was developed. Rice production was 400 kg/Mu.

Sichuan tried dry rice cropping in rain-fed fields in hilly areas and in young orchards, and found that "wheat/mealie/sweet potato+ dry rice cropping" and "wheat-sweet potato+dry rice cropping" systems had the highest production of 684.3 kg/Mu and 682.3 kg/Mu respectively. Different hybrid combinations were tested to select superior hybrid rice.

3.3 Hybrid rice cropping

Since the late 1970s, hybrid rice was rapidly developed in Shicuan. Until 1983, the area of hybrid rice reached 1.429 million ha. However, at sites below 400 m in the river valleys in southeast ern Shicuan, the hybrid rice did not have obvious improvement of production. The main reason for low production was found to be the high temperature during the pollination period. By using warm resistant hybrid rice and two stages of seedling raise, the rice could ear before the peak time of high temperature in later July, hence largely reducing the harm by summer high temperature. In 1983, the hybrid rice was cropped at 8 villages between elevations of 190-350 m with an area of 1,000 ha and average production of 7.8 ton/ha, increasing 25.3%-40% compared with the normal rice varieties.

3.4 Direct seeding of hybrid rice

In order to reduce labor demand and other consumption for rice cropping and to improve production, Hunan tried direct seeding of rice. Experimental results proved that direct seeding could improve soil structure and fertility, and enhance the activities of microorganisms and enzymes. From 1983 to 1985, the rice production was 402.7 –551.3 kg/Mu, 26.4% higher than the ploughing and transplanting system. The extension and demonstration of direct seeding was started in 1986 and the area reached more than 3,000 ha. It reached 43,900 ha in 1999.

3.5 Integration of agriculture and by products: rice-pig and rice-cattle systems

The first development was the combination of grain and feed. Jiangshu adopted two systems of wheat-mealie and wheat-rice in drought fields with difficulty for irrigation. While stabilizing the rice production, the feed production was improved, promoting development of farm husbandry. Similar systems were also applied in Shanghai and Beijing.

3.6 Rice-fish system

Hunan Huaihua tried to introduce the rice-duckweed/fish cropping for double harvesting rice system into single rice harvesting system. Studies on field preparation technologies, and technologies for high production of rice and fish and their economic and ecological benefits were conducted. Results indicated that the rigged rice-duckweed/fish system was an appropriate technology for improvement of ecological condition of rice fields and soil fertility, hence increasing the production and income. Rigged direct seeding was 11.1/%5-16.4% more productive than rigged transplanting. Fish production increased 95.5 kg/Mu by storing more water after rice harvesting and supplemented with feeding.

In Jiangshu yixing, the rice-fish system was supplemented with pool fish production. Rice field was mainly for reproductive fishes, providing large number of young fishes for pool fish production.

3.7 Publication of methodology of farming systems suitable for Chinese realities

The features of the methodology are: 1) suitable China's realities; 2) comprehensive and cross-disciplinary; 3) generality and specialty. The generality refers to many economic criteria common to many countries. The specialty refers to some of the criteria reflecting China's future market economy. The publication of the methodology substantially reduced the gap between China and other countries in cropping system studies.

During the past 10 years, 14 prizes were awarded to the project in different provinces and municipals. Of these prizes 3 were first grade prize, 2 second grade, 9 third grade prizes and 1 forth grade prize.

The project closely connected with practical production and served for the practical operation. Research achievements received attention by leaderships at various agricultural production departments. Many of the technologies developed by the project were listed as key technology transfer programs by the State Agriculture Technology Extension Administration and Sichuan, Hunan, Lliaonin provinces, making it possible for quick transfer of technologies into productivity. It was roughly estimated that the extension area of the project research results reached 8.17 million ha, bringing income increase of 0.6 billion Yuan RMB during 1988-1991.

4 Recommendations

1) The effective support from IDRC resulted from through understanding of the project by IDRC program officers. IDRC program officers participated in all cooperative working meetings including the feasibility study tour. They closely interacted with Chinese researchers and local people.
2) The effective IDRC support also attributed to deep understanding of Asian cropping systems by IDRC. IDRC was a donor for the Asian Cropping System Network, It supported China to join this Asian Network to conduct cooperative studies.
3) To apply for IDRC support, understanding of IDRC priority areas for support is necessary. The project proposal should be prepared according to IDRC's funding priorities.
4) The project completed in 1993, due to the shift of funding priority from agriculture to environment and resources, applications made to IDRC were not approved any more. Funding in environment and resources is necessary, however, the consideration that the world food production is secured was not a reasonable idea. Practices proved that the food problem is still a serious problem particularly for the developing third world countries. We hope that IDRC continue to support studies in agriculture.

Review and assessment of the China-IDRC cooperative research on rapeseeds breeding

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The IDRC project rapeseeds breeding started in 1983 and completed in 1996. The three-year effective collaboration produced a number of high yielding, high quality and resistant rapeseed cultivars. These cultivars were widely used in the major rapeseeds production regions and brought significant social and economic benefits.

1 Project background

Rapeseed is an important oil crop and a major source of vegetable oil for daily life. Before 1970s, only the traditional rapeseed crops were used in China. The oils produced from them have high content of 4 types of compounds of fat acids that are not easy to be absorbed and have low content of fat acid compounds easy for absorption. The residues of these rapeseed oils contain as high as 110-140 μ mol/g of compound that could be poisonous. Genetic improvement of rapeseed needs to be carried out.

Canada started the genetic improvement of rapeseed in the mid 1950s, since the first report of new variety of Oro in 1964, a number of new varieties of rapeseed were developed during the early 1970s. Since 1967 hybrid breeding were started. Some new hybrid varieties were developed during the later 1970s and early 1980s. Since the 1980s, Canada has made wide application of the superior varieties. Meanwhile, hybrid breeding was carried out to explore heterosis in order to improve the resistance to disease, pest, cold and herbicide. Up to 19822, all rapeseed productions were using genetically improved materials. The superior varieties were also introduced to European countries such as Germany, Sweden, Britain, France, Poland and Australia.

China started to introduce the Canadian bred varieties in the 1970s and extended to large area. In the late 1970s, some research institutions started genetic improvement of rapeseed. From the 6th five-year plan, rapeseed breeding was included in the national key research program, upto 1982, 16 research institutes were involved in rapeseed breeding and 53 new varieties with low content of poisonous compounds. In 19880 the State Science and Technology Commission (now the Ministry of Science and Technology) signed memorandum of cooperation on science and technology, and was responsible for coordination of IDRC projects in China. The rapeseed-breeding project was started in October 1983. Until 1996, 3 phases of rapeseed breeding program were conducted.

2 Project Implementation

The China-IDRC rapeseed-breeding program was conducted for 3 phases from 1983 to 1996. The first phase was from 1983 October to 1986 October, the second phase was from 1987 April to 1990 March and the third phase was from 1992 April to 1995 March. There was one year between the phases and a half-year extension after the second phase. The breeding program passed a time span from the 6th to 8th 5-year plan.

The host institutes of the first phase project were the Institute of Oil Crops, CAAS, Shanghai Academy of Agriculture and Qinghai Academy of Agriculture and Forestry. The Xinjiang Agriculture Academy was included in the second phase project and in the third phase one more academy, the Guizhou Agriculture Academy was included.

2.1 Project funding

IDRC provided about 0.2181 million CAD, more than o.52 million CAD and 0.28 million CAD respectively in the first, second and third phases. The corresponding funding from China was 0.5, 1.6 and 3.8 million Yuan RMB respectively in the first, second and third phases (Table 1).

Table 1, Funding from China and IDRC for the project

	Phase I		Phase II		Phase III	
Institute	IDRC (CAD)	China (RMB)	IDRC (CAD)	China (RMB)	IDRC (CAD)	China (RMB)
CIOC	8.96		4.369	31.715	5.900	106.55
SAA	6.72		6.300	54.744	8.880	95.20
QAA	5.13		5.100	47.890	3.680	36.77
XAA			4.213	36.000	5.71	98.75
GAA					3.134	42.9
MOA			1.600		1.080	
Total	20.81	160.56	21.582	170.349	28.386	379.56

IOC: Chinese Institute of Oil Crops, CASS; SAA: Shanghai Agriculture Academy; QAA: Qinghai Agrixulture Academy; XAA: Xinjiang Agriculture Academy; GAA: Guizhou Agriculture Academy; MOA Ministry of Agriculture.

2.2 Equipment

At the beginning of the project, IDRC provided 3 spectrometers, 3 sets of seed pulverizer, 3 sets of rotating evaporator, 1 set of nucleus and magnetic resonator, a number of batches of laboratory consumables and chemicals etc.

3 Training and visits

Exchanges of visits by researchers were attached importance by both Chinese Institutes and IDRC. Before the implementation of the projects, Visits to each side were made for feasibility studies. During the implementation, annual evaluation, works shops and academic meetings were held each year participated by both Chinese researchers and IDRC researchers from 1984 onwards. In 1994, Shanghai Agriculture Academy sent delegates to IDRC as the representative of Chinese project institutes to celebrate the completion of the cooperative research.

A international workshop on rapeseed research was held in Shanghai in 1994 and was participated by more than 123 people from 18 countries. 85 research papers were presented to the workshop. The workshop did not only share the information and research achievements, but also expanded the impacts of the China-IDRC cooperative rapeseed research.

In 1985, Dr Kimbel from Canada was invited for lecturing a training course held in CIOC (Wuhan) on biotechnologies of rapeseed. In 1987, Dr Mcgregor came to CIOC and gave a training course on TMS analysis. In 1989, Canadian experts were invited to Shanghai Agriculture Academy for giving a training course on rapeseed biotechnology.

Annual training courses were held within China to train the grassroots technicians and farmers, more than 3000 people were trained in the training courses, greatly improved the capacity of local technical personnel.

4 Research achievements

By the efforts of more than 100 researchers and technicians of the 5 academies and through about a decade of continued studies, the research capacity was greatly improved. The research project facilitated the rapid development of rapeseed research and crop production in China, expanding China's influence in rapeseed research in the world. China became the second largest country of rapeseed production. Great success has been made in selection of rapeseed varieties for different ecological conditions, monoploid breeding, testing techniques for compounds of the oil, collection of genetic resources, identification of genetic quality and resistance.

4.1 A number of superior new varieties with low content of unwanted compounds were developed and extended in mass production. It is worth mentioning that the series products of "Zhong Shuang" developed by the CIOC has made breakthrough in reducing the contents of the two poisonous compounds in the oil and resistance to a bacteria caused disease. The products were the first in the world that have high resistance to the disease. The products adapted to wide range of site conditions and were widely used throughout the country. Another superior variety was "Chun You 14" developed in Qinghai. It was the spring rapeseed that has the highest quality, the highest productivity and the widest adaptation and can be used to replace the introduced exotic rapeseed varieties.

4.2 A number of new lines with low contents of the two poisonous compounds and hybrid combinations for these lines were developed. All these have been under the pilot trials and multi-site trials.

4.3 New breeding technologies were successfully applied: by artificial treatment for the rape seeds and greenhouse transplanting, the rapeseed can be cropped one more cycle in a year, reducing the breeding cycle and the cost. A rapeseed spores culture facility was established in Shanghai and its application in practice has been started. Technical examination has approved this technique in 1990.

4.4 Significant progress has been made in rapeseed production technologies: paper bagging, yarn covering and net shading to protect from pollen contamination and maintain the genetic quality. Using natural barrier, 800-100 meter wide isolation buffers, no bee releasing, and clearance of buffer zones before flowering can also be effective in protecting pollen contamination.

4.5 Analysis method for content of poisonous compounds was developed and used in breeding.

4.6 More than 250 different sources of local genetic material of rapeseed were collected in Guizhou and a few disease resistant and high oil content sources were selected.

4.7 More than 40 research papers in rapeseed genetics, testing and analysis, reproduction technology, breeding technologies, were published, some of them were widely cited world wide.

4.8 Exchanges of genetic material between Chinese project institutions and Canadian institutions and documentation of genetic analysis.

5 Scientific, economic and social impacts

During the implementation of the project, IDRC provided substantial support in research equipment, breeding technology, research fund, genetic resources, technical training. By the efforts of all research institutions, every phase of the project has made significant achievements, promoting the rapid rapeseed development in China. So far, back ups of rich genetic resources for breeding were established, technologies of cultivation, quality testing have been developed. More than 100 institutions in China are now working on genetic improvement of rapeseed. The more than 10 years of China-IDRC cooperation on rapeseed research has greatly facilitate the rapeseed development in China, laid the solid foundation for China to become the world largest country for rapeseed breeding and production.

It was estimated that the area of the 14 superior varieties bred by the project was approximated 10 million Mu in 1995 and the accumulative area was more than 40 million Mu, accounting for 47.94% of the total area of rapeseed crops in China. For example the "Zhongshuang 4" was one of the most excellent variety, in 1995 only, the cropping area of the variety was 7.5 million Mu and accumulative area was more than 10 million Mu. The annual cropping area of it was still 5 million Mu in recent years.

Rapeseed is a soil-improving crop, suitable for the region along the Yangtze River and Huang Huai River systems. It grows in winter and does not compete with the grain crops for land. So it is good for making use of winter idle land and good for the winter cropping in southern China. Development of oil crops not only improves the unbalanced cropping structure but also provide high quality rapeseed residues for animal feeds, tackling the shortage of protein feeds, pushing forward the processing industry.

The cooperation with IDRC promoted the wide range of exchanges between China's rapeseed researches with Canada and other developed countries, improving the research quality and international reputation in rapeseed research. The more than 40 research papers in genetics, testing and analysis, breeding technologies etc. published during the cooperation have been widely cited in many countries.

Furthermore, the IDRC project produced 8 doctoral and postdoctoral researchers, and 5 master students (one was not completed due to illness) for the Chinese institutions. The project also supported training in Canada for 4 researchers.

6 Assessment and suggestions on project management

The project was initiated under the memorandum of science and technology cooperation between China (the State Science and Technology Commission) and IDRC. The Department of Science and Technology, Ministry of Agriculture and the IDRC were the management authorities in China and Canada respectively. This type of project governance was effective, practical, coordinated and efficient and facilitated the implementation of the project.

Regarding the use of research funding, the host institution submit annual financial report on details of spending to the responsible authority and the authority conduct examination and report to SSTC and IDRC, finally IDRC made confirmation and announced the report.

During the implementation, there were frequent international exchanges. With support from IDRC, the Chinese recipient institutions sent researchers to Canada, Britain, France, Germany, Sweden, Australia, Poland, US and India for study tours, conferences, substantially facilitating exchanges of genetic material and research information, learning of foreign technologies and mutual understanding. Also the project held annual workshops by inviting researchers from Canada and other countries and from Chinese researchers within China. In addition, training courses for technicians were held to share and disseminate advanced technologies, making rapid application in practices.

The shortcoming of the project was that there was lack of sufficient planning in inviting foreign researchers to China for lecturing and inspections. There was no direct contacts with the invited researchers before their arrival, thus the outcome of the visits was not too ideal. In general, the cooperative rapeseed project was very successful and fruitful. IDRC provided substantial support to China in rapeseed research with out any additional condition. The project was regarded as an "excellent mode project of IDRC supported third world projects".

7 Other foreign aided projects

During the implementation of the project, there was China-US rapeseed cooperation and China-Australia rapeseed cooperation in the Institute of Oil Crops, Chinese Academy of Agricultural Sciences. The China-US cooperation on rapeseed was between the Institute of Oil Crops, CAAS and the US Calgene Company and conducted during the period from 1988 to 1991. The cooperative research included exchange of 20 varieties (lines) of rapeseed crop and evaluation of their adaptation to both Chinese and US site conditions. In addition, exchange of visits to both countries was made.

The China-Australia cooperation on rapeseed was conducted during the period from March 1986 to December 1991 between CAAS and ACIAR (Australian Center for International Agricultural Research). The research activities included hybrid breeding of rapeseed. ACIAR provided about 0.5 million Australian dollars to China for research expenses, equipment and consumable, postgraduate training, visiting scholar and exchange of visits. The achievements obtained from this cooperation included: enriched the genetic characteristics by crossing between the materials from both countries; started the studies on utilizing hybrid heterosis and laid foundation for further selection of hybrid lines; established two advanced testing facilities for oil component testing and trained 1 Chinese technical staff. The cooperation accelerated the breeding progress of rapeseed in both countries.

An review of IDRC project
Development of new generation spawning promoters and its application

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1 Project background

Fish reproduction was affected by many kinds of hormones produced by the hypothalamic-pituitary-sexgland axis. Of these hormones, the GtH produced by pituitary plays a major role. Artificially bred fish usually do not have ovulation under artificial condition. It requires artificial measures to induce spawning to produce sufficient eggs. For a long time, external GtH was used for induced spawning. The external GtH was pituitary serum of carps or HCG extracted from pregnant women's urine. Although these external GtH were effective, the supply of them was limited, and their viability was instable and difficult for long time storage. In addition, the cost was high. The use of these external GtH could not meet the demands by the development of artificial fish production. From 1979 December to the end of 1981, I studied as a visiting scholar at the laboratory of the well-known professor R.E. Peter in fish reproductive biology at the University of Alberta. The study was concentrated on the impacts of LHRH-A on the secretion of GtH in gold fish. The study found that hypothalamus not only produces GnRH promoting the secretion of GtH, but also produces amines inhibiting the secretion of GtH. Only when the effects of amines were eliminated, the GnRH could stimulate the secretion of large amount GtH and induce the spawning. These findings provided solid foundation for the development of new promoters for fish spawning. However, whether the findings in gold fish apply to other fishes, whether amines in other fishes have similar inhibiting effect on the production of GtH and how to apply the results from basic research to the fish production practices to develop new fish spawning promoter are still questions to be answered. I discussed with Professor Peter about my intention to continue the studies in China when I go back to China. Later we made an application to IDRC for support. The application was approved at the end of 1988.

2 Project implementation

The project was entitled "Induced spawning" and supported for two Phases. The first phase was from 1984 to 1987 and was extended to 1988, the second phase was from 1988 to 1992 and was extended for 2 more years.

2.1 the first phase

The first phase of "Induced spawning" was supported with IDRC fund of 129,900 CAD, another 35,000 CAD was added for the extended 1 year. The total amount of IDRC support was 164,900 CAD. 50% of this funding (about 82,000 CAD) was used by IDRC to purchase research equipment and chemicals in the US and Canada and delivered to Zhongshan University. 34% (about 56,000 CAD) of the funding was used for experimental material, research, equipment maintenance, laboratory maintenance and administration. 16% (about (26,000 CAD) of the funding was used for international travel and living allowance for visits between China and Canada.

Internal funding was mainly used for experiment sites and facilities, laboratory and equipments, water and electricity, transportation and salaries of staff. For the first phase study, the research team at the Zhongshan Universtiy included 1 associate professor, 1 engineer, 1 technician, 9 mater students, and 1 fishing technician. A 120 m^2 laboratory, a set of facilities for spawning and hatching (200 m^2) and experimental fish pool were used for the project. An annual input for this study was about 200,000 RMB, the total expenditure of the 4 year study came to 800,000 RMB.

The experiment facilities and consumables provided by IDRC were used to establish a world level laboratory for fish hormone radioactive testing. Main equipment includes LKB γ counter, IIEC cooling centrifuge, low temperature refrigerator, small high-speed centrifuge, electric-magnetic stirrer, electric micro scale, advance microscope etc. These equipments were used for radioactive tests of fish GtH and GH and played very important role in the studies.

In order to improve our research capability, we started a training program for master degree students in 1982. 4 students enrolled in 1982 and 1983 started to work on the project in 1984. Their theses were components of the studies. Students enrolled from 1984 to 1986 were also involved in the studies. During the 4 years of the project implementation, a total of 9 students were produced. 2 of them were working for the lab after their graduation.

In order to have better collaboration, train researchers, study experiment technologies, exchange information on progress and discussion about research plan, visits to China and Canada were made by Canadiand and Chinese researchers. A visit to China was made by Professor Peter and Dr. Van Der Kraak in April-May, 1984 to discuss research plan and teach technologies of radioactive test of fish GtH. In 1985 May, Dr Van Der Kraak made a second visit to China to teach technologies of radioactive test of fish growth hormones. In June 1986, Professor Peter visited China for 10 days to discuss research progress and examine theses of the master students. A similar visit was made by Professor Peter in June 1987. Every year in October, the Chinese researcher Lin Haoran spent 15-20 days in Peter's lab at Alberta discussing research progress and future plan and writing up papers.

Significant achievements were obtained during the 4 year study of the first phase. These include: 1) the production of GtH was was promoted by a stimulating hormone and inhibited by amine in the 4 major fresh water fishes and other fishes of carp family and loach family; 2) Highly active hormones for promoting production of GtH, LHEH-A and sGnRH-A, highly active pimozide and domperidone of amine D-2 were screened and significant inducing effects of spawning by use of these hormones were achieved; 3) The use of the new type of spawning promoter and appropriate dosage of the promoter for different fish species were extended to nation-wide fish farms. In addition, researchers of the project were invited to international workshops held in Spain, France, Philippines, Israel, Singapore, Canada, Japan and China and to present research results in the workshops. 19 research papers were published in major academic journals in China and abroad.

2.2 the second phase

For the second phase, IDRC provided a total funding of 151,406 CAD (including for the 2 year extension). 53% of the funding (about 81,576 CAD) was used by IDRC to purchase equipments and laboratory facilities in the US and Canada and deliver to Zhongshan University. 22% (about 32,713 CAD) was used for experimental material, research, equipment maintenance, lab maintenance and administration, 25% (37,117 CAD) was used for international travel and living allowance for exchange of visits between China and Canada.

As in the first phase, the internal funding for the project was mainly used for experiment sites and facilities, laboratory and formal equipments, water and electricity, transport and salaries etc. The research team for the second phase included one each of professor, lecturer, engineer, technician and 6 mater degree students and 3 PhD students. The laboratory was expanded to 220 m^2. The other experiment site and facilities were the same as in the first phase. The annual expenditure for the second phase was about 0.21 million Yuan RMB and the total for the 5 years was about 1.05 million Yuan RMB.

The Equipments provided by IDRC include some supplementary facilities to the radioactive immune test for fish hormones and equipments such as LKB LCD counter, LKB sample collector, Macintosh computer for establishment of a advance laboratory for fish sexual hormones radioactive immune test and hatching experiment. During the second phase, 3 PhD students and 6 master students were produced by the project. One of them was co-supervised by Professor Peter. And got PHD degree in Canada in 1992.

In 1986 June Dr. Rosenblum visited China for 2 weeks to teach radioactive immune test of fish sexual hormones. In September in the same year, Dr Jiang and Dr Habibi visited China for 4 days to help the establishment of fish tissue testing laboratory. In 1990 May, Professor Peter visited China for 1 week to discuss research progress. Professor Lin Haoran made visit to Canada annually during the period from 1988 to 1991 for 2 weeks to exchange information and progress and to write up research papers and develop research plan.

Main achievements obtained during the second phase were: 1) Further achievements were made in expanded use of the new spawning promoter developed by the project in both China and Canada; 2) It was found that the amines can stimulate the secretion of GtH in marine teleosts, but is not as obvious as in freshwater fishes; 3) Similar results that the secretion GtH in eel was under the dual control of neural incretion, technology of induction of development of sexual glands; 4) multi-injection of sGnRH and amine D-2 domperidone can stimulate sex reversal (shift from female to male) of yellow eels, hence resolve the problem of lack of male yellow eels for artificial culture; 5) studies on effects of aging on reproductive function found that inhibition of amines on secretion of GtH was increased with increase of age, and reduced the production of a sexual hormone, hence the reproductive ability decreased; 6) Studies on daily changes and seasonal changes of secretion of growth hormones in grass carps prove that the secretion of growth hormones was intermittent, secretion of growth hormones was closely related to fish growth rate, nutrition directly affects secretion of GH and growth rate; 7) During the pre-development period of sex gland and spawning, testosterone increases the stimulation of LHRH-A on GtH secretion; 8) In collaboration with Hong Kong University, genes for growth hormones in grass carp were isolated and expressed in *E. coli* and hence recombinant growth hormones for grass carp was obtained. During the phase II, researchers of Zhongshan University were invited to 16 workshops held in Canada, Germany, Japan, Spain, UK, Singapore, Ireland, India, France, Hongkong and China to present the research results and received attention by colleagues from many countries. 34 research papers and one monograph were published in major academic journals in China and abroad.

3 Scientific, economic and social impacts

During the 10 years of cooperation with IDRC, we learned from each other, took the advantages of each other, and made full use of the funding from IDRC, the National Natural Science Foundation, State Education Commission and Guangdong Provincial Natural Science Foundation, in-depth studies on the effects of neural incretion on fish reproduction and growth were conducted and a number of achievements were obtained, not only contributing to the knowledge of fish reproductive biology, but also provided theoretical foundation for new technologies of artificial induced spawning.

Based on the research results, highly active fish spawning promoter was developed and qualified with high standards, ie. More than 90% of induced spawning rate and stable, complete spawning, rapid response to injection of the spawning promoter, the eggs by induced spawning could be normally fertilized and survive, now negative effects. The advantages of the new spawning promoter were: low cost, no limitation of sources, large-scale production, stable productivity and easy storage, simple operation, not species specific and widely applicable, no side effects, significantly low death rate after induction of spawning.

Although the new fish-spawning promoter passed the technical examination by the Zhongshan University in 1987, and the technology was demonstrated in a fishery farm, due to the limited area that the demonstration can have impacts, and due to the imperfection of the technology itself, the practical application of the technology was limited. The technology was not widely accepted by fishery farmers yet. However, we did not stop our experiments by this problem, instead, we continued to conduct more experiments and development of product with minimal side effects. Three other types of products with better effects were developed and available for practical use. Greater efforts were made to publicize the products. In close collaboration with Ninbo Hormone Company, 6 workshops on reproduction technology of cultured fishes were held with more than 470 participants from nation-wide. The use of the products was extended from Guangdong peral River Triangle to many fishery farms throughout the country. The technology was rapidly industrialized. During the past 12 years, the sales income has been more than 24 million Yuan RMB. The production capability is more than 480 billion fishes, equivalent to more than 0.58 billion Yuan RMB. In addition, driven by the market economy, more than 10 organizations in Guangdong province have produced the new types of fish spawning promoters, the sales income was even greater than that of the Ninbo Hormone Company. The formed a sales network connecting many fishery farms was developed. Its sales income of fish was more than 0.5 billion Yuan RMB. Therefore, the total benefits from the project was significant, more than 1 billion Yuan RMB.

The success of development of highly active fish spawning promoter was the first time in both China and abroad. The product was called the third generation fish-spawning promoter (or the third milestone of artificial fish spawning). In April 1987, the method was named "Linpe method" (after the names of Lin Haoran and Peter) at the workshop on Induced fish spawning held in Singapore. The method was then used cited by many researchers in other countries. The Linpe method of induced spawning of cultured freshwater fish was commercialized by Sydel Laboratories in Canada under the trademark Ovaprim, products were sold in India, Thailand, Indonesia, Malaysia, Vietnam, Laos and other Asian countries. South Africa also developed a product "Spawnrite" with use of the method. IDRC listed the Linpe method as one of its selected 101 technical achievements of IDRC projects. The 101 research achievements were and published in a book and disseminated world wide. So far, by rough estimation there are nearly 40 fish species in China have been applied with the spawning promoter very successfully. The highly active spawning promoter have been sold throughout the country including Taiwan and Hong Kong, becoming the most effective fish spawning promoter. Its application will be further expanded in the whole country.

The success in development and extension of the new fish-spawning promoter dramatically reflected the combination of "production, learning and research". A total of 23 master students and 20 PhD students were produced by the projects. More than 50 research papers were published in major academic journals (16 were included in the SCI). More than 20 international academic conferences were attended. These have made China standing in the international community of fish research. The research results were awarded 1 outstanding research prize by the National Natural Science Foundation, 3 second grade prize of Science and Technology Advancement prizes by the State Education Commission, one third grade prize of National Science and Technology Awards and one second grade prize of Guanghua Science and Technology Foundation. The results was included in the state key technology transfer program in 1995.

4 IDRC and MOST (Ministry of Science and Technology) program management

The work of IDRC and the MOST in project appraisal, funding, progress report and monitoring, assessment and research management and arrangement of international exchanges was very effective and satisfactory. This type of international cooperation was successful in program management, the benefits produced by the project was huge. It is worth of making further expansion of this cooperation and to solve more problems that the developing countries are facing with.

It was suggested that China continue to cooperate with IDRC, expand the cooperation fields, and deliver more projects on problems in China that need urgent solutions, make full use of the already established close cooperation and facilities to make more achievements. It is hoped that the exchanges in science and technology, exchanges of visits and information to be further strengthened.

Fish nutrition and feeding

Division of Fish Research, Zhongshan University

1 Project background

Guangdong is the largest commercial production base in China for fresh water grass carpbreeding. The area of fresh water grass carp breeding was 131,240 ha. The total grass carp production in 1987 was 566,659 tons. In Shunde prefecture only, the area of grass carp breeding was 20,000 ha and total production was 130,000 tons. This prefecture has the responsibility for supply of grass carp products (major protein food) for both local consumption and export.

The first task of studies on grass carp feed was to solve the problem of green feed supply. In the Pear River triangle, pools are highly centralized, the amount of daily feed much exceeded the availability of the feed production base. Considering this situation, the division started to study grass carp nutrition and feed composition. Through several years of study, the daily need for basic nutrition such as protein, glucose, fat and minerals have been understood. According to this, the feed composition was developed. Significant progress in improving grass carp production has been made from laboratory experiment to field trials. Research results have passed technical examination in 1986. Grass carp production reached 11,640 kg per ha. The protein consumption for 1 kg grass carp production was 449 g, protein transformation rate was 33.41%.

Although we have made achievements in grass carp nutrition and feed composition, there are still many problems need further study. For example, the pattern of amino acid, relation between the necessary amino acids and the unnecessary amino acids, assessment of metabolizing and nutrition, changes of physiological function under different nutrition conditions, effects of contents of mineral saline in the water on utilization of mineral saline in the feed, optimal ratio of protein to energy etc. To tackle these problems would facilitate the improvement of grass carp feed composition and increase of grass carp production.

2 Implementation

2.1 Project funding

The total fund provided by IDRC was 172,500 CAD, of which 129,200 CAD were managed by IDRC and 43,300 CAD (equivalent with 167,373.2 RMB) were managed by Zhongshan University. 67,257.2 Yuan were for breeding system, 13,700 Yuan for low temperature refrigerator and 38,080 Yuan for casual labor, 34,024 Yuan for chemicals, 34,024 Yuan for glass ware, 9,391Yuan for domestic travel, 10,498 Yuan for communication, 13,790 Yuan for training. Total expenditure was 185,740.2 Yuan, 18,367 Yuan in debt. The total funding from China was 160,000 Yuan RMB,

2.2 Equipment
A set of 80 fish breeding chambers, a feed stirring machine, 25 small water pumps, 1 energy meter and 1 low temperature (-80°C) refrigerator.

2.3 Training
Professor Lin Ding was supported to conduct collaborative research at Guelph university for one year and Lecturer Deng Dongfang was supported to study at the Australian Deaken University for 9 months. The training brought significant effects.

2.4 Exchange of visits
Professor Cho, C.Y. of Guelph University visited Zhongshan University to inspect laboratory and give sminars. Professor Desilva of Australian Deaken University Visited Zhongshan University for academic exchanges.

Professor Lin Ding attended the 20th annual workshop on fish nutrition and feed in New York in August 1991. He presented a paper "Amino Acid need by grass fish" at the workshop. In January 1993, Professor Lin Ding and Lecturer Deng Dongfang participated in the Asian Fish Nutrition Network meeting held in Thailand. 4 papers were presented at the meeting.

2.5 Research team
A high quality research team was formulated, consisting of 2 professors, 2 lecturers and 1 assistant professor.

2.6 Research achievements
For the first time, proposed the optimal ratios of energy to protein of grass carp feed for different period of grass carp growth. It was also the first time to completely study the rate of digestion and absorption of the local raw material of the feed. These two research results have significant implication for feed production. At the same time, study on metabolizing mechanism of grass carp nutritional fatty liver and its control, causes for fatty liver were found and its control methods were developed. This research filled an empty page in grass carp nutritional disease.

3 Scientific, economic and social impacts
3.1 Transfer and utilization of research results
Eleven research papers were published by the project staff. The composition of grass carp feed was adopted by feed plants and used for feed production. Products of these feed plants have been widely used in grass carp breeding areas, indicating the composition for feed production was cost effective, and the protein transfer rate for the feed was higher than 33%.

3.2 Economic benefit
From the statistics of Guangdong Fishery Bureau, the total production during 1992-1994 of grass carp feed directly and indirectly using the results from this project was 0.1 million tons. With a price of 1,700 Yuan per ton, the total income was 0.17 billion Yuan. The 0.1 million tons of feed can produce 50,000 tons of fish, with a price of 8,000 Yuan/ton, total income was

0.4 billion Yuan. The increase of using feed produced by the research results was 15%, the income increase was 0.06 billion Yuan (0.4 x 15%). The total income increase comes to 0.23 billion Yuan.

3.3 Ecological benefit

The grass carp feed produced with the results from this project, the protein transfer rate was high, and the excrement of nitrogen and phosphate was low, so the water for grass carp breeding was not enriched with some specific elements. Therefore the result facilitated sustainable development of fresh water grass carp breeding.

3.4 Social benefit

The current area of fresh water grass carp breeding in Guangdong is 0.2 million ha and mainly the 4 major fresh water species. Of The 0.2 million ha, 50% was for grass fish. With a production of 3,750 kg/year, the annual production of grass grass carp was 0.5 million tons. From 1989 to 1994, the Division provided the feed composition free of charge to feed plants in 4 counties/cities of Guangdong province, covering 1/5 of the total areas of the province. Furthermore, the division helped the Provincial Fishery Bureau to establish model sites, making the area of grass carp pools using the supplementary feed increased year after year, the grass carp production thus increased year after year.

3.5 Personnel training

Seven mater students and one PhD student were produced by the project. Two training courses were held by the division, the Provincial Fishery Bureau and the Provincial Association of Feed Industries. More than 80 fishery cadres and technicians were trained.

3.6 Technology innovation

For the first time in China, a complete nutrition grass carp production system was established, greatly pushing forward the studies on grass carp nutrition. A fairly equipped laboratory for grass carp nutrition was established, providing more accurate, more reliable and more comparative research results. In the study on energy to protein ratio of grass carp feed, for the first time it was found that the grass carp intestinal strip fat is mainly coming from glucose of the feed and the liver fat coming from protein of the feed. In studies on grass carp nutritional disease, quantitative criteria were developed for the first time for fish fatty liver. It was found that the cause for fatty liver was imbalanced nutrition of the feed.

Review on the project " Study on China reservoir fishing" funded by IDRC

Institute of Reservoir Fishing
Chinese Academy of Sciences and Ministry of Water Conservancy

1. Project background

A several ten-thousand reservoirs of different scale have been established in China during the past forty years, as a result, more than 2 million ha of water surface are formed. It is a newly- emerging industry to develop fishing on the water surface of the reservoir, which is of significance not only to China, but also to whole Asia as well as all developing countries. IDRC approved the project " Study on China reservoir fishing " in September 1991 due to its good awareness on importance of the reservoir fishing. The proposed content of the project was based on basic issues in China development of reservoir fishing. The achievements of the project promoted the development of reservoir fishing technology of China by solving a key problem regarding to reservoir fishing.

2. Project implementation

The total project budget was 90,000 Can$, of which 30,000 was for IDRC consultant, 15,000 Can$ was for equipment purchase, and the rest for travel, bait, sampling, analyzing, and training and etc. The small surplus of 1,700 Can$ was transferred to the other IDRC project implemented by the Information Institute of Agricultural Academy of Guizhou province according to the requirement by Wilfredo A Reyrs, a project official of IDRC in South-east Asian region.

Accordingly, the Chinese government offered the project 600,000 Chinese yuan for fishing equipment and construction.

The equipment of the project was mainly for testing nutritive fodder. One member of the project team participated in an international academic conference in Thailand, one participated in a conference in Cambodia, and one went to Thailand for training course on fishing fodder, one to Wuxi for half-month computer training.

During the project implementation, lot visitors came to our institute, including Mr. A. Mcnaughton, Professor Mathias from Research Center of Fresh Water of Canada, Dr. Silva from Tanging University of Australia. Also IDRC officials, such as Mr. B. Davy, Mr. J. Dafour and Madam J. Leith, visited our institute for checking project and exchange. Of all visitors mentioned above, Mr. A. Mcnaughton, Professor Mathias as well as Prof. Charles visited our institute for nine times.

The IDRC supported project was very helpful for personnel capability enhancement of our researchers, most of which were young persons. For example, Mr. Xu Guohuan, a member of the project, has been promoted as a Deputy Chief of the Research Division. Now he has certain academic influence in the field of fish fodder study in China. Lang Honjuan, who made study on ecological principle about high yield fishing of Meichuan reservoir of the project, is engaged in reservoir ecology research and will finish her Ph.D. course study as she had obtained an opportunity enhancing research ability in the project. Other members of the project have also raised their ability in the research aspect and foreign language application.

The final report of the project not only summarized the experience on China reservoir fishing, but also has some discoveries in the theory. Based on the issues in our reservoir fishing, the project completed research about manufacturing a kind of scientific, full and nutritive fodder with its application, put forward an advanced raising way that is to catch big fish by leaving small fish, and fishing in turn. The project report also proposed ecological principle on comprehensive raising fish. What we have studied in the project greatly promoted the development of China reservoir fishing.

3. Result evaluation on scientific research, economic and social effect

Compound fodder for raising fish, which is produced successfully by the subproject, " Study on compound fodder in reservoir fishing of China", has been applied in the raising Sanjiao Fish (a fish name in Chinese) in the reservoirs of Hongan county, Hubei province. As a result, more than 50,000 kg of fish is yielded annually, totaling over one million yuan of product value.

The good social effect was achieved by the project. The added subproject, " Social and economic status of immigrating people in the Danjiangkou Reservoir region ", provided a good way to investigate economic status of immigrated people in the reservoir region. The IDRC project has played a great role in training researcher. The members of the IDRC project team have enhanced their foreign language level through participating the conference at home and abroad, bilateral exchange, short term training, the guiding of foreign expert, and formulating report in English. Our capability building has been improved thanks to the project.

4. Evaluation and suggestion on project management by IDRC and MOST (Ministry of Science and Technology)

We feel that IDRC project was a rigorous one in view of formulating project proposal and completing project. During the implementation, IDRC officials both in Asian office and headquarter often came to our institute for advising, which was very helpful to project.

5. Make comparison with project funded by other country or organization in the supporting way and procedure if the implementing institution has the experience.

Since the establishment, our institute has implemented other projects supported by FAO, DANIDA, and Asian Aquatic Society respectively. We think that the IDRC supported project was better than others, and main reason is as following:

---IDRC project tallies with the actual situation of receiver country. More academic characteristics are strengthened than FAO, and more social characteristics and economic result are strengthened than Asian Aquatic Society.

There are many ways to train researcher, including: to participate in the international conference, carry out project research, to join the short term training and bilateral exchange. More members can be involved in the training activity. However, DANIDA project arranged only one or two members to study abroad for one year.

---We can obtain expert guiding of IDRC from the beginning to the end of the project.
Great achievement ahs been made in the twenty-year cooperation of IDRC with our country, so has our institute. We hope we could have an opportunity to cooperate with IDRC again in the future.

Community-based Natural Resource Management in the Mountainous Area of Guizhou Province, China

Guizhou Academy of Agricultural Sciences

Under the financial support of IDRC, Guizhou Academy of Agriculture Sciences (GAAS) has undertaken the project of "Community-based Natural Resource Management in the Mountainous Area of Guizhou Province." This project focused on the villages of Dabuyang and Xiaozhai in Changshun County, Guizhou province and lasted from February 1995 to January 1998. Under the guidance of Dr. John Graham and with the cooperation of the related institutes in the state, the supports of local government at all levels and the participation of all target villagers, as well as the efforts of the research team, the project has been accomplished for all its interventions and achieved the anticipated results.

1 INTRODUCTION

1.1 BACKGROUND

Guizhou province in Southwest China has a land area almost 90% of which is covered mountains and hills. It is a typical mountainous agricultural province in China, and has a concentration minority nationalities (taking up 35% of the population in the province).

Guizhou province is one of the poorest provinces in China. The major economic and social indicators such as per capita income, grain production, area of arable land are all among the lowest in China. Of the 34 million people in the province 30% are classified as poor and these account for over 10% of the poor people in China. Many of these people live in the south and southwest of Guizhou. In these areas the per capita income is less than 400 yuan, per capita grain production is 200kg.

The household and community natural resource system in the poor rural of Guizhou normally include; arable land (the irrigated and rain-fed paddy fields, upland fields)、forest lands、grasslands and wastelands as well as the lands for houses. Since 1949, there has been great changes in local same as the elsewhere in China, these changes have made significant impact to the management and utilization of natural resources. Especially after the implementation of a system of contracted responsibility linking remuneration to output in rural, this reformation of land utilization system has greatly stimulated the initiatives of farmers and enhanced the productivity of resources. On the other hand, due to lacking the effective policy interventions, managing and using technologies, while enhancing the using level of resources, the resources are damaged rapidly. In addition, since the state family planning polices allow more than one child for minorities, the population grows much faster in the mountainous area of Guizhou than elsewhere. Conflicts between population and resource have become increasingly acute. For a long period, the government at all levels have laid more attention on the grain production of arable land in order to achieve food security and maintain the social stability, and overlooked to take the agricultural natural resource system as a whole to develop、manage and protect. This has resulted in serious environmental problems such as deforestation for land reclamation、soil erosion、the drying up of water sources. The ecological environment is degrading. This leads to the ecological system is falling into a vicious circle of "population growth, environment degradation and grain shortage". The nutritional status in the poor minority mountainous areas of Guizhou is insufficient. Most food comes from the households' production. The diet is simple with deficiencies in calories, oil and animal protein.

The role of women in rural Guizhou is similar to women elsewhere in rural Southeast Asia. They not only take full responsibility for motherhood and household management, but also undertake most of the work (60%) in agricultural production. The minority women in Guizhou province play a certain role in the management of village affairs. Since 1949 the status of Chinese women has improved considerably, but they are still in a subordinate role in their families and in society. They also have lower education and nutrition rates than males.

1.2 OBJECTIVES OF THE STUDY

The general objective of the study is to study and improve the existing utilization of natural resource system, household food consumption patterns and community health situation in order to improve household and community resource management systems to enable local communities to achieve food security and enhanced family welfare and income.

The specific objectives include:

a. To describe the present economic and agro-ecological situations of the natural resource systems in two villages.
b. To describe the effect of social and cultural factors affecting the natural resource system in the communities.
c. To study and evaluate previous interventions and the current policy and infrastructure (at

the village, township, county, provincial and national levels) relating to development of the natural resource system in the villages.

d. To describe and evaluate the current nutritional and health status and their interaction with the current utilization of the natural resource system in each village.

e. To study current household and community resource management systems.

f. To identify opportunities for comprehensive intervention packages that will assist in sustainable management of the natural resource system in order to:

g. To design and implement research （on-farm, on-station and in-home）and pilot intervention packages with the active participation of members of the community and local government. These interventions will complement existing government programs.

h. To evaluate and report on the effectiveness of the interventions in the study area, and revise as necessary for wider dissemination in similar areas of China.

1.3 RESEARCH PROCEDURE

According to the requirement of the project proposal, the project was carried out in three period：

(1)First period lasted from February 1995 to July 1995. Adopting RRA、PRA approaches to carry out the investigation、research and evaluation on social、economic and natural resource situation in target villages, and to identify the existing issues in the natural resource management and community development and to design and work out the interventions and research plan for next period.

(2) The second period lasted from August 1995 to October 1997. Carrying out interventions and conducting specific researches.

(3)The final period lasted from November 1997 to February 1998. Summering and evaluating the project. Preparing the final report to submit it to IDRC and providing the suggestions on natural resource management to the Guizhou provincial and Changshun county governments.

2 METHODOLOGY, CONTENT AND EFFECT FOR THE IMPLEMENTATION OF INTERVENTIONS AND RESEARCH

2.1 IMPLEMENTING METHODOLOGY

It was the emphasis for the project to implement interventions and research, its aim is to identify a set of comprehensive policy and technical interventions that is suited to the sustainable management of natural resource in the poor mountainous area of China. Therefore, the period of implementing the interventions and carrying out the research is the period to undertake community-based natural resource management. On the other hand, at the beginning of the project the project team was facing a question that was what kind of methodology and theory for CBNRM could enable us to reach the goal of the project.

The traditional CBNRM methodology is: firstly what technologies can develop and utilize natural resources; secondly the governmental and community organizations' policies, laws and regulations or social morality and the like binding forces enable the people to develop and use the natural resource according to the predetermined goal. Under such traditional natural resource management, although people have devoted a lot of labors, material and financial resources in natural resource management and continuously revised and completed their theory, methodology and measures on it in order to effectively develop, use and protect natural resources. But, the people have to face the realistic situation that is the natural resource in the whole world are used by some destructive ways and some natural resources are close to be used up and face the crisis of pollution, ecological environment is increasingly deteriorated. Those indicated that it was difficult to solve the problems in current natural resource management and utilization using traditional approaches.

The recent researches at home and aboard and some successful practices in CBNRM show that success of CBNRM is closely related to the participation of community villagers or local people. Based on this, the participatory approaches for CBNRM have been put forward. This means that on the basis of emphasizing the importance of experts and their knowledge as well as the policy guidance of governments and community organizations, the indigenous knowledge and the participation of villagers should be fully encouraged. This approach overcomes the shortage of only stressing the roles of experts and the government in traditional CBNRM and overlooking the participation of community villagers who are core of CBNRM. It is a popular and successful CBNRM approach at present.

In the light of participatory natural resource management methodology and the specific technical and policy interventions, during the period of carrying out the interventions and researches, the specific work were as follows: In the respect of policy interventions, each management system was formulated by firstly on the basis of discussing with village cadres and the representatives of villagers, the project team made an outline of discussion; then the opinions from the general villager were solicited to revise and complement the outline; finally the management interventions were announced at the general villagers' meeting as the village regulations and folk agreements. In this way, each management intervention was understood by villagers before it announced, it was easy to be adopted by villagers and easy to be implemented and supervised as well after the announcement. In the respect of technical interventions, according to the approach of "test → demonstration → training → dissemination", the works on-farm, in-household all were conducted with the participation of villagers. Each technical intervention was evaluated by organized village cadres and villagers on the spot during its testing, implementation and after. The technical interventions, therefore, were rapidly disseminated and got an obvious effect.

2.2 CONTENT AND EFFECT

2.2.1 Basic Interventions and their Effects

1) *Disseminating and publicizing the relevant laws and regulations to strengthen the resource management by the laws.*
2) *Formulating and perfecting natural resource management institutions of village regulations and folk agreements; establishing the corresponding administrative organizations.*
3) *Setting up Village Development Fund*
4) *Conducting technical trainings, organizing study visits.*
   A. Training on Rural Social Science Methodologies for Natural Resource Management.
   B. Agricultural Technique Training
   C. Maternity and Child Hygiene and Health Training
   D. Study Tour.
   E. Community Management Training
5) *Improving the living conditions for target villagers*
6) *Investigation and study the nutrition and health status of the target villagers.*

2.2.2 Classified interventions and effects

1) *Arable land resource*

A. On the basis of consolidating and perfecting the two-level management system inarable land, which means the lands belong to the collective, and be contracted to individual household for long-term use, the laws and regulations related to arable land management were further carried out to conscientiously protect and rationally use the current arable land. The appearance of destroying arable land resource were forbidden, such as occupying arable land to build house and using the soil of arable land to make bricks and the like.

B. The management system on grazing cattle collectively was set up to stop cattle damaging the crops and to save a lot of labors.

C. According to the procedure of "introduction—testing—demonstration—dissemination" a set of agriculture technical measures were popularized and disseminated to rationally use arable land and to enhance the output of arable land.

D. Building up water conservancy facilities to improve the irrigation conditions for paddies. The irrigated paddy field has been increased from 19.0 ha. in 1994 to 26.3 ha.. The proportion of irrigated paddy fields area in the total paddy fields has increased from 52.9% to 73.3%. Through the implementation of above integrated measures, the arable land resource in target villages has been rationally used and effectively protected and its per unit area grain yield has increased greatly. In comparison with those in 1994, in 1997 the rice yield was increased from 4919.5 kg/ ha. to 6021.9 kg/ ha., by 22.5%; maize yield from 2206.5 kg/ ha. to 4363.0 kg/ ha., by 97.7%; rape oil yield from 553.5 kg/ ha. to 1270.9 kg/ ha., by 129.6%.

2) *Forest Land Resource*

A. Carrying out the forest rights and responsibilities. A two-level of community and household forest land management system was practiced on forest land in target villages, which combined the collective unified management with household management on allocated forest land as well as households co-management on the contracted forest land and clearly defined forest land tenures (usufruct rights) and rights over the use of forest products belonging to the farmers and their descendants for the long-term. This management system has stimulated villager's initiatives in afforestation, protection of forest resource and development of forest production. During the project period, forty five thousand trees have been planted (an average of 1000 trees per household), 2 ha. land has been stopped cropping to plant fruit trees.

B. Formulating forest management regulations and establishing forest management group. Due to the managing function of the community and the villagers' awareness on forest resource protection have been strengthened, the appearances of cutting down trees to use the land for cropping and setting fires on mountains have been disappeared.

C. Unifiedly planning and developing wasteland and slopping land suited to afforestation. 2 ha. of high-yield peach orchard and 1.2 ha. of Chinese chestnut orchard as well as 1.5 ha. Chinese pear-leaved crabapple have been built up. This practice has accumulated experiences on rationally developing and using wasteland and slopping land to increase the villagers' income.

Through above interventions, the proportion of forest land area (artificial and natural tree canopy density over 30%) in total land area has been enhanced three percentage. The degradation tendency of ecological environment in the target villages before project has been effectively stopped.

3) *Grass Land Resource*

A. Clearly defining the rights over the protection and use of grass land by all villagers, the grass land unifiedly managed by collective; formulating a management system to forbid the damages on grass land such as setting fire on mountains, burn the grassland for its ash. Those had achieved obvious result.

B. Supporting and encouraging the villagers to raise plant-eating animals in order to rationally develop and use the abundant grassland resource in target villages. By the end of 1997, there were 2.8 heads of cattle per household in Dabuyang village. This increased by 0.6 heads in comparison with that in 1994, 41 heads of black goats were introduced and allocated to four households to raise in May of 1996, they were purchased by joint investment of household and project. The black goat has increased to 120 heads by the end of 1997, each household earned the income of 2500 yuan CNY from black goat raising in verage. This has accumulated experiences for large-scale animal raising.

4) *Biological Resource*

A. The target villages are abundant in biological resource. The biological resources that are worth developing mainly included tea oil tree, vegetable brake and various kinds of Chinese herb medicine. The policy interventions defined that biological resource in target villages belonged to the whole village group, the collective and individuals had right to develop and use them and had responsibilities to protect them.

B. Setting up a botany resource nursery. There were totally 24 varieties of 16 kinds of fruit tree, vegetable, forage grass and the like were collected and introduced early or late in the nursery in order to test and identify the supervisor varieties suited to local conditions. The varieties of peach and Chinese pear-leaved crabapple have been selected to plant in large-scale in study area.

C. Taking the use of abundant rice straw and cattle waste resources to develop edible mushroom production. Since 1995, through the trainings and supervision of experts there have been 16 households in Dabuyang to cultivate mushroom. The successful cultivation of mushroom had helped the households increasing their incomes by 600 yuan CNY in average. Three-year study showed that the mushroom cultivation was a effective way to help household increase income and get off poverty as well as build up a fortune. It is expected to become a main industry in local. This is because that the technology is easy to practice and with low input and high benefit, the target village processes rich raw material.

5) *Water Resource*

A. Construction of water facilities. Following the input proportion of 40% funded by the project, 60% contributed by villagers' raised funds and labor input, an irrigation station, two tap water projects, more than 800 meters irrigation ditch, one inverted siphon tube and one 80-meter aqueduct were built in order of priority by villagers. These newly set up basic facilities (a) converted over 10 ha. rainfed paddy field into high-yield irrigated ones; (b) supplied the target villages with tap water for the first time in the whole township and it has thoroughly changed the extreme difficult situation of potable water in Xiaozhai village for long, and has greatly reduced the women's labor input. There have created improved health and hygiene for the villagers.

B. Formulating management regulations and setting up management group. Once a facility was built up, a set of management regulations was formulated and a management group was established in order to strengthen the management and protection on resource and facility.

C. Helping villagers set up the ideals of resource is negotiable and should paid for service management. After the construction of facilities, the water resource management group was in charge of managing, maintaining the facilities and scientifically supplying and allocating water, collect water fee regularly. The water fee included four parts ①35% of for electricity ②20% of for the remuneration of management personnel ③10% for maintainance ④35% as the reclaimed effect money, it is going to be used as development funds for productive and public welfare project in target villages in a rolling way. The implementation of this intervention has enabled the water resource management is on a path to effective and sustainable development and ensure the facilities can be used for a long time.

3 MAIN RESEARCH FOUNDINGS

A set of management systems consisting of village regulations and folk agreements on natural resource management have been formulated and established together with the relevant management organization. These regulations were formulated by target village leaders and villagers themselves with the assistance of the project team and through the whole villagers discussions over and over again. They stipulated in details for the management and clearly defined rewards and punishments, processed great authoritativeness and easy to practice as well. At present, the legal system in China is still uncertain and needs to be perfected. Law enforcement agencies are weak and law enforcement needs to be strengthened. In the poor rural, the villagers are with low education and with weak legal awareness. So, this management systems through village regulations and folk agreements can and are playing a distinctive role in managing natural resource and standardizing the villagers' behaviors. The distinctive characteristic of this project has been its focus on strengthening management systems and establishing the relevant organizations. In this regard it differs significantly from other Integrated Agricultural Development Projects run by the government. This characteristic has been found to be a key to realizing sustainable management of natural resources.

A group of community cadres and technical crackerjacks were trained for the communities. They possess a certain knowledge and method related to community-based natural resource management and utilization, learned a lot of applied technologies, have opened mind and keep forging ahead. Since the project started, we have held 38 times of training, study visit in early late. A total of 923 persons of village leaders, villagers and researchers have been trained or with females accounting for 60%. This has been a remarkable intervention for the project and enabled other natural resource management interventions to be carried out effectively and achieved their expected results.

Technical interventions combining the introduction of superior crop varieties and animals and the dissemination of applied agricultural technologies has greatly enhanced the production of current arable land resource. This has laid a basis for target villagers to have food security and to improve their food intake pattern. In comparison with 1994, in 1997 rice yields per unit area have increased by 22.5%, maize yields by 97.7%, oil rape yields by 129.6%. Per capita grain yield was increased from 489.1kg in 1994 to 657.3kg in 1997 in target area, and annual per capita rape oil seeds was enhanced from 17.6kg in 1994 to 40.7kg in 1997.

Preliminarily identifying a managing system for outside investment in community-based natural resource development and utilization. Rationally developing and using natural resource is the important content of community-based natural resource management in the mountainous area, and also an important measure for the rural to escape poverty and to sustainablely develop its economy. But, in the poor rural of Guizhou, especially in the marginal poor rural compactly inhabited by minorities, the villagers lack the funds to develop and use natural resources at village level. So, it is essential to have certain investment from outside to develop and use natural resources in scale and to bring out the effectiveness from. Based on this, Chinese government at all levels have launched a lot of projects in the poor rural of China, such as integrated agricultural development project, aid to poor projects. A lot of funds have been put in and a lot of facilities have been built to promote the development and utilization of natural resources. On the other hand, according to our investigation, all infrastructure construction among various project run by government were invested by government without any pay back and contracted to the construction team to build. After the construction, the facilities were handed over to villagers without relevant management regulations. This has formed the villagers' dependence on the government and did not ensure the quality of project. the villagers did not take good care of the facilities during their utilization. The facilities ware damaged rapidly and caused a lot of waste. In the light of this situation, for the purpose of developing and use waste land and water resources, the following improvements were adopted in the constructions of high-yield orchards and water facilities in the project. ①The local contributions （including local raised fund, material input and labor input） take up at least 60% of total input, and the project fund dose not exceed 40% of total input. ②The project is not allowed to be contracted to construction teams from the outside to build. Rather it was finished by organized community villagers themselves. ③Once a project is built up, a management regulation will be worked out and a person in charge will be selected to manage with payment. ④Paying for using the facilities. The input from the project will be deducted as a percentage from the reclaimed effect money and returned year by year after the project established. The returned money will be used as the original capita to set up community development fund. The fund will be used in other resource development projects in a rolling way according to its management regulations. Three-year implementation showed that this managing system ①overcame the villagers dependence on government, saved a lot of investment, improved the quality of project; ②educated the villagers on the respect of "resource is negotiable and should paid for the use of" and "paying for the management, paying for the service" which laid a good ideological basis for community-based natural resource management; ③The establishment of community development fund has enabled the community to form a self-accumulation and self-development system in order to strengthen the community's economic compact and managing function as well. These improvements were highly appreciated by local government and are planning to disseminate them in other projects.

The deteriorative tendency of the ecological environment in target area has been effectively hindered; villagers' living surroundings and health have been obviously improved; the community economy is on the path of sustainable development; villagers' living standard has been obviously improved.

4 RECOMMENDATIONS FOR FURTHER RESEARCH

The ultimate aim of community-based natural resource management is to realize sustainable and equitable development of the community. Since the start of the project, based on the general objective of project, using participatory approach stressed the participation and initiatives of community leaders and villagers who are the core of community-based natural resource management, according to the procure of "investigation and evaluation (identifying problems relating to CBNRM) —working out interventions and designing research (solving problems) —implementing interventions and studies (testing, evaluating and perfecting) , the CBNRM project focused on the villages of Dabuyang and Xiaozhai in Changshun County, Guizhou province. Through three years practice, the community-based natural resource management was successful in target villages and fully achieved the expected results. Feedback from project officer and some experts in and out of the state suggests that the project has been a successful, distinctive and effective CBNRM project. For future studies, , the following issues need to be further studied:

a. Village regulations and folk agreements for natural resource management was a successful intervention and play a major role in the current natural resource management in the target villages. But, they remain village regulations and folk agreements which lack strong support from the state apparatus. Restraints on villagers' behavior derive from kinship units and moral codes. These agreements may be weakened along with progress of society and a stronger national legal system. So, we should strengthen cooperation with governments at all levels, especially with departments in charge of policy research, policy advice and decision making. (On this basis co-management agreements complementary to the institutions of village regulations and folk agreements are possible.) The project will draw up legal provisions suited to community-based natural resource management, which will be provided to government for policy making and law enforcement reference. In addition, during the period of co-managing community-based natural resource, the issues of dividing, linking up and coordinating the competence between the villagers' management groups and the relevant government departments should be further studied and defined.

b. The project aimed to identify a set of community-based natural resource management system suited to poor minority mountainous area of Guizhou province. As a management system, it should process rational construction and perfect function. Therefore, it is not enough to have only policy and technical interventions to effectively manage natural resource, some support system such as community social service system and the like need to be studied and established to enable effective management on some tasks concerning community-based natural resource management which are unlikely to be done by individual households alone. The project will promote the process of commercialization of agriculture in study area by achieving equitable, efficient and sustainable management.

c. Technical measures combined with management measure are vital components of a natural resource management system. During this phase, the project focused on packaging and applying available applied technologies, and neglected the focused and deep research and experimentation, so, when disseminating and applying these technologies, the scientific basis were little bit weak.

d. The project focused on the management and utilization of arable land which is with a relatively short economic cycle and the villagers' concerning most, the water resource which is closely relating to villagers' life and production. Many more researches will be done on the management and utilization of grassland, wasteland and forest resources which have many issues in and have great potential to increase the villagers' incomes and to improve their nutrition.

Participatory Research on Utilization and Management of Forest land Resources in the experimental villages

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1 Background

The forest land resources are very abundant in the experimental villages except Chaoshan. According to the investigation, the forest land area is about 2.5 ha. per household, which is much higher than the average of Changshun County. However, these abundant forest land resources have not been properly and effectively utilized for a long time, therefore, only less than 5% of total incomes comes from forestland resources. At the same time, the frequent occurrence of the reclamation of forestland, deforestation, and etc severely destroys the local forestland resources. The local ecological environment is increasingly worsening. In view of this situation, since the project started, the in-depth research on the utilization and management of forestland has been doing using the participatory community-based resource management.

2 Research objectives

To study and identify a package technical and management measurements for effectively utilizing and rationally protecting community forestland resources to sustain the local economy and environment, and to build the capacity of community managing resources through this research.

3 Research method

This study was conducted mainly using the method of participatory community-based resource management. According to this method, villagers and cadres of community and local government officers actively participated in investigating and analyzing the current situation of forestland resource, identifying the problems to be studied, implementing the research plans, and evaluating and adjusting the research findings in the whole research processes. While project researchers were mainly in charge of the organization of the study activity, the guidance of the study method, and the collection and summarization of the information materials

4 Main research processes

The whole research included the following three stages:

First research stage (1995.3~1995.10):

Studying and formulating utilization and management interventions of forestland resources in Dabuyang and Xiaozhai villages.

Main work of this stage is investigating and identifying the problems existing in the utilization and management of forestland in two villages and analyzing the causes resulting in these problems by using the methods and tools of PRA.

Table 1, The problems and their causes in the utilization and management of forestland resources

Problems	Causes
● Lower utilization rate of forestland and ● Forestland resources are destroyed severely.	1. Lacking the policy incentives urging villagers to utilize forestland. 2. The forestland tenure is not clear. 3. Lower quality of the present forestland resources. 4. Lacking the forestland utilization technology 5. Imperfect management system (mechanism) and management regulation. 6. Villager's weak awareness of protecting environment and developing forestry production

In the light of the above problems and causes, and especially on the basis of using the experiences of formulating and managing the Folk Regulations and Villager Agreements for reference, the following intervention measurements of forestland resources were drafted out together with villagers and community cadres.

- PCarrying out a two-level management system of community and individual household in the management of forestland. The concrete contents are that Fengshuilin forest land and shrub land far away villages are managed by community, the forestland near village is allocated to households and managed by themselves. The management system encourages household(s) to contract to manage the community-managed shrub land and wasteland.
- Formulating the forestland management regulations, which is similar to the Folk Regulations and Villager Agreements, and establishing the related management groups.
- Carrying out planting fruit trees in the reclamation land and forestation to combine the economic profits with ecological effects in utilizing the forestland.

Second research stage (1995.11~1996.4):

The application of the above research result (interventions in utilization and management of forestland) in Dabuyang and Xiaozhai villages.

Taking into consideration of the different situation of forestland resources in Dabuyang and Xiaozhai villages, the following measurements were implemented:

- Clearly defining responsibility, obligation and right of managing the forestland resource through dividing the forestland originally belonged to group into individual household to manage in Dabuyang and clearly demarcating the forestland among households in Xiaozhai.
- Formulating forestry management regulations in Dabuyang and Xiaozhai based on the folk regulation and villager agreement, and establishing the relating management groups.
- Organizing villagers to plant tree (pine tree) in their contracted forestland (1000 trees per household) and to plant fruit tree (mainly the peach tree) in the reclamation land (2.0 ha. in Dabuyang and 0.5 ha. in xiaozhai).
- Organizing villagers and cadres to visit out studying the advanced experiences of community-based forestland management.
- Holding technical and policy training on the utilization and management of forestland resource

Third research stage (1996.5 - present):

Applying, testing, evaluating and adjusting the interventions of forestland resource in Dabuyang and Xiaozhai and the 4 newly selected villages.

After 1~3 year's implementation of the interventions, obvious effects have been achieved. Firstly, the two-level (natural village or group and individual household) forestland management systems, by which the poorly managed forestlands by community were allocated to individual household and defined the rights of forestland use and forestry products marketing that can be inherited, stimulated the villagers' initiative to develop forestry production. 90000 pine trees were planted only in Dabuyang and Xiaozhai before Feb. 1998; Secondly, the formulation and establishment of the forestry management regulation and management group overcame the limitations of national forestry regulations and the folk regulation and villager agreement and effectively enforced the management of the forestland resource. Therefore, the destruction of the forestland resource greatly decreased; lastly, the measures of planting fruit tree in the reclamation land not only increased the economic profits but also protected the ecological environment and were highly praised by local community villagers and local government. Up to now, most of the reclamation land in the experimental villages has been changed into orchards.

Focusing on the new problems, which were found in the implementation of these measurements, some adjustments of measurements were made based on the different situations of forestland resources in each village (Table 2)

2. Main research findings

- Preliminarily forming a set of locally suited policy (management) measurements and technical measurements for the proper use and effective protection of the forestland resource.
- Establishing the operation mechanism of the forestland resource management for the local community;
- Formulating the management regulations with higher practicability and the related management groups;
- Carrying out the utilization ways of forestland resource integrating economic profits with ecological effects such as planting fruit tree in the reclamation land.

The participatory research activities greatly enhance the local communities' capacity in managing resource, which provides a good basis for the sustainable use and management of the forestland resource.

(6) Suggestions for further study

- Further perfecting the regulations of forestland resource management;
- Seeking an effective resolution to increase the payment of management staff for strengthening and sustaining the management;
- Widening the thought of research. The further research should focus our attentions on incorporating the other study or intervention measures into the forestland resource

management to decrease community villagers' dependence on the forestland and thus to sustain the protection of the forestland.

Table 2. The problems, cause analysis and adjustments in the implementation of measurements in the forestland management.

Problems found in the implementation	**Causes for these problems**	**Adjustment made during the implementation**
The management group has no clear supervising and managing roles; sustainability and initiative of management are still very weak.	1.Imperfect management system (regulations) 2. Lower and even no payment for the management staffs; 3.Household can manage the forestland of their own; 4.Lower quality and economic profits of forestland result that part of villagers is not concern about their forestland even when destruction takes place.	1. Further perfecting management system (regulation) and empowering the rights to management staff.
The villagers' enthusiasm of developing forestry production is still lower.	Villagers still take a suspicious attitude to the regulations and incentives. Lower quality and economic profits of the previous forestation.	Carrying out a higher standard forestation, such as using good quality and fast-growing tree species and standardizedly planting as well. From 1998 to 1999, about 12.0 ha. of Cryptomeria were planted in Dongkou, Guntang and Chaoshan by 30 households. Formulating a regulation on the contract management of forestland with local government.
The flexibility of the double management system of forestland is still weak	There exist different situations of forestland resource and community management abilities in the target villages	In some villages where the forestlands are centrally distributed and community management abilities are strong, the forestland are managed by the collective and contracted to plant trees by household or group. On the contrary, the forestlands are allocated to individual household to manage by themselves.

Research on establishment and management of demonstration orchard

Guizhou Academy of Agricultural Sciences

1 Background

The project villages, located in Kaizuo Township, Changshun County, possess good conditions to develop fruit production: abundant non-arable land resources, suitable soil and climate and convenient transportation. The "Integrated Agricultural Development" Project availed these good conditions to develop fruit production in large areas in Kaizuo. 60 ha. orchards have been developed in 6 target villages, including 7 fruit varieties (peach, plum, red bayberry and etc) since 1990. However, most of these fruit trees, aged from 4 to 7 years old, have been completely damaged, 13.3 ha. orchards that were left and can bear fruit are also in poor conditions (lower yield, lower quality and lower economic benefits). In the results, the planting of fruit trees not only can't increase the villager's income but also waste precious resources. For the purpose of helping the local poor villagers indeed and making full use of local abundant resources, according to villager's opinions, 2 ha high-yielding demonstration orchards were established after our investigation.

2 Objectives

- To explore a set of household-centered methods on the establishment and management of orchard.
- To explore the technical measures of utilizing resources reasonably to increase income.

3 Process and methods

3.1 Process

On the basis of the general PRA investigation and focusing our attentions on the problems existing in resources and fruit production in two target villages, the in-depth investigations including semi-structured interviews were carried out to identify and analyze the existing problems of resource utilization and the causes of the problems:

- Low Utilization rate. The reason is the villagers are short of utilization technologies.
- The fruit trees planted during the implementation of "Integrated Agricultural Development Project" were damaged heavily, the existing varieties are with poor-quality and with low economic benefits.

Main causes are as follows:

(1) Blindness in developing fruit trees. Firstly, the over-planting of fruit trees resulted in lower input of fertilizer and labor force. In the result, most was with no planting plans, no planting

holes and no fertilizers in planting fruit trees. Secondly, the blindness in introducing fruit varieties resulted that some species and varieties can't suit to the local soil and climate conditions. For example 2.7 ha grape trees in Dongkou were dug out for poor quality.

(2) No matched services on management technology. Orchard management measures such as pruning, prevention and control of plant diseases and elimination of pests need professional technologies. After fruit planting, there were no technologies training and services available for farmers so that most farmers did not know how to manage the orchard and thus let it grow freely.

(3) The previous project adopted the 'Up-down' approach in the whole process without active participation of villagers. The villagers don't understand the fruit development clearly. There were no serious investigations on the villager's demands, the suitable varieties and the planting measures.

(4) The villagers are weak in commodity economy. From the investigation, some villagers planted fruit trees only for self-supply, they did not realize that developing fruit production could increase their incomes. In addition, the developing areas were divided evenly to each household, so some households with more paddy fields and with fewer labor force had no ability to plant and manage these trees.

Because of the above causes, developing fruit production could not increase the villager's incomes but wasted the precious resources, what's worse was that it lowered the villager's faith in utilizing the resources reasonably to increase incomes and alleviate poverty.

3 Solving methods

In light of the above problems and reasons, the following planting plan and some concrete measures were identified through discussion workshop with villagers.

Solving plan:

Establishing high yield, good quality and high efficiency demonstration orchard.

Combined villages' unified planning with the villagers' willingness and demands, 2.0 ha (0.67 ha in Dabuyang and 1.33 ha in xiaozhai) peach orchards were established in 17 households' land (8 in Dabuyang and 9 in Xiaozhai).

Concrete measures on establishing and managing orchard:

- The villager input labor force and yard manure (2500kg per mu), dig hole 0.8 m in depth and 1 m in width, plant and manage themselves.
- The project supplied seedlings and phosphorus fertilizer (total input by the project was

about100 yuan per mu). All the project inputs will be returned to Villager Group by contract to use as development fund.

- The project supplied technology training and services and select villager technician in order to sustain orchard management.
- Making up management regulations and organizing Orchard Management Group.

4 Preliminary effect of establishing demonstration orchard

Beause villager-centered approach was adopted in establishing the demonstration orchard. Villagers were actively involved in raising plan, constructing and managing the orchard, and input most of the needed materials. The project team was mainly in charge of providing technical training and services for villagers, organization and coordination of the establishment process. This method overcame the weakness of the previous establishment of demonstration orchard. The previous demonstration orchards were mostly constructed (by technical departments) only to provide visiting spots for local people or outsiders. But the demonstration effect of this kind of orchards was usually not good for no participation of local people. The villager-centered approach aroused the villagers' enthusiasm and achieved the expected objective. 2ha. orchards were completed smoothly with obvious demonstration effect.

4.1 Through a lot of technical training, the planters preliminarily mastered the cultivating technologies. Some planters played the great role in introducing technology, especially in establishing orchard in the phase 2 of the project.

4.2 The peach orchard is almost managed scientifically. The peach grows well and the economic benefit is obvious. The peach began to bear fruit in 1998, the average income from orchard was about 1000 Yuan. t

4.3 Demonstration effect is obvious. The success of demonstration orchard activated the target villagers to plant fruit trees (peach trees) greatly. 4 ha. peach trees (1 ha. in Dabuyang, 1 ha. in Xiaozhai and 2. ha in Dongkou) were planted in three target villages in January 1999. Till now, many villagers have realize that utilizing the abundant arable land and sloping land to plant fruit trees is an effective way to increase the income, alleviate poverty and make rich. Now each household has about 3mu orchards in Xiaozhai, it is estimated that each household will gain income of 3000 yuan from fruit trees after 3 years, which will be the main income of this village.

5 Problems and suggestions

5.1 There was only peach trees in the demonstration orchard with only 3 varieties (mainly earlyripen ones). The villagers found that the late-ripen peaches can get good prices and also avert the busy farming seasons. So, with the request of the farmer, chestnut and crabapple trees with good quality and suitable to local place were introduced and bred in 1997, and 3 late-ripen peach varieties were cultivated in 1999.

5.2 At the beginning of CBNRM project, many farmers wanted to plant fruit trees. The investigation revealed that some households are short of labor force and yard manure, but they want to plant in large areas; some poor households want to plant, but they have no money to buy fruit seedlings. In order to guarantee the planting quality and encourage the poor households, the planting of fruit trees must be abided by the following two requirements or conditions:

- The same planting standards as the demonstration orchard.
- Less the project input provided (half cost of the seedlings, about 40-yuan per mu).

5.3 Target villages are abundant in arable land, so labor force is short in busy farming seasons, especially in Dongkou and Xiaozhai in upland areas. Some orchard management measures (such as applying fertilizer, prevention and control of diseases and elimination of pests, pruning) must be adopted at the busy farming seasons, which brings the contradiction. Some management measures could not be taken in time and therefore influence the effect. For example, the prevention and control of diseases and elimination of pests could not be implemented wholly and timely, so the control effect was not good. Moreover, the villagers sold the fruits individually, which cost much time and could not get good prices. Therefore villagers think it is necessary to organize a service group to deal with the things that the individual can't do it or can't do it well.

Extension research on cultivating edible mushroom

CBNRM Project Team
Guizhou Academy of Agriculture Sciences

1. Background

Kaizhuo Township is abundant in rice, maize straws. These straws have only been used as the animals' (cattle) fodder or been put on the sty's ground for so many years, the utilization efficiency is at a very low level. Cultivating the edible mushroom is a good method to utilize the crop straws: it can increase the income; the material dregs can be used as manure; it also doesn't contradict with the farming season and the arable land. We introduce this technology to the villagers and extend it in the period of the CBNRM project (phase 2).

Kaizhuo Township Government usually extends the application technology by administrative order and forces the farmers to execute it. These extension methods usually bring the farmers' resentment. Some technologies don't fit for the local situation either, so the extension becomes difficult and the farmers don't want to adopt it

2. Objectives

2.1 Exploring the technology practicability of culturing the edible mushroom.

2.2 Exploring some methods and experiences of extending the applied technologies in the mountainous areas of Guizhou.

3. Process and Methods

3.1 Propagating and mobilizing the masses first, then holding villagers meeting, making household visit to introduce the advantages of the mushroom culture to the villagers.

3.2 We know the villagers need the technology training through the above steps. We choose 38 villagers (about 50 percent is women) after the villagers sign up. They all centralize to GAAS to get the technology training.

3.3 After the training, we choose 32 households in 6 natural villages as demonstration villagers to culture edible mushroom and to extend it based on their willingness. The extension process is as follows:

- In the 6 villages, we supply the facilities, the households raise money and input labor force to build the sterile stove. 1 or 2 representatives from each village centralize to learn how to build the stove and how to culture mushroom in one household, the teachers teach on the spot.
- All the households in every village centralize to culture the mushroom in their representative's house. The project researchers conduct on the spot.
- All the households exchange the work with the representative so as to invite the representative to teach them in their houses. Project team members go to help each household solve the difficult problems at the key stage of mixing materials, packaging, sterilizing, inoculating, managing, harvesting and etc.

3.4 Adjustment

All the 32 demonstration households succeed in culturing the mushroom. Their products go into the market and achieve obvious economic benefits, which testify the extension is practicable. After all the above extension procedures, we find there exist some problems in the extension process and will adjust in the future:

- *Solving the problem of crushing straw:* We thought there were no problems about straw fragrament??? because of abundant crop straws, but soon we found that crushing straw was the first problem for the household to solve. We help the villagers to remake the old crushing machine and organize the process-household to serve from house to house, so the households encounter no problems in crushing straws.
- *Training on the product sell:* After the mushroom culture succeeds, the villagers are afraid there are no good market We invite market specialist to train them, which sets up their faith. Some women who never went out before go out to sell the mushroom.
- *Selecting varieties:* At first, we provided the demonstration households many Yuhuanggu and other Pinggu varieties. After the villagers sold the mushroom for some time, they asked us to introduce some varieties local people like. So we introduce the villagers' preference in the next extension process.
- *Culture scale:* At first, because we provided some materials (plastic package, inoculum etc.), we limited the culture scale. Most of the demonstration households benefited from the culture and wanted to enlarge their scales, they found the larger scale, the better benefits. So we don't limit the scale any more. And now all the materials must be paid by the villagers, the villagers think it's good because of good benefits.
- Some technology-able people were cultivated, they can act as the technology conductor: these people possess culture technology and experiences, their abilities have been played in the next extension.

3.5 Because of the success of the 32 demonstration households, the further extension attracts many villagers. We continue the next extension and adopt two patterns:

- *Village with demonstration households:*

The villagers exchange their workday with the representatives. 1 or 2 labourforce participate in the whole culture process in the demonstration household to study. 1 or 2 labourforce go to the new households to conduct on the spot.

- *Village with no demonstration households:*

1 or 2 experienced households go to the village to teach 1 or 2 demonstration households, the next extension is conducted by the new demonstration households.

3.6 Adjustment of the further extension.

- There are more and more households who want to cultivate mushroom, so the needed inoculum and materials become more and more, which brings more inconvenient for us to take for each household. Also considering the sustainability after our project leaves, we help 2 households to set up the Inoculum Producing Factory and 1 household to build the Materials Supply Center in a traffic-convenient village. The villagers can buy all the materials not far from their houses, which creates good conditions for the future extension.

- Because more and more households cultivate the mushroom, the mushroom can't sell good prices. For the purpose of extending the mushroom in the future and utilizing the resources completely to bring good benefits. We're preparing to introduce outside merchants and to help the villagers to solve the process problems, so producing mushroom can become a stem industry in the target villages.

4 Results

4.1 Extending mushroom technology brought good economic benefits to the villagers:
Sampling 10 demonstration households, we know that there are 1392 packages per household (Pinggu or *auricularia auricula),* fresh mushroom 969.9 kg per household; 1.68 yuan per kilograms, the total output value is 1632.8 yuan; the value is 1.16 yuan, the expenditure is 0.16 yuan, the gross value is 1.0 yuan per package. This technology deserves to extend in the target villages.

4.2 We don't compel the villagers but cost much to persuade them to cultivate willingly.

4.3 We adopt the extension pattern: some trained villagers teach other villagers, so the villagers become the main body in the extension. Which makes the extension smooth and heighten the villagers' ability greatly. Meanwhile, this pattern can free the project team members and the villagers can continue to cultivate without the project members in the future.

Participatory Research in Weed Control

CBNRM Project Team
Guizhou Academy of Agriculture Sciences

Kaizhuo Township, located in the north of Changshun County, Guizhou Province, is abundant in paddy fields, per capita holdings is 2 mu. It is the main rice production area in Changshun, and the local villagers' income is mainly from rice production. In the four villages of the rice cropping area, there are many species of weeds that cause heavy damage to rice production. Local villagers usually control weeds by hand, but this method can't effectively control weeds for the shortage of labor force. Some villagers began to use chemical herbicides to control weeds in recent years. But the lower effectiveness of herbicide and even the occurrence of herbicide toxicity for the irrational use affected in some extend the extension of herbicide to large areas. In the light of the above situations, After the beginning of CBNRM (phase 2), the participatory research on weed control was carried out in order to formulate the integrated controlling strategies of weeds in the paddy fields and to further heighten the utilization level of the paddy fields.

1. Objectives

- Selecting locally-suites technologies of weeding control.
- Most villagers in the target areas use these technologies to lower weeding cost and labor force input.
- Enforcing the villagers' ability in introducing new agricultural technologies themselves and practicing technologies themselves.

2. Methods and Process

2.1 Investigating the current weeding status in the paddy fields

Using semi-structured interviewing and field visits, the in-depth investigations were carried out on the weeding technologies, service of weeding technologies, supply of herbicides and the existing problems of using herbicides and etc.

2.2 Investigating the weed situation in the paddy fields

The investigations were carried out on the growth regularity of weeds in different ecological environment and different cultivating pattern through field visits in 6.7 ha. paddy fields selected in four target villages and interviews with the villagers.

2.3 Experiment of herbicide effect

Focusing on the above problems and the cause of the problems, twenty-three households (6 in Dabuyang, 2 in Chaoshan, 4 in Guntang, 1 in Xiaozhai, and 10 in Niuanyun) were selected to develop weeding experiment with nine treatments. These nine treatments included seven herbicides varieties: Chaomian, Mianchaowang, Dichaolong, Chucaoling, Daotianle, Shachaohao, Xindeli, and two controls: no herbicides, artificial weeding. The design and management of the experiment, and the investigation and evaluation on the experimental effect were conducted together with the participating households

2.4 Extension and application of the chemical weeding technologies
According to the weed varieties and their growth regularities, also at the demands of the villagers and with the expert's suggestion, two herbicide varieties were selected to extend and apply in 25 ha. paddy fields of Niuanyun village at the same time with the experiment of varieties comparison.

2.5 Formulating the integrated weed controlling technologies in the paddy fields
On the basis of all the visit materials, the investigation results and the experiment analysis, and also combined with the local socio-economic conditions, the controlling technologies were drafted out after discussing with the community villagers.

3 Research results
3.1 Preliminarily knowing the weed varieties, their growth regularities and the main causes
Main varieties: *Monochoria vaginalis, eleocharis acicularis,* distinct pondweed, dwarf oldworld arrowhead, *eleocharis plantagineiformis* and etc.
Growth regularity: The weeds begin to emerge after one week of transplanting rice seedlings and emerge in a large quantity after 20 days, the weeds decrease obviously after 40 days because of the artificial weeding and begin to increase in large quantity after 50 days, which can even cover the water surface, also begin to decrease again after the earring. The harmfulness of weeds is heavier in the earlier transplanting fields than in the later ones and is also heavier in the fields by transplanting the upland-raising seedlings than in the fields by two-stage raising seedlings.
Main cause: the households weed incompletely in the weeding stage because of the shortage of labor force and other effective weeding methods.

3.2 Selecting the main herbicides suitable to local area
Through the investigation and evaluation on the weeding effects of seven herbicides, 3 herbicide varieties (Mianchaowang, Daotianle, Xindeli) were selected out by the participating households.

3.3 Extension effect

- Obvious social and economic effect: the 18yuan/ha. of herbicide input saves 29 labor forces (calculated by 30 labor force per ha. for weeding by hand, 1 labor force per ha for spraying herbicide).
- Villagers learn a lot about the chemical weeding technologies: all the 51 participating households know when to spray, how to spray and how to manage the paddy field at the spray stage through the participatory training and practice during the process of extension.
- Heightening the villager's ability to introduce and test the herbicides: parts of the villagers began to introduce other herbicides to make further experiment after the application in 1998.

3.4 Proposing the integrated controlling technologies and extension pattern for the local paddy fields.
Integrated controlling technologies (the combination of the following three technologies):

- *Lessening* the weed varieties base (heightening the multiple crop index, carefully selecting the rice seed, killing the weed in the seedling stage, clearing the field surface before transplanting and using reasonable planting density);

- Using chemical herbicides (Mianchaowang, Daotianle, Xindeli and other herbicides, 7~10 days after transplanting);
- Weeding by hand (20 days after using chemical herbicides, removing weeds that damage heavily).

Extension pattern:

training and service of technologies conducted by project team member+ experiment, demonstration, evaluation and adoption of the farmer

4 Problems and suggestions

4.1 No related technology services available to farmers

Cause: the local government doesn't care about the weeding technologies, the upper government never extends it before and there are no chemical herbicides for sell in the local market.

Suggestion: Establishing the weeding technology service system in the community and operating it by the pattern of "pay for service, pay for use".

4.2 Different villager groups should be taken into consideration in applying and extending the weeding technologies.

Cause:

- Women usually know herbicide technologies less than men do, some even don't know about herbicides. The introduction of herbicides is usually done by men;
- The richer households welcome the herbicide technologies more. Because they think it is worth costing a little money to increase the rice production and saves the labor force.
- The poorer demand improving the weeding technologies to heighten the rice production impressively, but they don't want to bear the increase in money.
- Households who step on the off-farm production want to improve the weeding technologies impressively, they hope to liberate more labor force to work on the off-farm production.
- The villagers with lower culture level adopt the new technology slower than the villagers with higher level
- The youth adopt the chemical weeding technology more easily than the older ones do.
- The communities near the main road (Niuanyun, Dabuyang, Guntang) adopt and practice the chemical herbicides more easily than the remote communities (Dongkou, Xiaozhai).

Suggestion:

Further exploring the difference of using herbicides in different groups. Organizing the villagers to demonstrate the experiment on herbicides (researchers provide technology training + households make demonstration experiment + farmers' cross evaluation and then adopt). Enforcing the participation of the women, poorer households, and remote communities' households.

4.3 Chemical weeding technology can't eradicate the weed damage completely.

Cause: Some villagers don't use other weeding measures after they adopt chemical weeding technologies.

Suggestion: Extending the integrated controlling technologies to effectively control the growth of weeds. Using the following indicators to monitor and evaluate:

- Easy to master and accept by farmers.
- Obvious social and economic benefits.
- Sustainability of herbicide use.

Participatory Study on Black Goat Raising

Guizhou Academy of Agricultural Sciences

1. Background

After the investigation and evaluation in the phase 1 of the CBNRM project ended, in order to formulate the interventions, we organized some cadres and villagers from Dabuyang and Xiaozhai to have a study visit to three counties in Guizhou in which the resources were used and managed well. The experiences of alleviating poverty and becoming rich through black goat raising in Dejiang county deeply impressed Wang Hua from Dabuyang village, Lu Zhangsheng (the village leader) and Xia Wanxian (the women representative) from Xiaozhai village. They actively asked the project team to support them to raise the black goat after coming back from visiting sites.

According to the requirement of the villagers, the project team discussed it with the people of the two target villages. Both of us think that the two villages have very good conditions to raise black goat, because there are, in the two villages, rich resources of the shrub and grasslands with an occupation of 418.9ha. shrub land and grassland in Dabuyang and Xiaozhai. These resources haven't been used effectively for a long time and just have the ecological benefits. Raising black goat can not only improve the utilization of the resources, but also increase the villagers' income. So we decided to carry out the study of raising black goat in the two villages.

2. Specific studying objectives

—Observing the adaptation of the Black goat in the two different ecological areas (upland cropping area and rice cropping area);

—Observing the economic benefits of raising black goat and its influence on the resources;

—Monitoring the problems coming out during the goat raising and adjusting the intervention in view of the problems.

The ultimate aim of this study is to assess the feasibility of the intervention through the research on the above specific objectives.

3.Organizing and implementing the intervention

3.1 Introducing black goats. The two ways were employed in the introduction of black goats: (1) purchasing by the goat-raising household themselves. Wang Hua in Dabuyang village prepared 2500 yuan and bought 12 black goats (1stockram, 11females) from the neighboring county. (2) Purchasing Jointly by goat-raising households and the project. The project provided 65% of the money for buying goats, the rest (35%) was paid by the goat-raising households themselves. 32 black goats (4stock-rams and 28 females) were introduced to the two villages in June 1996.

3.2 Selecting the goat-raising households. On the voluntary basis, 4 households (one in Dabuyang and three in Xiaozhai) were chosen to undertake the study on black goat raising according to their economic conditions and the distribution of the resources (Table 1).

3.3 Training of the goat-raising technology. After the goats were introduced, Prof. Zeng Xianzhang, the famous expert of goat raising in Guizhou, was invited to hold training on goat raising technology for the goat-raising households. The training included the construction of goat pen, the management technology of raising goat and the prevention and the treatment for the common goats' diseases. In addition, 2 women were selected to attend the short-term training course on goat raising in Duyun City.

Table 1. Basic information of the goat-raising households

Name of Househol	Popu-lation	Labor force	Income level	Arable land (ha)		Animal		Off-farm work	Social work	Initial No. of goats
				Paddy	Upland	Cattle	Pig			
Wan hua	4	2	Upper	0.3	0.3	2		Mushroo		20
Luzhang	4	2.5	Middle-upper	0.3	0.7	3	3		Village leader	8
Xiawanxi	3	2	Middle	0.1	0.7	2	3	Mining	Women leader	8
Lurenhai	7	4	Middle-lower	0.2	1.3	3	2	Mining		8
Total	18	10.5		0.9	3.0	10	8			44

4. Monitor and evaluation in the process of intervention

4.1 The rapid reproduction of black goats. Among the four goat-raising households, Wang Hua raised funds after the visit in Dejiang County and bought 12 black goats in Nov.1995, the rest 3 households started raising goats in Jun.1996. Because of the good quality of the goats, the expert's guidance and the training, the black goats were reproducing very fast and developing well. During the study, the number of black goats was increased from 44 to 207(see the table 2). The result showed that black goat has a good adaptation in the two kinds of agro-ecological areas of Dabuyang and Xiaozhai.

4.2 Economic benefits

(1) Direct benefit. Up to Jun.1998, a total of 196 goats were sold, the total income is 34,440 yuan, per goat-raising households sold 49 goats and got the income of 8610 yuan. After deducting the input of 20 yuan for each goat, which included the costs on epidemic prevention and the feed for breeding male goat, parturient female goat and newly born baby goat, the net income per household is 7630 yuan. The income was increased by 1913.3 yuan per household during the goat raising. The ratio of output to input was 2.2. Wang Hua, who introduced more goats and raised the goats longer, had 3.6 of ratio of output to input (table 2).

Table 2. The investigation on the reproduction and sales of black goat during study

Name of householder	Initial No. of goats	Duration	No. of goats sold	Total income (yuan)	Ratio of output to input	Per capital income	Notes
Wang Hua	20	1995.11~ 1998.6	126	23940	3.6	5985	Retail
Luzhangshe ng	8	1996.7~ 1998.12	24	3600	2.1	900	80% of goats were sold by wholesale
Xiawanxian	8	1996.7~ 1998.12	27	4050	2.3	1350	80% of goats were sold by wholesale
Lurenhai	8	1996.7~ 1998.12	19	2850	1.8	407	80% of goats were sold by wholesale
Total	44	1995.11~ 1998.6	196	34440	2.2	1913.3	

(2) Indirect benefit

---Providing a lot of high quality manure for the goat raising households. Wang Hua's family had more than 5000 kg goat manure annually.

--- Improving the villagers' nutrition pattern to certain extent. During the raising, 5 goats were killed for the consumption of goat raising households. Each household had consumed 1.25 goats, the intake of meat is increased by 6.8 kg per person.

4.3 Influence on the resources. According to the interviewing with other households, the current number of goats has not any negative influence on the brush and grasslands resource yet after one-year goat raising, and nor on the development of cattle raising. It is mainly because that the black goat mainly takes the brush leaves on hillsides and on the high mountains as food and the cattle mainly take the herbs as food. It was estimated that the number of raised goat below 500 in Xiaozhai and 300 in Dabuyang will not bring negative influence on resources.

4.4 Investigation and analysis of the causes resulted in the large sales of black goats during Nov. 1997 to Jun.1998.

In Nov. 1997, three goat-raising households in Xiaozhai sold out all 56 adult goats in the stage of the rapid development of goat raising. What they did was against to our preliminary expectation of this intervention. Why? Based on the question, we made the investigation on it by semi-structured interview. The result shows as follows:

(1) Xiaozhai village is abundant in brush resource, which is suitable to develop black goat raising. But the village belongs to upland cropping area with large uplands, most of the uplands are distributed among brushes and there has no special place for grazing. In addition, the black goat is good at climbing and running, so it is very difficult to raise goats in Xiaozhai. The goats' damage to crops happened often and caused some contradictions among households. According to the statistics, Xia Wanxian's goats had damaged the crops of other farmers for 50 times in one year and the largest amount of payment for her goats' damage was up to 84 yuan in a day. For this reason, she said, " no matter how great the benefit is, nobody in my family would like to graze goat".

(2) Dabuyang belongs to rice cropping area with flatland. The upland in the village is less and concentratedly distributed. A special place was delimited to graze, so it is hardly happen that the goats eat the crops of others. In addition, the village is abundant in brush resource suitable to developing black goat raising. Wang Hua of this village had taken the favorable conditions to raise black goat and gained the great economic benefit from it (see Table 3). However, he sold out all the goats in Jun. 1998. The main reasons were that his family is short of labor and has a lot of ways to make money. Besides cropping all the arable land, Wang Hua, the householder, needs to take care of large orchard and to culture edible mushroom in a large scale. His family has many sources of income and therefore has better economic condition. His wife is weak in physique. A total of more than 20 goat was lost for her weakness. They had planned to employ a labor to graze goats, but nobody was willing to do it. They have to sell out all goats.

(3) Besides the above two reasons, the thoughts of quick success and the worry of the goat market was another important reason for selling out all goats. Especially for the poor goat-rising households in Xiaozhai , it was a great seduction to them to gain 1000 ~ 2000 yuan at one time by selling the goats.

Table 3. Economic profits of black goat raising

Name of house-holder	Initial No. of goats	1995.11~1996.7		1996.6~1997.7			1997.7~1997.12			1998.1~1999.1			Total No. of sale
		Total No.	No. of death	Total No.	No. of sold	No. of death	Total No.	No. of sold	No. of death	Total No.	No. of sold	No. of death	
Wan Hua	20	2	27	72	18	16	98	18	16	102	90	4	126
Lu Zhang sheng	8		8	24	1	3	30	23	4	4		1	24
Xiawanxian	8		8	25	2	3	33	25	8				27
Luren hai	8		8	21	2	4	22	17	5				19
Total	44	2	51	142	23	26	183	83	33	106	90	5	196

5. Evaluation and adjustment of the intervention

The two-year study showed that black goat can grow well in the study area with very obvious economic benefit and can improve the utilization of the current resource. It is possible to properly enlarge the goat raising scale with the following conditions:

--- The community has to define a special place to graze.

--- The selected household should be poor and can arrange a male labor to graze goat.

Based on the above evaluation, the intervention on goat raising was adjusted as follows:

5.1 Dabuyang village is chosen as an experiment site to further carry out research on black goat raising together with the households that have more labors, lower household income and eager demand.

5.2 A total of 20 female goats, 8 goats of which were returned from Wang Hua were distributed to two households of Chen Guolin and Ban Shulin in average. The two households are poor and have many children, each has a 15~16 year old son to graze goat professionally. In the meanwhile a developed stock-ram was bought for them and was grazed in turns.

5.3 The households have to sign the contract for goat raising before the black goats were allocated to them. According to the contract, each household has to return 5 pregnant goats one year later. The returned 10 goats will be reallocated to other poor household which is willing to raise goat. Tow years later, each household will return the other 5 goats either, the returned goat will be allocated to others. At the end of the project, there will be 5 households to raise goat (4 in Dabuyang, 1 in Xiaozhai).

5.4 The above adjustment had been made in Jun.1998. At present, the goat has reached up to 39. According to the estimation, all the adult female goats are pregnant and the number of goat will be increased to more than 50 by the end of 1999.

Review of the implementation of IDRC projects and their economic, social and environmental impacts

Institute of Technology Economy and Energy System Analysis
Tsinghua University (ITEESA)

1 List of IDRC projects hosted by ITEESA from 1984 to 2001

Table 1, List of IDRC projects

No.	Project tile	Duration	IDRC funding (10 k CAD)	File code
1	Rural energy technology assessment and reform	1984—1987	4	3-p84-0291
2	Non industry urban energy consumption and supply in China	1986—1987	3	3-P-87-0341
3	Improvement and extension of fuel saving stoves in China	1987—1990	3.7	3-p87-0314
4	A survey on urban residents' energy consumption and indoor air pollution	1988—1991	7	3-p-88-0123-02
5	Strategic study on resource utilization and environment protection in Tarim basin	1992—1993	2.4	92-8012
6	Assessment of environmental and economic impacts of biogas program in husbandry farms in China	1994—1995	0.8	92-0419-04
7	Prevention of desertification and water management in Tarim basin (Phase 1)	1994—1997	25	94-8007
8	Web page design for the project "Prevention of desertification and water management in Tarim basin"	1998.6—1998.12	0.5	003192-01-3-7
9	Prevention of desertification and water management in Tarim basin (Phase 2) — Implementation strategy of water management and demonstration community	1998—2001	22.5	97-8012/40410

2 Implementation, achievements and impact assessment of IDRC projects

2.1 Rural energy technology assessment and reform

2.1.1 Project background

In the early 1980s, energy shortage in rural areas severely restricted the economic development and improvement of farmers' living standard. "No worry about lack of rice in the pot, but worry about no fuel under the pot" exactly reflected the situation of fuel shortage in rural areas at that time. Commercial energy supply to rural areas were very limited, as a result, farmers had to use a large amount of crop residues and fuelwood, leading to environment degradation. Under the dual pressure of energy and environment, Chinese government adopted the rural energy development strategy "adjust measures to local conditions, inter-complementary of different energy resources, integrated utilization and pay attention to the benefits" and developed plans of making full use of the usable renewable energy resources such as small sized hydropower, husbandry manure etc. Through efforts in the past decade, the hydroelectricity technology and biogas technology have been matured and applicable in practice, suitable for extension in the vast rural areas in China. Since the early 1980s, the country started to implement the programs of development of small sized hydropower and extension of household biogas taking the county as the experiment unit. According to these two programs, an assessment of technological, economic and environmental impacts was conducted and analyses of mechanisms and barriers for technology extension were carried out, at the mean time, policy recommendations for further development were also proposed.

2.1.2 Research activities and objectives

1) **Research objectives**

   By conducting micro and macro analyses of selected rural energy technologies, ie. Household biogas and small sized hydropower and analysis of barriers of technology extension, to develop supportive policy recommendations.

2) **Research activities**

   - Demand and supply analyses of rural end-use energy;
   - Comparison and selection of different energy technologies. 4 counties were selected to conduct surveys. Assessment of technological, economic and environmental impacts. Cost analysis for energy demands. Assessment of contribution of the biogas energy and hydropower to the rural development.
   - Policy recommendations for technology extension and the industrialization.

2.1.3 Implementation

Funding

Project fund was mainly used for research, survey, travel and accommodation, data collection and computation.

Exchange of visits

This project was under the IDRC's RETAIN network, consisting of more than 10 countries from Asia, Africa and Latin America. RETAIN invited experts from other countries to visit small sized hydropower and biogas in Wuxi, Hangzhou.

Research achievements

- Final report and presented at several RETAIN network conference.
- Policy recommendations to Ministries of Hydropower and agriculture, leading to wide application of the technologies.
- 3 papers published in core Chinese journals including the paper "Extension and development of biogas and small sized hydropower in China" presented in journal "World Development".

2.1.4 Scientific, economic and social impacts

Since the project conducted complete assessment of small sized hydropower and biogas in China, received attention from various administrative departments of the Ministry of

Agriculture and the Ministry of Water Resources. The assessment of hydropower and biogas by the projected was considered correct and successful and the assessment would help further development of the two technologies in future in China. Up to date, the number of biogas pools has exceeded 6 million and the success rate is almost 100%. Total capacity of small sized hydropower reached 20 million KW and annual power generation reached more than 60 billion KWH. In China more than 700 counties rely on the small sized hydropower.

2.2 Improvement and extension of fuel saving stoves in China

2.2.1 Project background

In 1980s, the rapid development of rural economy and improvement of living standard led to rapid increase of demanding for domestic fuels. Although the supply of commercial energy was increased from 95 million tons of standard coal in 1978 to 0.193 billion tons in 1985, the fuel demands in rural areas could not be met. Consequently, the farmers had to use a large amount of crop residues and harvest forests as their daily fuels. Since the crop residues were not returned to the soil, the soil content of organic matters was reduced. The soil degradation and the deforestation had led to degraded ecology and environment. For this reason, the government implemented several emergent programs, including development and extension of household biogas, small sized hydropower and fule saving stoves.

Since 1993, an extension program of fuel saving stoves was launched, up to 1998 about 0.1 billion farming households (accounting for 45% of the total number of household) started to use stoves with energy efficiency of 25%. The successful experience of extension of fuel saving stoves and the positive impacts need to be summarized and assessed, this project aims to analyze and evaluate the most influential technologies of fuel saving stoves.

2.2.2 Objectives and activities

Objectives:

General: Analysis and evaluation of development and extension of fuel saving stoves in China.

Specific:

1) R&D and production of fuel saving stoves in China
2) Planning, activities, institution and management of national and provincial extension programs of energy saving stoves
3) Selection of 4 counties to conduct on-site survey and investigation to evaluate the actual effects of the production, sale, extension and operation of the energy saving stoves.
4) Policy analysis of extension of energy saving stoves in China and its implications to other developing countries

Activities

1) 4 typical counties were selected for on-site survey of about 1,400 households in total and 373,000 data entries were collected.
2) Analysis and evaluation of energy saving techniques in China
3) Evaluation of extension program of energy saving stoves, analysis of production and sale of energy saving stoves, extension institution and management, financial input and policy
4) The extension of energy saving stoves boosted rural energy industry

5) Impacts analysis and evaluation of extension of energy saving stoves, including energy, ecological and social impacts
6) Understanding of R&D of energy saving stoves in other developing countries by international visits, comparative analysis of China and other developing countries
7) Prediction of future potential of applications of energy saving stoves

2.2.3 Implementation

Funding

Project funding was mainly provided by IDRC and RETAIN and mainly used for survey, data collection, travel and accommodation. As this project closely connected with the energy saving stove extension program of the Department of Environment and Energy, Ministry of Agriculture, experiment sites and 35,000 Yuan RMB for consultation were provided by the Department.

Exchange of visits

Three times international study tours and workshops by the Chinese researchers and one visit to China by Dr Kirk Smith of the East West Center of the US.

Research team

In addition to the researchers of ITEESA, 2 officers of the Department of Environment and Energy, Ministry of Agriculture and 2 of Northeast Agricultural University and Institute of Agricultural engineering were invited as advisors. In specific activities, local experts and survey specialists were involved.

Achievements

1) Final report "Diffusion improved firewood stoves in China"
2) Many times of participation in international rural energy conferences and presentations were highly regarded
3) Together with MOA (Ministry of Agriculture) programs, systematically summarized the experience of extension of energy saving stoves in China, the research results were awarded the 2nd class prize of MOA science and technology advancement awards.
4) The paper "One hundred million improved cook stove in China, how was it down" coauthored with Dr Kirk Smith of the East-West Center was published in World Development, Vol. 121, No. 6, 1993
5) A monograph "Technology and economic assessment of extension of energy saving stoves in China" was published
6) "Diffusion of improved biomass stoves in China" was published in Energy policy, Vol. 24, No. 5: 463-369, 1996

Scientific, economic and social impacts

The project systematically summarized the successful experience of extension of energy saving stoves in China, including technology innovation, cost effective analysis and impacts on energy environment and rural economic development. The project received much attention from the Department of Environment and Energy, MOA. With the leadership of MOA, monographs were published, workshop were held, research results were disseminated. These largely facilitated the extension program of energy saving stoves. Up to 1998 there were 0.14 billion households were using improved energy saving stoves. Approximately 70% of the farming households were using improved stoves, leading to a reduction of crop residue and wood consumption of about 70 million tons. This helped the protection of arable land, increase of forest coverage and improvement of ecology and environment. Energy saving stove is still a main technology in the ongoing environment protection program. It plays an important role in ecological and environmental protection in the middle and upper reaches of the Yangtse and Yellow Rivers.

2.3 Assessment of environmental and economic impacts of biogas program in husbandry farms in China

2.3.1 Project background

The policy of economic reform and opening up adopted by the Chinese government boosted the rapid economic development and improvement of living standard. The improvement of living standard led to the increase of demand for meat, fowl and eggs. To meet this demand, the government launched the "vegetable basket" program. However, while the large-scale husbandry was rapidly developing, the environment pollution was becoming more and more serious. The biogas program that utilizes anaerobic techniques together with other relevant techniques is a possible way to solve the problem. The biogas program is not only an environment program that protect environment pollution, but also a energy program that provides quality energy and a fertilizer program providing organic fertilizers. This project was intended to use theories of environment economics and method to analyze the environment impacts of the biogas program, to find out causes affecting biogas development from diverse viewpoints of beneficiaries, investors and government and to find the way of promoting biogas development.

2.3.2 Objectives and activities

Objectives

By analyzing several biogas programs of husbandry farms with different scales, to study the environmental impacts of the biogas programs that use agricultural wastes.

Specific objectives:

1) Assessment of cost and benefit of biogas program with consideration of environment effects, economic analysis of the scale and integrated resource utilization
2) To study the factors that constrain biogas development in China
3) To develop a strategy that encourages biogas development and are beneficial to both the farms and the state

Activities

1) Study on methods of economic assessment considering environment impacts
2) On-site survey and data collection for 3 selected typical biogas programs
3) Economic assessment of biogas program considering its environment impacts
4) Analysis of constraining factors for biogas development
5) Development of policy

2.3.3 Implementation

Funding

IDRC provided 9,500 USD in total and the Ministry of Agriculture provided 30,000 Yuan RMB.

Personnel training

The main research staff of the project participated in a 6-week environment economy workshop held in Harvard University. 3 time of participation in environment economy held in Singapore by the workshops Environment Economic Program of Southeast Asia (EEPSEA) of IDRC.

Achievements

1) Final report "Method and application of economic assessment of environment impacts of biogas program in husbandry farms" in both Chinese and English
2) A paper "Economic assessment of environment impacts of biogas program on livestock farms" published in Tsinghua University Journal
3) A paper "The Biogas Plant Program on Livestock Farms in China" published in IIEC.

2.3.4 Assessment of scientific, economic and social impacts

It was the first time in China to conduct assessment of environment impacts of biogas program. It utilizes the advanced environment economic theories and methods, systematically and quantitatively evaluate the environment benefit of the biogas program. The research results have been presented in many workshops on biogas programs in China and research papers were also published.

Since the biogas program is an effective program of livestock manure treatment, but also an energy program that provides clean biogas-fuel, the program has significant external benefit. Proposals on biogas development have been adopted by relevant government agencies such as the Department of Environment and energy, MOA.

The methods of assessment have become the main applicable methods for assessment of economic and environmental impacts of biogas programs.

2.4 Urban non-industry energy consumption and supply in China

2.4.1 Project background

Since the adopt of reform and opening up policy in China, the national economy have been rapidly developing and the living standard are continually improving, consequently the demands for energy also rapidly increasing. Energy supply has become a major constraint for social and economic development. Studies on energy supply and demand as well as relevant policy are therefore drawing more and more attentions. In the past, China emphasized on energy problems in production sectors, particularly the industrial sector as it is the largest energy consumer. Energy policy was inclined to the production sector, priority of high quality energy supply was given to these production sectors. However, due to the rapid increase of domestic energy demands, demands for high quality (clean and convenient) becoming more and more evident. This trend is a development necessity, however, studies in this field was very weak in the past. The State Science and Technology Commission (now the Ministry of Science and Technology) and IDRC agreed to support a study on urban non-industry energy consumption and supply by the ITEESA, Tsinghua University.

2.4.2 Objectives and activities

Objectives

To study the urban domestic energy supply and consumption in China and the relationship between urban household income and energy consumption. To predict household energy demands and consumption.

Activities

Four typical cities, Beijing, Wuhan, Hangzhou and Xinxiang, with different sizes and functions were selected to conduct survey. The study was conducted according to different sectors and types of fuels. The main sectors were public construction and public facilities, transport and residents. Involved energy types were coal, oil products and electricity. The study expanded the urban domestic energy demand and supply model (UEM) and analyzed the relationship between household income and energy consumption. Beijing was taken as a case study and its domestic energy consumption demand and supply were predicted.

2.4.3 Implementation

Project funding

The total external fund was 30,000 CAD, mainly used for research, documentation, travel, labor, computing and communication. Internal funding was 25,000 Yuan RMB, mainly for salaries of researchers, administrative and equipment etc.

Personnel training

Two training courses with each at the early and later stage of the project were held. 30 officers and technical staffs participated in the first training course and 20 participated in the second one. The training courses were mainly on research methodology and modeling.

Visits

Two Chinese experts made a 3-week overseas study tour.

Research team

A research team was formed with experts and management staffs. The team later became the backbone for urban domestic energy researches.

Achievements

1) Direct achievements

- Urban domestic energy survey was conducted in 4 selected cities. Reports on the survey and relevant data were prepared.
- The Urban domestic energy model (UEM) was improved, computer programs with Chinese interface was developed and application was made.
- Prediction of urban domestic energy consumption demand in 2000 was made for Beijing
- A urban domestic energy development strategy was proposed.

2) Attention by some cities and government sectors was draw to urban domestic energy and facilitate relevant works.

2.4.4 Scientific, economic and social impacts

The research results indicated that urban domestic energy consumption in China was not high, at present, accounting for about 13-19% of the total commercial energy consumption. Average energy consumption per capita was only 400 kg standard coal. Coal is the main energy, accounting for 80%. Even in the capital city Beijing, the energy consumption in coal was about 60%, but the efficiency is very low (lower than 30%). More over, average household electricity consumption is also very low. With the economic development, improvement of living standard, urban population increase, the urban domestic energy consumption will continually increase. Therefore the present policy of urban domestic energy consumption including subsidy need to be appropriately adjusted.

This study is a frontier research in supply and demand analysis for urban domestic energy consumption. The research methodology, research results, prediction and policy recommendation provided valuable references for future studies on urban domestic energy, attention was drawn from relevant sectors:

- The impacts were expanded by holding training courses
- The research method and results were used in "Energy in China in 2000" program.
- Studies on urban domestic energy were strengthened. For example, the China Energy Research Association formed a Urban Energy Subject Committee to strengthen the researches in the field. The State Science and Technology Commission and the Ministry of Energy supported some relevant studies, such as "Urban energy survey in China" and "Medium and long term energy strategy" etc. As the frontier research, this project laid the foundation for studies on urban domestic energy demand and supply, prediction and policy while the reform and opening-up policy is deepening.
- The research staffs have become the backbones or leaders of urban domestic energy studies.

2.5 Urban household energy consumption and indoor air pollution in China

2.5.1 Project background

China has one fifth of the world's total population. The energy consumption is huge. Since the reform and opening up, national economy is rapidly developing, continued expansion of cities in both size and number has led to rapid expansion of population and accelerated urbanization. With the increase of urban consumption, the urban energy consumption is also continually increasing. The proportion of high quality energy is correspondingly increasing. The average annual increase of urban energy consumption for ling was 11.2% during the period from 1981-1988, much higher than increases in other sectors. Of the urban energy consumption for living, more than 75% is coal, leading to severe urban indoor and outdoor air pollution and seriously harmful to people's health. Chinese energy statistic system did not include household energy consumption. In order to study the development trend and corresponding strategy for urban household energy consumption, it was very necessary to conduct on-site survey of urban household energy consumption and indoor air pollution.

From February 1989 to July 1991, Tsinghua University ITEESA joined the Asian Urban Energy Network including China, Hong Kong, India, Thailand and the Philippines. With support from IDRC, completed the studies on urban energy consumption and indoor air pollution in Beijing and Nanling.

2.5.2 Objectives and activities

Objectives

- To study urban household energy consumption and energy structure and affecting factors
- To study the reasons for and scope of transformation of urban household energy from tradition to modern fuels.
- To measure urban indoor and outdoor air pollution caused by different fuels
- To develop strategies to strengthen planning and management of urban household energy and environment

Activities

- Urban household energy consumption survey: 500 and 200 households were randomly sampled respectively in Beijing and Nanling.
- Urban household indoor and outdoor air pollution survey: 60 households were selected from the sampled households in Dongcheng and Haidian districts of Beijing for indoor and outdoor air pollution survey.

2.5.3 Implementation

Project funding

IDRC provided 70,000 CAD equivalent to 230,000 Yuan RMB. The project funding was mainly used for labor, collaboration, and compensation to the surveyed households, report translation, typing, printing and administrative. 200,000 Yuan RMB of internal funding were mainly used for salaries, local transportation and computer equipment etc.

Personnel training

An EWC scientist trained six of the research staffs at ITEESA. How to use the indoor air pollution measuring machine was conducted in the training course.

Research team

The research team consisted of 2 from LBL, 2 from EWC, 6 from ITEESA, 10 from Beijing urban social economic survey team and 8 from Nanling urban social economic survey team.

Achievements

Following reports were submitted to IDRC:

- Urban Household Energy Consumption and Air Pollution Survey in China.
- Indoor Air Pollution Survey in Beijing.

2.5.4 Scientific, economic and social impacts

Research results transfer and application

The study was the first time in China to conduct on-site survey on urban household energy consumption and indoor air pollution. The study provided actual facts on urban household energy demand and supply and on the serious indoor air pollution caused by coal energy consumption as the main urban household energy resource. The research provided reliable evidence for optimizing urban household energy structure and policy making of urban energy and environment planning and management. Fundamental data was obtained for prediction of urban household energy demand and supply. Meanwhile, the study also lead to the improvement of statistic work of the government statistic agencies.

Personnel training

A master student was supported by the project.

2.6 Strategic study on resource utilization and environment protection in Tarim basin

2.6.1 Project background

Xinjiang Autonomous Region is located in the northwest border of China and covers an area of 1.66 million KM^2, accounting for one sixth of the total land area of China. It is the largest province/region of China. The geographic location of Xinjiang is at the heart of Euro-Asia continent and connects Asia and Europe. It was the gateway of the silk road in the ancient time from China to the western, therefore it is of strategic importance.

Tarim basin is in the southern part of Xinjiang, lying at the south side of the largest mountain range, Tianshan mountain, in Xinjiang. The weather there is typical arid continental climate. The total area of the basin iw 1.04 KM KM^2, of which 31% is desert and 47% is mountains and only 22% is plains and oasis at mountain foot and basin margins. The basin is dry and rainfall is small. The annual rainfall is about 50 mm and annual evaporation is as high as 2000-3000 mm.

The basin covers 5 prefectures, 42 counties and 3 agro-cultivating divisions and 1 agro-cultivating bureau. The people are mainly minorities. One third of the rural labor force is illiterate. Most of the rural households had an annual income less than 500 Yuan RMB, living a poverty life. The ecology and environment and protection of natural resources in the Basin are degrading, mainly indicated as shrinking rivers and drying up lakes, declining natural desert forests, aggravating desertification, increasing wind-blown sands and floating dusts, pickled soils and salty water, degraded pasture land and reduced grass production, short of rural energy for living.

Drought, poverty, energy short, inappropriate water resource management, unbalanced resource utilization have led to the degradation of rural ecology and environment and worsened situation of protection of natural resources. This is a serious problem that not only exists in Xinjiang but also in the northern and western China and even in other third world countries. Therefore, it is of significant meaning not only for Tarim basin, but also for the whole Xinjiang and China as well as some other similar regions in the developing countries to study the improvement of ecology and environment, protection and appropriate utilization of natural resources and sustainable economic development in order to develop a solution and strategy suitable for the local social economic condition and cultural tradition.

2.6.2 Objectives and activities

Objectives

- To study the current situation of ecology and environment, and utilization of natural resources in typical counties in Tarim basin, in order to analyze the factors that affect sustainable economic development in the region.
- To develop a solution and an proper strategy suitable for the local social economic condition and cultural tradition.

Activities

- On-site investigation by Research staff and foreign experts and interviews and discussions with local experts and officers in the selected typical counties of Weili, Hejin and Hetian city, in order to understand the present ecology and environment situation and resource utilization.
- Assessment and evaluation of barrier factors constraining sustainable economic development and development of possible solutions.
- Hold a hearing meeting with 30 participants consisting of research staffs, foreign experts, Xinjiang government officials and involved personnel from the 3 typical counties.

2.6.2 Implementation

Project funding

The project duration was one year from May 1992 to May 1993. IDRC provided a support of 24,000 CAD, equivalent to 150,000 Yuan RMB, mainly for accommodation and transportation for the on-site investigation, data collection, various discussion meetings and hearing meeting as well as compensation for local researchers. Internal funding included salaries and equipment of about 130,000 Yuan RMB.

Visits

Five foreign experts were invited to participate in the investigation and the hearing meeting at the termination of the project.

Research team

Seven researchers of ITEESA of Tsinghua University, 6 researcher of Institute of Modernization, Xinjinag Academy of Agriculture and about 100 advisors and researchers of prefectures, counties and various departments (Bureaus) of the Xinjiang government joined the study.

Achievements

Research report on appropriate resource utilization and environment protection strategy was submitted. A lot of preparations for the next stage project "Desertification control and water resource management in Tarim basin".

2.6.3 Scientific, economic and social impacts

1) Three typical counties with different characteristics were selected for on-site investigation. Data collected was representative.

2) The study found that although the three counties had different problems, but desertification, pickled and salty soil, short of water resources and improper use of water resource and the gradual ecology and environment deterioration were the common problems to all three counties. In particular, the "green corridor" in the lower reaches of Tarim River was threatened to disappear, the deserts in the two sides of the Tarim River already connected at many sites, it is urgent to save the "green corridor".
3) An international workshop on appropriate resource utilization and environment protection was held in Urumqi in May 1993. The workshop was participated by more than 30 persons from both China and overseas. Research findings for the project was highly commented by Xinjiang governmental officials and foreign experts and was considered to be of significant implication for the sustainable development in the region.

2.7 Desertification control and water resource management in Tarim basin

2.7.1 Project background

With the continual expansion of the economy, expanded petroleum exploration, population increase in the Tarim basin, the development of agriculture, pasture and forestry imposed the increasing demand for water resource. On the other hand, while the local economic development and water consumption is increasing, the increasingly aggravated desertification made the issue of environment protection an pressing problem. Furthermore, there were serious problems in utilization and management of water resource in the basin. These problems mainly are: Sever waste in water use, free or low cost of use of water, lack of a water resource management system integrating responsibilities and rights, threatened "green corridor" in the lower reaches of the Tarim River, and the increasingly expanded and aggravated desertification.

2.7.2 Objectives and activities

Objectives

To study measures that can be used for improving water resource management, water saving agriculture and desertification control in the Tarim basis, hence to improve the water use efficiency and land productivity.

Activities

- Water valuation reform for agriculture and effective management of water resource
- Water conservation technology in agriculture and water conservation potential analysis
- Measures of desertification prevention and control, policy analysis
- Water resource allocation in the Tarim River basin and protection of the green corridor

2.7.3 Implementation

This project was the largest IDRC project that ITEESA ever hosted, with the longest duration and largest funding. The duration was more than 3 years from Novmber1994 to March 1998. It involved more than 100 researchers and technicians from various sectors such as water use, forestry, agriculture and pasture etc, total investment was about 3 million Yuan RMB. IDRC provided 250,000 CAD, equivalent 1.5 million Yuan RMB, DIDA provided 50,00 CAD for training and China invested about 1.2 million Yuan RMB.

The IDRC fund was mainly used for traveling allowances, transportation for on-site investigation, data collection, meetings, water conservation experiments, local researcher's allowance, consultation, communication and service charges. The internal fund was mainly for salaries, computer, fax machines and consumables. A field vehicle was purchased for research staffs traveling to experiment sites.

Personnel training

Two overseas training were conducted. Two researchers Yu Suhua and Dai Jian from Tsinghua University were trained at Lethbridge Agricultur Development Center from April to September 1995. Four researchers Dai Jian, Zhao Xiusheng et al. made a study tour to Israel to study water conservation technologies and application.

Six within-country training courses/workshops were held during the period from 1995 to 1997. research staffs were also sent to other IDRC workshops held in Guizhou and a Canadian scientist was invited to give lectures in Xinjiang Agriculture Academy.

Achievements

1) Five applied models were developed:

- A water pricing model was developed and applied in the water pricing system for Tarim Riveer basin;
- A cost effective comprehensive evaluation model was developed, and was used to evaluate water conservation technologies. Based on the analysis, a number of water conservation technologies was chosen.
- A model for assessment of environment impacts of desertification control was developed to quantify the ecological benefit of forests.
- A model for optimal deployment of water resource in Tarim basin were studied using the advanced integrated resource planning (IRP) and demand and supply management (DSM) methods. Statistic data and spatial data based GIS technology and computer multimedia technology were used in the demonstration of the model.

2) Based on the research results, 7 development proposals were submitted to the Xinjiang government:

- Understanding the development advantages and potential of Xinjiang and the Tarim region, and their strategic position in the 21st century economy.
- With sensitive environment condition, over agricultural development and over exploitation of water resource are facing severe challenges
- Fully explore the great water conservation potential, agriculture development should take the water conservation as the core
- Strengthen water resource management, realize the integration of government macro control and industrialization of water resource management
- The development of Tarim basin should combine economic benefit and ecological benefit together, while engaged in economic development attention should be paid to desertification prevention and control. Strengthen forestry development, gradually improve the desert ecosystem into oasis ecosystem

- Proper water resource allocation in the Tarim River basin. Implement the strategy that "control the headstream, govern the upper reaches, improve the middle and guarantee the lower". Achieve the dual goals of economic development and environment protection.
- Protection of "green corridor" is of strategic significance; proper deployment and utilization of water resource could lead to effective protection of water resource.

3) A book "Desertification control and water management in Tarim" was published in 1998 by China Agriculture Publisher.
4) Fifteen research papers were published in national and international journals. Of these 3 papers were presented in international conferences and 4 papers were award winner. A web site and homepages were created in the Internet.
5) Annual reports and final technical report submitted to IDRC.
6) The project produced 2 PhD students and 2 Master students.

2.7.4 scientific, economic and social impacts

The project produced or is producing substantial economic, social and environment benefits.

1) The proposed the water transfer plan was an effective way to solve the problem of water shortage in lower reaches of Tarim River. This proposal received much attention from the Xinjiang Provincial government. The provincial planning commission is planning to implement the water transfer proposal.
2) The 3-step water pricing reform improved the water use efficiency and facilitated the development of water resource management. The proposal was adopted by Xinjing provincial government and the Bureau of Water Resource. The water pricing methods developed in this study were further confirmed by officials from Ministry of Finance and State Planning Commission. It was considered to be of significance to water pricing reform in the country.
3) The proposed institutional reform for water management strengthened the integrated management capacity and boosted the water resource commercialization. The proposal was regarded by the provincial government as being of significant practical implications.
4) The project proposed a list of water conservation technologies that were suitable for the Tarim basin and the extension plan for these technologies. The provincial Bureau of Agriculture adopted the proposal and the Land Resource Bureau considered the water conservation potential analysis was of great implication to agricultural land development particularly for the development of cotton production bases.
5) The innovative proposal using highly efficient artificial ecosystem to gradually improve the natural desert ecosystem would bring substantial ecological, economic and social benefits.
6) Successful application of GIS in modeling studies.
7) The research results were reviewed by more than 50 experts and officials, and were considered to be at the leading level within the country. The results were already used in important decidion making by Xinjiang provincial government.

8) The project was awarded the second class prize of the Xinjiang provincial science and technology advancement awards.
9) The research results are of significance for other similar arid regions in northern China.

2.8 "Desertification control and water management in Tarim basin" Phase II – implementation strategy of water resource management and establishment of model community for water management

2.8.1 Project background

The phase I study made 7 piece of suggestions and new ideas of reform. The Xinjiang provincial government paid much attention to these. However, how to apply these research results in the practices and to solve many specific problems. For example, to implement the water transfer plan, the investment estimation and fund raising channels, implementation measures and procedures, ecological and social benefit analysis for the protection of green corridor after implementation, how to realize the integrated resource management and utilization and optimal deployment of resource, corresponding management reform such as water pricing, how to practice water rights and water trading, how to run the water market, the attitudes of local officials, farmers towards the water pricing and management reform, attitudes towards application of new water conservation technologies and desertification control measures. All these problems need to be answered. Therefore the phase II study was conducted in both macro and micro aspects with emphasize on implement strategy of water resource management and model community. Three demonstration sites were selected to conduct the studies. The project duration was from April 1998 to March 2001.

2.8.2 Objectives and activities

Objectives

In order to improve the sustainability of measures for water resource utilization, agricultural production and desertification control, establish applicable management system and corresponding policy and supporting measures, improve water resource management in the whole basin, reduce conflicts raised in the use of water resource. Implement community resource management in the demonstration counties, study the relationship between agriculture production and water resource, and analyze the impacts of water pricing and innovative water use technologies.

Activities (Macro and micro aspects)

- Applicability of the water transfer plan, fund raising channels and assessment of ecological and environmental impacts.
- Corresponding management system and institutional innovation (such as concepts of water rights and water trading) to the water transfer plan.
- Assessment of reactions of communities (demonstration sites) to the water management institutional innovation and water pricing reform, water conservation technologies and desertification control measures.
- Assessment of the effects of non technical factors such as land use and cropping methods during the contracted duration, folk tradition and historical background on different water pricing, water conservation technologies and desertification measures.

- Establishment of monitoring and encouraging mechanism at the demonstration sites to strengthen effective use of water resource. Micros study on rural participatory resource appraisal (PRA) and a survey on 200 rural households.

2.8.2 Implementation

Project funding

IDRC provided 225,000 CAD equivalent to 1.285 million Yuan RMB, mainly for local research, survey, discussion meetings, data collection, transportation, accommodation, consultation, equipment, research results transfer, study tours by farmers of experimental community, training for farmers. The internal funding was 1.07 million Yuan RMB, mainly for salaries of researchers and daily consumables.

Equipment

In order to implement the water pricing and training for. the farmers (including water management, water conservation technologies and desertification control measures and experiences), water meter, video camera and video recorder.

Personnel training

- Research staffs participated in PRA training and workshop
- Training for community PRA personnel
- Training for farmers on water management, advance water conservation technologies, desertification prevention measures and optimal cropping structure in variety of forms of lecturing, computer demonstration, video show and discussion.
- Visit by local officers and farmers to neighboring areas where the water management and conservation was good.

2.8.4 Scientific, economic and social impacts

This project is still on the way. In the first year, the PRA survey and 200 households survey were completed in the three demonstration sites. A study tour to Yellow River basin was carried out in order to understand water pricing in different regions. By comparative analysis, water pricing reform proposal was developed. As the project is not finished yet, the expected achievements and benefits are believed to be great.

3 Assessment of IDRC and MOST (Ministry of Science and Technology) program management and suggestions

IDRC and MOST were very strict from the project initiation to termination examination. IDRC headquarter and its program officers were very conscientious and highly creditable, they had very strict requirements on annual technical report and financial report. The IDRC funding was delivered quite on time. The program officers provided instructions or provided helpful information in project implementation, preparation of technical report and translation etc. For example, Dr Stephen Tyler was an typical IDRC program officer, for him, the Xinjinag provincial government wrote a special letter (attached) to IDRC headquarter to praise his excellent job he did with the project.

- Hope IDRC continue and intensify its support to projects that are evidently effective, of significant importance and have large impact on sustainable development of developing countries, not to restrict support to only 1 or 2 phases.
- Suggest IDRC widen its support areas.
- Suggest MOST periodically hold workshops to put all IDRC projects in China together to exchange, share and discuss experiences and information so that they can help each other and make greater benefit.

The IDRC style that it supports researches is a better way of getting foreign aid. From the viewpoint of country, we hope IDRC can intensify its support and widen its support areas. Research fund should be mainly used for studied within the country and the principal researchers should be Chinese scientists, so that the studies can be combined with the Chinese realistic situation, research results and recommendations can be more applicable to the Chinese situation, more workable and applicable. It is necessary during the implementation of the project to invite foreign scientists to give lectures and exchange new technology and experience, and send Chinese scientists to overseas to learn new knowledge and widen views.

4 Features of IDRC support

4.1 IDRC has strict and detailed requirements for project proposals to be supported

Before filing the application, IDRC program officer asked the project team to have very clear and explicit research objectives, activities, implementing techniques etc. For this the proposal went through quite a few times of revisions. During the revision, IDRC program officer provided specific supervision and help. For example, when we were going to make the application for the project "water management and desertification control", the project proposal was revised for 5 times before the final version. Program officer Dr Stephen Tyler provided detailed the instruction on research objectives and activities. The proposal went through revisions until it was satisfactory. The final proposal had clear objectives and idea flow. The research activities and methodology were very detailed, and strongly workable. All these ensured the smooth implementation and progress.

4.2 The IDRC support strengthened the capacity building for the Chinese scientists, significant benefits were obtained from the study

IDRC fund was delivered to the host institution so that it can be managed together with the Chinese fund. Main research staffs were Chinese scientists and local technicians. Since they understand the Chinese situation and the reality, their research results and recommendations were easier to be accepted by the local people and government agencies. According to the research needs, training for research staffs both in China and abroad can improve their research capability. For example, when studying the water management in Tarim River, only Chinese scientists together with local technicians and officers can the situation be thoroughly understood, hence a innovative proposal can be made based on local reality together with introduction of foreign advance experiences, but not simply borrow foreign technologies and methods.

4.3 Emphasize on local participation and combining with practice, care about the actual effects

IDRC requires detailed research activities, emphasize on on-site investigation to get first hand information. It stresses the participation in the study by local, governmental and grassroots people. This were reflected in all the IDRC project hosted by our institute. For instance, in the project "Desertification control and water management in Tarim basin", there were a lot of surveys participated by local officers, scientists and farmers of different groups. This made the study combined with practice and the results produced were more applicable.

IDRC pays much attention to actual effects. Program officer attaches importance to the reactions by the local officers and technicians. The project to be supported must be really helpful for the research field or governmental agencies and must be able to bring good economic, social and environmental benefits.

4.4 IDRC support matches with the sustainable economic development of developing countries

From the IDRC projects that the ITEESA hosted, we can see that IDRC paid attention to the development situation in developing countries. Areas supported by IDRC are key problems related to sustainable economic development encountered during the development. These problems covers from rural energy technology innovation, urban domestic energy structure changes, environment pollution to water resource utilization and environment protection in the remote poor arid areas in northern China, all these are problems in China's economic development that need urgent solution. The solutions to these problems are of significant demonstrative importance to other relevant agencies and regions.

Appendix: A thanking letter to IDRC headquarter

December 1997

Canadian IDRC,

Xinjiang is located in the western part of China and is the largest cotton production area in China . However, Xinjiang is a poor area heavily populated by the minority people, and also a fragile agriculture area with arid and semi-arid eco-environment.

The project of Tarim Basin Desertification and Water Management has been financially supported by IDRC, and has been carried out since 1994 and was successfully evaluated in October 1997. From the expert point of view, this project was being aimed very clear, happened to coincide with the requirements of the economy development in Xinjiang or even in China. The scientists have been taking systematic research on water resource management (Water is the principal limited resource in Tarim Basin) and desertification, which is the most important environmental problem in Tarim Basin. The conclusion and suggestions from the project have decision-making and practical leading meaning towards the economy development in Tarim Basin, the construction of cotton production base and the sustainable development of agriculture.

Your support to the project play a very important role in the economy development in Xinjiang , particularly in the decision -making on how to efficiently utilizing natural resources and protecting environment. It provides us with a scientific foundation on decision-making, so the contribution is much bigger than those aids to technical engineering.

We show many thanks to your assistance, thank you for your helping us to solve the major management problem in the economy development. And what is more, we thank Dr. Stephen Tyler for his remarkable work and great contribution to the project.

We are also looking forward to receiving your further aids to the projects about resource management and keeping the poor peasants becoming richer in Xinjiang, helping us solving some big problems we are facing, in order to raise the utilization and management level of natural resources and maintain the sustainable development in Tarim Basin and in Xinjiang .

The People's Government of Xinjiang Uygur's Autonomous Region, P. R. China.

Report on the implementation of IDRC-supported Project

Xinjiang Science and Technology Commission

Project Background & Applicant Course

Tarim Basin is the important base for implementing the transforming strategy of dominant resources, of which the white resource is cotton and the black resource is crude oil. The Basin is 1050 thousand km^2. It has rich sunshine, heat, water, land, oil and gas resources. It is the reserve petroleum base, main cotton and other agricultural-products base of China in 21-century. But the ecological environment is very weak. The second largest desert is in it, and it makes 31% of the total area. The extreme dry climate, bad desert environment, unchecked reclamation and unreasonable utilization of water resource intensify the environment badness and desertification. Environmental protection is becoming the main constraining factor, which effects the sustainable development of local economy. The contradiction between rapid economic development and ecological environment protection shows in three aspects:

i. New trend of economic development in the Basin intensifies the pressure on water.

ii. In the whole Basin, it is lack of centralized and efficient water management system.

iii. The environmental protection of Tarim River Basin is increasingly severe.

The environmental problem of the Basin, especially the problem of desertification control and water management, is not only the key question of Xinjiang, but also draws the attention of foreign experts and international institutions. In 1992, the research group applied for the support of IDRC for the project of Tarim Basin environment protection.

On July 1992, the project official of Asian-Pacific area Dr. Stephen Tyler and Dr. Chi Chang of the Lethbridge Research Station of the Agriculture Department of Canada went to Xinjiang. During three weeks, they visited around the Basin, especially in Hetian City, Hejin and Weili County. After the visit, the two experts believe that the local key problem in the management and utilization of natural resources is lack of efficient management system and measures. It was the main factor causing the environment badness in the course of economic development. After that, according to their suggestion, the research group had a year's pre-feasible study. Four counties were selected as example.

On May 1993, the starting and discussion meeting of the project held in Urumqi. The technical counselor of Canadian Embassy in China and experts from Canada, Africa, Beijing and Xinjiang attended the meeting and pre-meeting trip to the project site. The leads of the Autonomous Region also took part in the meeting. All the participants agreed that the project is very important and has large-scale applied value. On November 1994, the project was approved by IDRC. Meanwhile, the Chinease Sci-Tech Committee and local government also gave great support to the project.

1 Project Content

During three years, the research group collected more than 1.5 million data and many historic materials and data in the four selected typical sites. They organized five times of large-scale field trips for foreign and local experts alongside the Basin. The total travelling distance reached 30 thousand kilometers. They investigated 360 households, held twelve special meetings and training. Beside this, the group did winter irrigation trial at the Tarim River.

The whole research covers four aspects:

i. Optimizing the configuration of natural resources

After comparing the three water regulation programs, the research group put forward the least cost water regulation program

ii. Creation of management system

By referring advanced foreign experiences, the new water management system suitable for local situation is formed. The renovation program of water price is designed by fully considering the bearing capacity of farmers.

iii. Efficient utilization of natural resources

The water-saving techniques with priority were listed after analyzing cost and benefits and local economic bearing capacity.

iv. Measures of desertifcation control

By analyzing the present situation, damage trend, the mode of desertification control was put forward.

2 Achievements & Effects

The people's government of the Autonomous Region paid great attention to the achievements of the project. Some of the achievements are applied directly. So in the letter giving to the headquarter by government, it is said that the support of IDRC to the project, has great effects on local economic development, especially on the efficient utilization of natural resources and protection of ecological environment. It gave scientific base for making strategy. The practical effect is far more than an important support on technology and engineering. In 1998, it is awarded the second prize of Science & Technology Progress by the government. It was utilized by many other international organizations, such as CIDA. The achievements includes:

i. The water regulation program gives scientific base for local government to solve the problem of water resources of Tarim River.

ii. The practical program of management system and water prize renovation is applied in the work of water price regulation by local government.

iii. The water-saving techniques and program gave scientific references for local farmers to utilize water-saving techniques.

iv. The new ideas of environment construction supplied practical and technical program for ecological environment protection and desertification control.

v. During the research period, thirteen theses were published. Three of them are exchanged in international scope and four of them are awarded prizes of different level.

The Chinese Agricultural Publisher formally published the research report. And all the achievements were made multi-media form and CD-ROM, and were communicated and extended by Internet and IDRC in the world.

3 Funds and Technical Support

IDRC support 180 thousand Canadian dollars for the project. The national Scientific &

Technological Committee and the regional government give some amount of necessary funds. The total funds reaches 2.13 RMB Yuan, which is 333 thousand Canadian dollars. That guarantees the study of the project.

i. By training the group members of the project. The research method of IRP/DSM was applied in the study on water resources management for the first time in China. The marginal conception was used in the study of water price regulation for the first time in China. The two evaluating models of water-saving techniques and environment effects were developed by applying the theory and method of applied techno-economics and environmental economics to the study on water-saving techniques and techniques of desertification control for the first time in China.

ii. In the study, the field investigation, expert consultation, discussion and systematic analysis were combined together.

iii. Besides studying, the project also took great attentions to the personnel of production management and the strategies applying by the upper managers.

iv. According to the practical situation in Xinjiang, by regulating the ecological efficiency and the social efficiency, the researchers put forward three modes for desertification control.

v. By introducing the international experiences on water resources management, the new water resources management system and regulation program of water price were put forward also.

4 Comparing with Other International Cooperation Project

The Institute of Agricultural Sciences & Information is a special scientific institution, which is engaged in the study on agricultural resources and environment, rural economy, agricultural system engineering, agricultural information consultation, and agricultural market information. It took part in the cooperation project of IDRC, CIDA and UNDP, and also it has good relation with JICA, CIRAD (France) and Vrije University of the Netherlands. But it is believed that the project of IDRC has some specialties:

i. The project is selected strictly. To solve key problems is its target.

ii. Paying attention to the participation of local governmental officials and farmers.

iii. The support fund is based on guaranteeing the study of the project.

iv. The project combines study with the training of local technicians.

v. The project involves the experts of international, national and local origins.

vi. The project takes importance to field investigation and collection of local data and information.

After all, the project of IDRC is suitable for local needs. It can solve the key problems with high efficiency. Its achievements have great application value and effects on the development of local social economy.

Review of "Environmental Education in China's Primary and Middle Schools"

Yu Chaoran

China Environment News

Sponsored by the International Development Research Center of Canada (IDRC) and undertaken by China Environment News, the project "Environmental Education in China's Primary and Middle Schools" started in June 1993 and brought to a successful close in December 1995. Based on the sampling surveys all around China and fairly wide typical sampling investigations, the project has done comprehensive surveys and analyses of the present situation of China' s environmental education (EE for short) in primary and middle schools and the students' environmental awareness, conducted the comparative researches between China's EE and foreign countries', put forward counter-measures and recommendations and drafted out "Outline to Implement Environmental Education in China's Primary and Middle Schools"(the outline for short). It is the first time that our country did such a large scale of investigation in EE. The project's achievements plays an active role in promoting EE. in China's primary and middle schools.

The project was concerned and supported by National Environmental Protection Agency, the State's Commission for Education and the State Science and Technology Commission. It was also warmly aided by many environmental and educational departments at provincial and municipal levels. Moreover, the project adopted the open research methods such as sampling surveys, the collection of teaching papers and teaching materials and the activities of evaluation and selection. The project has exerted a fairly wide influence in China's educational and environmental circles. The leaders such as Wang Bingqian(Vice Chairman of the Standing Committee of the National People's Congress), Qu Geping, Xie Zhenhua and Zhang Kunmin positively appraised and commended the project. In the meetings of expert assessment committee, the experts unanimously held that the project and its reports fully reflected the situation of more than a dozen years of EE in China' s primary and middle schools, summarized the experience, affirmed the achievements of EE in China's primary and middle schools and analyzed the problems in the field. Moreover, the project put forward`some counter-measures and recommendations to deal with the weak-links of EE in China's primary and middle schools. To view the sub-projects as a whole, all of them are of depth and width in practice and theory. And they are worth applying and spreading.

The Project' s Background

In June 1972, the First United Nations Conference on Human Environment held in Stockholm, issued Declaration on Human Environment, marking mankind's awakening to global environmental crises. Hence, EE has been gradually enfolded in many countries.

In 1975, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP)formally formulated and implemented the International Environmental Education Programme. The programme expounds the aim, significance, function, targets, content, guiding principles and measures for implementation of EE, as well as how to bring EE into various countries' educational systems.

In 1977, the Environmental Education Conference of Governments was held in Tbilisi of the former Soviet Union and issued "Tbilisi Declaration", which points out that EE should be offered through regular and irregular education at all levels to all the people of different age groups. The mass media are responsible for giving full play to its huge ability for the educational mission.

In 1987, the working plan was formulated at the International Conference on Environmental Education and Training held in Moscow, the capital of the former Soviet Union. The plan made an overall explanation of mutual relation between human and the environment from various points of view in economy, society, culture, ecology and aesthetics. The conference recommended that the 1990s of the 20th century be the decadeof international EE.

In 1990, the co-operative and coordinated consultative conference on EE and training of UN organs and organizations was held by UNESCO in Paris, France. The conference pointed out that the meeting participating representatives of UN organs and the organizations should appeal to governments to pay close attention to EE and its training, urge the governments to disseminate more rapidly and widely the research achievements of environmental science and technologies among their decision-makers and transform the achievements into the action of environmental protection. "

In June 1992, the UN Conference on Environment and Development was held in Rio de Janeiro, Brazil. In 20 years from 1972 to 1992, tremendous progress was made in human society, economy and culture, while more deep-wide world-wide crises came into being, such as destruction of ozone layers, greenhouse effect, acid rain and extinction of species, forming a real threat to human survival and development, forcing people to_re-examine the traditional development and its pattern. People have understood that the old basic way for development characterized by high put-in and consumption neglecting environmental and resources protection can not meet any longer the demand of the development at present age and in future. The old way for development can not last for long.

In the conference, "Rio de Janeiro Environmental and Development Declaration", "Agenda 21 " and "Principled Announcement Concerning Forests" were adopted and UN "Framework Convention on Climatic Change" and "Convention on Bio-Diversity" were signed. These documents have fully demonstrated present international society's new ideology and thinking of sustainable development and reflected the global common understanding in the field of environment. These documents have fully demonstrated present international society's new ideology and thinking of sustainable development and reflected the global common understanding in the field of environment and development and the governments' political promises. It is another milestone of human understanding of environment.

How to realize sustainable development is a major issue that relates to many domains. It is of utmost importance for education to promote sustainable development and for the public to effectively participate in making decisions. "Enhancement of the awareness for environment" in Chapter 36 of "agenda 21" points out that currently, there is still a lack of awareness for internal relations between activities of mankind and environment. It is suggested that global educational activities be conducted so as to intensify the attitude, concept of value and action of harmless environment and support sustainable development. It clearly puts forward the measures for people from primary school age to grown-up to receive education on environment and development. EE in China's primary and middle schools started in the end of 1970s. It started and progressed along with the development of China's environmental protection cause. "Education is the foundation for environmental protection". To do EE well, raise the nation's environmental awareness and enable people consciously protect environment are the fundamental strategic task with practical significance. To do EE well shall start with children. The 220 million of primary and middle school students who are in the time of physical growth, increasing their knowledge and gradually forming their concept and consciousness. They are the future of China and the main force for China's construction in 21th century. Developing EE in primary and middle schools and raising the students' awareness are the basic work to raise the entire nation's environmental awareness and also the fundamental measure for ability building in China's sustainable development.

It was against this background that IDRC paid close attention to the project entitled " Environmental Education in China's Primary and Middle Schools " put forward by China Environment News. After the investigations and demonstrations made by Dr Stephen Tyler and the experts, it was believed that the time was ripe for researching in EE in China's primary and middle schools; thoroughly investigating and understanding the present situation of EE in China's primary and middle schools and the students' environmental awareness; studying on EE experience in primary and middle schools and the present conditions and ability including the conditions on teachers, teaching materials and teaching facilities; analyzing the factors limiting EE in China's primary and middle schools; putting forward counter-measures and recommendations based on the above research work. Moreover, it was believed that the project could provide reference and bases for developing China's EE and working out mid and long plans of EE and providing information and references for international exchange. Therefore, the project was filed in IDRC's 1993 sponsored research project (Center file No. 92-8022) and it was approved by National Environmental Protection Agency and the State Science and Technology Commission [(93)GUO KE WAI SHEN ZI 1399 HAO WEN].

The Project's Main Achievements

The project was generally divided into two stages. During the first stage lasting one year, main efforts were devoted to investigations and studies, and keeping abreast of the developments. The project in first stage was consequently based on investigations and studies; during the second stage lasting one year and a half, the project mainly dealt with the design of the project's overall framework, six sub-projects namely monographic studies. Some of the sub-projects were studied in turn during the first stage.

The Project's Administering and Follow-ups

The total that IDRC sponsored the project is 149,930 Canadian Dollars, in which 96,734 Canadian Dollars were administrated by the project group, 53,200 Canadian Dollars were administrated by IDRC. In line with the research plans, the funds were appropriated respectively in two years: in first year 55,910 Canadian Dollars were appropriated; in second year 40,820 Canadian Dollars were appropriated (15% of the funds was appropriated after the project's completion. In 53,200 Canadian Dollars administrated by IDRC, 5500 Canadian Dollars were spent for buying a computer (model 486) for the project's office and some related software; 47,700 Canadian Dollars were spent as the training fees for the principals experimental training course held at Qinhuangdao in August 1994 (27,000 Canadian Dollars were spent for the course) and for the project's study tour in Canada (20,700 Canadian Dollars were spent for the study tour).

In the arrangements for the researches, the project's leading group strictly implemented IDRC's support funds' allocation plans, carefully made the arrangements and tried its best to save money in various aspects. At beginning, the project's difficulties and complexity were underestimated. With the researches developing, the project was added with the subproject "the Comparative Study Between EE of Primary and Middle Schools in China and That in Other Countries". Thus the project was extended by half a year. The added expenses were paid by the project leading group who got the money from the counterpart funding of China Environment News without making an application to IDRC for supplementary funds. According to the project's final accounts, the total that China Environment News paid from its domestic counterpart funding is 543,000 Chinese Yuan. The counterpart funding was mainly used in transportation, communication (including the equipment), the salaries and consulting fees for the newspapers' researching and working persons and some temporary consultants.

The project leading group thinks that the project officials and financial administrators of IDRC in Singapore Office have done a lot of work to assist the project leading group. Their precise working style and warm directing enhanced the project's work. The project leading group is satisfied with the efforts IDRC made. China Environment News and IDRC had a very delightful cooperation. After the completion of the project, China Environment News took full advantages of its own predominance. The newspaper made a lot of reports to disseminate the achievements of the project and drew a wide attention of the society.

The project achieved the experiences on "the Schools with EE Feature" created in Shanghai City and Hunan Province, "Running Environmental Protection Experimental Primary Schools" in Qingdao City and Benxi City and "EE Bases Construction" of Guangdong Province. These experiences have been comparatively widely spread all over the country. Shanghai City's "Schools with EE feature" were later changed into the name "Green Schools". The targets and standards of the "Green Schools" have also been publicized and spread through the newspaper. The project's countermeasures and recommendations including the suggestion that the State or some departments urgently issue the documents of laws on enhancing EE were paid much attention to by National Environmental Protection Agency and the State's Committee for Education. On December 10,1996, National Environmental Protection Agency, Propaganda Department of the CPC Central Committee and the State's Committee for Education jointly issued "Action Outline on the Nation's Environmental Propaganda and Education". Having drawn on the project's achievements, the outline has some regulations to do EE well in the basic education in primary and middle schools.

Simultaneously, the project leading group submitted the project's report to UNEP, UNESCO and UNDP to provide information and background reference materials for international exchanges on EE. The research on EE in China's primary and middle schools is only a beginning. It has laid a good foundation for overall researching and enhancing EE in primary and middle schools. The project group has specially invited some experts to research and demonstrate the project's follow-ups. The experts consistently reckoned that at least there are two researches which need to be conducted by the project's follow-ups: one is to research in compiling a set of EE teaching materials which integrate EE with various subjects in Nine-Year Compulsory Education and a set of teaching materials for special courses in high schools, selecting some schools to conduct experimentally teaching and revising the teaching materials; another is to do well for the capability-building, researching in primary and middle school teachers training on EE. We think that both the two researches are very important, but teachers training is the key to improve EE in primary and middle schools.

Therefore, we planed that if we get IDRC's financial support, we are to conduct the project entitled " Teachers Training on Environmental Education in China's Primary and Middle Schools". The research contents are as follows: a. respectively researching and compiling the plans (namely training modes) to implement teachers training on EE in natural science and social science; b. researching to compile a set of training teaching materials for primary, middle and high schools; c. researching in the nation's training channels and training mechanism; d. based on these, holding 3-5 demonstration courses in order to achieve experience. Through the project's research, we will try to achieve the following: a. urging the State's Committee for Education and National Environmental Protection Agency set up as soon as possible the teachers training system and mechanism on EE in China's primary and middle schools; b. providing a set of comparative mature training plans and training teaching materials; c. asking the State's Committee for Education to integrate the outlay for the teachers training on EE in primary and middle schools into the State finance's educational outlays, namely the outlays of teachers' advanced studies and in-post training, so as to turn it into a normal outlay channel.

We think, this project is of great significance to promote EE in China's primary and middle schools. It is undoubtedly a very important project to bring up the students to be the eligible persons with abilities and implement the tactic of sustainable development in China. But it is a pity that IDRC has not integrated it into its sponsor project plan, we have not yet found other international cooperators. So far, this important project has not yet been carried out. It is very regretful. After the completion of the project sponsored by IDRC, we solicited the opinions of the experts in educational and environmental protection circles on "Implemental Outline on Environmental Education in China's Primary and Middle Schools (Draft)" researched and sketched out by the project group and we got good evaluation and affirmation of its advantages. But it is not paid much attention to by some departments of the State's Committee for

Education and National Environmental Protection Agency. In December 1996, the ministry and committees of the three issued "Action Outline on the Nation's Environmental Propaganda and Education". But because this document is an overall and programmatic document on environmental propaganda and education, it needs the implemental outline on various specific work to be reinforced. Therefore, in order to promote the development of EE in primary and middle schools and make the schools' EE tend towards standards and sciences and bring it into legal system, "The Outline for Implementing Environmental Education in China's Primary and Middle Schools (Draft) " researched and drafted by the project is still of important practical value today. We are to recommend again this scientific research achievement-the outline to the related leaders and departments of the State Environmental Protection Administration and the State's Committee for Education. We hope the State's Ministry for Science and Technology will take the opportunity of this conference to make some efforts on down-lead and recommendation to put this important scientific achievement into effect.

Review of IDRC Joint Research Program between University of Victoria and East China Normal University

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East China Normal University

With the fund supported by the International Development Research Center (IDRC),College of Educational Sciences in East China Normal University in China and College of Education in University of Victoria in Canada had conducted a seven-year joint research program which lasted from May of 1983 to May of 1990. The whole program was called "Education Research", who including two projects: "Education Research and Education Reform" & "Teaching Reform in High School".

I. Background of the Program

The program of joint research benefited from the reform and open-door policy of China. We believed that education research achievements acquired by any country would provide us with rich learning resources and wealth. That's why we made the choice of carrying out this program.

The program was the outcome of the friendship between the Chinese and Canadian people. With the financial aid given by IDRC who affiliated to the Parliament of Canada, we got substantial economic support to carry out the program.

The whole program was put into effect by ECNU and UVic. The two universities shared some common grounds in many aspects. The original goal of UVic was to train high school teachers. As the time went by, it gradually turned into a comprehensive university with high level of scientific research. However, it also took teacher training as its major task. The College of Education still maintains an important position in the university. ECNU is one of the key normal universities in China with a strong team of scientific research on education. The first College of Educational Sciences in the nation was set up there.

The common characteristics of the two universities could be obviously seen in developing scientific research on education and training high-quality secondary school teachers. That's why the leaders and experts in the two universities reached an agreement of collaboration. The intention of collaboration was first established in 1981, when Dr.H.E.Petch, the president of Uvic, visited ECNU.

It was in 1982 that the possibility of joint research was discussed by the representatives from both sides. The Cultural Counselor of Canadian Embassy in China and officials from IDRC played an active role in promoting the program. The former State Commission of Science also showed its great support to the program. The program was established formally at the end of 1982,and was carried out in May of 1983.

II. Practice of the Program

A. Settlement of the Research Contents and Anticipated Objectives

The whole program was conducted in two periods including three phases. The first period included the first phase (May,1983—May,1987) and the second phase (May,1987-May,1988). The second phase was for evaluation and adjustment. The second period was the third phase

(May, 1988-May,1990).

1. Research Contents

The contents of the first period of joint research were decided with two elements.

First, the program should meet the needs of ECNU. After several careful discussions, ECNU held that the program should benefit ECNU in two aspects --on the one hand, strengthening the disciplines of education with relatively good foundation so as to enable them to become the first class home and abroad; on the other hand, developing the disciplines of great importance in education development in China but very weak or even blank in ECNU. Through the joint research , ECNU anticipated the profit of learning materials accumulation, staff training, and the research method grasping. Therefore it might fill some blanks of educational research in China. With careful consideration, ECNU proposed some projects for selection.

Second, the program should be able to make use of the advantage of UVic. The projects ECNU chosen would better gain great help from the related experts in UVic. After exchange visits and discussions, seven collaborative areas were settled: Active Learning, Foreign Language Teaching, School Administration, Educational Evaluation, Computer Assisted Learning, Distance Education and Applied Psychology. Among them, School Administration, Educational Evaluation, Computer Assisted Learning, Distance Education were the new areas that ECNU planned to develop. In the second year of the first period (1984), Career Education in High School was added into the program. This research area might be new but needed necessary study in China.

Since educational administration reform being carried out in China from 1985 had made considerable headway for Chinese education, it could be obviously seen that teaching reform would also be important. Thus, the second period of the program was named as "Teaching Reform in High School". It was just the right time for us to do some research work in this area. The program included 5 subsidiary projects:

(1) Research on compiling learning materials for hihg school students(Subjects involved : English and mathematics)

(2) Research on teaching strategies for high school (Subjects involved : Geography, English, Chinese, etc.)

(3) Research on career education

(4) Research on educational evaluation and educational administration

(5) Research on distance education for training high school teachers

2. Anticipated objectives of the program

(1) Introduce reform in the areas of teaching materials, teaching methods and strategies in Chinese education by studying the learning materials and books offered by the experts from UVic and making use of educational research achievements of other countries. For instance, the research on the theory and experience of Active Learning did benefit in changing the teaching method of mechanically cramming students or the phenomenon of stuffing the students to gill. Meanwhile, the research on theory and practice of Evaluation would be a great help in making Chinese education be more systematic and scientific. At the same time, the research on the theory and

practice of the career education would promote the work of career guidance in high schools.

(2) Carry the reform forward in educational sciences in ECNU. On the one hand, already existing disciplines in ECNU, such as Theory on Instruction, Psychology and so on, would be pushed forward by the joint research; on the other hand, some new disciplines that China needed urgently, such as school administration, educational evaluation, computer assisted learning, career education and so on, would be set up in time. Therefor, it would be quite helpful in raising the level of teacher training in ECNU, so as to give impetus to the Chinese education reform indirectly.

(3) Raise education scientific research level of ECNU by exchanging visiting scholars, joint research and training of the young scholars.

B. Research Methods

The basic research methods being used in the whole program included documents and materials analysis, experiments, investigation, statistics, etc.

The research work was undertaken separately by the scholars in the two universities. But the connection was kept with each other. After a period (usually a year), experts would have a short-term visit to the other university to exchange experience and achievements and discuss some new problems.

The advantage of this research pattern reflected in four aspects. First, the researchers stayed at their own posts, so the teaching and administrative work they took on responsibility would not be influenced. Second, the researchers would not be separated themselves from their research collectives. Those who worked with them would have the chance to take part in the research work. Third, since the collaboration is a long term one, both sides might understand each other very well, and was in harmony with one another in the cooperation. Forth, comparative study on culture difference could be conducted. The same topic being studied by the scholars from two universities might not acquire exactly the same results and information, which would be helpful for them to explore the culture difference between the two counties.

C. Usage of IDRC Fund and Domestic Fund

1. Fund allocated by IDRC and distribution to the two Universities (unit: Canadian Dollar)

	Phase I	Phase II	Phase III	Total
Total	88,000	159,000	187,500	434,500
Canada	83,500	149,000	183,000	416,350
China	4,500	9,150	4,500	18,150

2. Usage of Fund

(1) The fund allocated to UVic being used by ECNU could be divided into three parts:① international travel, accommodation, living and traffic expenses being spent by the ECNU researchers who went to Uvic for academic visit, ② international travel , living and traffic expenses being used by the trainees,③ cost of buying a pickup camera, video equipment, books, and reading materials.

(2) The fund allocated to ECNU was spent in doing scientific research at home, servicing

(printing, translation, etc.) and purchasing a duplicator. These expenses might make up about 55%, 52%, 36% respectively of the total fund which could be used by Uvic in the three phases.

(3) Another $2000 was subsidized by IDRC to support the publication of the research outcome of the third phase.

1. Domestic Fund

In the whole program, ECNU spent about ￥80,000(not including salaries to the researchers) to be accessory money. It was mainly spent to subsidize the research expenses, to pay the expenses for the staff going abroad (including cost of passport, training, and dress), to pay the expenses being spent for the visitors from Uvic.

D. Instruments and Equipment

In the mid-term of 1980s,the tools used most for Chinese scientific research on education were still paper, pen, notebooks, etc. Supported by the fund given by the IDRC, ECNU could purchased some new instruments and equipment, including duplicator, printer, portable pickup camera, IBM-PCXT computer, software, VcRs/Monitors(3), Teledon, Decoder, etc. These instruments and equipment played an important role in doing the research work.

E. Staff Training and Exchanging of Expert Visitors

1.Number of trainees in the three phases:(unit: person/time)

	Two-month Training	Four-month Training	Eight-month Training	Master Degree Candidate
Phase I		4		2
Phase II		4		2
Phase III	4		3	1

2. Experts from ECNU visiting Canada:

Before the formal joint research 13

Phase I 7

Phase II 15

Phase III 9

3.Experts from UVic Visiting China

Phase I 13

Phase II 16

Phase III 18

(Phase III included those who came to China to attend International Conference on Teaching Reform in high School.)

F. Scientific Research Team

Because this program was the largest, longest, and fund-spent most one in ECNU among its international collaborative programs at that time, ECNU put into plenty of researchers to form the research team.

the help of the foreign counterpart, ECNU could take the lead in the research and promote their development.

From the above general evaluation on the joint research program, we can see that our expected target has been basically met.

1. Promote the educational reform in China by spreading results of the cooperative research.

The results of our research have been widely spread through thesis, lectures, and various academic conferences. They played an active role in promoting the educational reform in China, especially the reform on the teaching of secondary school. Examples are as follows:

The result of the research on vocational guidance drew the attention of Wenhui Daily and was reported as a major issue worth of attention in the lead of Oct.31 1986. Chinese Vocational Education Agency, who had an excellent tradition in vocational Guidance, also opened a new volume on same issue in its periodical "Education and Vocation". Besides, they held a national seminar and invited experts of our university to introduce the research program. The Vocational Education Department of State Education Commission proposed that the research should be listed in "the 7th 5-year Plan" of the national educational research as a major program. The Basic Education Department proposed to introduce vocational guidance lesson in all junior high schools and entrusted us to draft the documents concerned. These, together greatly promote the practical and theoretical development of vocational guidance in Chinese secondary schools.

The research on "Active Learning: Teaching of Geography" and "Active learning: Teaching of English" were closely bound up with secondary school teachers from the very beginning. The process of the whole experimental research facilitated the transformation of teaching concept and the reform on teaching methods in these schools. They won the prizes in the subject teaching competition, and the teaching pictures made by them were highly prized at the professional conferences, too. Their students made progress in academic achievement and their learning interest increased.

2.Promote the reform on educational disciplines in ECNU by replenishing and renewing the content.

In mid-1980's, the teaching profession in China knew very little about the development of Western educational theory. Development of educational disciplines is tardy with limited newly-rising subjects and traditional subjects out of date. The cooperative research provided us with good opportunities of contacting with Western educational research staff. And through them we could collect materials on Western educational research. Our teachers could timely replenish their teaching with the newest research results. There are many examples. Such as they replenished the teaching material of Instruction Theory with experimental material and theoretical discussion of Active Learning; The teaching of "Psychological Linguistics" and "Linguistic Development" absorbed some latest materials and theories in content and adopted some methods of cross-culture and computer processing technology in scientific research. Another example is that we chose some research materials from the books offered by Canadian staff in the teaching of graduates in Educational Management. The other contribution is to promote the construction of new subjects, e.g. educational evaluation, computer-assisted instruction, vocational guidance etc.

All these together made ECNU take lead in some areas of educational subjects and spread its influence in the world of education in China.

Teachers' training is one of the main tasks of ECNU. The replenishment and renewal of educational subjects will be helpful in training of new teacher staff.

3. ECNU's capacity of educational research increased.

During the period of joint research, 44 experts in all visited Canada and undertook long-term joint research there together with Canadian experts. Uvic provided Master-degree training for 5 graduates and short-term training for 15 young teachers from ECNU. They received great deal of new knowledge and information there. This will play an active role in raising our capacity of scientific research.

IV. Reflections

The joint research between ECNU and UVic has lasted 7 years and has already made great outcome. The success has grown out of hard endeavor. We believe that it should be attributed to the correct approaches with which we treated the following relationships.

1. The relationship between Chinese education and foreign education.

Education belongs to social phenomena and is restricted by various social factors including politics, economy, culture, population, etc. Therefore, countries with different backgrounds will be different in the nature, aims, contents, and methods of their education. The domestic status in China and Canada are different from each other,. They have great difference in education, too. However, education in different countries also have some issues in common and some useful experience can be shared. Our joint research was undergoing on the basis of this understanding.

The joint research can help us draw lessons from foreign educational experience. But the fundamental aim is to construct our own education with Chinese characteristics. So we should focus our work on digesting, absorbing and creation instead of entire borrowing from foreign experience.

2. The relationship between Chinese experts and Canadian education

Experts from both countries jointly participated in each program with their own strong points. Canadian experts' strong point was their more knowledge on international educational theory and practice, while Chinese experts were more familiar with their country's situation. Both of them made up for each other's deficiencies and played an important role in promoting the development of Chinese educational theory.

Experts from both countries made great efforts in learning from each other's merits and making up for each other's deficiencies. During Chinese scholars' visiting in Canada, Canadian scholars arranged various activities for them to thoroughly learn foreign education by great deal of visits, interviews and extensive connections with people from various backgrounds. Similarly, during Canadian scholars' visiting in China, Chinese scholars invited them to introduce educational theory and practice of other countries. Besides, they also organized extensive visits to various types of school and offered them more information about the situation in China. Through a few years' efforts, scholars of ECNU have got thorough and profound knowledge about international educational theory and practice, and become accustomed to consider various educational issues from a wider view and boldly absorb helpful experience from foreign countries. While the scholars from Canada also have got more knowledge about the situation of China and can purposely provide some suggestions and strategies applicable for China.

Because we correctly treated the relationship between scholars from both countries, the joint research staff could cooperate together and support each other in good friendship.

3. The relationship between practice and theory

Foreign education have numerous schools of thought in theory and various styles in practice. The rightness of these theory need to be tested by practice. Especially their application to Chinese education must be taken serious.

Most of the joint research programs persisted in the principle of testing by experiment. The active teaching program was linked with some secondary schools in Shanghai from beginning to the end, where they undertook long-term experiments. At the beginning of programs on educational evaluation and vocational guidance, the investigation on its needs was made first, then we made plans and carried out experiments. Lastly, on basis of extensive experiments, we generalized concerned theory and presented it to the community step by step.

4. The stability and development of research team

The research team of this cooperative program was basically stable during the 8 years' research periods. Each branch program was under the cooperative charge by 2 experts, 1 from UVic, 1 from ECNU.

We highlighted the training of promising new staff during the joint research. With the financial aid from IDRC, some young teachers of ECNU had short-period study in UVic and then joined the collaborative research team. Therefore, although some Chinese and Canadian professors who first joined the collaborative research have already resigned, the program is still continuing and developing.

Through 7 years endeavor, each cooperative project has built up its own research team. This is a delightful phenomenon.

REVIEW of "BIOGAS REFRIGERATOR PRODUCTION TECHNOLOGY"

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Biogas Refrigerator is powered by biogas as the main energy resources, which is based on the principle of refrigeration by diffusion-absorption. Refrigerant is NH_3 using water as the absorption medium. When the concentrated NH_3-H_2O solution is heated, the ammonia is released and then cooled in the condenser. The liquid ammonia diffuses in the evaporator. This diffusion is accelerated by the circulation of small quantities of hydrogen (or helium), which draws heat from the refrigerator. In the absorber the ammonia vapor is absorbed by the diluted NH_3-H_2O from generator through a thermaosiphon. The concentrated solution is kept in the storage tank. The refrigerator operates within the closed loop.

The Project "Biogas Refrigerator Production Technology" (91-0226) is following project of "Biogas Refrigerator" (85-1016), is also the second stage of "Biogas Refrigerator". It is a practical application phase which includes the establishment of a viable production technology for the manufacture of a biogas refrigerator, the development of production facilities, field test for trial-products, market investigation and promotion.

Under the guidance of State Science and Technology Commission of the People's Republic of China and supported financially by IDRC, Canada, the research team had successfully implemented stipulated tasks. In the course of the project Canadian Gas Research Institute had considerably cooperated with us in improvement and simplification of combustion and control system. Canadian combustion expert, Mr. John Overall visited China in May, 1993 for helping us in field test, program officer of IDRC Duly came to our institute and consumer field to instruct our work. We are deeply thankful for their help and support.

The research team started to work immediately as soon as the project "Biogas Refrigerator Production Technology" was approved by Canadian IDRC in April 1992. In 1993 and 1994 we had completed the small-batch production and field test. In order to reduce production cost and promote market we trial-produced small biogas freezers and propagandized these new products on newspapers, magazines, TV and broadcast etc. in 1995. All these did help us to transform research results into commodity and benefit peasants of China and other countries.

Our main activities are as follows:

REDESIGN AND DEVELOP THE PROTOTYPE OF THE BIOGAS REFRIGERATOR

At the beginning of the project, we had redesigned and developed the prototype of the biogas refrigerator. In terms of the users' requirement and reducing production cost, the original biogas refrigerator, developed in the first stage of the project "Biogas Refrigerator" should be modified. It took first three months for us to revise the original design.

The specifications of the biogas refrigerator and freezer:
a. The performance of the biogas refrigerator and freezer
We confirmed two biogas refrigerators as first generation products.
Number 1 is "XCD-150" biogas refrigerator.
Number 2 is "XD-65" biogas freezer.

The "XCD-150" refrigerator:	Freezer capacity 21 liters, below –12℃	
	Refrigerator capacity 129 liters, 0 to 6℃	
	Total	150 liters

The "XD-65" freezer: Freezer capacity 65 liters, below -12 ℃
This feature and specifications will satisfy ordinary farmer family of 3-5 persons.

b. The biogas refrigerator is also to be powered by electricity when biogas is used up.
This design will provide reliability for usage. Our measuring results show that consumption is 1.0-1.4Nm3/day for "XCD-150" and "XD-65" and electricity consumption is 1.5 to 2.0 kwh/day, respectively. This power consumption could be reduced by means of enhancing coefficient of performance of the refrigerator core and increasing wall thickness of refrigerator insulation.

c. Simplify the combustion and control system
In the Biogas Refrigerator the automatic reignition system in original prototype is omitted for cost reduction. In normal operation there are very few times for ignition. We had developed manual and electronic ignition. When you adopt electronic ignition method, a small battery will be used and can last for more than half year. You can also use a match to ignite the biogas refrigerator without battery.

d. Design new cabinet of the biogas refrigerator
According to freezer and refrigerator capacities, the "XCD-150" biogas refrigerator was designed in double door type. The "XD-65" biogas freezer was designed in single door type.

SETTING UP OF MANUFACTURING REFRIGERATOR CORES AND CABINET PRODUCTION LINES

On basis of the new prototype, we looked for a few cooperative factories for trial-production and further, the batch-production with economic scale.

According to requirement of cooling unit production process, our cooperative factory, Qinhuangdao Household Electric Appliance Factory had provided necessary facilities such as three sets of tube benders, welding apparatus, tube washing apparatus etc. We designed and fabricated some special facilities and main equipment for manufacturing cooling units. QHEAF had the capacity of manufacturing 10,000 sets of the cooling units per year.

As to refrigerator cabinet, besides making full use of existed facilities, special moulds and a lot of subsidiary components for cabinets were designed and fabricated. The manufacturing cabinets were entrusted to Xinrong Refrigeration Equipment Factory in Sanhe county, Hebei province. This factory was a deep freezer manufacturer. We handed over them the refrigerator cabinet drawings and cooling units which were finished by QHEAF. Then, according to the contract, they would deliver the whole refrigerators on time. This factory had production capacity of more than 10,000 sets of refrigerator cabinet per year.

For components in combustion and control system we chose some factories to trial-produce at first. Then, on basis of the product quality and price we had confirmed a few factories which can provide mass-scale components.

Safety valves had been fabricated by Xinshi Household Gas Appliance Factory, Zhejiang Province. The performance was fine through one year's operation. They could be able to batch-produce for us. Electronic igniter was developed and fabricated by Beijing Public Service Research Institute. Fire indicator was batch-produced by Beijing Automatic Control Apparatus Factory.

The another cooperative factory was Guangxi Measuring Instrument Factory which was located in Nanning City, Guangxi Province, South China. They had plentiful experience in manufacturing absorption refrigerator. We considered there were potential market in South China. In order to reduce the transportation cost we entrusted them to manufacture biogas refrigerators. This factory could produce not only refrigerator cores but also refrigerator cabinets, which had about 200 employees.

LAY OUT PROCESSING DOCUMENT AND QUALITY INSPECTION CRITERIA

1. Cooling Unit Production

The performance of total refrigerator mainly depends on the quality of the cooling units. So at first, we worked out the cooling unit production requirements through many tests. Besides, general technology-requirements which were expressed on the drawings, the key parameters have to be controlled, such as: vacuum degree inside the finished cooling unit, filling NH_3-H_2O solution, etc. The cooling unit could be installed into the refrigerator cabinet when the minimum temperature on the evaporator surface of the cooling unit has been lowered to -12°C and it has a certain length of frost such as 200-300 mm.

It is important to enhance the qualified rate and to reduce production cost, through limited production runs we discovered that main factors affecting qualified rate of products was as follows:

(1).Washing key parts such pump tube, condenser tube, evaporator tube, rich NH_3 solution tube etc. must be reached to be absolutely degreased.

(2)Strictly check the cooling unit dimensional conformance.

(3)It must make high pressure tests at 40 bar for cooling units. In this way it could guarantee the welding quality of cooling units.

(4)It has to ensure that the cooling unit is evacuated to required vacuum degree such as above 1×10^{-2} mm Hg.

(5)Correctly filling the volume of water-ammonia mixture and hydrogen(or helium) pressure to 22 bar.

Through these processing conditions the product qualified rate for batch production could be reached to 95% more. Therefore, it would possess the possibility of mass-batch production.

2. Refrigerator cabinet production
The requirements for biogas refrigerator cabinet production are almost alike as the compressor-refrigerator.

The thickness of wall for biogas refrigerator has to be larger than that for the compressor-refrigerator. The evaporator tube has to keep tightly close to the wall of freezer and cooling cabinet. Usually the special glue with good heat conductivity has to be used.

3. The combustion and control component production.
The safety and reliability of biogas refrigerators in operation is mainly determined by the combustion and control system. Biogas usually consists of methane (CH_4) and carbon dioxide (CO_2); The volume contents are CH_4: 50-70%, CO_2: 30-50%. Sometime, not only the proportion of these components is variable, but also the pressure is fluctuating. So the pressure regulator should be applied in the system. Ordinary pressure extent has to be controlled in the 50-100 mm H_2O column. The size of jet orifice diameter correspondingly should be about 0.8-0.85 mm. In this condition the burner of the combustion system could be operated efficiently.

FIELD TEST

Field test is important to convert the research result in the previous phase into the product for consumer so as to obtain socioeconomic benefit. From lab research to trial production many problems may be encountered. Meantime, it is an inspection for new product and first step of acquiring response from users.

We had used a advanced measuring method in the field test. At first, special measuring software could be set into Data-taker through micro-computer such as AST-286. Then the date-taker could be sent to test sites. No person needs to operate and manage. It could record test data about the biogas refrigerator.

We sent many biogas refrigerators to consumers in Beijing and other provinces such as Sichuan, Zhejiang, Shandong. In order to examine operation situation of the refrigerator easily, a choice of five focal sites was made. Now we introduce the status of five focal sites and response of using biogas refrigerator:

(1) Weigou Pig Farm in Beijing
There were more than 120 workers in the farm. About 20,000 pigs were fed. A large biogas plant could produce biogas of about 20m^3/day. It utilized the pig farm waste as raw material. Our refrigerator had been used for storage meat and other foods since September, 1992 in the kitchen of the canteen. The user was very satisfactory with the biogas refrigerator.

(2)Hugezhuang Village, Tong County
The biogas refrigerator in this village was powered by biogas from small pit. This was typical individual household biogas pit. It possessed 8 m^3 volume for producing about 3-3.5m^3/day of

biogas. The biogas was used for cooking, lighting and operating the refrigerator each day. This family was located at suburban of Beijing about 50 km away and had 5-6 persons. The host had plentiful experience in using biogas.

We measured the biogas consumption of the refrigerator. It was about 1.3-1.4m^3/day in Summer months (July, August). So there was plenty of biogas for cooking and operating the refrigerator.

(3)Liuminying Village, Daxing County
This was a model of ecological village located in the South of Beijing City about 60 km away. There are more than 100 farmer families. A medium scale biogas plant had been built in the village as biogas plant field test. It could produce about 300m^3/day of biogas. The raw materials are provided by its breed chicken farm. The pipe line for transporting biogas was also built in the village and the secondary biogas engineering project will be started soon. So this was a model of modernization village for hundreds of millions of Chinese farmers.

(4) 41 Gwihuazhong street, Guanghan City in Sichuan Province
Waste materials in the town were fully utilized for improving environment and producing biogas. Here was a 50 m^3 of biogas plant built in underground. This plant utilized urban sewage and waste materials coming from a brewery and produces biogas. It didn't occupy urban construction field. On contrary, it could supply biogas for cooking. The biogas refrigerator field test functioned well.

(5) Yong Quan Shao Zhuang, Mianahu County in Sichuan Province
This was a village in South China, Sichuan Province. The biogas refrigerator was sent to a farmer's family with 4 persons. The farmer's name is Mi Yungui. He had two biogas pits with 6 m^3 volume each. The advantage of couple pits was without interruption supply biogas when replacing raw materials. This farmer breed 4-5 pigs and 7-8 chickens in his back yard. It was told that its cost for constructing two pits was only about 500 yuan RMB. The production biogas rate reached to 2.5-3.0 m3/day and it could resolve anxious problem of cooling and storage food and meat in Summer.

Some problems were discovered in field test. We had resolved in practical usage, For example: (1). Pressure fluctuation in the biogas pit made harmful affect on the combustion system of the biogas refrigerator. (2). There were some impurities such as sulphuric hydrogen (H_2S) etc. in the biogas. They seriously corroded.the parts of combustion system. (3). Biogas yield rate was fluctuated upon ambient temperature, namely, the pit temperature. The refrigeration is more necessary in Summer months. Meanwhile biogas production rate is higher. Hence, South China is more suitable than North China in practical utilization of biogas refrigerator. In North China during Spring and Autumn it should keep the pit temperature at some level so that there is plenty of biogas for operating the refrigerator.

MARKET STUDY AND PROMOTION
In order to investigate biogas refrigerator market, the project researchers in BSERI traveled in

Beijing, Sichuan, Guangxi, Jiangsu, Zhejiang provinces etc. They brought with manual instructions and photographs of biogas refrigerators and directly visited farmers, village women and local cadres worked on rural energy source. Biogas utilization situation in many counties were recorded in detail. They mainly collected the material as following:

(1). The biogas pits or stations could provide how much of biogas each day. (2). The consumers would like which fashions of refrigerator type, which colors of the appearance and how much volume of freezing cabinet, etc. (3). How much income did local farmers have every year. The expenditure structure of farming families was how to arrange.

We had written many articles and reports on new product application to magazines, newspapers. Through various meetings, bulletins, special issues etc. this product had been propagated to all over China. Farmers in many areas began to know that biogas not only could be used to light or cook but also powered to the refrigerator operation. Many people called or wrote us for purchasing biogas refrigerators.

Through the market study on biogas refrigerators following conclusions can be drawn out:
1. Biogas refrigerators have a large potential market in China because of enormous amount of inhabitants utilizing biogas. The farmers' income is also increasing year by year. They considerably like and need the biogas refrigerator.

2. Biogas refrigerators market must be gradually developed. In the first two years only a few hundred sets could be sold in the high sale price. We think that the market of biogas refrigerator will grow up rapidly with demonstration and advertisement. It has three factors to speed up marketing promotion. The first is that the dramatic growth of Chinese economy will promote energy consumption growth, so it will cause serious lack of electricity in many areas. The second is that government and all people pay much attention to improving and protecting environment to establish ecological balance. The third is that the farmer's income enhances considerably year by year.

Biogas refrigerators must take up Chinese market even could be sold to South-East Asia such as Philippines, Thailand, Viet Nam etc. countries as long as it reaches large scale production, the production cost will be considerably reduced.

Project review of "Sedimentation Processes of Tidal Embayments and their Relationship to Deepwater Harbor Development along the Coast of Hainan Island, China"

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Nanjing University

1. Background

This project was carried out by the cooperation of Marine Geomorphology and Sedimentology Laboratory (MGSL), Nanjing University from China and Atlantic Geoscience Centre, Bedfold Institute of Oceanography (BIO) from Canada during the period of December 1988- December 1992. Issued in March 1988 by state education committee of China as 010, and by IDRC as 3-P-87-1003-02, the project was known in short as China Harbor Siltation Project (CHSP). According to the demands of China side, Canada side provided CN$361,240 for the acquisition of equipment and CN$130,790 for the purposes of academic cooperation and information collection. Professor WANG Ying from Nanjing University was assigned as the chief scientist of this project. Dr. C. T. Schafer was assigned as co-chief scientist from BIO, Canadian side.

2. Project Activities

The guiding ideology of this project was to give full play to the superiority of both sides, which included advanced marine technology, international cooperation experience and certain amount of foreign exchanges from Canadian side, research experience in Hainan Island, high standard coastal scientific research team and the capability of basic experiment from Chinese side. The objectives included: (1) to promote the high level scientific research in tidal embayment, (2) to promote the harbor development in Hainan Island, (3) to set up an advanced coastal ocean laboratory and to train young scientists and technicians.

Technical action plan includes following four aspects:

(1) to train the technicians, to establish two new laboratories, to update the old equipment, to improve the lab analysis capabilities

- **Coastal Ocean Survey Laboratory:** This lab was established based on the following equipment supported by IDRC: Trisponder Navigation system, Geopulse Sesismic Profiler, Leehigh core, scuba diving equipment, under water video camera, PC, pneumatic boat,
- **Isotope ^{210}Pb lab:** ^{210}Pb and ^{137}Cs can be analyzed in the lab, which improved the capabilities dating and sedimentary rate analysis.
- Improvement of the particle size analysis system and establishment of the suspended particle analysis system realize the process automation of the particle analysis. 10 technicians were trained.

(2) Field survey was carried out in main harbours of Hainan Province, such as: Sanya bay, Yangpu bay, Xiuyin Harbor in Haikou and Dongshui harbor in Chengmai from Nov.- Dec.

1988. Including:

- tidal hydrologic measuring of 14 stations
- Historical Suvery data analysis including temperature, salinity, density, transparency, suspended particles, wind, wave and tidal of data recorded during 1965, 1975,1983, 1987,1988 by Nanjing University at 27 locations, within which, data of temperature, salinity, density and transparency were firstly obtained in 1988 by joint project.
- Seismic Strata measurement in Sanya, Yangpu and Haikou harbour's areawas firstly made, for 130 km profile.
- 19 cores and hundreds samples were collected.
- Submarine, under water investigation and survey
- Over 1100 samples were analyzed for size, mineral, pollen, microfossils, organic matters and chemical elements, and sedimentary rate etc.

The field survey enabled MGSL to learn the systematic approaches of marine geologic survey. Meanwhile, 6 technicians were trained and 6 graduate students as well.

(3) Based on the field survey in 1989 and 1990, 13 special topic theses and 17 academic papers were completed, as well as 8 application reports on coastal development.

(4) International symposium on exploitation and management of island coast and embayment resources (ICER), joint organized by China and Canada, was carried out from 2-10 Nov. 1990 in Haikou city and Sanya city, Hainan province. There were 81 participants from 10 countries. 81 abstracts were submitted to shared in the conference. A book of "Island Environment and Coast Development" was published in 1992, within which, 45 theses were sellected. 12 of them were the achievements of this joint project. Afterwards, a Chinese treatise "Coast of Tidal Inlet and Embayment of Hainan Island" was written by the chief scientist, which was then published by the Environmental Press of China in 1998. This treatise was mostly based on the work of this joint project, with some other data and materials collected by Nanjing University during 1960's –1990's.

The main characteristic of this project is to combine the scientific research with the local harbor development, providing the scientific assistant to the harbor development. For instance, the research in deep water channel of Yangpu harbor, the feasibility research of Sanya ten thousand tonnes wharf's extension. The stability and feasibility study of Haikou new harbour in Dongshui Inlet.

3. Outcomes

1.1 Achievements

(1) Research on tidal inlet embayment coast: Three main types of tidal inlet embayments were identified, they are:

- Sand barrier-lagoon type, typified in Sanya, with the construction potentiality of large-, medium- and small-sized harbor series. The critical factor is to maintain larger volume of tidal prism.
- Estuarine type, Tidal Inlet developed along abandoned river mouth channels

developed from abandoned original delta branch channels, for instance, the Dongshui Harbor, which was classified as sand barrier-lagoon coast. Our investigation recognized that it was branch channel of the Nandu River delta. It can be developed into a new (middle- small-sized) port area of Haikou Harbor by deepening and dredging its wide water. The water depth can be maintained for long period. Harbor development relies on new scientific findings and the Dongshui Harbor is a good example that received investment and now is under construction.

- Tectonic drowned valley type, represented by Yangpu Harbor, Tidal Inlet Embayment has developed along a fracture fault zone and along ancient river channel with the sea level rising effect. This type of embayment is ideal site for harbor construction as with its wide and deep water area with less silt discharge and low sedimentation rate.

The classification based on above studies probing into the formation processes has important implications in practice. Academically, it is an example of innovation in coastal theoretical studies of tidal inlets both in China and the world.

(2) Harbor site selection, planning and siltation analysis: Estimation was made on sedimentation rates of Sanya, Yangpu and Dongshui inlets and siltation rates after harbor construction in the 3 areas were also predicted. These studies met and satisfied the requirements of the China-Canada cooperation project, and were applied in the harbor construction of Hainan Province. Since the establishment and operation of Yangpu Harbour in 1992, no siltation was observed in the navigational channel and channel gate. The harbor displays good performance, which supports the research conclusions and the rationality of the suggested solutions and design.

By comparison study between the past and present environments, it is confirmed that both Sanya Harbor and Yangpu Harbor are still in pretty good natural status. We reach the conclusion that Yangpu Harbor can accept 20-30 thousand tonnes vessel under natural condition, and 50 thousand tonnes vessels after navigation channel improvement. Sanya Harbor now can be used for vessels of up to 5 thousand tonnes, and for vessels of 10 thousand tonnes after proper dredging at the channel gate, and for 30-50 thousand tonnes in the inner side of the Baipai after proper dredging. Meanwhile in Haikou Harbor, some docks with different functions of 5-10 thousand tonnes vessels are good planning for substituting the present one-function development situation.

(3) The distribution pattern of volcanic activities along north coast of Hainan Island was discovered, which shows that from east to west, land to ocean, the time period of volcanic eruption are getting younger. Holocene Volcanic eruption formed a series of special coastal morphology since 7,000aBP. Environmental analysis to volcanic coast has improved the understanding to the regional marine geologic processes.

(4) Coral reef research. It was further proofed that the coral reef around Hainan Island was formed in Holocene (8,000aBP). 3 periods of high sea level and related tectonic movements were distinguished in offshore islands. These are 4-5kaBP, 3kaBP and 2kaBP.

(5) to develop a coastal ocean research base in Nanjing University

- To develop a set of coast and island laboratory with international level, including coastal ocean survey lab, ^{210}Pb isotope lab. Later one has recognized by international Atomic Energy Agency (IAEA) for it's excellent scientific level on ^{210}Pb analysis after several times comparative testing.
- 22 young teachers, technicians and graduate students were trained through the project. A coastal ocean research team in N.U. since that time as well as an efficient management and operation model.
- The long-term relationship with BIO has been built up. Drs. C. T. Schafer and J. Smith from BIO were engaged as concurrent professors.

2 Volumes of monographs and 13 special topic summary reports were published or led out from this joint project.

1.2 Evaluation

Following is the evaluation made by IDRC with the signature of Sylvain Dufour, the senior program officer, Environment and Natural Resources Division, IDRC in March 1994.

"The research carried out by the two partners is at the leading edge of sedimentation and erosion studies today. The quality of the data and the validity of the conclusions and recommendations of the research team are most certainly beyond questioning. The research partners have succeeded not only in generating good science, as evidenced by the number of scientific publications produced, but also in disseminating their results to users and in making decision-makers aware of the consequences of different development scenarios".

"We view the impact of the project as fairly significant. The Chinese authorities have designated the MGSL Pb210 facility as one of the key research facilities in the country. Before the end of the project, the MGSL Pb210 facility had become an official participant in the International Atomic Energy Agency intercalibration network. This should ensure continued adherence to international standards. As an additional caution in intercalibration, an ongoing contact was established between the MGSL and BIO facilities. Furthermore, and largely as a consequence of this project, MGSL has now established a permanent field research station on Hainan Island.

The ICER Symposium, held at near the end of the project, served as the main vehicle to consolidate the various research efforts undertaken in Sanya and Yangpu harbours. As mentioned above, the local researchers have effectively networked with local authorities to influence the development process.

This project shows that strong local commitments go a long way towards making a project successful. The project did not include more downstream, or follow-up, research on the anthropogenic causes of erosion within the watershed, including the formulation of mitigation policies. A second phase to achieve just that was loosely envisaged during the second half of the project but never materialized due to IDRC's restructuring."

This project was also evaluated in December 22nd 1994 by an appraisal team, which was formed by experts from China, United States and Canada, and organized by State Education Committee of China. "With the application of marine physical survey, isotope dating, mathematical model and GIS, following aspects were identified. (1) the types and the evolution pattern of tidal inlet, (2) depositional and erosion process of embayment coasts, (3) the movement pattern of water and sediments and the sedimentary rates, (4) characteristics of volcanic coast in Hainan Island. Furthermore, embayment evolution theories were successfully applied to the harbor development, which is worthy to be spread. Fringe coral reef was recognized as a barrier to longshore drifting, which was also successfully applied to the harbor planning. Tourism planning developed based on the understanding of the natural system was another successful example.

The appraisal team also regards that the research carried out by this project plays an international leading role in the coastal science. The achievements on water and sediment movement in tidal inlet and embayment, its evolution theory and the application experiences are significant advance.

1.3. Benefits

The research achievements have been applied to the following areas: (1) development of Yangpu harbor 20 thousand tonnes and navigation channel, (2) enlargement planning of Sanya harbor, (3) Sanya inner harbor planning, (4) To load the Haikou new harbour at Dongshui Inlet, (5) Marine tourism planning of Yalong Bay, (6) Artificial beach development of Luhuitou and Xiaodonghai, (7) Marine tourism planning of Shimei Bay. Passed the appraisal, all these planning have been put into action.

The marine tourism planning of the Yalong Bay resort was made based on the understanding to the local the environmental evolution and resource distribution. According to the estimation made by the government agency of Hainan, this project totally generate 350 million Yuan. The artificial beach and beach nourishment project in Xiaodonghai is the first time to design the artificial beach and nourishment in Hainan, which provide the possibility of some sea shore development in the Coastal Bay.

1.4 Post Project Impact:

This project helped MGSL to be developed into an advanced "State Pilot Lab of Coast & Island Exploitation (SCIEL). This project also promoted the exchange between Chinese and oversea coastal scientific research, being regarded as "one of the most fruitful project supported during last 20 years since IDRC established".

Protection of Soil Erosion in Granite Areas in Guangdong Province

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The study on soil erosion and its control in granite area in Guangdong Province is an IDRC supported research project. Recommended by the State Science and Technology Commission, this project was approved by the board of directors of IDRC in November14, 1986. An agreement (from Jan, 1987 to Dec, 1989) was signed by director of Guangdong Academy of Science and president of Toronto University in December 1986. The project was completed at the end of June 1990. Project assessment was conducted in late May 1990.

1. Project Background

A research report "Xiaoliang permanent observation Station" presented in a workshop held by Canadian and Chinese in Canada in 1983 got funded by IDRC. It was an international cooperative project funded on basis of a research paper when the opening-up and reform in China just started. Chinese research institutions involved in the project were Guangzhou Geology Research Institute of Guangdong Academy of Sciences, Geology Department of Southern China Normal University, County Science and Technology Committee of Deqing County, Water Conservation Office of Deqing County, Forestry Research Institute of Deqing County. Canadian institutions were the Geology Department of Toronto University, the Geology Department of Mcmurst University and Geology Department of Hongkong Chinese University. The Geology Research Institute of Guangdong province and Geology Department of Toronto University were responsible for the project at each side. The project leaders were two conscientious persons, professor Yao Qing Yin (China) and Lu Zhaoxiong (Canada). Experts from both Canada and China worked together to develop the research plan and goals of the project.

Affected by tropical climate, hard bedrock is easy to be weathered, changing the hard rocks into soft weathered shells in the tropical and southern subtropical regions in the world. After destroying the vegetation cover on the earth surface, the run-off water causes soil erosion, nutrition drainage, decrease of soil fertility and soil degradation. The run-off soils bury farmlands in the sloping areas, choke riverbed and water reservoir, large soil slides destroys houses, roads, railways and factories, leading to severe disasters. The weathered red rock shells mainly distribute in tropical and subtropical regions where countries are developing countries. Due to the severe deforestation by the local people, the Earth surface was exposed leading to soil erosion and environment deterioration. There were 5-6 million ha land in the world did lose its reproductive capacity. Therefore the project was of great international significance. An observation station was established in Deqing County. A number of different measures including 2 large experimental dams, 7 observation sites for sand sedimentation, 5 triangle weirs, 8 observing posts, and many other facilities were used in the field observation station. There were 62 observing items in total. All the observations started on June 13, 1987. Also studies on microclimate, hydrology and topography variation in sloping area (including different directions and positions), hydrological variation and sedimentation in the upper and lower valley, surface erosion and nutrition loss in slopes were conducted at the same time. More than 2.5 million data were collected. Soil erosion map of Deqing county was generated by air-born image、 satellite image and computer image processing systems. Based on field investigation data, basic mapping elements, such as geology, landforms, vegetation and hydrology were produced. In the three years of study, the following objectives were achieved:

(1) Mechanisms of formation, development and interruption of weathered shells of the granite;
(2) Determination of mechanisms of soil erosion in the watershed in granite region;
(3) Assessment of different types of soil erosion and efficiency of erosion control measures;
(4) Establishment of an optimized slope-valley artificial ecosystem model.

In July 1987, Dr Anton, who was director of Canadian IDRC International Cooperation department, came to Deqing station to have a check. He was fully satisfied with the rapidness and high quality of the establishment of the observation station and the experiment facilities. He also said it was a new breakthrough and it was the first in the world.

2. Project implementation

Research fund was a necessary factor for completing the project. Instruments, personnel training and academic exchanges and meetings were important measures for the project implementation. Corresponding funding from China was the focus when program officers of both sides and the project leaders were developing the project agreement. IDRC funded 442,198 Canadian dollars for purchasing instruments, computers、 car(one) and experiment equipment, to train 5 Chinese persons in the Geology Department of Toronto University for half year and to attend international network meeting and water and soil conservation workshops held by IDRC. The money was also used for the project summarizing-up in May 1990. Most of the fund was used for salary, research, and traveling for of Canadian experts in China. Chinese government funded 330 thousand yuan, including 110 thousand yuan from Guangdong provincial government, 100 thousand yuan from Science and Technology Bureau of Guangdong Province, 100 thousand from Water and Soil Conservation Bureau of Guangdong Province, and 20 thousand yuan from Deqing county government. Chinese fund was used for establishment of field stations, field operation, biological treatment, travel allowance, data manipulation and publication, temporary salary, sample analysis, survey and mapping etc. 60 thousand Yuan was added by Water and Soil Conservation Bureau of Guangdong Province. In the delayed phase, IDRC funded another 57 thousands Canadian dollars to China.

The project was actually the extension of a Human and Biosphere project "Tropical plantation ecosystem"-Xiaoliang permanent observation station funded by UNESCO. Professor Yao was a subproject leader. In 1978, when Dr. Anton visited this station, he highly regarded the station. In 1988, when the 'International Education and Research Center for Water and Sand' was launched in Beijing by UNESCO, Deqing station was chosen as its teaching and practicing base, and research reports produced by the station were its main teaching material till the last term of 1990. In addition, many visitors from abroad and home visited the station many times. In winter of 1988, the workshop held by IDRC in Toronto University discussed the establishment of an international research network. Dr. Anton suggested that 4 well-established stations should be first networked. They were Deqing station in China, Uruguay station of South American Continent, Swaziland station of Africa and one station in Kenya. This plan was not implemented due to Dr. Anton's job shift.

In order to complete the project, both IDRC and Chinese government had assured the funding and facilities needed for the project. Deqing county government provided supports in many aspects to facilitate the project implementation. The project staffs were chosen from involving institutes with strict selection criteria. Chinese researchers: 10 researcher memberss from Guangzhou Geological Institute with 4 majored in topography, 1 in hydrology, 1 in economics and 1 in biology; 4 researcher members from the Geology Department of Huanan Normal University with 1 majored in soil and vegetation, 1 in fluvial erosion, 1 in hill collapse and 1 project consultant; Four researcher members from Deqing County government with 1 majored in economics, 2 in water and soil conservation and 1 in station management. In total, there were 18n Chinese research members and 8 Canadian researchers were involved in the project. The termination assessment of the project was conducted in late May 1990. The assessment pointed out that more than 2.5 million pieces of experiment data were observed through 3 years of observation on microclimate at different positions at slopes, hydrology, topography variation, hydrology and sediment feature in upper and lower reaches of valleys, slope surface erosion and loss of nutrients etc. Maps of geology, topography, hydrology, vegetation and soil erosion as well as relevant research reports were made by using air-born images, satellite images and computer-processed images. The mechanism of soil erosion in granite areas was understood, and establishment of slope-valley artificial ecosystem model was put forward.

3. Scientific, economic and social impacts

3.1. Natural condition and studies of soil erosion

The experiment station experiences a southern subtropical climate, which is warm, full of sunlight and rich in rainfall. The forests were monsoon evergreen broad-leaved forests. The soil is red soil. After the disturbance of vegetation, the habitat in the south slope and top of the hills was dry and the soil was shallow and poor. The soil formation process is desilication and Aluminum enrichment originating from granite and weathered shells, which are usually more than 50 meters deep.

In order to understand the climate, hydrology, topographical variation in the sloping areas and the way of vegetation restoration, many kinds of methods were applied in the study and results were listed below.

3.1.1. Hills and tableland where granite occurs in South China was easy to collapse hence soil for erosion. Erosion and collapse came after the vegetation disturbance. Deep layer red weathered shell was the basis for erosion and collapse in addition to rainfall as the impetus for erosion.

3.1.2. The great difference of erosion and collapse between south and north slope was attributed to their microclimatic difference. There was strong sunlight, high temperature, low humility, strong wind and heavy rainfall in south slope, favoring erosion by raindrops. While the north slope was the opposite. In addition, wind velocity could increase the speed of the array of raindrops, strengthening the eroding force of rainfall.

3.1.3. The extent of soil erosion in the raining process was a function of rainfall intensity and runoff. The regression among tem was significant. Linear change of rainfall intensity, amount of runoff and sand concentration were similar. The peak value of runoff lagged 10 minutes behind the rainfall intensity. Compared to runoff peak value, sand content peak value could be in advance or synchronous or lag behind due to different contents of weathered shell and previous water content.

3.2. Mechanisms of formation, development and disturbance of weathered granite shell

It took a long geological period for granite to evolve into weathered shell when it is exposed on the earth surface. In the granite rock region, the earth shell first went up until the entire covering rock layer came come off. Then granite came out of the earth surface and go through the weathering process phase.

3.2.1. Granite weathering process:

Granite weathering process was affected by composite effect of climate, topography, rock feature, structure and time etc. These factors led to accelerated or slowing-down the weathering process due to interactions among each other of the factors. High temperature and heavy rain were favorable for weathering because high temperature could accelerate O_2 and CO_2 exchange between space and soil layer. Then the gas went into the deeper part of the rock from the fracture. Liquid could enter the rock from fracture. Therefore, rock was easy to be weathered in high temperature and heavy rainfall. It was determined that if the temperature increased by 10 ℃, hydrolysis could enhance 2.5-3 times. Rock was composed of many kinds of minerals with different swelling efficiency. Large temperature difference weakened the rock cohesion. accelerating rock collapse.

3.2.2. Effect of topography on weathered shell evolution

The effect of topography on weathered shell evolution showed vertical variation. In the 800-1000 m high mountain of South China, the vertical zones were weathered shell of clastic rock. of SiAl alumina and of SiAl red soil. There was weathered shell of laterite in low altitude tableland hills of Hainan Province. Weathered shell of Al-Si red soil was the main category in Guangdong province with the best evolved shell usually below 500m altitude. especially on high platform and in low hill region of 60-150m altitude.

3.2.3. Effect of rock structure

① The larger the difference between the conditions for rock mineral formation and earth surface condition, the faster the rock weathering. The rank of rock formation rate from fast to slow was plutonite rock, hypabyssal rock, extrusive rock and sedimentary rock.

② The higher the crystallizing temperature, the faster the minerals weathering. For example, silicate mineral plgioclase, whose crystallizing temperature was high, was easier to weather than patassium feldspar, white mica and quartz, whose crystallizing temperature was low.
③ Large crystal was easy to weather, while little one was more difficult. So, grant granite, phenocryst granite or coarse grain granite weathered faster than fine grain of particle granite.
④ The rock with fracture was easier to weather than that without fracture.
All the above were the prerequisite for rock to weather and to evolve. Only with water and other weathering medium, the rock could begin different kinds of weathering process.

3.2.4. Effect of time span

It has took several hundred thousand years to million years to form thick layer weathered shell. According to the age determination of Goa region in India, it took at least 700-800 hundred thousand years to form laterite weathered shell. Without age determining data, the sequence of weathered shell evolution, evolving feature and formation geological age could be determined on the relation of landform developing phases by the method of geological age limitation and correlated sedimentation. According to the above, it was reported that weathered shell of red soil in Guangdong Province of South China began at late Tertiary Period when the hills tableland of South China gradually formed.

Five factors are essential for forming the thick weathered granite shell. They are:
①Very long geological period; ② Platform with some height; ③ Hot and heavy rain climate;④ Structure fracture evolved in rock; ⑤ Water and other weathering medium in the fracture. Thick weathered shell of South China formed at late Tertiary Period because there were 5 factors meet the demand of weathered shell formation. Data indicated that soil eroded when the vegetation on the slope, composed of thick granite weathered shell of red soil, was destroyed. Thus surface erosion, gully erosion and hill collapse took place in succession and became severely with great harm.

3.3. Techniques and measures of slope treatment

75% of soluble nutrients and organic matter were kept in plant in tropical region. When the vegetation was destroyed, soil eroded seriously because the soil lost nutrients and nutrients cycle and it was difficult to restore vegetation. All the above indicated the importance of earth surface vegetation coverage. Thus techniques and measures of slope treatment was put forward.

3.3.1. Slope measurement system was first built.

Different determinations and data collection were the scientific basis for slope treatment design.

3.3.2. Contour cropping replace traditional cultivation along slope

Combined with local good varieties, fast-growing and multi-purpose plants were introduced. Traditional cultivation along slope was replaced by contour cropping to form contour terrace to block sand, to lower water storage and to conserve water and soil. Contour cropping also could better barren slope, remake environment and finally provide a basis for slope development and production.

3.3.3. Screened good varieties were introduced.

Trees, shrubs and grasses were mixed to plant. To fast cover the slope surface, grasses was planted first with bean family plant the first of grasses. It took grasses a few months to cover the earth surface. The leaf-litter went into the ground changing into organic matter. Bean family plants fixed nitrogen to increase nutrients of earth surface. Then trees and shrubs were planted. After 2-3years, slope vegetation with multi-storey structure could change the slope environment greatly.

3.3.4. Live fence was planted in trial:

Short earth dam was built on the head of valley, of collapsed hill and in the valley. Grasses, bamboo and shrubs were planted on the earth clam densely like fence. When it rained, slope runoff could overflow the biological dam(fence), while the sand with the water was kept in the bottom of valley upper the dam. When the valley bottom was full of deposited silt, biological dam can be rebuilt. Then the valley bottom could form new natural slope after building biological dam many times. Live fence (biological dam) was important measure to treat slope with good results.

3.3.5 Introduction exotic good multi-purpose varieties was combined with local good varieties.

Spiradiclis cylindrica (Wall) Benth et Hook f, Melinis minutiflora Beauv., Macroptilium lathyroides (Linn.) Urban, Pennisetum Purpureum Schumach, Hibiscus cannabinus Linn. were introduced grasses. The introduced trees were *Leucaena glauca(L.) Benth, Acacia mangium Willd, Acacia holosericea A. Cunn.ex G.Don., Albizia falcata Buck., Eucalyptus camalddensia Dehnhardt, Calliandra tweedii Benth.* Local good varieties were *Schima superba Gardn. et Champ., Lespedeza bicolor Turcz, Thysanolaena maxima (Roxb.) Kuntze (T. agrastis Nees). Gahnia tristis Nees, Phyllostachys flexuosa A.et C. Riviere,* and bamboo hybrid.

Many products can be produced from these plants, such as fodder, fertilizer (fix nitrogen), fuel, paper pulp material, wood, medicinal material and different kinds of food. Introduction many fast-growing and multi-purpose plant to slope was important measure to treat slope, to protect environment and to develop slope sustainable production.

3.4 Optimal slope-valley artificial ecosystem model

In serious soil-eroded region, its natural environment was destroyed to different degree. Residents lived in poverty for bad condition of agricultural-forest-animal husbandry production and frequent natural disaster. According to ecological principles, artificial ecosystem building was the direction of mountain area to develop economic using scientific method to change the poor life. In the slope-valley artificial ecosystem, small river basin was single research unit designed as the characteristics of slope and valley

3.4.1. Implementation of slope ecosystem:

The techniques and measures of slope treatment are the basis of application of slope ecosystem. The slope was divided into three parts, upper, medium, and lower. The details are as follows:

In ecological principle, the relation of early evolution and stable evolution of biology community was used to enhance production. Stable ecological community was of many kinds of species and its organic structure was complex. The energy of the stable ecological community was cost by itself. Its structure could be adjusted by itself. It could control its temperature, humility and water content. It was of great meaning to protect environment because it could enhance the capability of water and soil conservation and increase the soil fertility. The soil was poor and dry, lack of nutrients in the upper slope. So, the upper slope was the worst one. Ecological forest should be built and the mountain should be sealed for afforestation to build a stable ecological community. Natural conditions of the medium slope were the transition of the upper and lower slope. Fuelwood forest should be developed in the medium slope. It would be a failure to build water and soil conservation forest and to seal the mountain because fuel problem wasn't solved in rural areas. So good plan should be made to divide the planting area and to introduce fast-growing trees. Contour forest not only could conserve water and soil, but also could provide fuelwood. The introduced *Calliandra tweedii Benth* was fast-growing and could fix nitrogen. In addition, *Acacia confusa Merr., Acacia auriculiformis A. Cunn. ex Benth* and *Schima crenata korthals* were fast-growing fuelwood tree species and were of great significant for afforestation of bare hills, settlement of village fuelwood and water and soil conservation. Water conditions were the best in lower slope. The lower the slope, the better was the water and the nutrients of the soil. Fruit trees and economic crops should be developed in the lower slope because the content of organic matter and Nitrogen, phosphorus and potassium were times higher than of upper and medium slope. It could gain high net production to increase economic benefits if it was directed by the ecological theory of early evolution community. Planting herbaceous and woody fodder plants and development of animal husbandry were a great direction for the thick soil layer and high water and nutrient content in the soil of lower slope. If the fodder food problem was resolved, the food problem of Guangdong was resolved because of the Guangdong fodder food accounting for 42% of the total food. Herbage and fodder crops, instead of food crops, were planted on hills and platform areas to cover slope surface and conserve water and soil, to fix nitrogen to improve soil fertility and to protect environment. The fodder crops could be harvested to develop animal husbandry to resolve the food problems of Guangdong. Therefore, more crisscrossing belts were designed to increase edge effect and to promote the hills to be agricultural-forest-animal husbandry production economic corridor.

3.4.2.Valley treatment and ecosystem model:

With a great amount of mud and sand, flood from deep gush, collapsed hills and river erosion, rushed into the farm field and covered the field. The sand alluvial land became wasteland. The further from the collapsed hills, the thinner was the sand alluvial land and it gradually transferred to farmland. If farm land covered by the sand alluvial land was pressed firmly, it became hardened and a relative water-proof layer. In the place, where there is no sand alluvial land, the shallow water came out to form a waterlogged depression. In lower reach, it restored to normal farm land. The new evolution of the topography of modern river and valley was attributed to soil erosion. Valley treatment and building a new ecosystem model was put forward based on ecological theories. First trenches were dug to treat valley, such as trenches around the hill, trenches around the field and trenches in the valley. The first two kinds of trenches could drain flood and sand off to avoid flood and sand entering into field and the latter one could lower the underground water table and remove the poisonous matter. Thus the valley change basically after the above treatment. Then a plan was made to treat and develop valley in 3 phases according to valley feature.

(1) Improve alluvial sand land
(2) Improve waterlogged sites

The underground water of upper reach and flood gathered in the lowest part of the valley. Waterlogged sites came into being because the lower trenches could not drain too much water. According to pond system theory, the waterlogged depression was rebuilt into pond. The pond embankment width was enlarged to increase the base area to develop planting, livestock industry and fishery. Multi-function draining trenches were built under the pond to drain the poisonous matter and cold spring off and to purify the water quality. The waterlogged depressions could be remade to production base of pond system after 2-3 years trial. The usage of food chain in breading industry was not discussed here.

It was favorable to plant crop plants in the lower reach of pond area because of enough water and good soil. As food barn of mountain area, the food production must be ensured to resolve the contradiction between supply and demand of food. From the whole small basin, artificial ecosystem was composed of ecological forest in upper slope, fuelwood forest in medium slope, economic corridor of agricultural-forest-animal husbandry in lower slope, drought cropping area in sand alluvial land of upper reach of valley, pond system in waterlogged depression of medium reach of valley and food cropping area in lower reach of valley. This was a base for regenerated resources development and sustainable development.

3.5. Evaluation of benefits:

Synthetic treatment of soil erosion was an ideal method. It could not only gain fast benefit in the treated region after 2-3 years, but also gain good results for the whole river basin. Now three benefits are in details:

3.5.1 Assessment of trial region and Deqing county:

In Sino-Canada trial station, there were ecological forest belt (environment water and soil conservation forest), fuelwood forest belt and economic crops, which were contour planted. In the valley, economic crop area was in land alluvial land with planting and breeding area in waterlogged depression and food cropping base in lower reach of the valley. All the slope-valley composed artificial ecosystem model. With stable ecological forest belt in the upper of the mountain, fuelwood forest belt and economic cropping belt in the medium and lower part of the mountain respectively, contour development could conserve water and soil and keep the mud and sand off the field and finally could gain many kinds of products. Barren valley changed into economic cropping region, fish and livestock breeding region and food cropping region. It was academician Wang Bingwei who directed the peasants of mountain area to alleviate poverty and become prosperous. In Deqing county, the treated soil eroded area was 280.71 kilometer^2, accounting for 80% of the total area 354.39 kilometer^2. Afforestation percent was 95%(it was 30% before liberation). Forest coverage percent was 64%. 30 thousand Mu field covered by sand was restored to plough. 70 thousand Mu low-production field now enhanced its production. The annual food production was increased to 646 kilograms (1987) from 165 kilograms in 1949. Now Deqing county changed from short-of-food county to surplus-of- food county. Wood annual production was increased from $1000m^3$ to $4000m^3$. The peasant increased their income and got rid of the poverty.

3.5.2. Significance and three benefits of a group of trial:

3.5.2.1 Significance of retaining water, fixing soil and blocking sand by contour cultivation.

Planting shrub and trees after grasses could fast cover the land. In the early summer of the second year, contour planting could block 7cm thick mud and sand. The bare slope was primary ecological environment with a good cycle. In the third year, it formed multi-storey plant structure of grass-shrub-tree. Eroded slope changed into forested slope, which could retain water, block sand and fix nitrogen, with good ecological benefits.

3.5.2.2. Biological dam-live fences trial:

Short earth dam was built on the head of valley and of collapsed hill with grasses and bamboo densely planted on it. Flood could overflow the dam, while the plants did not block the water but the sand. *Pennisetum purpureum schumach* was 2-3 m above the ground and could hold sand well although it was buried 1.5m by sand. Diurnal rainfall 97.5mm did not lead to disaster because of 3 years biological dam, of which the engineer cost was 74% less than stone dam. Biological dam was economic and high benefit. It should be well popularized.

3.5.3 Fixing-nitrogen plants planting trial:

Spiradiclis cylindrica (Wall) Benth et Hook f of 10 months, planted on the land of 80% quartz sand, could grow 2 meters high and 4.5 Kilograms weight. The grass clump was 1.5 meters high with annual production each Mu of dried fodder 2-4 thousand kilograms and could fix nitrogen. *Acacia holosericea A.Cunn. ex G Don.*, an afforestation pioneer tree, was fast-growing. In the first 3 years, it could grow 2-3 meters every year and in the fourth year, it gradually deteriorated. When *Acacia holosericea A. Cunn. Ex G. Don.* was planted, the organic matter content of sand alluvial land was 0.03%. After 1.5 years, the organic matter content of surface soil layer was increased to 1.5%. Through small river basin treatment, slope-valley artificial ecosystem model was built, especially planting fodder plants and developing animal husbandry. It was of great significance to plant grasses instead of food to resolve the lack of food problem in Guangdong. Introduction multi-purpose plants diversified the products and changed the traditional agriculture of single food production. It provided the conditions for mountain area to alleviate poverty and become prosperous.

3.6. Scientific and technological innovation

The project was directed by academician Wang Bingwei himself from the beginning to the end. For instance, contour planting of introduced fast-growing and multi-purpose plants, biological dam (live fences) and building multi-storey plant structure of grass-shrub-tree. He also pointed out that the forestation of single forest-type couldn't control the soil erosion of earth surface.

Biological ecology and environment was first combined together as a whole to be studied in academician Wang's research. Small river basin as units, slope-valley artificial ecosystem model was built. This was the breakthrough of the project and it was high appreciated by researches home and abroad. Reports of it by newspapers and TV home and abroad were at least 10 times. Director of international cooperation department of IDRC (Canada) said the design of station was also a breakthrough and was in the first place in the world. An international mud and sand research and training course was held in Beijing by the international water and soil research and training center of Education, Science and Culture Organization of the United Nations. Deqing station was chose as its teaching and practicing base. Research report of Deqing station was its teaching materials. The participants of the training course practiced and made investigations in Deqing station three times from 1988 to 1990. The chairman of the society said that the research measures were complete and synthetic treatment combined with production closely with good ecological environment benefits. IDRC considered to construct international net work. If it was approved, Deqing station would have the priority to be included in. Later it was shelved for personnel change of IDRC. The research capacity of the project was very strong because there were seven professors (4 professors of Canada), 2 associate professors, 3 workers conferred Master and 1 Doctor and 4 Master students who attended the project. The achievements can be applied in south provinces and in abroad tropical region. The high level achievements has an effect home and abroad.

4.Conclusion:

If the vegetation was disturbed, the erosion evolved quickly causing immediate the hill collapse in thick granite weathered shell region. The structure of thick weathered shell was the geological basis for serious soil erosion. The multi-disciplinary study on microclimate, hydrology and topography variation in the sloping areas was successful in understanding the mechanisms of disturbance of the whethered granite shells. Planting of fast-growing, multi-purpose plants was favorable for ecological restoration, hence to build slope-valley artificial ecosystem model. Sustainable development and regeneration resources were discussed. It was of tremendous social benefit for poverty alleviation and well being in mountain areas, environment protection.

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Review of PVC plastic manual pump project

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In order to resolve the hygienic problem of drinking water in villages of China, the Mechanical and Industry Ministry of China and International Development and Research Center (IDRC) of Canada signed a project memorandum on further experiment and popularization of the IDRC and Malaysia University developed PVC plastic manual pump in China. This project was led by Chinese Agricultural Mechanization Academy. Two phases were included in the project. In the first phase, two pumps were used to do lab experiment. One was tested on its characteristics, the other one was exposed to the simulated durable experiment, in which the pump was driven by power-driven machine and slowed down its rotating rate through a gearshift equipment to continually run 4000 hours. In the on-site experiment 19 pumps for site experiment were used by peasants to test its fitness, including adaptation to the local climate, the proper number of people to use the same one pump, its easiness of installation, operation and maintenance. Design was improved based on the quality problems found in the first phase, and the improved pump went on through the site experiment in the second phase. The project goal was to analyze and assess the technical properties, social response to and feasibility of wide application PVC plastic manual pump in China based on the results of lab and site experiments.

IDRC put 130,134 Canadian Dollars into the project for well drilling, equipment used in lab, transportation, communication, materials and salaries of project members. In addition, equipment, such as cars, computers, mapping instrument, printers and digital detector, were bought by IDRC for the project. A four-floor lab building and part of experiment equipment such as water chamber, water cycling pipe and lift simulated valve were put into use in the project. In order to implement the project, the main work done by project members are as follows:

1. Site selection

We selected the experiment sites in 15 counties in Beijing and neighboring regions of Hebei province during May to July in 1988. After a great amount of sites investigation and comparison of hydrology, geology, and drinking water sanitation conditions in different places. Baima Xiang and Liujing Xiang of Yi county in Hebei province were finally selected as the experiment sites. The two villages are located to south-west of Beijing, being about 100 kilometers far from Beijing. The total area was 140.8 kilometer squares with a population of 21,403. The features of the two villages are as follows : They are near Beijing with convenient traffic. The drinking water sanitation conditions were bad. The farmers had great demand for manual pump. They were suitable to be the experiment site.

2. Experiment equipment

Cars, computers, digital detectors, dynamic reactors, drawing instruments and printers were purchased during June 1988 to March 1990. Also we finished purchase of equipment within China and designed and manufactured the hydraulic driven devices for properties test and durable test of the manual pump. All these above ensured the smooth running of the lab experiment and site test.

3. Technical training and improvement of pump

Four project members were trained on plastic manual pump techniques in Malaysia University from 5 to 16 in Nov. 1988. During that period, they visited manual pump lab, experiment site and plastic product factory and understood lab experimental equipment, computer controlled system and pump manufacture craft. Also they tried installation of manual pump. A question about how to develop the project and popularization in China was discussed seriously between trained members and workers in regional office of plastic manual pump. This training played a instructive role in building of lab experiment devices and development of site experiment in Beijing. Two project members went to Malaysia University second time to improve design of plastic manual pump in Dec.1990 and the modified pumps were installed in Baima and Liujing Xiang in July 1991 to undergo the site test.

4. Other two experiment sites-- Xinjiang and Zhejiang

There was a great demand for plastic manual pump for bad hygienic drinking conditions in southern part of Xinjiang. Further extension in Xinjiang of the manual pump was needed. Two PVC plastic manual pumps were installed in Xinjiang in May 1990 with the assistance of Water Transfer Office belonging to Water Conservancy Department of Xinjiang. Two PVC plastic manual pump were also installed in Tiantai county of Zhejiang Province in order to popularization the pumps in this region.

5. Lab test and on-site test

Devices for testing properties and durability were designed for lab tests.

For properties tests: hydraulic system was adapted to manual pumps in place of man operated manual pumps (This is the difference with manual pump lab of English Consumer Society for they operated pumps by man.) to eliminate the human effect on experiment accuracy. The feature of hydraulic driven system is that driving force can be adjusted randomly in the designed range. operating stably and can be easily driving manual pumps of different lifts. Adjusting system can change oil cylinder rate without grade and easily change the reciprocating times of pump. It also can change the relative location of the course switch and can also change pump course.

Durability test: Its structure is compact and it operates freely for the pump handle connecting with driving pole by a sliding suitable case. If something wrong with the pump, it can automatically give an alarm and stop by its automatically counting device.

On-site test: Some people were trained on how to maintain before the pump installation. The aim and implication of the use of manual pump, the principle, structure, installation, usage and fixation were taught to the fellows, also with installation demonstration, by the project member of Chinese Agricultural Mechanics University. Three level monitoring group, composed of project member, fellows from Water Conservancy Bureau of Yi County and maintenance personnel, is in charge of monitoring, recording and fixing the pump. 38 manual pumps were trialed in two places to provide 6,574 people with hygienic and safety water. Farmers appreciated them very well.

6. Academic exchange

We prepared and arranged the "IDRC manual pump network workshop", which was held in Beijing in Oct.1992. More than 10 foreigners and fellows from Yi County and Water Conservation Bureau of Xinjiang attended the workshop. That was an experience-exchanging meeting of PVC plastic manual pump project. Foreigners from different countries made representations on special topic. Project member from Chinese Agricultural Mechanics University introduced IDRC project progress and presented a paper titled "Understanding of undertaking the IDRC plastic manual pump project and viewpoint of its popularization".

7. Benefit Analysis

According to the demand of the project, we finished final technical reports of Phase I and Phase II with a tatol of 96 pages.

The experiment of PVC plastic manual pump in China was successful. In Baima Xiang and Liujing Xiang of Yi County, Hebei Province, peasants drank the water lifted by winch from large well in the past. Now after installation of manual pumps, drinking has become safety and hygienic because dirty things were protected from falling into the well by the closed mouth. Peasants said that drinking water is hygienic with the manual pump and there were fewer people frequently suffering from diarrhoea in the summer now than in the past. The advantage is safety. In the past, adults ofen worried about children dropping off into the well. Now even if you want to jump into it, you can't. The results of water quality test from nine wells built by local sanitation department showed that water quality was better after installation of manual pumps. The total number of bacterium was averaged at 587/ml and coliforms group was 110/L at installation. After 9 months of installation, the total number of bacterium was averaged 26/ml and coliforms group was 52/L. The total number of bacterium and coliforms group decreased respectively 96% and 53%.

PVC plastic manual pump is one of the pumps for deep well with the lift of 40cm. The lifted water was deep underground water without pollution. Therefore, it is hygienic. It is suitable for the remote villages with no electricity and farmers residing scatterly with no electricity or oil. Those villages were very poor so that farmers had no money to drill wells and to buy pumps, but had to drink the water from pools, kilns or shallow wells. If the country support the farmers to drill wells and buy pumps, deep well manual pumps are well acceptable in these regions.

PVC plastic manual pump project has been greatly supported by IDRC and its regional office of Southeast Asia and East Asia in Singapore with fund and experimental equipment. In addition, Professor Wu Qingyao gave technical help in reciprocal communications and he came to China to give demonstrations directly in Beijing lab and in Hebei and Xinjiang experiment sites. So, we acknowledge to IDRC regional office in Singapore and Professor Wu Qingyao.

Report on cooperation between China's Child health care and disease control center and IDRC

Center for Child Health Care and Disease Control, China

Under the leadership of the State Science and Technology Commission (now the Ministry of Science and Technology), the Center for Child Health Care and Disease Control (affiliated with the Capital Pediatric Institute) started collaborative research with IDRC since 1987, and so far three phases of the collaboration have been conducted.

The first phase of collaboration was from 1987 to 1991. The project was titled "Pneumonia prevention and cure in rural areas in China". IDRC provided 80,000 CAD research fund. The objective of the research was to develop a strategy to reduce and control the child death.

Studies on causes for child death indicated that the most frequent cause for child death was pneumonia. The number of deaths caused by pneumonia accounted for 23.9% of the total infant death and 22.7% of the total deaths of children less than 5 years of age. Meanwhile, due to the poor medical diagnostic facility in rural areas and the rapid development of child illness that makes it difficult to determine causes for illness. It was estimated that in China there were about 300,000 children less than 5 years old died of pneumonia and related diseases, accounting for 25-30% of the total infant and child deaths. Therefore, a major measure to reduce child death in rural areas was to strengthen the prevention and cure of child pneumonia. That was to reduce death rate of child pneumonia through prevention and cure of pneumonia, hence to reduce the total child death rate.

Based on the situation of China that the social and economic development is slow and cannot be quickly improved, the first thing to prevent and cure child pneumonia is to develop an applicable strategy to prevent and cure the child pneumonia under the current situation of health care. With this objective in mind, the project conducted the following studies:

1. Strengthen the primary child health care network: establish a county, township and village three-level service, hospital transfer system for acute respiration channel infection and instruction and monitoring system for management of cases of illness.

2. Human resource development for rural primary health care: develop appropriate training material and training methods for primary health care

personnel.

3. Health education: develop health education methods suitable for young parents in rural areas to prevent and cure the acute child respiration channel infection, develop appropriate education booklets and videos for family tending of child acute child respiration channel infection.

Three counties, Shunyi of Beijing, Shiffang and Nanchuan of Sichuan, with different social and economic development levels were selected as project areas. Three year research results showed that the death rate of infant by pneumonia, the death rate of children less than 5 years of age and the total child death rate in areas with interference were significantly reduced compared to the control. The achievement was awarded the third class prize of Beijing Municipal Science and Technology advancement awards. This project was also a collaboration with the World Health Organization. A few techniques of classification criteria of the classification of acute child respiration channel infection were adopted in the WHO's global program of control of acute child respiration infection. Based on the research results of this project, the ministry of Health developed the "National program of acute child respiration infection control". The research results were applied in more than 500 counties, about 50,000 children less than 5 years of age escaped from death each year.

The second phase was from 1993 to 1995, the project was titled "strategic research on reduction of risky factors leading to death of child pneumonia". IDRC provided 130,00 CAD of project fund. Based on the results of the first phase study, this study further explored the non-biological risky factors that cause child death of pneumonia. According to the extent of the risk, heath care technical condition and community comprehensive capacity, to develop corresponding condition to control and eliminate the risks. By adopting better prevention and cure strategy, to further reduce the death rate of children less than 5 years of age in rural areas.

Two poor counties, Enshi and Jianshi, in the mountainous region of Hubei province were selected as experiment sites for comparative studies. Results indicated that the risky factors leading to child death of pneumonia were mainly the social and economic facors including family history of child death, poor parents education, father being a farmer, family income per capita less than 450 Yuan RMB, lack of knowledge of the disease by the mother and fire stove in the house etc. The research results indicated that the health education and dissemination of knowledge of prevention and cure of pneumonia was the major measure to further reduce child death of pneumonia and also provided foundation for the Ministry of Health to make policy.

The third phase was from 1998 to 2001. The project was titled "Urban community health care program in China". IDRC provided a fund of 360,000 CAD.

This project is a feasibility study on urban community health care reform and service transformation. The objective is to learn from the foreign experience of community health care and to explore possible model of urban community health care based on the current situation and to expand its application.

The project is the only one relevant to the proposal of development of community health care made at the national health care conference in 1996. The community health care reform, which involves management, economy, human resource and service, is a comprehensive program. Neglect of research in any of the areas may lead to bias of the research results from the project.

The two experiment site were Zhongguancun Hospital and Zhonguancun community in Beijing city; Yulin Hospital and Yulin community in Chengdu city.

The project is currently under way. Periodic achievements in grassroots health care reform, human resource development for community health care, community health care economy and the contents and way of community health care service have been obtained. Some of these achievements were adopted by the Ministry of Health and the local government.

For example, the proposal made by the project that the current street-district-municipal three level urban health care network be restructured into two level health care service network, community health care centers (street hospitals and small second level hospitals) and advanced hospitals for further diagnostics (large second level and third level comprehensive hospitals and specialty hospitals) was adopted in the Beijing Municipal Community health care conference in June 1999. The meeting decided that "in 2000, 80% of the urban street hospitals and small second level hospitals are to be gradually turned into community health care service centers, providing service to the communities". Based on the successful experience of computer application of Zhongguancun family doctor service center, the meeting also considered that the community health care service and management should take the advantages of modern information technologies, so that high quality and comfortable health care can be provided to the community residents.

The trial organization, Zhongguancun hospital has obtained successful experience of institutional reform, personnel training, resource redistribution and function adjustment towards community health care service, providing a good example for transformation of the small second level hospitals into community health care service centers.

A review of the Environmental and Community Control of Dengue Fever in Hainan Island

Hainan Provincial Immunization Station

The memorandum of co-operation on the "Environmental and Community Control of Dengue Fever (DF)"was signed by Hainan province and IDRC in 1991. The program started in July,1991 and ended in June,1994. Through 3-year-practice, it had gained a marked effect. At present, the achievements of the program are being spread in the high-density-Aedes aegypte areas.

1. Background

In Oct.,1979, the DF caused by dengue virus 4 spread in the villages and towns along the coast in Danzhou city and this caused the pandemic of DF in Hainan. In 1980,there were 14 counties/cities had reported cases and the total cases were 440,063 and 65 people died. In order to find a way to control the DF spreading again, we tried to feed fish in water vats to control the reproducing of Aedes aegypti larvae. But the method had no effect, and the epidemic of DF appeared in Danzhou city again in Sep. 1985. We tried to gain the virus in time and confirmed it was dengue virus 2. At first, we planned to control the DF in Danzhou city, so in Feb.---May 1986, we sprayed pesticide to the houses of the residents once two weeks, and the reported cases were only 25 for each month. But when we stopped spraying in June1986, there were 356 reported cases, and the reported cases reached the peak in August 1986,and the number was 10,711. We did not get planned goal finally. At that time the main method was to spray pesticide. Its characteristic was: where there were cases, we sprayed with pesticide, and after the spraying, there was few case, but as the time past 2-3 weeks, the number of case rose up again. The result was that you sprayed ahead, the cases appeared behind. So this pandemic of DF ended two years later.

I realized that the method to control DF in Danzhou city was not good, but I had no ripe experience. So I could only learned some methods from books,and there were no other methods in the books at that time. But I thought that the main dissemination vector of DF was Aedes aegypti and it reproduced in the water vats and small water containers, if these water containers could be washed regularly, the DF should be controlled. Having this idea, I went to the Lingao county where the epidemic of DF was the most serious and I found a village called Baocai where the local leaders paid attention to the disease. The leaders organized the staff to spray pesticide in all the village at once, and at the same time we carried out health education about DF control to the residents and required the householders to wash the water vats every 3-5 days and put the small water containers upside down. Every village cadre took responsibility to several families and had a check every week. After two weeks, the density of the larvae (Breteau Index, BI) decreased from 89.9 to 5. We persisted in doing this work for 3 years and got good effects. The village had over 3,000 residents. When other villages around it had pandemic of DF, it just had 74 cases.

The Public Health Bureau of Guangdong province talked the program of DF control with IDRC in 1988,and they chose Hainan to be the testing ground. The official of IDRC required the delegate of Hainan should take part in the discussion. At the meeting, the delegate of Hainan raised a different view that to control the DF need the community administration and health education. The new idea was accepted by Dr. Panduka who was the high-ranking official of IDRC. Under this situation, the memorandum of "the Environmental and Community Control of Dengue Fever" was signed in 1991 by Hainan province and IDRC.

2. The situation of implementation.

A). To confirm the research area.

Dr. Panduka, the high –ranking official of IDRC, visited Hainan in the Spring of 1991 and walked over the most serious area of DF and talked to the grassroots cadres and the local people to find out how much the residents know about the DF. He finally decided to do the research work in 8 villages and towns which circle around Baimajin town. The area included 85 administrative villages,371 natural villages, 29,590 families and 178,373 people. The area covered 382.08 squire km. In the research area, we set up experimental area and comparative area. Between the two areas the distance on the sea level was 2 miles and the distance on the land was 10 km, and there were villages and towns along it. In the past two pandemic of DF, the research area was the first area to report the suspected cases. So the area was a natural and perfect research area.

The situation of the baseline investigation was that the knowledge level of residents was very low, the illiterate and half-illiterate people held 46.24% of the population of above 7 years old people; The B.I. of the larvae was 46.24 and only 7.13% of the residents knew about the DF.

B).The construction of the research team .

The core research team was composed of 20 people who were from the Institution of Health Education and Anti-epidemic Station of province/city. They were divided into the following groups: secretary of the program, health education, epidemiology, transmitting vectors, laboratory and spot managing. Among them there were 4 professors/associate professors and 5 middle-ranking people. They were under the guidance of the program director. During the research time there was 1 person died and 7 people leaving the program because of other work.

Besides the core team, there were a lot of grass-roots staff. There were 13people who were hygiene directors of village hospital being responsible for transmitting vectors surveillance, and 55 village leaders and 82 presidents of local schools for health education. Their work were checked by the core team once a month and evaluated once half a year. The situation were reported in the bulletin by the core team and the bulletin was distributed to the government, villages and towns and schools.

The core team was responsible for training, guiding, checking, evaluating and solving difficult problems on-the-spot. It was also responsible for the routine surveillance of mosquitoes, developments of DF and patients and observation of external ships.

C). The staff training.

The staff were divided into senior, middle and junior groups. The senior group was the core research team. The middle group was made up of hygiene doctors. The junior group was composed of village leaders. The method of training senior group was to combine the theory with practice. Learning in the practice and practice promote the understanding of theory. The group got together to study once half a year. Besides these, there were professors who were sent by IDRC to give lectures to the senior group, such as: Professor Manderson coming from Kunsland University of Australia came to Hainan three times to pass on health education; Dr. Suntharee coming from the virus department of the National Public Health Institution of Thailand came to teach us serological test of DF; Dr. Boondee coming from the Ministry of Public Health of Thailand taught us how to check the safety of the program.

The middle group was trained by the specialists in the senior group. The training contents included explaining the plan of the program, living history ,organisms' habits and reproducing environment of the Aedes aegypte and Aedes albopictus which are the main transmitting vectors of DF, and how to identify the adult mosquitoes and the larvae. In the first year, the group got together to study and conclude once a month; In the later two years, the group got together to study once half a year.

The training of the junior group was also taken by the senior group. The junior group was divided into several sub-groups according to the villages and towns. Once half a year, to train the village leaders and presidents of schools concentrately and distribute pamphlets of DF prevention to them and require them to grasp the "three remarks": (1) DF is spread by the bites of Aedes aegypte. (2) Aedes aegypte live in the water vats and small water containers, such as jars, tins and pots. (3) To wash the water vats once 3-5 days and put the water containers upside down or feed fish in the water vats can control the growth of the Aedes aegypte and this can prevent DF. Then the village leaders organized the village cadres to study and then the cadres took charge of every family and let everyone under his charge know the "three remarks". Besides these, there were also broadcast and large-character bulletin to propaganda. The students were taught in the school and required to educate their family members when they were at home. The work was checked once half a year.

D). The funds and materials.

The funds aided by IDRC were Ca$192,675 and supplied by the government of Hainan province were 480,000 yuan (RMB). The money aided by IDRC were mainly used to buy the necessary and supplementary equipments, such as ESPEC incubator, computer and vehicles and to pay the cost of visiting, communication and fragmentary material needed on-the-spot. The money supplied by the government of Hainan province were used to pay the cost of gasoline, eating and allowances.

E). The achievements of the program.

Through 3 years research, the knowledge level of the DF prevention in the residents had been risen. The percentage of knowing the "three remarks" in the village cadres rose from 12.06% (17/141) to 100.00% (162/162). The percentage in the students rose from 0 to 92.96% (317/341) and in the house women rose from 1.89% to 75.21% (710/944). And the behavior had changed. In the experimental area, the residents got used to wash the water vats every 3-5 days and the percentage of the small water containers upside down rose from

0 (1110 families were checked) to 52.53% (592/1127). The Breteau index decreased from 42.38 to 3.07, reaching the index to prevent DF spreading. The program had gained the expected goal. After the program, we kept on doing the routine surveillance of the research spot every year. Until now, 4 years went by, and the local residents remain the "three remarks" fresh in their memory and the Breteau index is still under 5. (The checking result of 1998 was 3.1). It showed that the achievements could last long time.

F). The visiting of specialists.

Mr. Duane J. Gubler who was the director of mosquito-borne virus department in CDC came to visit the program in 1992. We had the identity views of the cause, development, control and vanishing of DF. And IDRC also sent its director of the health ,society and environment department ---Dr. Gilles Forget and its high-ranking official of the occupational health and environmental toxicology department ---Dr. John Markham to Hainan to investigate the program and guide the work on-the-spot.

Under the support of IDRC, we organized 5 professional workers to visit Singapore and Malasia. In Singapore, the methods of controlling DF were to reduce the causes and health education. They used the pesticide to kill mosquitoes in some area only when they had to do. Their experience enlightened and benefited us.

3. The evaluation of the program.

A). The usage and transformation of the scientific achievements.

In 1996, after the program finished, its achievements were applied to 6 villages and towns of the following 6 cities/counties :Haikou, Shanya, Qionghai, Changjiang, Lingao and Danzhou. In the application, the result in the Haiwei town, Changjiang county was bad because of no support of the local leaders. Excerpt that, the results in other places were good. The percentage of knowing the "three remarks" was between 41.51% and 84.44% and the Breteau index was controlled at 5.66 to 6.67. Under this B.I, the DF will not spread in the area even though there are pandemic of DF in the places around it.

Some achievements of scientific research in preventive medicine field have only social benefits, so the operation was difficult if there is no investment of fund. The propaganda, health education, travelling allowance of staff and reward, all these are necessary and need money. But in the preventive medicine field , the biggest contradictory in economic distribution is: when there are diseases, there is money, and there are more diseases and dead cases, there is more money.

When the program finished, we had 8 essays published in "Chinese Journal of Epidemiology", "Chinese Journal of Health Education", "Chinese Journal of Vector Biology and Control" and "Hainan Medicine". Mr. Duane J. Gubler, the director of the mosquito-borne virus department in CDC, published an essay named as "Community-Based Intergrated Control of Aedes aegypte" in "the American Journal of Tropical Medicine & Hygiene" (1994, No. 6) to introduce the program.

In Sep. 1993, I was invited to San Diego, U.S.A, to join "the First Meeting on the World Insect Biology & Control" and in Oct.1993, I took part in the Meeting on Australia Tropical Hygiene & Nutrition, and I got a chance to introduce the program on the meeting. In Aug. 1995, I was invited to Taiwan to introduce the program in the Institution of Preventive

Medicine (Taibei) and Gaoxiong Medical University.

B). The social benefits of the program.

The program belongs to the preventive medicine research. Its benefits mainly reflect on the social benefits. Its economical benefits can't be valued by the usual method of input-output ratio. Between 1979 and 1989, there were two pandemics of DF in Hainan Island and there were 88.772 cases and 32 people died. The average course of the DF was 7 days. The loss of working time totaled 621,404 days. The average cost of curing and nutrition was every patient 300 yuan . So the total cost was 26,631,600 yuan, and this did not include other cost, such as transportation, allowance of the doctors and chemical for controlling the pandemic. From the beginning of the program to today, there are almost 9 years and the DF doesn't spread any more. From the facts I mentioned above, we can easily get the conclusion that the social and economical benefits of the program are countless.

C). The creation of the program.

(1).To create the new model of community administration, health education and environmental control to prevent the DF.

(2). The contents of the health education are "three remarks" : a. The DF is transmitted by the bites of Aedes aegypte. b). Aedes aegypte grow in the water vats and small water containers, such as jars, tins and pots. c). To wash the water vats every 3-5 days and put the water containers upside down or feed fish in the water vats can control the growth of Aedes aegypte and prevent the DF. The "three remarks" include the cause , development and control of the DF, and it is easy to understand and remember, and can be carried out completely.

(3). The method to control the DF is easy for the residents to grasp and manipulate.

(4). The method need no chemical and can not pollute the environment.

A study on education for early fundamental qualities—IDRC project review

Shi Huizhong

Human knowledge development has the characteristics of both continuity and periodicity. The effectiveness of knowledge development of a man is closely related to his early education. With the attention by the leadership of the Central Education Research Institute and the support from the Ministry of Science and Technology (previously the State Science and Technology Commission), thanking to the IDRC aim of supporting the Third World studies, the hope of the Chinese education community that study on early education was realized by this project. The achievements from this project, divided as basic studies and allied studies, were awarded the first class prize in the 2nd national education research achievements awards.

1 Project backgound

In the early 1980s, the call for 4 modernization of the country and improvement of the nation's knowledge quality by the central government and the theories on early knowledge development by world brain studies stimulated the motivation of Chinese educational researchers to study early education for children. The 21st century belongs to the present and future children; the quality of a nation is based on the quality of individuals and groups.

An objective factor closely related to the quality improvement of a nation is the improvement of material and spiritual environments, direct and indirect environments. A prerequisite to this is to understand the current environmental condition that affects the people's knowledge quality. For the nurslings, it requires to survey the environments for nurslings' living and education. However, the survey of the current situation is to improve the situation to allow better quality development. "Survey" is not the ultimate goal, but a diagnostic tool. After survey, experimental studies on improvement of the environment should be conducted. Attempt is to be made to change the negative effects into positive effects; on the other hand, those positive factors will be kept for sustainable development under the prerequisite that they can meet the requirements by reality and the 21st century. Series research projects on quality education for nurslings were born under such situations.

2 The IDRC support and friendship

The two IDRC supported projects were "Preprimary education (China) Phase I" and "Preprimary education (China) Phase II" were listed as the key project of the Education Commission during the 6th 5-year national education research plan and the key project of the China Social Science Foundation respectively. With the support from the State Science and Technology Commission, the projects obtained the financial support from IDRC. The financial support and technical cooperation have greatly facilitated the studies. It clearly reflected the aims of IDRC and the friendship between China and IDRC.

2.1 Research quality is IDRC's emphasis. This was clearly reflected in the development of project budget. In the project proposal drafted by Chinese researchers, most of the budgeting items were meeting, travel, documents, equipment and allowances for collecting data etc.

After modification by IDRC, more budgeting items such as international advisors, overseas training and conferences etc. were included. The budget for these activities was unaffordable by the Chinese Institutions. This obviously reflected that the IDRC placed more emphasis on research capacity building and research quality. A certain amount of the project funding was used for capacity building for the research staffs. The overseas training and meeting opportunities provided research staffs to widen their views, improve technical skills and exchange ideas in various international education forums, as a result, they were more motivated to make greater contribution to the project.

2.2 Studies aimed at national education policy need to produce reliable evidence to describe the current status and ways to overcome the disadvantages. Chinese Education researchers had never experienced this difficulty. With technical helps provided by IDRC, the difficulties were overcome and the happy feelings were never experienced ever before.

The study "A survey aiming at improve knowledge quality of nurslings under the current realistic situation" had to break the tradition at its beginning that samples were not merely restricted within nurseries. It expanded to cover wide range of nurslings within and out side the nurseries in cities and in rural areas. By this way, the samples taken were more representative in area and number. This was discussed with IDRC program officer Dr. Neilson at the project design phase and later the difficulties were overcome with the help from statistic specialist Professor Kish. The project staffs were really moved not only by that they did grasped the complicated sampling techniques, but also by the IDRC guidelines for effective service and high responsibility in designing the sampling strategy. Specifically, a research population composed of samples taken from 10 provinces (Autonomous Region and Municipal) considering factors of economy, culture and geography according to the statistic data published be the State Statistic Bureau. The sampling error reached as small as 5%. The samples from each province were independent each other and were used for separate analyses for different province. Results were used as reference for the provincial education policy and also for the neighboring provinces. All provincial sample pool together with different weights and by manipulation to form the national sample and provided evidence for national policy making for early education. Although it was more difficult to conduct the survey, the results produced were certainly more valuable. The project surveyed in total 25,478 children from 88 cities, 70 towns, 2500 villages of 10 provinces (Autonomous Regions and Municipals). The samples were examined according to the criteria published by the State Statistic Bureau, i.e. the relative proportions of different professions, education levels, family composition, average per capita income, average of housing area per capita. It was proven that the samples were representative and the sampling method for the survey was qualified.

2.3 Project management and personnel training were weak for the Chinese research institute. The project staff worried about these. Surprisingly, the project external advisor, Professor Alam Brimer had already realized the problem and included it in his advisory plan.

Regarding project management, professor Brimer made lectures on management theories of research project to the project staffs. He asked for the staff to make a structure chart of all administrative and research institutions and researchers related to the project. A top-down project network involving governmental education administrations at various levels and led by heads of relevant organizations was formed. The research network was stratified into two levels; one was the national research committee consisting of national coordinator, provincial coordinator, member of technical steering group and few experts. The other was provincial level. At provincial level, a provincial research center consisting of leaders of provincial education administration and research organizations, provincial coordinator, and main research staffs. Each provincial research center and county (city) research centers under its supervision recommended research staff and data collector according to the requirements set by the national research committee. Finally, the national research committee decided the responsibilities for the research staff and data collectors and had the written responsibilities delivered to every researcher. The network had rigorous organization and clear responsibilities so that the decision of the top administration of the project could be effectively delivered to the grassroots staffs and the problems encountered during the process of collecting data could be quickly feedback to the national committee and be solved in time. With the network, information flow was kept very efficient and the huge research team was easily mobilized, making the collected data qualified. The data collectors and researchers were under the direct leadership of local and provincial research committee; their work was very earnest and effective. For example, it was common in city that the data collector had to spent 1 or days to look for family situation of children who had migrated to other places but the registration was not updated. In rural area, many target children were living in the high mountains; it took several hour to reach their houses. In some cases, the target children did not understand the survey and hided to avoid being questioned, thus the collector had to patiently spend much time on explanation and even to play with the children. It was really a hard work for the data collectors. Gratefully, they did a very successful job. It was the difficulties that make us the feeling that the project management is of significant implication for research quality.

As for the personnel training, it was initially planned to hold training course by giving lectures. But professor Brimer asked us to adopt a different way of training. An imitated interview was conducted. The survey and visiting documents were edited into scripts. and the members of the national research committee acted as the interviewer, interviewee and teacher. Two children were invited to act as sampled children. Videotapes of this play was recorded and distributed to the data collectors. The visualized training material made the training much more effective. This endured that the data collection in the survey was qualified.

There were many more examples reflecting IDRC's principles of technical guidelines. The sincere material and spiritual support provided by IDRC made us deeply felt the friendship of Canadian people and the grand spirit of IDRC.

3 Achievements of soft science are also important

The director IDRC Singapore office Jingjai Han Chanlash once said in a SSTC/IDRC workshop held in Hanhzhou "Schievements of soft science are also important, but currently there are very few appropriate projects". This was the reason that the early education research obtained consecutive two phases of IDRC support.

Preprimary education as a soft science research project, the research results were disseminated throughout the country in the form of four published monographs (30,000-40,000 sales). There are still requests for taking some of the region or nurseries as experimental bases. Such good social benefit of the project was due to the need of the society and the value of the research results. More specifically, due to the following reasons:

Firstly, the good vision of the project has me the social demands. The first phase of the project started in the mid 1980s, at that time quality education was not hotly debated, but our project had started the investigate objective factors affecting the preprimary education of children. Up to the mid 1990s, based on the results of the first phase study, we developed strategy to improve the living and education environments for children in China, which received very good effects. Today, the government has decided to implement quality education at various educational institutions, we have got 10-year research results, and the results can meet the current demands for practical education work.. Consequently, the research results have brought good social impacts.

Secondly, the research conclusion based on well-designed research plan and reliable research results has played roles in improving current conditions.

The tools developed in the first phase included 4 categories of parents interview, visits to nurseries and children caring places, measuring the knowledge development of children. questionnaires to children residential areas. More than thousands of variable were included in the collected information and the information collected was very detailed. In the data manipulations, in addition to the descriptive statistics, bi-variate and multi-variate analysis were conducted. Emphasis was placed on finding factors that affect children development and that could be used to improve the current situation. For instance, the education level and type of profession of parents were variable that the educational policy maker could not change. but the education behavior of parents was a variable that could be affected. These two types of variable were separated and multi-variate regression and variance analysis were conducted. making the results more convincible. Suggestions to improve current situation had produced impacts that exactly matched the research purpose. The practical implication was also significant. There were so many similar examples but only one or two can be listed here.

Another example was the suggestion that "the nursling education be not kindergarten education", which challenged the traditional concept of nursling education. The suggestion was made according to the living conditions and education status of the children. It asked the education authorities not only to pay attention to the institutional development of nursling education, but also to pay attention to improve the living and education conditions of those nurslings who have not yet received any education, and to put the improvement of family education condition and improvement of conditions that affects nurslings' quality development in the residential areas into the coverage of education. This type of suggestion received attention from the State Education Commission and was distributed to local governmental education departments in the form of official announcement. So far, some regions have already taken actions, such as the education commissions of Beijing, Shanghai. They have announced the family education program, taking the family education as component of the responsibility of the education administration. Regional education also started to receive attention, some areas (Tianjin) are conducting experiments at the moment.

Thirdly, at the same time as the investigation of current educating condition, development levels of children's basic motion, knowledge and personality were also measured. More than 200 environmental variables were taken as dependant variables, and the developmental levels as the independent variables to conduct multivariate regression analysis. Based on the multivariate regression, analysis of variance was also carried out. By these analyses, the amount of effects explained by family, education institution, daily activities on the above three development levels and interactions among these factors were obtained, providing evidence to improve various education condition and promote children's quality development.

For example, regarding the impacts of family on children knowledge and personality development, the parents teaching activity was the most influential factor. The impact of this was higher than the impacts of family economic condition and parents' profession. In the parents' teaching activities, the time on story telling and the amount of knowledge were the factors that had direct impacts on knowledge development. The contribution to children development was larger in rural area than in the cities. Furthermore, the more the parents did not spoil children in material requests, the better for children's knowledge development. This provided evidence for answering the currently controversial questions. The results also provided evident instruction to help parents to realize the interrelationship of personality and knowledge development, and to pay attention to the influence of non-intelligent factors on intelligence development.

Another example, the variables that had the highest contribution to children knowledge development were the teachers' teaching activities and toys and teaching facilities of nursling education institution. From the viewpoint of organization style of teaching, group activities were better than single class activities for knowledge development. From the viewpoint of teachers' attitude towards children activities, respects to children. such as giving ear to children's intention, approving that children were willing to think, had significantly higher positive impacts on knowledge development than asking children to simply follow what the teacher had done. This had played important role in having correct attitudes towards children and effectively design the teaching activities. In terms of toys and teaching facilities. the most favorable ones were sand boxes, water pools etc. This helped to cool down some nursling education institutions attention to get new and expensive equipment.

The impacts on children development of other factors such as the size of nursling education institution, the degree of freedom for nurslings, regulations were also analyzed and each had different advantages and disadvantages, providing evidences for improving education conditions.

Fourthly, since the survey included children from both city and rural areas, how to strengthen and improve the nursling education in the large rural areas has drawn much attention from rural teachers. Improvement of nation's quality must in no way to exclude the children in rural areas. On one hand, to strengthen and improve the quality of family education should be started immediately; on the other hand, the old idea of only caring about the nurseries should be shifted. According to different rural economic situation and geographic condition, different forms of children education should be adopted. What important is to "do" rather than to "wait", to "create" rather than to "lockstep". The first of this is the concept change and the actions should really follow the conceptual change. The positive impacts of the first phase project have been widely accepted by the public. The results from the second phase have put forward new positive suggestions on education model and curriculum etc. actively promoting the improvement of education conditions for children development in rural areas.

In short, the project was featured meeting contemporary development needs, early commencement, strong research procedures and research methods, reliable conclusion and valuable for both basic and applied studies. The research results produced from the project have been highly appreciated by the State Achievements Examination Group. Research professor Wu Fusheng from the Committee of Science, Education and Culture of the National people's Congress highly commented on the research results from the first phase project. He urged that the results should be widely extended and applied in early children education. The results from the second phase were also highly appreciated and were considered as very significant progress in theory and practice and innovative. The project has brought significant positive impacts on children early education.

Finally, we sincerely thank the Department of International Cooperation, State Science and Technology Commission (now the Ministry of Science and Technology) for its helps in getting contacts with the IDRC.

Review and Reevaluation of IDRC project
"Educational Strategy to Reduce Contraceptive Failure in Urban China"

Shanghai Luwan Women and Children Healthcare Center

We sent a proposal to IDRC in 1989. After inspection and investigation for project in Shanghai by a specialist who was sent by IDRC. We received IDRC approval on March. 1990. And started our research work on May 1990. The research was carried through for 3 years. According to the concern of Shanghai Municipal Family Planning Committee and Luwan District Government. And Also the help of Luwan District Family Planning Office. And Luwan Women's Association, the later 2 units were the co-operators of our research. Our Project was finished successfully on time at March 1993. The achievement was accomplished the original requirement of the project. . The project was introduced and communicated nationally an also abroad. We continuously educated the uneducated units of control Group after the project was finished. The education was also extended to the basic woman cadres and family Planning (EP) cadres of all the communities of Luwan District. In education, MCH knowledge was also added. Then the influence of our research was more extended and deepened. So the project. Obtained 3rd degree award of "Shanghai Major Scientific and Technical Progress Award of 1994". And "1st Degree award of Luwan District scientific and Technical Progress Award of 1995."

I. The Background

During the end of years of Eighties, the National Policy of FP had been implemented for 20 years, most childbearing aged women would follow the Policy. The contraceptive rate was high, then the birth rate and natural population increment rate in our country were decreased apparently in comparison to the years of seventies. As the implement of National FP Policy in Shanghai was excellent, so Shanghai's birth rate and natural population increment rate were usually the lowest among cities of nationwide. But the artificial abortion rate was very high. Although Shanghai municipal government had made great effort to elevate the efficiency of contraception by various methods through scientific research, but the abortion rate was continuously stepping up. It's well understood many complications and consequences are accompanied with abortions, some consequences may last throughout the life. If pregnant the possibility of prenatal and natal complication will be very common. So abortions not only jeopardize women' health, but also influence their work. Either family or society will endure much financial expenses. Therefore how to elevate the contraceptive efficiency and lower down abortion rate was a major problem concerned by officials of various level of government and all the persons worked for FP in Shanghai. We had preliminary surveyed for causes of abortion in Luwan District, which revealed that most abortions were caused by contraceptive failure, as most women lacked contraceptive knowledge, and couldn't select and manipulate the contraceptive methods appropriately and correctly. So we must educate them to increase their ability and efficiency of contraception. When one of our researchers studied in America 1987, Prof. Virginia C. Li of UCLA advised us to apply proposal to IDRC for research granting. Then under Prof. Li' recommendation, we formally sent the proposal "Educational Strategy to Reduce Contraceptive Failure in Urban China." to IDRC at 1989.

II. Implementation of Project Research

1. The expenses of Research Funds

After received the funds allocated from IDRC, we set an account in the bank special for the Project, managed by an appointed accountant. All the money received or expensed were recorded in a special book. The account of Project funds was separated from the funds of hospital. One of chief researchers was in charge of supervision and examination of funds expenses. All the expenses were strictly confined to the budget. According to the budget, our hospital had provided same amount of funds for research work.

The main expenses of research funds was detailed as follows:

(1). The expenses of pre- and post- educational surveys. The sample of survey was 1800 childbearing aged women (600 women each group), 510 husbands of experimental group 1, and 170 FP service providers of all the units of 3 groups. The main expenses for surveys included salaries and rewards of all the respondents; All the printings for survey; salaries and rewards of 20 interviewers who are Obs. doctors or senior midwives expert to FP service. Each survey was lasted for 6 months. Salaries and rewards of 2 experts for data computerization and expenses for statistical analysis managed by Shanghai Population Research Institute.

(2). The expenses of health education (HE): All the participating units were divided into 3 groups; in group 1 all the childbearing aged women and their husbands were educated: in group 2 only women were educated; in group 3 not educated for control. 170 FP providers of groups 1&2 were also educated. HE was lasted for 21 months (Jan. 1991 to Sept. 1992). There were 6,579 women educated, for 51,123 times in various forms of education. The fund was expended for HE, the salaries and rewards of all the acceptors of education: salaries and subsidies for traffic and meals of 10 Health Educators; the teaching materials we specially made including a set of videotapes of basic Knowledge of contraception, produced by Shanghai Movie production company, and copied 100 tapes for educated units and workshops. And we also wrote and published 10,000 sets of booklets. (5 booklets a set) of the same content for every education acceptor. All the health education was recorded on a special card, one card for each educated person: and salaries and subsidies of specialists for date computerization and statistical analysis.

(3). Salaries and entertainment of consultants

We invited 5 Chinese consultants for FP propaganda, HE and statistical analysis. And 2 foreign consultants invited by IDRC, Prof. Yuzuru J. Takeshita and prof. virginia C. Li. They came to visit us separately once a year.

(4). Expenses of instruments and apparatus: we purchased computer and printing machine, duplicating machine, camera, projection machines, 2 sets of video and colored T.V and other apparatus needed for survey, education, date collection, computerization, and statistical analysis.

2. Training for project personnel

The training of Personnel was very important, it not only related to the success or failure of the project. and also influenced the extension of aftereffects of the research.

The methods of the training of personnel were follows:

(1). Various Kinds of personnel were trained successively according to theirs levels. At first, the project researchers were trained. We sent 2 senior visiting doctors to study in Michigan University of America, each for 6 months. One studied HE, and the other studied Survey and data analysis. Both of them came back on time and played important role in implementation of research. We invited 10 health educators. They were Obs. And Gyn. doctors and senior midwives with FP service experience. They attended lectures before work. studied the detailed Knowledge of reproductive physiology, principles and methods of contraception, and also the targets and significance of the Project. The chief researcher of the Project gave the lectures. In the course of HE in participate units, we trained chief FP service providers, the doctors of factory clinic at first. All the doctors responsible for FP service were collected. To attend lectures given also by chief of the project, taught them Knowledge of reproductive physiology, principles and methods of contraception. Technique of implementing HE. And also the target and significance of the Project. The health workers of all the units of educated groups who were in charge of FP service to the workers, were trained by the health educators of the Project, and doctors of factory clinics through various forms. The women workers of childbearing age were trained by health workers under the instruction of project educators, mostly in from of personal conversation. After 21 months of HE, there were 6,579 women were educated, for 51.123 times. Husbands of childbearing aged women of group 1 were educated by their wives and health workers of the workshop. following the contents of teaching materials.

(2) The training of personnel was formally and strictly.

Various kinds of personnel were trained separately according to their requirement. All the interviewers of pre- and post- educational survey were collected for 10 to14 days before work to study the book " Interviewer's Manual " published by Michigan University (1981). "Survey Research " written by Backstrom (1981). After they understood the technique and moral requirement of survey, they accomplished the survey successfully, and obtained praise from participating units and responders. As for the training of doctors of factory clinics. we hoped them to know well the contents of the teaching materials. An examination was taken place after each lecture, and instructed them personally if there was any difficulty in learning.

(3). Training of cadres was key problem of HE. as educating all the childbearing women was the main target of the Project. for this purpose training of basic cadres the health workers was apparently very important, because all the basic cadres are working or living intimately with women. They will be the important forces of HE in the units if they are well trained. They can educate women in form of converse no need to interrupt women's works. Then HE will be established continuously after the Project.

3. Exchange visits of Project experts.

Two foreign expert consultants of the Project. Prof. Virginia C. Li of Public Health College of UCLA of America, and Prof. Yuzuru J. Takeshita of Public Health College of

Michigan University of America visited us in Shanghai every year separately for examination and instruction of our research works. They not only gave lectures to project personnel and other medical doctors of our hospital, but also gave lectures to chief FP officials of all the districts and counties of Shanghai, under the invitation of Shanghai Municipal FP committee.

We had entertained Prof. Sun Xiao Ming of Nanjing FP Research Institute, who was the chief researcher of another IDRC project for investigation of FP survey. We communicated and discussed what we learned from IDRC granted projects.

After the Project was finished, two chief researchers of the Project Prof. Zhou Mei-rong and Prof. Lu Shu-hua went to America to attend 121st and 122nd Annual Meetings of American Public Health Association (APHA), on Nov. 1993 and Nov. 1994. 4 papers were presented and communicated on these two Meetings, and obtained good evaluation.

4. The Research Personnel

All the researchers of the Project increased their ability and experience of implementing a research, after 3 years research work. The young doctors joined the Project increased their consciousness of scientific research and improved their technique to use computer and do statistical analysis. The person in charge of the Project, Prof. Zhou Mei-rong have retired, now she is the Honorary President of Luwan MCH Hospital. Recently she is carrying on a research granted by Research Department of Shanghai Municipal FP Committee. Chief researcher Prof. Lu Shu-hua, also retired recently serves as consultant of Luwan District Health Bureau. She joined the projects of "Three Better Project", "Establishment of Baby Friendly District and City", and " Child protection and Development of National Program of Action (NPA)", and "Women's Protection and Development of NPA ". She obtained award of "Shanghai White Magnolia Award ". The researcher Wang Hai-yun, a young doctor was promoted to Vice-chief doctor after passed doctor promoting examination and evaluation held by Shanghai Municipal Health Bureau. After he studied in Michigan University for 6 months sent by the Project, he can use computer to manage data collection and statistical analysis by himself. He exerted important role in the Project research. Now, he is a member of 1st period of "Shanghai Officials Assist Xingjiang Team " for 3 years. In Xingjiang, he not only fulfils the duty of a clinic doctor, but also teaches Xingjiang young doctors voluntarily, and obtained high praise from local people and leaders. The researcher Wei Yao-ru, also a young doctor was promoted to Vice-chief doctor by Shanghai Municipal Health Bureau. After studied abroad for 6 months, she joined the Project to do HE and survey. Now she is the chief of doctors department of the hospital, Five Chinese famous experts were invited to be the consultants. Prof. Wu Jie-ping, a famous scholar of reproductive science was highly concerned to our research. Every time we met him in Beijing or in Shanghai. He heard our report about the progress of the Project with high interest. Usually he gave us encourage and said:" The Project of HE in FP sphere is a significant research, like a landmark. I hope you do it well". The other consultants were Prof. Zheng Huai-mei (Obs. and Gyn. of Shanghai Medical University), Prof. Zhang De-wei (Consultant of National FP Committee), Prof. Zhang Zhao-huan (Medical Statistician of Shanghai Medical University), and Dr. Jiang Yun-fen (Vice-chairman of Shanghai Sex Education Research Association and Expert of FP Propaganda). We reported to them the progress of our research and asked for their opinion and instruction 1 to 2 times a year. Prof. Liu Yong-liang, vice-chairman of Shanghai Municipal FP Committee, concerned and helped us very much. Before the Project finished he arranged to all the district and county FP officials to carry on the HE of FP. as one of the main program of their work. So the achievement of our research might be quickly popularized in Shanghai.

5. The Achievement of the Project

Our research is the precedent of HE in FP area. The main achievement of the research are as follows:

(1). HE increased women's knowledge of contraception, then enhanced their efficiency of contraception, as they can select method appropriate to themselves and manipulate correctly. Thus quite a number of abortions will be avoided, the abortion rate will be effectively cut down.

(2). If husbands are educated, they will be willing to participate contraception. With the co-operation of husband and wife, not only the contraceptive efficiency will be improved, also the communication between husband and wife will be much increased.

(3). An effective method of HE of FP was explored.

(4). After education the basic FP cadres' ability of FP service and applying HE for people are much increased. And their prestige and confidence in people will also be increased. They will be the basic force of undertaking any public health service in units or communities.

(5). A set of teaching material of popular science of contraception was provided, which was easily understand and well accepted by people.

Therefore, our Project was obtained 3rd degree award of " Shanghai Major Science and Technique Progress Award " of 1994. And 1st degree award of "Luwan District science and Technique Achievement Award " of 1995.

III. The Scientific, Economic, and Social Evaluation of the Project

1. The transformation and Utilization of Achievement of Scientific Research.

After the Project finished, the first thing we did was to educate the childbearing aged women and FP service providers of all the units of uneducated control group. At same time. we also educated the basic women cadres and FP service cadres of all the neighborhoods and communities in Luwan District with same teaching material. Let the scientific achievement of the Project popularized in Luwan District.

In the course research, Prof. Liu Yong-liang , the deputy director of Shanghai Municipal FP Committee visited us and highly evaluated the significance and practical value of our Project. He arranged us to introduce the achievement and experience of our research to the chief members of offices of all the districts and counties of Shanghai on a meeting, and announced that popular HE of FP was an important task of their daily work. Then our achievement of research was further extended all over Shanghai. Jia Ding County was the experimental unit in the rural area to test HE of FP. The success of the test was revealed that HE of FP can be carried out in farmers of rural area. Our achievement was published in newspapers of Beijing and Shanghai.

When the leaders of National FP Committee visited Shanghai, they inspected Luwan District and highly appraised the excellent FP service, especially the popular HE. They appointed Luwan District to be one of 5 "FP Nice Testified Model Point ". By efforts, Luwan District passed assessment examination, and highly praised by Chinese and foreign experts at 1998

We wrote 9 papers after Project finished, published in Chinese and foreign medical journals. 4 papers were presented on Annual Meetings of American Public Health Association, 3 papers were presented on National FP Science and Technique Progress Conference in Hohhot city, and 2nd International FP New Technique Conference in Beijing.

After the Project finished, we introduced the method and experience of popular HE into Maternal and Child's Health Care area, to unite FP and MCH care to increase the quality of population of newly born, and also protect women's and child's health. 1991 Luwan District was appointed as one of 28 "National Three Better Project (Better Birth, Better Growth, and Better education) experimental district". According to the contribution of the Project, Luwan District was awarded as advanced District of "National Three Better Project " by Women's and child's Work Committee of State Council at 1995, and also named as "National Model District" of "Women's Program" and "children's Program ". In the nationwide action of establishing " Baby Friendly District and City", Luwan District was first to be a "Baby Friendly District ", and gave important contribution to "Baby Friendly City " establishment in Shanghai. So FP service and MCH care in communities of Luwan District are usually advanced in Shanghai and also in the country. In 1998, Luwan District was also ahead in " National Community MCH Service Experimental District " movement run by MCH Department of National Health Ministry.

2. The Social and Economical Benefit of the Project.

The benefit of a project research are usually exposed in later years. Our Project has been finished for 6 years, through the review and re-evaluation of the Project, in relating to the progress and changes of FP in recent years, the significance and benefit of the Project are reflected as follows:

(1). Decrease the number of artificial abortions.

The total number of abortions of Luwan District in 1990, the year of the Project started, was 8,504 cases. And decreased to 5,869 cases in 1998. 30% abortions were avoided. The level of decrement of abortions is similar all over Shanghai that means huge amount of expenses for abortions was saved in Shanghai. Of course the causes of decrement of abortions are various. But from the data of our research, there were 263 cases of abortions in 1990 among the respondents of educated groups in pre-educational survey. After education, the number of abortions same groups of post-educational survey was 170 cases in 1992, showed 35% decrement. So we think HE is one of the main causes of abortion decrement in Shanghai. Abortion decrement not only saves economic expenses, but also protects women's health, which is more significant.

(2). Increase women's ability of contraception.

After educated, women's knowledge of contraception was much increased, their ability of selecting contraceptive method appropriate to themselves, and method manipulating were obviously improved. They could solve problems in contraceptive practice by themselves. If any trouble or annoyance encountered, they visited doctor or FP service provider for help spontaneously. Along with increase of contraceptive knowledge, their knowledge of reproduction were also much increased, which was very significant for launching MCH care movement in mass of people.

(3). Promoting husbands to participate contraception and enhance the intercommunication between husband and wife.

Post-educational survey showed that in experimental group 1, the group of both wife and husband were educated, after education husband not only supported his wife to adopt contraception, but also actively participated the contraception himself. So the abortion rate of group 1 was lowest in post-educational survey. Otherwise with husband's participation the intercommunication between husband and wife was apparently enhanced, not only in contraceptive practice, also in discussion for other family affairs, such as money expenses, child' education etc. In surveys women' answer to question "How about the intercommunication between you and your husband?" For contraception, intercommunication intimately before education occupied 33.3%, after education 42.7% ($p< 0.05$), for other family affairs before education 50.2%, after education increased to 83.3% ($p< 0.01$).

(4). Women cadres and FP cadres of basic level were educated.

In launching any work in the mass of people, the ability and efficiency of cadres of basic level is very important. The Project emphasized the education of cadres of basic level. After studied the knowledge and exercised HE practice in the masses, most cadres of basic level highly increased their work efficiency and confidence in women they served. In surveys women's evaluation to their FP providers in the basic department was that most providers increased their ability of FP service and their confidence in people was also much improved.

(5). A set of FP scientific popular booklets and videotapes were provide, which explain the profound knowledge in simple terms and welcomed by people. It is suitable for teaching material of HE of FP.

3. Training of Qualified Personnel.

Two young visiting doctors, who worked for the Project, were promoted to vice-chief doctors after passing through the doctor promoting examination held by Shanghai Municipal Health Bureau after the Project finished. One doctor got the post of chief person of department of doctors of Luwan District MCH hospital. She was appointed as a successor of backbone of scientific contingent of Luwan District. The other doctor was posted as Vice-president of Luwan District MCH Hospital, and President of Luwan District MCH Institute. He has been awarded twice as one of the "Ten Excellent Young Persons of Luwan District" of the years 1997 and 1998. He was also listed as " Excellent Reserve Forces of Shanghai Official Rank". Now he joined first period of "Shanghai Officials Assist Xinjiang Team " since 1997 for nearly 3 years, and obtained high praise from native people and officials.

4. New Idea in Science and Technique.

To utilize HE in FP area is a new idea and new trial in Shanghai and also in China. We have probed in Shanghai Medical Scientific and Technique Information Institute at 1994, realized no such kind of paper reported in national literatures. There were several papers found in foreign literature, but these papers discussed about HE in teenagers to prevent extramarital accidental pregnancy and STD. No paper dealt HE in married childbearing aged women.

IV. Evaluation and Suggestion for IDRC's and Chinese National Science and Technique Ministry's Administration of Project.

We have obtained great concern and help from IDRC and Chinese National Science and Technique Ministry. After we sent the proposal to IDRC through National Science and Technique Ministry, within a short time, Prof. Yuzuru J. Takeshita (Public Health College of Michigan University), came to Shanghai, who was sent by IDRC, to inspect our research team and our hospital, and examined our application report, He gave us instruction and encourage. As we were informed the approval of IDRC through National Science and Technique Ministry, the Project fund was allocated a few days later. Then we could start research work on time. Every year, after we sent out Annual Technical Report and Financial Report we could quickly receive the fund of next year. So our research could be smoothly finished on time. As we usually received funds on time, there was no trouble in project expense.

For need of research, we changed the schedule, as we sent two persons for training abroad for 6 months in stead of one person for one year. For international exchange, two chief researchers went abroad after project finished, in stead of one person went abroad in 2nd research year. These changes were all approved by IDRC.

Both IDRC and National Science and Technique Ministry are very earnest in administration of project, funds were usually allocated on time, so there was no apparent barrier in the process of our research.

We thank two foreign consultants sent by IDRC, Prof. Y. J. Takeshita and Prof. V. C. Li. They worked earnestly and went to participated units and workshops to hold conference to discuss with women, cadres, and officials. They gave us many books and information materials. So their concern and help is one of important factors of success of our Project.

A review of IDRC supported project "sustainable economic development in southern China"

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1 Background

The project "Sustainable economic development in southern China" involved 10 southern provinces and 2 municipals, including Social Science Academies of provinces of Jiangshu, Zhejiang, Anhui, Jiangxi, Hunan, Hubei, Guangxi, Sichaun, Yunnan, Guizhou and Municipals of Chongqing and Wuhan. The project started from December 1992 and finished in December 1997, with a total amount of financial support equivalent to 0.7 million RMB. The project focused on the southern part of China, and made use of the better economy of the southern provinces and their longer opening-up experience. Objectives of the project were: 1) the research results can be adopted by the local governments or can be referred when making decision, beneficial to local economic development; 2) to improve the research capacity and quality of the local social science researchers; 3) to promote collaboration between relevant organizations within provinces and inter-provincial collaboration.

2 Project implementation

2.1 Project management

Since the approval of the project, Chinese scientists managed the project. IDRC program officers were included in both the advisory group and the expert panel. The project steering committee consists of a Chinese representative, Jia Zhen, the vice president of Jiangshu Social Science Academy and IDRC representative, Samule He. professor of Universoty of British Columbia. Professor Liu Guoguang of the Chinese Academy of Social Sciences was invited as the project advisor. The Steering Committee supervises the work of the expert panel. The expert panel consists of 7 specialists of whom 4 were standing specialists, and the other two were alternate representatives of different collaborative organizations. Two of the 4 standing specialists were appointed by the IDRC. 22 experts were invited for assessment of the project achievements. The expert panel was responsible for examining and approving research plan and research budget, identification of good research results. 5 meetings were held during the project implementation by the expert panel and has played an important role in the success of the project.

A coordinating committee was formulated within the Jiangshu Social Science Academy. It consists of a coordinator, Professor Gu Jirui, a project assistant, a finance administrator and a finance assistant. The project management also involved director of the research management division and director of foreign affairs of the Academy. 4 types of documents were drafted in December 1992 to facilitate the project management. The documents include "Rules for project management", "Code of practice for expert panel", "Guidelines for sub project application and screening", "Code for fund management" and "Detailed rules for fund management". These regulations and guidelines ensured smooth running and efficiency of the project.

2.2. Use of project fund

The total fund for this project was 668,800 CAD of which 522,930 CAD were managed by the Jiangshu Social Science Academy and 145,880 by IDRC Asian Regional Office. The received actual project fund was 2,601,788.38 Yuan RMB in equivalent and the actual spending was 2,594,986.49 RMB Yuan. Detailed spending were: 1，672，205.59 Yuan for research, accounting 64.4% of the total funding, 282,640.36 Yuan for technical workshop, accounting for 10.9%, 64,466.50 Yuan for the termination technical workshop, accounting for 2.6%, 177,468.59 Yuan for publication, accounting for 6.8%. The above 4 categories added to 84.7% of the total spending. In addition, 252,206.18 Yuan were spend on project coordination, accounting for 9.7%, 110,154.72 Yuan for expert panel meetings, accounting 4.2% and 35,826.55 Yuan, accounting for 1.4%. These 3 categories add to 15.3% of the total spending.

The annual spending during the 5 year project duration was: 292， 874 Yuan for 93. 848， 603 Yuan for 94, 840,734Yuan for 95, 377,783 Yuan for 96; 234,991.75 Yuan for 97. A balance of 6,801.89Yuan RMB (equivalent to 822.74 USD) was returned to the Regional Office in Singapore.

The funding from China included 2 categories, the first is the salaries of the researchers, which was 0.91 million Yuan in total estimated on 10,000 Yuan as the average of annual salary for a high level researcher. The second is the salaries, welfare, transport, housing and communication for 5 administration staff, which came to 0.6 million Yuan in total. The total input from China added up to 1.51 million Yuan.

2.3. Workshops and training courses

Two training courses were held by the project. The first one was in April-May 1993, a 14-day workshop on "Western economics" was held in Nanjing and Chengdu respectively. 5 renowned professors in economics from North America were invited to give lectures in the workshop. There were 215 participants in total attended the workshop (accounting for 50% of the total research staff of the project). Participants studied theories of the western economics, which greatly facilitated the project design and improvement. The second one was a 14-day training course on "computational economics and statistical analysis" held in May 1994 in Nanjing. Invited Canadian professors lectured the training course and 22 persons participated the training course. By the training course, participants gained skills in computation and capability of using the SHAZAMN software.

2.4. Research equipment and English literature

According to the project agreement, 10 sets of computers (including monitors, printers and software) were purchased by the Singapore Regional Office and imported to China and distributed to 10 provincial Social Science Academies (excluding Jiangshu and Chongqing as these two Academies got computers from a previous project). To some of the participating provinces, this was the first time to use computer in social science research. Asked by the expert panel, professor Samule He proposed a list of publication after consulting with a few North American publication-purchasing agencies. The list of publications was for the 22 participating institutions in economics to select their interested publications, each institute could purchase publications within an amount no more than 800 CAD. 90 types and 411 items of publications were purchase with a cost of 25,300 CAD, equivalent to 150,000 Yuan RMB. These publications were all the latest versions and very helpful for research staffs to understand the research progress in their own research areas.

2.5. Research network

Since the 380 research members located in 10 provincial and 2 municipal social science academies, it is an important problem how to coordinate the research team to accomplish the project tasks. Following measures were taken: the first was to strengthen the monitoring system through the research management divisions at the academies and the directors of the participating research institutes. On the other hand, the coordinating committee established direct contacts with sub project leaders by direct documentation exchanges and deliver of research fund. The second measure was issuing 9 editions of the project newsletter "research updates" which were distributed to each research leaders during the 5-year period from 1993 to 1997 in order to exchange experience among research members. The third was the inviting of experts from China and abroad for the assessment of research results and feedback of assessment comments to the research leaders to help improving research quality. The fourth was to provide opportunities for researchers who obtained significant progress to participate in the workshop on economic development in southern China held in Hong Kong. By this incentive. researchers could be motivated. The project published a series of 3 books "Studies in economy in southern China".

3 Research achievements

The research reports produced by the project covers a wide range of areas. approximately include: regional economy; rural economy including land resources. agriculture. forestry. population and labor; township industries etc.; industrial economy including industrial infrastructure and its restructuring. technology progress: resource utilization. environment protection and sustainable development: trade, market. distribution and consumption etc. All reported research achievements were back grounded by the socialist market economy and goaled at pushing forward fundamental transformation of economic growth. These achievements represented many innovative explorations in many aspects and the obvious features are summarized as follows:

3.1 Emphasis on local characteristics and practical application

One of the general purposes of the project is to provide theoretical evidence for local governments for their decision making. Therefore in the screening and design of sub project, attention was paid to local characteristics and specific to different regions. From the final results, it is clear that most of the achievements reflected this principle. In fact, many of the sub projects received attention from local governments and relevant administrative sections. They did not only provide support and cooperation to the projects but also invited researchers in their decision-making. Many of the research results have been adopted. Even some of the results were not directly applicable, the still provided edifications in the way of thinking and received attention.

3.2 Brave exploration and innovation, academic values

Although the 91 sub projects dealt with many old topics of economics, many new problems and situation are emerging in the market economy environment and facing challenges of sustainable development and modernization, these new problems urgently need theoretical explanations. Therefore, exploration and innovation were the key criteria in judging the academic value of the projects. Most of the research results were based on existing results, but were not simply repeating the old jobs and produce many new insights, new features, new understandings and opinions. Although these new understandings and opinions are still to be tested in the practice, in the view of economic theories, they are certainly innovative and attempting. Their contribution and academic value should be acknowledged. Many nationally and internationally renowned experts in the project assessment showed positive attitudes towards this.

3.3 Improvement of research methods, reflecting the realistic situation

Since the main purpose of the entire project was for practical application that was used as one of the criteria for project screening, traditional research methods had to be renovated and new ideas and methods should be introduced. To achieve these goals, three aspects were important in improving the research methods: the first was going to the front-line of the practices, collecting large amount of data through investigation; the second was the use of economic computations and statistical analysis; the third was the use of computer modeling for studies. This method was much better than the old method of logic with qualitative analysis, principle plus examples. It was unacceptable to over exaggerate the mathmaticalized economic studies, but pure logic was also lag behind. Most sub projects have adopted improved research method, leading to increased applicability and reliability of the research results. Furthermore, it laid a solid foundation for further studies.

In addition to the numerous published research results, there are other two achievements worth of mentioning. One is the improved capability of research staff that is one of the project purposes. Foreign financial support is temporary and limited. The improvement of research capability of research members by participation and practice in the project, the impacts is long lasting. In order to achieve this goal, during the implementation of the project, two workshop/training courses were conducted. 237 researchers were trained in western economics and economic computation and statistical analysis through participation in workshop and training course lectured by the invited foreign experts. This was very much appreciated by the participants. The other achievement is that the institutional capacity has been enhanced by providing computers and English publications that have long term impacts.

4 Experience of project management

The project involved number of local social science academies and foreign institutes, it was a large, long-lasting and more strict requirements to achieve the project goal, all these made it more difficult to manage. It had more specialties and complexities that were not met in other projects. We have no experience on how to organize and implement such a large scale academic engineering. Looking back to the practices of the project, we think that the following aspects are of significant importance:

4.1 Consultation to reach agreement and standardize the project management

The project was led by the Jiangshu Social Science Academy, however, all the participating institutions were equal. Jiangshu Socail Science Academy only had the responsibility to serve the participating institutions, but had no privilege to make orders to others and make benefit for its own. It shares a equal rights with other institutions. On the other hand, the project needs management. The only way is to seek common understanding, to reach agreement by consultation with each other and to institutionalize and standardize the project management. All members should conduct under the project regulations. With such consideration, a steering committee, an expert pane and a coordinating committee were formed through discussions among Chinese and Canadian scientists and among research leaders from the 10 provincial and municipal social science academies, so that the responsibilities for each member institutes and relations among the institutes were made clear, facilitating the coordination. Meanwhile, a number of regulations and rules such as the code of practices for expert panel, rules for sub project formulation and rules for research fund management were formulated to ensure the principles of open, equal and fair. 5-year practice showed that these methods of project management were effective and has made significant contribution to the success of the project.

4.2 Motivation and cooperation

The main purpose of international academic exchange and cooperation was not for cooperation per se, not only for obtaining financial support, but through sincere cooperation to make use of the advantages of the foreign partners to supplement our own shortcomings so that the project can produce valuable academic results and to push forward the progress of researches within China. In the case that different opinions were expressed, appropriate opinions of foreign partners were supported and adopted as much as possible, for the impractical suggestions, through explanations were conducted to seek understanding. For those requirements set by IDRC that were of world standard, such as the annual working report and financial report, were carried out in full attention. Mutual trust and respects were ensured throughout the implementation of the project.

4.3 Expert role is the key point of project management

This project was a research project, actually a process of making use of collective intelligence of the experts and drawing on the wisdom of the masses. Although the expert panel was supervised by the steering committee, the expert panel was given full independent rights. For instance, the formulation of sub projects, funding strategy, implementation of workshop plans, recommendation of outstanding research results, all the key decisions were made by the expert panel. Since the experts had high academic standards, wide view, more knowledgeable, making full use of experts and respecting of their rights have ensured the effectiveness and authority of the project.

4.4 Equal competition and proper overall balance in sub project delivery

There were 298 applications for sub projects, but it was impossible to approve all the applications due to the funding limitation. This imposed a problem, whether to select projects on the basis of equal competition or on the consideration of regional balance. It is clear that the equal competition is more fair and reasonable and helpful to introduce competition in project management, hence to produce better research results and ultimately to achieve the project goals. In this regard, the competition was imposed throughout the process of sub project formulation. The practical applicability, local characteristics, justification, priority and research method as well as the budget were the major criteria in sub project delivery. However, "fine tuning" was conducted to balance among the different provinces to consider the project overall interests. Practices had proven that these strategies were correct.

4.5 Coordination, communication and better service

Because the project covered a wide range of geographic areas, there were a large number of internal and external connections; as a result, the workload of coordination of the project was very heavy. The coordination became a fundamental work of the project management. The internal and external communications by the steering committee before a decision, the complicated implementation after decision by the steering committee and the expert panel, information exchange, funding distribution were all the critical aspects that play significant role in project implementation. During the project implementation, the coordinating committee and the expert panel worked closely together to ensure the smooth running of the project.

The project has obtained numerous achievements and the project management was successful. However, as some of the research leaders pointed out, there were some shortcomings in the project management, mainly are: the exchange of information among different sub projects was not sufficient although several issues of research newsletters were distributed. If there were several small regional meetings to provide opportunities for information exchange, there would more helpful for promoting and improving the research quality. Another shortcoming was raised in the purchase and distribution of the English publications. Due to lack of experience, listing of publications for different institutions was changed to listing publications for all institutions. led to delay of delivery of the publications. The publication could have arrived at an earlier time. contributing more to the project. A third shortcoming was that only 2 experts were invited for the assessment of final research results. If 3 or more experts were invited for the assessment. it would have obtained even better results. Finally, the dissemination of research achievements was not well done for all the sub projects. The research achievements could have been publicized more widely.

5 Assessment of the project implementation and IDRC project management

5.1 Assessment of the project achievements

Personnel training were significantly effective. The project design required the project proposals not only meet the application rules but also meet the national reality. Project screening was open. equal and fair. Assessment of research results was strict. By participating in the project. researchers were trained at the same time as they were working. This has been much appreciated by participating researchers. The social reaction to the project achievements was also positive.

IDRC expressed satisfaction with the project finance management after its financial examination for the project. IDRC Asian director Dr Randy Spence also expressed satisfaction with the project management during his inspection trip in 1995. He praised that the established research network would greatly facilitating further studies.

5.2 Assessment of IDRC program management and suggestions

This project was the largest social science project since IDRC started its support in China. It was proven that the project management was very successful and got twice the result with half the effort. 84.7% of the total IDRC funding was used for training, research and publication. only 15.3 of the funding was used for administration. Three program officers were involved in the project management, not only ensured the smooth progress of the project but also saved labor force.

IDRC has strict requirements for pre-project preparation. This was very important. IDRC requires annual working report and financial report for each year. IDRC program officers and regional director who inspected project in Nanjing displayed earnest and easy going working style.

Most of the participating researchers expressed the hope that IDRC could support similar studies in China again.

IDRC project " United catalog system of Chinese periodical of science and technology " promoted the technology development of Chinese information retrieval

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Chinese Institute of Scientific and Technological Information

One of the important works for scientific and technological information is to spread information, telling user where he can find out information he needs. Therefore, an information department should purchase domestic and foreign materials of science and technology, then process them into catalog easily to query, which is called as purchase and catalog editing in library science. However, the library collection is limited due to finance and storage capability. If a great number of information institutes are united, and their collected information are put into a catalog called united catalog, the information institute can share information each other, and the user can easily find out information in each institute.

At the beginning of 1980's, the library and information department in advanced countries of Europe and America used computer to purchase and edit catalog instead of traditional hand work. Their information retrieval system was so fine that user can get information from the database consisting of thousands of papers in a few seconds from a long distance. At that period, the Chinese Institute of Scientific and Technological Information, which was a top one in this field, only worked on editing theme table and Chinese database using computer. At the later period of the " Seventh Five-Year Plan", the Ministry of Science and Technology (MOST) took a series of projects, including " establishment of national on line system of western language", "Establishment of the united catalog of Chinese periodical of science and technology", "Establishment of some Chinese information database " as important projects of science and technology, and "development of large software for Chinese information retrieval " as key projects in order to speed up modernization of scientific and technological information.

It was urgent to establish a national retrieval on line system on western language because the scientific and technological information was mainly from overseas. Although the institutes in China had purchased more than 70 kinds of data tape with a value of several millions Chinese yuan, no any institute could run service on line due to a lack of soft and hard ware platform. The institutes had to use a long distance call for connecting the international retvieval system in the United States and European countries, paying several hundred thousands yuan of phone fee annually. As Chinese periodical of science and technology was an important part of domestic information of science and technology, it played a very important role in publishing scientific and technological paper, exchanging information, enhancing scientific, technological and cultural level of nationality. It was calculated that China published more than seven thousands scientific and technological periodicals, which were distributing in large, middle and small size library, information department. It was necessary to establish a united catalog system of Chinese periodical of science and technology, to edit, publish its catalog so that user in the fields such as science research, production, industry and agriculture can use information in the scientific and technological periodicals better, and the scientific and technological periodicals of whole China could be managed effectively. Compared with public library, the collection of scientific and technological periodicals in the information system of science and technology was much better. The collection in the information system of science and technology of whole country was taken as a base to establish a national united catalog of Chinese periodical of science and technology, was used to serve each user department. More important was that China was a main user using Chinese periodical of science and technology. China had to rely on itself to solve a series of Chinese processing technology in the united catalog. Other Chinese speaking-region or country was impossible to replace us.

When the project " United catalog system of Chinese periodical of science and technology " was put into cooperation with IDRC, we hoped to obtain financial support from Canada side originally instead of technology. The following cooperation showed that this cooperation brought us lot benefits beyond our original expectation.

1. The IDRC project in cooperation with China taught us how to conduct a project.

Our proposal was paid great importance by IDRC. The project belonged to scope of Chinese and orient language processing to be developed in technology, which was different from mature Latin language processing technology. In December of 1984, IDRC organized a workshop on technology on Chinese information processing in Hong Kong. More than 10 computer experts processing Chinese information from USA, Canada, Japan, Taiwan and Hong Kong were invited to attend. Four members of our project team participated in the workshop. Like " audience", they felt the workshop was held only for them. I just returned from abroad study at that time, and attended the workshop. I was only one getting financial support from China at the workshop. At the later days in Hong Kong, the workshop moved to Beijing and continued for a few days. Mr. Robert Valantin, a manager official of IDRC discussed project with me after the workshop. Although our members of the project team knew the project importance, we were not clear about its general objective, specific objective, technological approach and final achievement because we were not good at using system analysis and designing method at that time. We hoped to get financial support from abroad, which was much and better, but we did not know how to apply for it. Mr. Valantin smiled, said that he met a lot partner similar to us, who also did not know how to formulate a proposal and budget. It did not matter and he could helped us do. He said he would ask me some questions, then I answered one by one, and confirmed it at last. If I agreed with all, then what we discussed would became my writing report. I met Mr. Valantin before. I visited IDRC for one week when I studied abroad. He hosted me. That was why our discussion was fine and direct. He said that the discussion between both of us was easy to understand and light-hearted. A 15-page project framework was worked out during the following two days, which included as follows: general objective, special objective; system input and product output, approaches, technology standard, equipment; meeting with different scale, purpose, how many people to attend, what field; how many and what experts and technician the project needs; how many people and how long for a special work; what country to be visited and purpose; how many people to be sent abroad for study and training, their purpose, duration; allowance standard for domestic and overseas travel, etc. The total budget was easily worked out at last. IDRC support was mainly for Chinese training, and had strict rule for purchasing equipment. But considering much technology development in our project, IDRC approved buying terminal of Chinese processing , computer, laser printing which were expensive at that time. Finally, the project duration was determined to be three years, would be finished in June, 1988. The budget from IDRC was 80,195 Can$, of which 40,000 for equipment, 28,000 for visiting and training at abroad, 12,000 for consultant expert send by IDRC. Mr. Valantin said to me : " You can help other country do supporting project as same way I teach you today when China becomes strong in the future."

2. The IRDC project of international cooperation made important contributions to the success of the project.

It is often seen that some projects could not be completed well due to working slow in the beginning and working hard at the end. In fact, the practical situation of our project was much complex beyond our expectation. Due to huge work amount, we only completed less than a half of total in April, 1987. If it was a common project, we would find out some reasons to postpone. The institute leader paid great attentions to the project because this was an international cooperation one. I was appointed as project chief by the institute and required to complete the project without any delay. Thanks to the title of " international cooperation project", we got a lot of favor from the related sectors. Our team members worked very hard so that we could complete it in time. The project finally got the Award of the second grade on scientific and technological progress of the MOST.

3. " The united catalog of Chinese periodical of science and technology " has become the basis of retrieval technology of Chinese information of our institute.

The project was to solve the technology on data input and output, without any consideration of retrieval technology of Chinese information. Due to a huge amount of data to be processed with small type computer, we abandon the ideas to develop it using PC, and selected VAX by chance. A Sweden friend brought us TRIP software to be run in VAX of DEC data company, which was the earliest and most successful data software. I used it when I studied in Sweden before. The " united catalog" consisted of two parts: the data of periodical and book catalog, and the storage information of library. The data of periodical and book catalog contained Chinese, and 8000 kinds of catalog stored in the Chinese Institute of Scientific and Technological Information have been into computer. The storage information of library had much more data, all of which were volume, year and number in western characteristic but no Chinese. Why not use TRIP to load the storage information of library? After testing, we were glad to find that TRIP not only could be used to input the storage information of library, but also could identify Chinese. It mined that TRIP displays Chinese when reading Chinese code, and displays English characteristic when reading English code, which was greatly different from other software. This function was owing to the DEC branch company in Hong Kong that owned the most advanced operation system processing Chinese characteristic through adding a set of Chinese software in the operation system VMC of VAX. (a computer was only used to input Chinese and print at that time.) However, TRIP was not able to process and retrieve

Chinese. After discussing the possibility of developing function of retrieval Chinese on TRIP with Sweden side, Sweden side would modify the core software and we make test. Because of the difficulty processing Chinese characteristic, we determined to use reverse order technology for single Chinese characteristic, meaning that each Chinese characteristic was processed as an English word, and Chinese word consisting of multi-characteristic was processed as an English word group. This way could use mature technology of English retrieval. With more than ten tests in a year, TRIP could retrieve Chinese database as it retrieve English by the end of 1987. It was the first retrieval system for Chinese and western language database in China as well as in the world. As the first Chinese database for retrieval use, the "United catalog system of Chinese periodical of science and technology" owned 1023 records, which was the largest one in the world at that time. IDRC made its introduction at " International workshop on computer processing Chinese and orient language" in Toronto in 1988. My presentation was "Retrieval system for scientific and technological periodical", which was concerned greatly by participants.

Since 1989, Chinese Institute of Scientific and Technological Information started to provide service for Chinese retrieval earlier than two years for western language. The main cause was that we had a by-product, TRIP Chinese retrieval system during conducting the project " United catalog system of Chinese periodical of science and technology ".After that, some development of Chinese and western language retrieval system was concentrated on Chinese processing function of TRIP. TRIP in replace of western language platform costing US$ 1.6b million in 1994 loads 80 databases for retrieving thousands of Chinese and English materials. It is widely used by scientific and technological information departments at province and city level as well as by " Xinhua News Agency" and " Economic Daily". Without IDRC project, there would no TRIP, no wide application of TRIP in the scientific and technological departments. It is IDRC project that promoted the development of retrieval technology of scientific and technological information.

Many people asked me what IDRC wanted to take from our side because it gave us great help. I told them IDRC did not take anything from us, no data tape, no united catalog, except of a final report.

Dongting Lake steping into information era

Review on IDRC supported project " GIS of Dongting Lake"

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1. Project Background

China is a country with frequent and serious flood disaster. Dongting Lake region and Jianghan plain located at the middle reaches of the Yangtze River is attacked by flood annually. Headed by Mr. Chen Shupeng, a famous Academician, a group of scientist of the National Key Lab, Resource and Environmental Information System of the Geographic Institute of the Chinese Academy of Sciences put forward a proposal on making research about prevention and mitigation of flood disaster using high and new tech such as remote sensing and GIS to the related department of the state in 1985 since they had cognition about its significance in social and economic development of China and its need to high and new tech. The proposal was approved by the state. As a result, the project " Information system for forecasting flood " was implemented as one of the national key projects during the Seventh five-year Plan of national economic development. Its test plot was located at Dongting Lake region, the middle reaches of the Yellow River and Yellow River delta respectively. The main tech support for the project was GIS. It is well known that Canada is the hometown of the first GIS in the world, and Canada has most advanced research and application in GIS field. With the support of National Remote Sensing Center of China, G. Clidhe, manager of remote sensing and mapping project of Information Science Division of IDRC visited the National Key Lab, Resource and Environmental Information System of the Geographic Institute of the Chinese Academy of Sciences in October, 1987. He had a wide exchange with our lab on carrying out the design and application of the Dongting Lake Dam region database in cooperation of our lab and Remote Sensing Center of Hunan province. He indicated that

IDRC could support the project and hoped to extend the designing method and application software to the other developing country with the similar environment as Dongting Lake region. Under the support from He Chanshu, Zheng lizhong, leaders of the National Remote Sensing of the MOST , our lab and Remote sensing Center of Hunan province submitted a proposal on Design and Application of Space Database of Lake Dam Region to IDRC based our research made during the Seventh five-year Plan of national economic development. After the MOST sent the official notice on implementing IDRC supported project " GIS-Dongting Lake" (project number is 880093, total budget is 213,050 Can$), we started the project immediately.

The general objective of the project was to collect, sort, analyze and manage the data covering environment, disaster, social and economy etc. in order to provide support for policy-making in region development. Particularly, the database and application system resulted from the project has to be applied into policy-making on prevention and mitigation of the flood, and extended to other countries in Asian monsoon region.

2. Project implementation

The project duration was three years from 1989 to 1991. The implementing institution was National Key Lab, Resource and Environmental Information System and Remote Sensing Center of Hunan province, besides, Beijing University, Nanjing University, Zhejiang University, Chinese Academy of Agriculture, Remote Sensing Center of the Ministry of Water Conservancy etc. participated in it. The National Remote Sensing Center was the managing institution of the project. The budget of 213,050 Can$ from IDRC was for equipment purchase, remote sensing image data, foreign expert visit to China, publishing project result, training in Canada for Chinese researcher, international workshop etc. 800,000 Chinese yuan from the 75-73-03-04 project of the Seventh five-year Plan and the Hunan Province Government was for research and development, purchase and processing data except the remote sensing image data, travel cost etc.

The equipment and software provided by IDRC included as the following : a personal computer of Compag 386/20e (20MHZ CPU,2MB RAM), a color monitoring set with high resolution (NEC MULTISYNC- II),a digital instrument (ALTEK AC30, A_0 size), a drawing instrument (HP7570 A_0 size), a printing machine (Epson LQ-1050), a set of GIS soft ware of PC-ARC, a set of software of Paint Show Plus etc. The equipment and software provided by China side was VAX11/785, a digital instrument (Ca;comp, A_0 size), a Vestec drawing machine (Color), ARC/INFO software etc. The equipment and software provided by both sides were advanced at that time and played important role in implementing the project.

With regarding to training , the project provided financial support to Dr. Zhou Chenhuo and Liu Gaohuan for their study further and cooperation research in the Ontario Hydro Office , Canada. Dr. Zhou Chenghuo studied computer modeling related to flood disaster, and theory and technology of dam safety evaluation. During his stay in Canada, he visited IDRC, CCRS and Carlton University in July, 1990. He participated in two international conference in 1990, Canadian Dam Conference and Geographic Information System Seminar. Mr. Liu Gaohuan joined the training about computer modeling on hydro and water conservancy in Ontario Hydro Office from May to October, 1991. Besides, the National Key Lab provided training course on GIS to several tens researchers from the Remote Sensing Center of Hunan province. As a part of extensions of our project achievements, the training on " GIS and its application in the prevention and mitigation of flood disaster " was provided to 6 persons from Bangladesh. The project also offered the financial support to Dr. C. F. Lee from Ontario Canada and Dr. Eric de Man from Netherlands for short cooperation study and exchange with our project team.

Headed by Prof. Huang Xuen and Director Liu Xia of the Remote Sensing Center of Hunan province, the project team consisted of old, middle aged and young researchers. Mr. Cheng Shupeng, a famous Academician, was consultant of the project. All young researchers owned Ph.D. or M.D degree. The fruitful results were achieved through industrious hard work, which included as the follows:

---A comprehensive GIS database of Dongting Lake Dam region with total area of 18,760 square km was established, more than 600 various maps were input, a huge amount of data and information on remote sensing, social and economic statistics and flood in history were processed.

---Water and land distribution in 8 historical period since recent 200 years were studied and restored, the historical evolution of Dongting Lake region was modeled by computer.

---The computer modeling on sand distribution in Dongting Lake region was set up, the sand distribution from 1950 to 1970 was calculated using computer model.

---Modeling on Dongting Lake trend was created, the situation of Dongting Lake in 2000 was calculated under certain condition.

---Two-dimension modeling on area of water storage was developed, and the dynamic display was achieved.

---The dynamic modeling system on victims withdrawing process was developed.

---" Map on resource and environment information of Dongting Lake region" and " Paper collection on resource and environment information of Dongting Lake region" were published.

---The international workshop " Evaluation information system on flood disaster and wetland utilization" was organized in Chansha city, capital of Hunan province in 1991 and its proceedings was published.

3. Project evaluation on scientific study, economic and social effect.

The database and GIS supported by IDRC was transferred to the Remote Sensing Center of Hunan province, a maintaining institution in 1991. During the following two years, the system from the project made very important contributions to flood and watershed management in Dongting Lake region. Wang Keying, Deputy governor of Hunan province said at the international workshop organized by our project team： " The application of GIS in the flood control is very helpful to reduce disaster loss at maximum and enhance capability to prevent and control flood. The social and economic effect of GIS is incalculable and very important to economic development of our province." At the workshop, some leaders of the related departments of Hunan province indicated that the system would try to work for the Flood Prevention office of the government in the first year, after that, it would be extended to the fields such as agriculture an transportation etc,

The project team also participated in other project " Remote sensing application test in flood prevention" implemented by the Remote Sensing Center of the Ministry of Water Conservancy and organized by MOST. The project achievement was chosen as a First Grade Award of science and tech progress of the State and Ministry of Water Conservancy, also the Second Grade Awards of the science and technology of the Chinese Academy of Sciences through evaluation.

IDRC project not only achieved fruitful results, but also enhanced our capability building. The young researchers who were involved in IDRC project have become important scientists in the fields of RS/GIS nowadays. Some of them were chief of state key project during the Eight and Ninth five-year plan period, were evaluated as " Young Scientist of the Chinese Academy of Sciences", and were leaders of Key Lab at the state, province and ministry level. A part of previous members had good achievement when they studied further abroad.

As a renovation research results, the IDRC project made us to form scientific approach and primary technological model using RS/GIS to monitor and evaluate the flood disaster., which has been recognized by the state and society nowadays and supported continually as one of the " Key Important Projects" in the scien-tech research of the Ninth five-year Plan period. In addition, Dr. Wu Binfang and Dr. Xia Fuguo who were appointed by ESCAP of FAO went to Bangladesh for assisting the state to establish an information system on flood early-warning and disaster evaluation.

4. Evaluation on project management

It is the support and guiding of IDRC, the Department of High Tech and National Remote Sensing Center that our project completed successfully. IDRC made full understanding and investigation when a project proposal was submitted and to be approved. It has strict requirement and regular check in the budget amount control and utilization. IDRC provided consultant guiding and condition for receiver country in the international exchange and achievement extension, including expert visit, organizing international workshop, conducting academic exchange, especially, the extension to the developing countries. IDRC always attached great attentions to organizing international conference, for example, some experts from India, Bangladesh, Indonesia, Thailand, Srilanka attended our workshop. The national Remote Sensing Center also paid attentions to the project. Its leaders came to our institute to make exchange and investigation, and provide assistance and guiding in budget allocation, equipment purchase, training, organizing workshop and academic exchange. Of all international cooperation projects our lab participated in, the work attitude, high efficiency of both Canada and China sides in the IDRC project management are highly appreciated.

Our lab participated in other project of international cooperation supported by the World Lab (its headquarter is located in Switzerland), the content of which was similar to the IDRC project (the test area was situated in the middle and low reaches of the Yellow River). The IDRC project was much better than the project of World Lab. Although its supporting field, research direction, project duration and classification were same as that of IDRC project, lot of issues appeared in the project application, , and confirmation, particularly, in implementing procedure.

For example, the World Lab project was too big, consisted of too many subprojects. Too many institutions from different departments, regions, research fields were involved in the project. In addition, the procedure to determine a project was complex, of a long time, as a result, we paid much time and energy for it. The subproject of ours totaled US$ 400,000, but we could not implement the project using the amount of budget due to too many restrictions. For example, Italian equipment was appointed as the first choice to purchase because the budget was provided by Italian government. There were many issues in project management. For example, manager officials were changed twice (two Italian, then one American). It was very difficult to deal with the relationship between departments, institutions, foreign manager and Chinese manager, project and subprojects. Contrarily, the IDRC project was easy to manager and check due to its clear objective, small but fine scale. With regarding to managing aspect, IDRC control only big right, and small right were given our project team, thus playing initiative of our researcher fully. We appreciated the IDRC management.

Review on MINISIS Resource Center (MRC), an eight-year IDRC project

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1. Project background

MRC is the abbreviation for " MINISIS Resource Center", an IDRC-supported project in 1978. MINISIS, a management system of relation database running on HP3000 small size computer for processing multi-language literature, is very suitable for literature processing and information retrieval in the developing countries. The Information Research Institute of the Machinery Science and Technology (IRIM) was the first institution in China to develop information retrieval software successfully in 1976, and was awarded a prize of National Science Conference in 1978. China accepted the first grant of US$ 6 million by UNDP in 1979 for purchasing a big-size computer (B6810) and five small-size computers (HP3000), one of which was allocated to IRIM for information retrieval. Five sets of software were introduced from IDRC in October 1981 for five small-size computers. At that time, I just returned from the United States where I studied computer software, and was responsible for developing MINISIS software. Since then, I had been having the cooperation with IDRC for 18 years. From 1982 to 1986, IRIM achieved important success in the development, application, in Chinese, and extension of MINISIS, as a result, its client amount increased to more than 20 from 5. As I was invited to be adviser by IDRC in 1986, I was in charge of training client in China on behalf of IDRC. In the fall of 1987, IDRC determined to implement a MINISIS project in cooperation with IRIM after accepting my suggestion. The main purpose of the project was to provide Chinese user technology training and service of MINISIS in free charge. In the project, IDRC would offer MINISIS software and budget; IRIM would provide software expert and office. Its major activity included: training client and solving technology issue; editing and publishing materials in Chinese of MINISIS and " Newsletter of Chinese User of MINISIS" (Quarterly); establishing "Chinese MINISIS User Association" with its routine. IRIM established MINISIS project team consisting of five software experts and appointed me as a chief. I was elected as Council leader of MINISIS User Association in 1980.

The first phase of MRC project with two-year duration was from November 1987. It was extended for five months at the end of 1989, receiving budget of 102,400 Can$. The second phase of MRC project with budget of 930,790 Can$ was from April 1990 to March 1992. The third phase of MRC was from April 1992 to March 1995, allocating budget of 199,950 Can$. The total MRC budge for seven year and five months from IDRC was more than 390,000 Can$.

2. Project implementation

" Grant Condition Memorandum ", the formal document of each MRC phase, was formulated by project officials of IDRC and our project team after discussion. The main content of the formal document included: objective and activity, grant budget, technological report and accounting report, MINISIS software offer and support service etc. The formal memorandum had two copies, and become effective after IDRC and IRIM signed the copies.

Before fixing the grant budget, we proposed the prediction based our project cost to IDRC and discussed in the detail. The grant budget was included such as allowance for project team member, technological materials, cost for publishing " News of Chinese MINISIS User ", travel cost, cost for equipment and software, coping and communication. We complied the terms and budget of the grant memorandum strictly as IDRC stressed that the specific fund was for special purpose, residual balance was to be sent back and no compensation for overspending, financial report was to be submitted annually. IDRC was in satisfactory with our eight financial reports and eight technological reports during the implementation of MRC.

The budget provided for MRC by IRIM was also included in the Grant Budget Memorandum. For example, IRIM provided more than 340,000 Chinese yuan for MRC in the third phase. Although the main task of the project was to provide user with HP300 version of MINISIS, the payment for equipment was not large because IRIM had had two sets of HP3000 computer with related equipment.

During seven-year implementation, 12 person-times from IRIM participated in MINISIS international annual meeting, 10 person-times for MINISIS training course organized by IDRC abroad, 15 person-times of IDRC officials and expert as well as 3 person-times of MRC member of other country experts were received by IRIM.

3. The main achievement of MRC

During the duration of 89 months from November, 1987 to March 1995, MRC project achieved a lot as the following:

- More than 30 terms of MINISIS basic training and 5 terms of MINISIS advanced training were organized in Beijing and other cities, training 300 persons involved in application and development of MINISIS for more than 60 clients;

- 21 volumes of " News of Chinese MINISIS User " with total 1200 pages and 1.8 million characters were edited and published;

- The book of MINISIS G version with 150 characters was translated and published, which consisted of " User Hand Book", " Guiding for database management" and " Guiding for programmer";

- Three books for basic and advanced training course of MINISIS with 1.2 million characters were formulated and published;

- The MINISIS.0 version was translated (0.7 million characters);

- More than 60 papers and reports were published, of which 10 were in English. Some of them were presented at international workshop and listed in proceedings, or by foreign magazine;

- Two books (about 1 million characters) were published by press house, one of them was evaluated as the Excellent Book Award of the Second Grade;

- " Chinese MINISIS User Association " was established in 1988. The Association organized 6 annual meetings in Beijing, Chengdu and Chansha city. As a host, the Association organized the eleventh annual meetings of international MINISIS User in Beijing;

- More than 50 clients were developed, having over 70 users;

- All- around technological support, consultant and service were provided to over 79 users with a various way, which included: providing and installing new version of MINISIS; providing basic and advanced training; assisting user for designing, developing and evaluating application system of MINISIS;

- Receiving user's visit, letter, phone, fax and email and visiting user for solving a various of technology issues;

- Assisted IDRC to develop MINISIS G in Chinese Version. This Chinese version became ideal tool for more than 70 users to establish large database and retrieval service. For example, the first database entering retrieval network of scientific and technological information of China, as a database of machinery engineering of China, was set up and managed by MINISIS software. Besides, a few western databases of them were established using MINISIS. All these database were evaluated as award of ministry or state level;

- The achievement of MRC was awarded every year by IRIM, and was appreciated by IDRC and users;

- Sent person to participated in MINISIS international annual meeting of 10, 12 and 13 session, MRC meeting and MINISIS. H version publishing meeting;

- Testing MINISIS .8 version.

4. MINISIS User list in China

4.1 Information and library sector

IRIM, Electronic Information Center of National Sport Committee, Information Center of Science and Technology College of China Agriculture, Information Center of Science and Technology of Textile, Information Center and Library of Chinese Academy of Physic, Literature information Center of Chinese Academy of Social Science, Information Institute of

Chinese Academy of Military Physic, Shanghai Literature information Center of Chinese Academy of Sciences, Population Information Center of China, Population Information Center of Shanghai, Population Information Center of Guangdong Province, Population Information Center of Shanxi Province, Population Information Center of Tianjin, Population Information Center of Liaoning Province, Population Information Center of Sichuan Province, Beijing Information Center, Library of Dalian city.

4.2 University and college sector

Beijing University, People's University of China, Aviation and Space University of China, Beijing Computer College, Beijing Diplomatic College, Youth Political College of Beijing, Shanghai Transportation University, Shanghai Political College of Air Force, Shanghai Tongji University, Shanghai Finance College, Shanghai Machinery College, Chemical Industry College of East China, Nanjing Aviation and Space University, Nanjing Normal University, Nanjing Medical College, Zhejiang Normal University, Ninbo Normal College, Harbin Industry University, Chanzhun Geological College, Anshan Cadre Management College of Metallurgical Industry, Central China Technological University, China Electronic University of Science and Technology, South-West Finance University, Kunming Industry College, Yunnan University.

4.3 Economy and trade department sector

Calculation Center of the Ministry of Foreign Economy and Trade, Shanghai Foreign Trade and Transportation Company, Calculation Center of Foreign Trade of Gaunxi Province, Calculation Center of Economy and Trade Committee of Hebei Province, Calculation Center of Economy and Trade Committee of Shandong Province, Calculation Center of Foreign Trade Group of Lianing Province, Calculation Center of Foreign Trade of Anhui Province, Calculation Center of Foreign Trade of Tianjin, Calculation Center of Economy and Trade Committee of Henna Province, China Import & Export Group of Yarn Products, Calculation Center of Economy and Trade Committee of Jiangsu Province, Calculation Center of General Foreign Trade Company of Fujian Province, International Economy and Trade Center of Shanxi Province, Calculation Center of Economy and Trade Department of Zhejiang Province, Import & Export Commodity Inspection of Zhejiang Province.

4.4 Company and plant sector

China General Company of Nonferrous Metal Industry, Electric Welding Piece Company of Tianjin, Petrochemical Engineering Company of Luoyan, East Steam Turbine Plant, Anshan Steel and Iron Company, Jinling Petrochemical Company.

4.5 Research institute and hospital sector

Comprehensive Economy and Technology Institute of Machinery Instrument and Meter, Development Center of Chinese Children, Research Center of Freshwater Fishing of Wuxi, Qigong Research Center of Army 89950, Hospital 301 of People's Liberation Army of China, Friendship Hospital of China and Japan, Xiehe Hospital.

5. Economic and social effect of MRC project

The biggest achievements and social effect of MRC was to have made MINISIS extension in China and promoted computerization procedure of China literature and information processing greatly. As there was a booming of information processing computerization of science and technology in China in the early 1970's, the work of the information center and library owning abundant information resource was concentrated on information computerization. As early as 1976, IRIM developed the first information retrieval system with computer in China, which became the following model for library and information institutes to learn. That US$ 6 million grant from UNDP was allocated to purchase computer by the Ministry of Foreign Economy and Trade in 1979 was to make five information institutions including IRIM to realize computerization of information processing and retrieval. It was coincidence that IDRC developed MINISIS system running on HP3000 which was offered to the developing country in free charge. Therefore, five information institutions including IRIM became the first MINISIS users in China.

IRIM started to provide retrieval service for specific topic using the software developed by itself in 1980. After setting MINISIS up, IRIM immediately established four kinds of large database of scientific and technological literature for retrieval service through connecting computer. Around 1985, IRIM developed MINISIS in Chinese version in cooperation, which the library and information departments of China were greatly interested in. More than ten institutions bought HP 3000 installed with MINISIS in 1986 and 1987 because MINISIS worked only on HP3000 at that period. MINISIS user increased rapidly in China. That MINISIS successful development, application and dissemination of IRIM was why IDRC determined to make cooperation with IRIM for MRC project.

During the first phase of MRC project, the total MINISIAS user increased to more than 40, making China become a country owning most MINISIS users in the world. In October 1978 when the first phase of MRC was at the end, we successfully held " The eleventh annual meeting for international MINISIS user " in the newly-built office building in IRIM. Chinese and foreign participants greatly appreciated the " Achievement Exhibition of MRC project " and made excellent comment on it. IDRC determined not only to make MRC follow up, but also extension in other countries and region with considerable user. As a result, MRC project was implemented in India, Egypt, Mexico, and Ethiopia. After completing the first phase project of MRC, IDRC invited expert from Singapore for making evaluation and check through visiting MINISIS client and MRC achievement in Beijing, Shanghai, Xian etc. The expert submitted an evaluation report to IDRC, which had very good comment on our project. The achievement we made in the first phase of MRC played a basis for applying for the following up project.

The amount of MINISIS user was much more than other software in same field in China due to MRC projects. Users in China felt very happy for powerful function, advanced trait, software in free charge and good technological service of MINISIS. The most users have achieved a lot in their application. We trained several-hundreds persons for MINISIS clients through organizing training class, annual meeting, sending book and periodicals in Chinese, some of which become core staff of MINISIS.

The achievements made by MRC project was concerned by news media. In the recent years, eight newspapers published paper on MRC, which included " Economical Daily", " China Youth", " Computer World", " China Electron Newspaper". "Electron Business", " Commercial Newspaper", " IT Newspaper" and " Beijing Youth".

AS MINISIS users in China are large research institutes, famous universities, well-noted hospitals, industry and business enterprises, the computerization of literature information processing is very necessary for them. If there were no MINISIS, they would buy other computer much expensive than HP3000 from overseas and information processing software costing several ten thousands. Due to MINISIS extension in China, each user saved US$ 50,000 at least, and more than 70 users saved US$ 3.5 million at least totally. In addition, MINISIS application in each institution also yielded good economic effect.

6. Evaluation on IDRC and MOST in project management

Since 1981, I have been developing MINISIS. I could meet IDRC officials and experts almost every year and have communication with them by mail and fax almost every month. As a project team chief and a main member, I was involved in many activities, including discussion and formulation of project agreement document, receiving IDRC official and expert, participating in training and workshop, formulating technology and finance report, sending mail, fax and email etc. Because I had more opportunity to meet IDRC staff, I established close ties and deep friendship with IDRC. I am familiar with IDRC characteristics, tenet and activity through 18-year work and have very deep impression on related staff of IDRC and MRC project.

In order to make MINISIS users of China have deep understanding on IDRC, we published two papers about IDRC introduction on our " Newsletter of Chinese MINISIS User " (1992, vol. 5, issue 3), which were selected from IDRC publishing and translated into Chinese. One topic was " IDRC strategy: absorb force from knowledge ", another topic was " IDRC guideline and its main activity in Asia region". In addition, we also made the detail introduction for IDRC at MINISIS technology handbook we translated and published. It can be seen from these articles that IDRC goal is to encourage, support, initiate and conduct research in light with issues existing in developing regions, and seek approach to extend the scientific and technological result and other knowledge for promoting the development of economy and society in these countries. In according to the goal, IDRC always supports scientist and research institute in the developing countries to conduct the study that is of significance to his country and region, which includes: providing guiding for research direction and financial support for research project, if necessary, providing assist for these activities. During 20 years from 1970 to 1990, IDRC provided as much as ten billion Can$ for more than 5000 projects in more than 100 countries. Because IDRC knew information significance in the developing countries, it began to study MINISIS database suitable for the developing country and offers them in free charge. In addition, during past 20 years, IDRC not only provided thousands institutions in the developing countries with MINISIS software and technology service freely, but also provided about 600 information projects in 95 countries with Can $ 150 million.

We think that the cooperation memorandum signed by MOST and IDRC in 1980 was an important, far-sight action for reforming and opening to outside world, which promoted our progress of science and technology as well as cooperation and friendship between China and Canada. MOST and IDRC did very well in such aspects as project confirmation, budget use, international exchange, information management and exchange, project coordination. MOST provided a lot support and promotion to MRC project, which were highly appreciated by IDRC and us. Through implementing MRC project, we understood IDRC project management and strict rule in formulating proposal, confirmation, formulating budget, project monitoring etc., which were made for our reference when we provided other countries add. For example, when we implemented the project nearly for one year, IDRC send the attentions to us for our submitting project progress report and financial report. IDRC usually allocated the budget of the following year after checking our two reports. Before nearly ending the project, IDRC always asked us to submit final report and financial report. One more example, IDRC project official kept close communications on his own initiative with us during project implementation. Its project manager visited Beijing once a year to check project progress. During seven to eight years of MRC project, Mr. Gavin, Manager General of MINISIS system of IDRC, Mr. Richard Lee, General Designer of MINISIS software and Mr. Ed Brandon, MRC project official gave the great concern and enthusiasm to MRC project. Mr. Garvin visited Beijing for several times for understanding and guiding project. Mr. Richrd Lee visited Beijing for more than ten times, putting himself out of the way. He made important contributions to Chinese user as he solved a various technology difficulties in Chinese language processing of MINISIS. Mr. Ed Brandon managed MRC project earnestly. Here I would like to express my great thanks to three gentlemen mentioned above and Madam Mary Campbell, Mr. Bill Swift and Mr. Lorraine Vinette and Mr. Bob.

7. The following up activity of MINISIS in China after MRC project

The third phase of MRC project ended in March 1995. Before that, IDRC had developed DOS version of MINISIS. As the budget was tight before March, 1995, IDRC indicated that it could not provide financial support no longer, and hoped we could sell DOS version of MINISIS and take in service charge in order to continue to extend MINISIS in China. IRIM also asked us to be responsible for our profits and losses after project ended. In the summer of 1994, Minshi Computer Company was established on the basis of original MRC project team under the consent of IDRC and IRIM. This company continued to use IDRC budget for completing the third phase project of MRC. After ending the project, IDRC appointed Minshi Computer Company as only one general agency to develop MINISIS market in China. In 1997, I was retired. The company had to be closed. As a result, several tens users in China lost technology support, and MINISIS lost its base in China. After I retired, IDRC send its staff to Beijing twice for discussing solutions with me about continuing to extend MINISIS in China. At last, Tianjitong Computer Company, as a sole agency of MINISIS in China, was established. Today Tianjitong Company is making its every effort to extend Windows 95 version of MINISIS and develop library system, archives system, museum system, and software on line. I believe that those systems can attract user and open market because they are powerful, most advanced in technology.

Review on the project "Biodiversity Conservation and Sustainable Development in Xishuangbanna Biosphere Reserve" funded by IDRC

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A multi-discipline project, focusing on the biodiversity conservation and sustainable development was carried out in past years, from October 1994 to March 1999. This project got the support mainly from The International Development Center (IDRC) of Canada. The project title is Biodiversity Conservation and Sustainable Development in Xishuangbanna Biosphere Reserve. The location of the project is in China's Yunnan Province, Xishuangbanna Biosphere reserve, and mainly in Mengyang reserve, that is the largest reserve of five reserves in Xishuangbanna Biosphere Reserve.

Chinese Man And Biosphere Committee(C-MAB) Organized and coordinated the project. Institute of Ecology and Geobotany in Yunnan University (IEG) was responsible for and conducted whole research work. 12 researchers, including 3 professors, 5 associate professors and 4 lectures participated in the project. Among them five were females and seven males. Xishuangbanna Biosphere Reserve(XBR) provided with research area, provided field support, they got the training from the project and got the final research result.10 men and 2 woman participated in the research and 8 of them got the training.

1. Background

Xishuangbanna, a Dai Nation Autonomous Prefecture, is located in southern part of China's Yunnan Province, neighboring from Laos and Burma. Xishuangbanna is located in humid tropical area, tropical rain forest is the major vegetation type. Because of the mountainous topography and crisscross of the different vegetation types, the biodiversity is rich here. Lancang-Mekong River flows through Xishuangbanna and connected the China with lower reaches countries as Burma and Thailand. There are thirteen different ethnic people lived here, many of them still remain the traditional living and producing habit, they make up the culture and social diversity. As it is far away from the center of China, the social and economic development in this area is not as fast as in other area of China.

Xishuangbanna Biosphere reserve, one of the first nature reserves established in China, situated in Xishuangbanna Prefecture. The reserve is a comprehensive reserve set up primarily to preserve the tropical rain forest, monsoon rain forest and populations of rare and precious tropical wildlife. There are the most integrated tropical rain forest remaining in China and very rich diversity of plant and animal life in the reserve. With many local people live in the reserve, they established the relationship with the environment and influence the nature.

Funded by the International Development Research Centre (IDRC) of Canada, co-funded by the Yunnan Provincial Science and Technology Committee(STC), the project was carried out in Xishuangbanna Biosphere Reserve. Experts from Parks Canada joined in the project. Starting in October of 1994 and ended in October 1997 at first stage, through the research work of the project, new technologies have been used to improve the management of the reserve and to protect more effectively and practically the biodiversity. Research has also been conducted on the manner of natural resources use by local people and on sustainabl development of the area. With exploitation along with the Lancang/Mekong River and in Xishuangbanna, the conservation and management of the reserve might influence the economic development and natural resources use. This project provided with a basis and tool for evaluation, planning and prediction of local development and the effective use of natural resources.

With the first stage of the project finished and it was found that some research results of the project have not been practical used by the managers, such as the established GIS of the

Xishuangbanna Biosphere Reserve was not used in the daily management of the reserve. Some plans proposed by the researchers were not recognized and to be used by the managers of the reserve. The project had also some shortage because of the time and fund limit, such as the distribution of some protected species was not very clear. The supplement project was carried out to help the project to be more effectively and make it to be used in practical. This supplement project was approved in the February of 1998 and the duration was one year.

2. Research Project Objectives

2.1 First stage

According to the project plan, there were four purposes of the project:

* To design a data base and establishment of GIS for the Xishuangbanna Biosphere Reserve, for the monitoring, management and effective conservation of local biological diversity. This is one of the important points of the project.
* To investigate, analyze, and summarize indigenous knowledge of natural resource use in the reserve, and to evaluate this knowledge to make plans for sustainable development by using GIS and other methods.
* To select and plan suitable sites for economic plants cultivation.
* To provide a basis and tool for evaluation, planning, and prediction of economic development and natural resources use which may influence the reserve conservation and management.

2.2 Objectives of the Supplement Project

Through the training course, workshop and publication, to dissemination the project results.

* To cooperated closely with the reserve managers to refine the first stage GIS models;
* To train the managers of the reserve for independently operating and maintaining the established GIS after the three years project.
* Through the training course to extend GIS application in management of various departments at different levels in this region and other regions.
* To recommend the research results of this project to the managers and decision makers of other nature reserves, especially those which are undertaking GIS projects within the China Biosphere Reserve Network.

3. The Main Activities And Results of the Project

3.1 A basic information database of the Xishuangbanna

Biosphere Reserve was established, electronic maps by using collected data, information and existing maps are constructed. These data included the natural environment, social and economic conditions and the past research information.

3.2 A basic GIS and a Demonstration System for Xishuangbanna

Biosphere Reserve was established. The GIS could be used by the Reserve to demonstrate the basic database and information of Xishuangbanna and also the reserve, to help the management for Mengyang reserve in the nature conservation and sustainable development, to make the development plan for the reserve and local people. The GIS was used in the project research and focus on the following subjects.

3.3 Amomum research

Amomum villosum(Latin name) is a kind of herb planted under the rain forest, its fruit is used as an important medicine and food. It is one of the very important economic plants for the local people. After field investigation, analysis and information collection, the distribution information of Amomum in the Mengyang reserve of Xishuangbanna was got. This information included the distribution area, sites, slope, direction of the slope, and growth conditions of Amomum, etc. As an important economic source for local people by planting the Amomum villosum, with increase of the market need and its value, the planting area was enlarged in these years. The economic analysis was made on Amomum plantation and the market evaluation for Amomum development, the influence of market fluctuation on Amomum plantation and plantation policies. Through research on the increasing growth conditions of Amomum and continuing field study, a suitability map of Amomum growth in Mengyang and a detailed explanation was obtained. On the basis of the above, GIS was used to analyze the influence of Amomum plantation on the rain forest, the relationship between Amomum plantation and biodiversity conservation, the relationship between distribution of villages and Amomum , the relation between Amomum productivity and variety, habitat and planting technique. The management and development plan on the Amomum was conducted; this was a synthesis plan in considering nature conservation, species structure, and the best habitat of Amomum growth, economic benefit in the market and the local people's development.

3.4 Relation between traditional land and natural resource use and natural conservation and sustainable development. The management models and development of a land use plan in the Mengyang reserve.

3.4.1 Landscape map.
By the overlay of different environmental factor's maps, three different natural landscape types have been classified. This is the basis for the land use plan and other plans connected with sustainable development and conservation of the Reserve.

3.4.2 The location of the villages in Mengyang and the changes from 50's to 90's.
Through this map it reflected the tendency of the village movement from 50' to 90'. The research shown the change was happened because of the political policy, disease control, economic development(especially the tropical crops plantation), transportation and communication need.

3.4.3 Land use models of the villages.
Through the research of traditional land use and resources use of several minority villages in Mengyang, according to the relationship between population, economic and social development conditions and nature conservation, to evaluate the present patterns. Three major land use models were classified and in the village there were four different use models. The research shown that some models in the village was better for local sustainable development and was worth to be introduced to other part of Mengyang and Xishuangbanna.

3.4.4 Land use plan.
On the basis of ecological landscape map, by using GIS to overlay distribution maps of rare and endangered species and present land use map. From the ecological map and the biological sensitivity map through the determination of different sensitivity standards, and also in considering the requirement in the division of reserve function areas, a division map of the reserve function area was obtained. Through this research and also considering the present distribution of villages and lands of the local people in the reserve, a land use plan of the reserve was made according to the relationship of biodiversity conservation and sustainable development.

3.4.5 Tradition and nature conservation.
The evaluation of the relationship of traditional customs of local people and nature conservation, indigenous knowledge(IK) of some local people was made. Through the investigation and research of the productivity, life styles and traditional culture and customs, from the concept of a green culture to analyze and evaluate these forms and customs. The project was working to find a national root and tradition for local nature conservation and sustainable development, and the collision and change of modern social and economic environment to the minority nation's tradition. The research was made on Dai, Bulan and Jinuo people lived in Mengyang.

3.4.6 The influence of gender to the nature conservation
The research shown that the women would be more active in the nature conservation, but this activities were decided by the family and society position of the women, different ethnic people had some difference in this position and influence to the nature.

3.4.7 Population of the reserve and its relation with the nature conservation
Population increase in the reserve is the most serious problem to the nature conservation. The research has shown the reason of population increase, the relation of population and conservation and development, the proposal was provided to the reserve for the effective population control.

3.5 The distribution, population and management of the Asian elephant in Mengyang reserve of the Xishuangbanna Biosphere Reserve
The Asian elephant is one of the major protected wildlife in Xishuangbanna Biosphere Reserve. The largest population of the Asian elephant in China is in Mengyang reserve. The living conditions and activity pattern of the elephant is directly related to the conservation action and development of the Xishuangbanna Biosphere Reserve. Primary research on the distribution, population and basic activities of the elephant in Mengyang reserve have been made. The proposal for the managers of the reserve is made. This information would be the basis for the conservation and development strategy of the reserve by the use of GIS to analyze and make maps.

3.6 Joint research with the reserve managers to refine the former project results.
The final report of the former project has been provided to the reserve managers of the Xishuangbanna Biosphere Reserve. But in the supplement project it was needed to help the managers to understand the results and use the results to the daily management work.

The supplement project has been conducted for the refining the project results according to the practical needs of the managers and the accurate date and information. Radar image date from Parks Canada has been used to check the high point of the former maps and some revised work has been done on the maps. The new established database has been used to refine the research, and some district and manager collaboratively management plan have been added to the project and help the managers of the reserve in the management. The final recommendation is conducted for two times and one time in Xishuangbanna in May and another time in Kunming in September for the staffs from Yunnan Forestry Department and the managers from Yunnan Province.

4. Training
From the start of the project, training is one of the major contents of the project. The training included different level and subjects.
4.1 GIS Training
GIS is an information system using computer and taking spatial data as a basis. Using GIS is the most important part of the research work of the project. Four researchers from the institute and two from the Reserve have been trained on the use and establishment of GIS. Two of them have got the higher training in Beijing of China. The GIS should be used not only by the researchers from IEG, but also shall be used by the staffs from the reserve. The staffs from XBR have been trained in the former project. Two training course in the GIS use in the nature reserves and the reserve management have been held separately in Kunming and Xishuangbanna.

4.2 Basic Computer Knowledge Training
With the development of nature conservation, computer is used more and more wider in Xishuangbanna. Seven staff of the reserve have been trained on the use of computer and also the basis of GIS in Yunnan University in the year of 1996. They have been working on the establishment of the database in Xishuangbanna.

4.3 The training course for local people.
By the use of the research result of the project, and also connected with the management work of the reserve. The training course was held in February of 1997 in Mengyang. The participators were villagers and managers from five reserves.

4.4 PRA Training
At the start of the project, an investigation method training course was held by IDRC in Guiyang of China. Three researchers from IEG and XBR were trained on the Rural Rapid Appraisal(PRA) and Rural Participating Appraisal(RPA), these methods were used in the project research.

5. Seminar/workshop
5.1 Organizing the seminar
From 1994 to 1998, total six formal seminars were held in the process of the project. An international seminar has been held in Jinghong in November 1997. The title of the seminar is "biodiversity Conservation and Sustainable Development in the Biosphere Reserve ". Through this seminar, the researchers and conservation experts have exchanged and discussed the work and experiences in the biodiversity conservation and sustainable development in the reserves. The project have been summed up and evaluated in this seminar. The participators more than 80, and more than 30 of them came from 5 different countries. The project result was reported in the meeting and got good appraise.

5.2 Atended meetings
The project provided the chance for the researchers and managers to learn and to exchange experiences in the relevant areas from home and abroad. From 1994 to 1998, more than 25 persons participated the domestic and international seminars in other province of China. Two of the researchers have brought the results of the project to participate the international workshops held outside of China.

A seminar for the result dissemination was held in Beijing in 1999. The participators were from many reserves of China who are interested in the GIS use for the management project and also from the MAB Chinese Committee, through these workshops, the influence of the project will be more wider not only in China, but also abroad.

6. Visit and receive foreign visitors
In the begin and in the process of the project, we received many international visitors, especially the experts and officials from IDRC. The former Chairmen of IDRC and Director of IDRC Singapore Office have visited Yunnan in 1994, and paid attention on this project. Dr. Stephen Tyler, the coordinator of the project from IDRC has paid great attention to the project and often provided with corresponding materials and information on the GIS use and indigenous knowledge research in other part of the world.

Two experts from Parks Canada(Dr. David Welch and Mr. Jean Poitevin) as the senior advisors of the project visited project three times differently from 1994 to 1997. Some important proposals for the project were made by them are very valuable and which were accepted in the research work.

The project has funded the Chinese experts visit to Canada, the visit was helpful to the success of the project. Project experts has visited Laos and Vietnam by the help of IDRC. They visited nature reserves and research agencies in these two countries, exchanged the experiences and ideas in the nature conservation. It would be help the project results to be known by these reserves as they locate same area and faces some similar problems.

7. Publishing research finding
With the completion of the project, the research findings have be published. Four research paper collections have been published. A special issue about the project research was published in the Journal China's Biosphere Reserve in September 1996 in Chinese with English title, A supplement issue in Acta Botanica Yunnanica was published in 1997 in Chinese with English abstract, A special issue for the project in Applying Ecology was published in October 1997 in Chinese with English abstract. A paper collection titled "Biodiversity Conservation and Sustainable Development in the Biosphere Reserves" was published in Kunming in December 1998. This is the final work of the project. More than 15 papers from former IDRC supported project were in the book. More than 30 research papers have been published in Chinese and English in different academic publications, journals or meeting reports, some of these papers are in English.

Multimedia Demonstration System of Xishuangbanna Biosphere Reserve and GIS.The practical used GIS, demonstration system and management system has been finished and provided to the managers of Xishuangbanna Biosphere Reserve. The managers and also the local people can use this system to demonstrate the general document, photos and moving pictures of the Xishuangbanna, including natural, social and economic information, which can be used directly in the management of the reserve. The former projects, from database, land use plan, settlement research, Amomum plantation, elephant research and others have been put into the system and can be demonstrated. The system is in multiple-media form and in a CD plate. The major menu of the system is in both English and Chinese.

8. Summarizing the Results of the Projects
8.1 The management of the Reserve has been improved by the use of GIS and from the results of the project. Some of the proposal and suggestions were accepted by the reserve in the management.

8.2 A GIS(hardware, software and staffs) for the Xishuangbanna Biosphere Reserve, focus on the Mengyang reserve was established for the demonstration and practical management;

8.3 The local villagers from the project have got the training, they could use the knowledge from the training course to the practice, such as the land use pattern, Amomum plantation, and these will help them to understand the effect and relation of nature conservation and sustainable development.

8.4 Researchers from IEG and XBR got the training in GIS and also in some new technology. That will help them in the research work. Through the project, one doctor and three masters have got the degree, four of the researchers have been promoted.

8.5 Equipment including hardware and software, such as the car, the digitizer, the ARC/Info and ARC/VIEW software are the basis for the IEG and XBR in the project and also in future research. A biodiversity protection information center in Yunnan University has been established after the project, the ability to establish this center is relying on the project.

8.6 International connection was established and the experience from the project was got. This project as the start, the projects such as from UNESCO and from Provincial Government was approved.

9. Acknowledgment
The project speaks highly the support by Dr. David Welch and Mr. Jean Poitevin from Parks Canada. Especially in the first stage in the establishment of GIS, the tips from them were accepted and reference materials of GIS were useful for the researchers. Each time when they visited the project the report would be given for the project to consider the exacted problem and their experiences have helped the project a lot.

The success of the project is also du to the help of Dr. Stephen Tyler, the project official of IDRC, from begin to the end of the project, he provided with many useful help. The thanks is to Yunnan Science and Technology Committee, the committee provided the project with the fund from Chinese side. Thanks are to Mr. Zhang Hongqi from Ministry of Sciences and technology in Beijing.

I would like to thank Prof. Zhai Xianying, former secretary of C-MAB, she is the project leader and the person to proposal the project be caried out in Xishaungbanna Nature Reserve. Mr. Han Lianxian, the secretary of C-MAB, he is an excellent coordinator of the project. The thanks are to my colleagues in Institute of Ecology and Geobotany, Yunnan University, the managers from Xishuangbanna Nature Reserve. The hard work in the fields and in the door is the results of the project.

Bio-absorbent project Review

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Institute of Ecology, Nankai University

1. Project background

This project was developed according to the ten-year plan of "Biotechnology talents exchange and education" between Nankai University and Mitchell University of Canada. At first, Yaoting Yu went to Montreal University of Canada as a visiting scholar to the Artificial Cell and Organ Research Center in the beginning of 1980. During his study there, contacts and collaboration were initiated and developed between the two universities. After negotiation and discussion, an agreement on a ten-year (1984-1994) cooperation program on training--"Staff exchange and training in biotechnology" was formally developed between Nankai University and Mitchell University of Canada. The program was funded twice by CIDA of Canada with 1.5 million Canadian dollars. Professor Yu met many professors from many different departments and institutes and went to CIDA headquarter in Ottawa many times, consequently, he got to know that that Sino-Canada research cooperation can be funded by IDRC.

After meeting with Dr. Volesky of Chemical Industry Department of Mitchell University, both were interested in the use of bio-absorbent in protecting of environmental pollution caused by heavy metals. Thus, a joint application for support was made to IDRC by Dr. Volesky and to National Science committee by Professor Yu for a research cooperation. And finally the application was approved in 1994. The research project was titled "the use of one waste to treat another waste."

There were three collaborators:

(1). Professor Volesky, Chemical Industry Department of Mitchell University in Canada.

(2). Professor Yaoting Yu ,Molecular Biology Institute of Nankai University in China

(3). Professor Jianhua Wang, Sichuan University

2. Project implement

- Fund usage:

  Fund granted were 35.4 Canadian dollars in total

  Nankai University: 50 thousands CAD

Sichuan University: 52. thousands CAD

Canada: 252 thousands CAD

Fund allocation was decided IDRC with agreement by Volesky and IDRC but without agreement of Chinese collaborator, although Chinese collaborator expressed disagreement.

- No corresponding domestic fund from China
- Apparatus: Two automatic instruments for liquid analysis were provided by IDRC the rest equipments by China.
- Personnel training: A teacher from Sichuan University studied in the lab of Volesky as a visiting scholar and later changed to Ph. D study.

  In addition, Two 3-week study tours were conducted by 3 young faculty members and 2-3 Ph.D students and 3-4 master degree students were produced in the two Chinese Universities.
- Exchange of visits:

  Professor Volesky made short visits to Sichuan University and Nankai University as a visiting professor and 2 professors from Sichuan University and Nankai University made a visit to Mitchell University.
- Research team

  The research team involved 47 research staffs from the Chinese universities for a 2-year period of research..
- Scientific achievement:

Nine different waste hyphae, produced from medicine production, such as black root mould were used to absorb heavy metal, such as lead, copper and chromium. Among the above nine hyphae, black root mould can absorb the highest amount of different heavy metal and streptomycin hypha can absorb the highest amount of lead (q200=103mg/g). The absorbent capacity increases with temperature going up, pH value decreasing and content of particles decreasing. The rank of heavy metal absorption capacity was $Pb^{2+}>Cu^{2+}>Mn^{2+}>Cr^{2+}$. The highest quantity of lead absorption by black root mould at pH 2-4 was 88mg/g. The absorbing amount of black root mould can be increased after being treated by NaOH because NaOH can hydrolyze the phthaleined amino group in the structure of hypha. There are many kinds of metal ion in polluted water. Absorbing capacity of black root mould in the systems of Zn+Pb, Zn+Cn and Cu+Pb. Results showed that the effect of Zn and Cu on absorbing by fungus black root mould was small and the effect of Cu on hypha of streptomycin was large. In order to make practical use of the research on treatment of metak pollution by hypha, we conducted fixation study, ie. elimination of Pb in polluted water by hypha. Based on a series of experiments, it was found that the hypha buried by gelatin was better than the other carriers with respect of absorbing amount, strength and price. All data obtained laid a good foundation for future industrialization.

3. Assessment of the science research, economic and social effect

The dynamics and mechanisms of absorbing and eliminating different metal ion in polluted water by different fermented hyphae were introduced in the achievements with a series important data and results. Because of the limited time and fund, its industry application, that is the pilot test, was not studied. So till now, there was no practical economic benefit obtained yet. However, it was a very economic method to treat heavy metal pollution in wastewater. Its economic benefit was analyzed. Compared with all other methods, it was a novel one and the most economic one.

- Ecological benefit:

  Only a small part of medicine waste was used as fertilizer and the major part of it was released into the rivers, causing heavy water pollution, degrading water quality and to disrupting ecological equilibrium. Significant ecological benefits would be achieved with use of the method developed in this study.
- Social benefit:

  The occupational disease of workers poisoned by heavy metal, such as Pb, Cr, Mn and Cu, can be avoided by the research achievements, bringing substantial social benefit.
- A number of middle and senior technical staffs were trained through the project.
- Scientific and technique innovation:

  (1). The innovation was the use of bio-absorbent, the waste hypha in medicine production, in treatment of heavy-metal polluted water. Absorption of heavy metals of 10 kinds of hyphae and some alga were studied. Results showed that black root mould was the best for absorbing and eliminating the Pb ion in the water.

  (2). The study of disturbance of symbiosis of heavy metal ion showed that not obvious effect of Zn and Cu on the Pb ion absorption by black root mould.

  (3). Both physical and chemical effects were proven in the absorbing process and the latter has the main effect. The mechanism of chemical effect is ion exchange.

  (4). Dynamic study conforms the Langmiur formula of single layer absorption.

4. Assessment and suggestions on the project management by IDRC and the Ministry Science and technology

- Project application and approval

  Because of the demonstration and verification by experts, the application and approval were more scientific. But the time for this was too long.
- The fund usage:

  The fund allocation by IDRC was not so reasonable that only 1/3 of the total fund were gave to two units of China, who were in charge of the most work. A problem was that the fund allocation was determined only by Canadians without discussion with Chinese. The advantage of fund application was that the money was directly posted to cooperation.
- International exchange: Research results were exchanges in the middle phase of the study. After the lectures, the committees discuss the future research.
- Information management and exchange:

  Information exchanged was well done because that data and reports exchanged once half year and that papers and reports were reported to IDRC headquarter.
- Project coordination:

  There was only division of the work and no coordination because the three collaborators made studies independently.

5.Comparison the funding method between IDRC and CIDA

- Advantages and disadvantages are as follows:

  CIDA funding was managed better than IDRC. For example, there is one meeting between two partners to exchange the process and to solve the problems and to prepare for the next project.
- The openness of fund usage by CIDA is good, while that was decided only by Canada in IDRC.
- IDRC post the fund to cooperator, while CIDA control the money in Canada with China not seeing the fund. CIDA does not fund for science research, only supporting training. Most of the trained Chinese doctors are now abroad.

A Review on
"The Change of Urban Land Use and Spatial Patterns of Medium-Sized Cities in China"
(A Joint Research Project funded by IDRC of Canada)

Hu Zhaoliang

The Department of Urban and Environmental Science, Peking University

1. Background

In 1990, the dean of the Department of Geography of the University of Montreal, Prof. Peter Foggin came to the Department of Geography of Peking University for a one-year holiday. At that time he conferred with the dean Professor Hu Zhaoliang about applying for projects of IDRC along. After two year's efforts, the research project achieved ratification from Canadian and Chinese government. The dossier number is IDRC 91-1028, and Chinese National Science (foreign) sanction (92) 1854.

Initially, we had selected the following seven cities as samples: Xiainen, Wenzhou, Tai'an, Ma'anshan, Wuzhou, Yinchuan, Luzhou. Due to the limitation of time and funds, the actual work focused on Xiamen, Wenzhou and Ma'anshan.

We originally scheduled to fulfill the project in 24 months from 1991 to 1993. Since the sanction was obtained in late 1992, it was postponed for two years and was finished by the end of 1995. The results was published in October 1996.

2.The state of execution

The operation of the funds

The total amount of the project funds was 140 thousand Canadian dollars. Among it, 50100$ was allocated to Chinese side. All the funds were spent in researching.

Domestic complete set of funds

There were special domestic funds, however, the related cities such as Ma'anshan, Yinchuan, Wenzhou and so on also bore reception costs.

Equipment

During the process of research, we purchased French Spot satellite pictures (with a resolving power of IOX 10), two 386 computers, rent a no.0 drafting instrument. And we also used the equipment of the department.

Personnel training

This project achieved a lot in personnel training. It successfully trained: two doctors, one was Canadian, the other was Chinese; twelve masters, 4 were Canadian, 8 were Chinese. Most of the Chinese scholars went abroad to continue their study or work.

Exchange of experts

Two Canadian experts visited China:

(1) Prof. Peter Foggin investigated Xiainen, Wenzhou, Tai'an, Ma'anshan, Wuzhou, Yinchuan, Luzhou seven medium-sized cities respectively in 1992-1994.

(2) Prof. Claude Comtois (from the University of Montreal) led his students to investigate Ma'anshan in 1992.

Two Chinese experts visited Canadian:

Hu Zhaoliang and Sun Yinshe (from Peking University) investigated Montreal, Vancouver, Ottawa and several east U.S. cities.

Research staffs

The Chinese director of this project was Hu Zhaoliang, professor and dean of the Department of Geography of Peking University. The Canadian director was Peter Foggin, professor and dean of the Department of Geography of the University of Montreal.

Main technical director:

1.Wang Chao (Ph.D, Peking University and the University of Montreal)

2. Sun Yinshe (lecturer, Peking University)

3.Li B iao (lecturer, Peking University)

Cooperator:

1.Zhang Qin (section chief, the Planning Department of the Ministry of Construction)

2.Wang Yifang (bureau chief, urban planning bureau, Ma'anshan)

3.Shang Jianxin (capital planning committee)

4.Fan Zhaochang (city construction section, construction committee, Ningxia Autonomous Region)

Members:

Zhang Xiaodong, Chen Hong, Li Xinfeng, Zhang Zhiqiang, Li Xiangrong, Zeng Zanrong (masters, Peking University)

Consultants:

l.Qiu Weizhi (professor, Peking University)

2.Wang Enyong (professor, Peking University)

Research results

Two treatises:

l."Changing Spatial Patterns of Medium-Sized Cities in China (1980-1992)", China Environmental Science Press, 1996. 1 0.

2."Chinese Cities in the New Century", Taiwan Tangshan Press, 1996.12.

Seven thesis.

1. Hu Zhaoliang and Peter Foggin, "Gaige kaifang zhence yu chengshi fazhan" (The reform and open-door policy versus urban development). Urban Science. 1993, No.3: 33-37.
2. Hu Zhaoliang and Peter Foggin, "Chengshi xiandaihua sanyi" (Remarks on urban modernization). Guotu kaifa yu zhengzhi(Territorial Development and Management). 1993, No.3: 33-37.
3. Hu Zhaoliang and Wang Chao, "2020-Blueprint of China's Guangdong Megalopolis". Territorial Development and Management. 1993, No.4: 11-15
4. Hu Zhaoliang and Peter Foggin, "Daoqiang qianyuan . shangtian rudi . tianren heyi". Urban Science. 1993, No.5: 16-2 1.
5. S.Hu Zhaoliang and Peter Foggin, "Liangge tongji xilie zhongde chengshi renkou bijiao". Urban Problem. 1994, No. 1: 2-4.
6. Sun Yinshe, "Chengshi yingqu yu bianyuandai chengzhen fazhan". Urban Science. 1994, No.3: 42-46.
7. Hu Zhaoliang and Peter Foggin, "Beijign renkou de quanceng bianhua". Urban Problem. 1994, No.4: 42-45.

3. Evaluation of the scientific, economic and social benefits

The transformation and application of the scientific results

The results of this project can provide basis for urban planning and management, and enhance conciousness of them as well.

Social benefits

The main results were all published in English so it is easy for international comprehension of Chinese cities and convenient for exchanges between the Western and Eastern academia.

According to this project's results, Taiwan Tangshan press published "Chinese Cities in the New Century", which enhanced the understanding to the cities and the urban science in mainland of Taiwan academia.

Other benefits

The results were compiled into two textbooks, enriching the content of two courses-China Economic Geography and Urban Problems.

1. "China since open-door policy", China Environmental Science Press, 1996. Textbook for undergraduates.
2. "An outline of Chinese regional development", Peking University Press, 1999. Textbook for graduates.

Due to the substantial teaching content, Prof. Hu was chosen "the most popular teacher" in Peking University in 1998 by the students' union and was awarded Japanese Ahanzong excellent teacher praise.

Personnel training

This project achieved a lot in personnel training. It successfully trained two doctors and twelve masters. Among them, one doctor and four masters were Canadian. Most of the Chinese scholars went abroad to continue their study or work.

Meanwhile, there were four experts exchanging visits and improving understanding in each other.

After the project was finished, Canadian side sent students or students leaded by professors to China for academic exchanges and investigations four times.

Scientific innovation

The major achievement of this project was to seek the circular changing law of urban spatial patterns in China since the reform and open-door policy. This law worked obviously not only in large cities but also in medium-sized cities.

4.Evaluation and suggestion in project management to IDRC and the Ministry of Science and Technology

The declaration and approval of the project

The period for Chinese side to examine and approve the project was too long, lasting one and a half years or so. This was one of the reasons for the project to postponed two years.

The operation of the funds

At that time there was a dual exchange rate in China, that means, the University paid RMB in official rate while we purchased computers in market rate. There was a two-fold disparity between them. At the same time, the University deducted 25% of the funds, so the project experienced serious deficit. In the end, appropriating funds from other projects fulfilled the project. Because of the long duration and the deficit, the final result appraisal and reward application both encountered much difficulty.

Review of the IDRC Projects

Y. Qiu
Xi'an Jiaotong University

I was fortunate to get two projects financially supported by IDRC. One is Gas Insulated System (China) (3-p-84-1037-02), and the other is Gas-Insulated Transformer II---Utilization (93-1204-02). It has been 15 years since the first project was initiated in 1985. Over these years, the IDRC projects have greatly benefited the development of my research, and therefore we are indebted to International Development & Research Center of Canada.

1. Background

I was working as a visiting scholar at the University of Manitoba in Winnipeg on SF_6 Gas Insulation from January 1980 to January 1982. I selected this project myself, because in our country it was just beginning to develop the SF_6 Gas Insulated Apparatus at that time, and there was no institution taking systematic research on such kind of gas insulation. I selected SF_6 Gas Mixtures as my research emphasis for this was a new topic in the world, and there haven't much research outcomes. After two years' study, we got some important achievements. Five papers were published internationally, among which one was published in a first-class international journal. Therefore, my supervisor, Prof. E. Kuffel, asked me to prolong my visiting term in University of Manitoba. I explained to him that I must return to China as scheduled, and within a short time period it was impossible for me to do a long-term research there again. I suggested that the research be carried on mainly in China by way of international cooperation. One year later, he proposed that we apply a joint research project from IDRC, so that is the background of the first project.

Due to the important research findings achieved during the first project, Prof. E. Kuffel and I put forward the idea to IDRC for applying the second phase of the project in the year that the first project was just completed. However, there was a problem in the funds of that year, so the officer in charge of our project told us that there was little chance for the application to be approved. So we didn't apply again. It was 4 years later that we were informed that we could reapply for the project, but the emphasis must be put on the development of new products, and a market investigation report was necessary. After endeavoring for more than one year, the School of Management of Zhejiang University at the request of IDRC finished the market investigation report. Moreover, we found two manufacturers to be our new partners, and finally got the second project from IDRC.

We have an important experience on shooting for the funded projects, that is you should try all your best and don't give up in a hurry. When we applied for the first project, the project proposal, which was more than 20 pages, was modified for many times. It was really time consuming. Two professors in our university also wanted to apply for an IDRC project when they knew that I got the grant. But they soon gave up after they saw our research proposal. It was more difficult for the second application. Although the investigation of the market demand was done by another unit, but they were not familiar with the specialty, and had no idea of where to send their questionaries. Consequently, we also spent a lot of time and manpower to help them doing the work.

Relative to other fields, the industrial projects in China financially supported by IDRC are very few. Without our endeavor we couldn't have been supported twice. Of course, it was also due to the good reputation of Prof. E. Kuffel in Canada.

2. Performance

As these two projects are different in nature, they are reviewed separately.

2.1 Gas Insulated System (China) (3-p-84-1037-02)

The performing term of this project was from June 1,1985 to May 31, 1988. IDRC financed our university 180 thousand Canadian Dollars, and our university took the main facilities used in the research and personnel wages as the corresponding co-funding. The main apparatus and devices bought with the IDRC fund were a Tektronix 7934, 500 MHz Oscillograph (the price was 41 thousand US dollars); a PA (□□A) Galvanometry Instrument (10 thousand US dollars) and a personal computer (20 thousand RMB yuan). In the aspect of personnel's training, an associate professor and a lecturer were sent to the University of Manitoba for advanced studies for four months each person. The travelling expenses and the cost of living were paid by IDRC. On the other hand, Prof. E. Kuffel came to China to have a one week visit in 1986, exchanging the research findings with us. In addition, during the period of the projects, I myself three times went to University of Manitoba to carry out supplementary experiments, have discussions with Canadian colleagues, and finalize some journal papers. My visits to the University of Manitoba were in Nov. and Dec. of 1985, two months in the summer of 1987, and one month before the end of project in 1988, respectively. Due to the financial support of IDRC, my research group developed to consist of 5 professors and 2 postgraduates. During the period of our first IDRC project, we had more than 40 papers published, in which 31 papers were published internationally.

2.2 Gas-Insulated Transformer II---Utilization (93-1204-02)

This project was carried out from Sep.1994 to Feb.1996. Different from the first one, China had 4 institutions taking part in this project, i.e., Xi'an Jiaotong University, Tsinghua University, Beijing Second Transformer Factory and Hanzhong Transformer Factory. IDRC financed 125 thousand Canadian Dollars in all, in which two manufacturers received 30 thousand Canadian Dollars each, and two universities received a little more than 30 thousand Canadian Dollars each. The funds for the manufacturers were used to purchase apparatus, while the funds for the universities were used to do research. Since there was no factory manufacturing gas-insulated transformers in Canada we didn't arrange to send technicians for training there. In the end of the project, we arranged the principal research fellows of each unit (seven people from 4 units) to participate in the Canada Electrical Conference in 1996, reporting, introducing the products and visiting the Development & Research Center of Ontario Hydro. During this researching period, Prof. E. Kuffel, taking charge in this project on behalf of Canada, came to visit us twice. Once was to coordinate the researching schedule in the summer of 1995, and the second time was to participate in an evaluation meeting for two new products in the beginning of 1996. The IDRC officer in charge of the project and the head of Canada Electrical Union, J.A. Roiz, also came to visit us in the second time.

Through this project, a research group of Gas Insulation was formed in Tsinghua University, and the two manufacturers also enlarged their research and manufacture abilities. There were two achievements obtained in this project, SF_6/N_2 Gas-filled Transformer and F_6/Air Gas-filled Cubicle Type Switchgear. There already had been products of SF_6-filled transformer and cubicle type switchgear overseas, but using SF_6 gas mixtures as insulation hasn't been reported yet.

3. Project Benefit Evaluation

3.1 The First Project

The first project is of the nature of basic research. It has been proved that using SF_6 gas mixtures is technically feasible, and therefore it has the ecological and social benefits. It was not long after the first project was over, the greenhouse effect caused by SF_6 gas was discussed internationally, and many scientists proposed to use gas mixtures. A paper with the title "SF_6/N2 Mixtures. Basic and HV Insulation Properties" was published in a first class American journal in 1995. The author is Prof. L.G. Christophorou, very well-known for his research in the area of gas insulation. In his paper six of our papers resulting from the first project were cited. Thus it can be seen that our research is recognized by international academia. It was in Jan.1992, three years after the first project finished, IDRC awarded a certificate of merit to Xi'an Jiaotong University, and suggested we apply for the second phase.

Through this IDRC project, our research work has become well-known in the world. For instance, the author was appointed as Session Chairman of the Gas Dielectrics Session at the International High Voltage Symposium held in Germany in 1987. Thereafter the author was appointed as a member of the International Organizing Committee of the International Symposia on Gaseous Dielectrics. Soon after the first project finished, the author received research grant from Natural Science Foundation of China, and based on the achievements of the first project "the Method for Evaluating the Dielectric Strength of SF_6 Gas Mixtures" was awarded the Second Class Science & Technology Progress Award by Chinese National Education Commission in 1990.

3.2 The Second Project

The two new products developed during the second project should have good economic benefit. But because of the market circumstances recently, the manufacturers think that the time has not yet come for the products being commercialized. According to the international development trend, the time will come ultimately. For instance the national electric company in France, EDF together with ABB Corporation and Siemens Corporation began to develope SF_6/N_2 Gas-filled Transmission Lines not long after our second project was completed. They plan to decrease the content of SF_6 to about 30%. This new trend shows that our research orientation was right, but how to apply our research outcome to power apparatus may need further effort.

4. Suggestions for the Project Management of IDRC and Ministry of Science & Technology of China

We got firm support from the Ministry of Science & Technology, which was National Science & Technology Commission at that time, in the applications of the two projects. But the personnel change often influences the administration of our project, and actually no inspection was made by the Ministry to our project. Our university had the same problem. Only when they must report their work to the higher authorities, they will ask the project group for a summary or relevant data. Sometimes the Department of Science & Technology and the Foreign Affair Office asked for the same materials, and sometimes the materials were requested repeatedly just because the previous one had been lost. In the second project we had 4 participating institutions in China, and I was in charge of the coordination and was supported by all the people involved in the project so that the work went smoothly. Therefore, it will be more convenient to let the unit who is responsible for the project to do the coordination work, including the coordination between Canada and other units in China. To my viewpoint, what the principal researchers of the project need are mainly to be cared about and supported by their leaders. As an institution leader, he should show his concern to the project more often during the project period and not always ask for the reports afterwards. As for the concrete contact and coordination, the project coordinator can do it himself completely.

5. Comparison with the Financial Support from Other Countries

The author has been financially supported by British Royal Society in 1992, but the of the scale and term of the support could not be compared with IDRC projects. At that time I was in cooperation with University of Strathclyde in Glasgow, applying for a research project of smaller scale than that of the IDRC project. It was also financially supported by Natural Science Foundation of China and was carried out mainly in China. I did research in Britain for three months where Strathclyde University financed the research cost and Royal Society provided me with the living allowance of which the standard was lower than that offered by IDRC, but higher than that offered by British Council for the same purpose. The application is rather simple, and therefore it is quite advantageous for those small scale joint projects.

Appendix 1, Basic information of IDRC projects in China

IDRC #	Title	Year of Approval	Duration	Amount of grant (CAD)	Field	Location of implementing institution
730069	Gonadotropin (British Columbia)			15,375	Agriculture	Canada
810130	Bamboo (Phase I)	1982	82/04/01 to 89/07/31	241,400	Forestry	Zhejiang
810199	Wood Adhesives	1982	83/09/01 to 87/09/01	200,080	Forestry	Beijing
820037	Management of Information Centers-China		82/06/28 to 83/06/28	72,610	Information	Beijing
820121	Paulownia	1983	83/02/17 to86/02/17	323,640	Forestry	Beijing
820122	Training Program		82/00/00 to83/06/01	36,815	Education	Canada
820126	Demographic training workshop		82/00/00 to83/07/00	15,700	Social and economic sciences	USA
820144	Rapeseed	1983	83/02/17 to86/02/20	50,080	Agriculture	Hubei, Shanghai
820188	Vegetable (China)	1983		480,410	Agriculture	Tailand
821020	Issues in Chinese Education	1983	83/05/01 to 85/05/01	4,500	Social and economic sciences	Shanghai
821022	Marine Ecosystem Enclosed Experiment (MEEE),Phase I	1983	83/04/01 to 83/11/01	32,800	Environment	Shandong
830002	Cropping system (China)		83/01/01 to 87/12/31	424,400	Agriculture	Beijing
830116	In-depth fertility survey			200,000	Social and economic science	UK
830230	Training Program on Integrated Fish Farming	1984	84/02/13 to 86/02/13	105,000	Agriculture	Wuxi, Jiangsu
830329	Scoliosis	1985	85/05/30 to 87/05/30	179,790	Health care	Beijing
830341	Urban Household Energy Survey (China)		84/06/00 to 88/12/31	116,400	Energy	Beijing
831011	Induced Spawning	1983	84/01/01 to 86/12/31	129,900	Agriculture	Guangdong
831024	Leukopenia	1985	85/06/25 to 89/06/25	39,630	Health care	Sichuan
831025	Cytomegalovirus Infection (China / McMaster University)		85/06/12 to 87/06/12	103,070	Health care	Sichuan
831026	Marine Ecosystem Enclosed Experiment (MEEE) phase II	1984	84/06/01 to 87/05/31	473,400	Environment	Fujian (Xiamen)
840041	Regional Socio-economic Impacts of Export Processing Zones	1984	84/07/17 to 86/01/17	59,200	Social and economic sciences	Guangdong
840273		1985	85/05/10 to 90/05/18	206,000	Forestry	Guangdong
840287	Union Catalogue of Chinese Scientific and Technical Periodicals	1985	85/04/09 to 88/04/09	80,195	Information	Beijing
840291	Rural Energy Technology Assessment and Innovation Network	1985	85/05/27 to 87/05/27	40,250	Energy	Beijing
841022	Remote Sensing Research and Training With Digital Image Processing	1984	84/12/05 to 86/06/05	8,430	Information	Beijing
841027	Weather Radar	1985	85/02/14 to 88/02/14	204,090	Environment	Gansu (Lanzhou)
850023		1985	85/08/01 to 90/07/31	224,100	Forestry	Zhejiang
850026	Epidemiology training phase III			276,000	Health care	Canada
850065	Integrated Fish Farming	1985	85/11/07 to 88/11/07	290,100	Agriculture	Jiangsu
850107	Training: Integrated Fish Farming II	1985	86/04/27 to 88/04/27	222,000	Agriculture	Jiangsu (Wuxi)
850175	Information network on new and renewable energy resources and technologies for Asia and the Pacific (INNERTAP)		86/04/24 to 89/04/24	125,285	Information	Philipine
850233	Agricultural Information Services	1985	86/03/25to90/03/25	357,913	Agriculture	Beijing
850251	Fuelwood	1985	86/05/12to89/05/12	139,000	Forestry	Guangdong
850274	In-depth fertility survey		86/06/06to89/08/02	338,200	Social and economic sciences	Netherland
850313	Pre-Primary Education	1986	86/04/16 to 89/04/16	50,000	Social and economic sciences	Beijing
851011	Issues in Chinese Education (Phase II)	1985	85/09/01 to 87/08/31	9,150	Social and economic sciences	Shanghai
851047	Biological Control	1986	86/07/01 to 89/06/30	252,500	Agriculture	Beijing
851051	Fish Genetics Network	1985	86/05/01 to 89/04/30	100,400	Agriculture	Shanghai
860005	Training-Advanced Demographic Techniques		86/06/04 to 86/09/01	45,670	Social and Economic sciences	Canada
860009	Wood Utilization (China)		86/12/10 to 89/12/10	185,800	Forestry	Beijing

860037	Economic and Demographic Interactions	1986	86/10/28 to 89/10/28	111,300	Social and economic sciences	Beijing
860041	Training: Educational research in China		86/08/01 to 87/08/02	41,440	Education	Hongkong
860083	Pyrethroid Poisoning (China) - Phase I		87/01/24 to 89/01/24	104,680	Health care	Beijing
860121	Epidemiology of Diarrhea in Hefei	1986	86/12/02 to 88/12/02	97,945	Health care	anhui
860164	Paulownia II	1987	87/04/01 to 90/03/31	336,000	Forestry	Beijing
860169	Farm Forestry Training Program	1987	87/02/11 to 87/08/11	100,580	Forestry	Beijing 、jiangsu (Nanjing)
860194	Town Development	1987	87/03/01 to 88/11/30	252,644	Social and economic sciences	Beijing
860240	Paragonimiasis	1987	87/04/01 to 90/03/31	99,780	Health care	Beijing
860246	Wood Gasification	1987	87/04/13 to 90/04/13	225,800	Forestry	Jiangsu (Nanjing)
860248	Arboviral Encephalitis	1986	87/03/25 to 89/09/25	48,300	Health care	Shanghai
860330	Vocational Training in the Service Sector	1987	87/07/23 to 89/07/23	66,830	Social and economic sciences	Beijing
861007	Economic Legislation	1986	86/11/25 to 89/11/25	361,260	Social and economic sciences	Beijing
861013	Rural Non-agricultural Development in Jiangsu		86/09/05 to 89/12/01	45,100	Social and economic sciences	Jiangsu
861021	Soil Erosion	1986	86/11/4to89/11/4	39,460	Geology	Guangdong
861046	Rapeseed II	1987	87/04/01 to 90/03/31	433,600	Agriculture	Beijing 、Shanghai, Qinghai, Xinjiang
861049	Aphid Biocontrol	1987	87/04/01 to 90/03/31	51100	Agriculture	Beijing
870004	PVC Handpumps	1988	88/02/12 to 90/02/12	227,170	Energy	Beijing
870106	MINISIS Resource Center	1987	87/11/11 to 89/11/11	102,400	Information	Beijing
870113	Post-Harvest Systems	1987	87/12/14 to 89/12/14	100,100	Agriculture	浙江
870127	Bamboo Information Center	1987	87/12/17 to 90/12/17	140,195	Forestry	Beijing
870145	Regional Socioeconomic Impacts of Export Processing Zones (Phase II)	1987	87/11/27 to 88/11/27	24,185	Social and economic sciences	Guangdong
870237	Farming Systems Phase II	1988	88/04/01 to 91/03/31	444,600	Agriculture	Beijing
870249	Hepatitis B Immunization/Path (China)		88/08/31 to 92/08/31	334,525	Health care	Canada
870260	Acute Respiratory Infections	1988	88/07/06 to 91/07/06	123,220	Health care	Beijing
870314	Diffusion of Improved Biomass Stoves	1988	88/04/06 to 90/04/06	76,685	Energy	Beijing
870329	Paulownia - Dissemination of Research Results		88/07/15 to 91/01/15	49,500	Forestry	Beijing
871003	Harbour	1987	87/11/16to1989/11/16	130,790	Geology	Hainan
871028	Induced Spawning	1987	88/01/01 to 89/12/31	110,500	Agriculture	Guangdong
871029	Mariculture	1987	87/11/26 to 90/11/26	438,500	Agriculture	Guangdong
871041	Childhood Nutrition	1988	89/01/06 to 94/01/06	295,750	Health care	Guangdong
871042	Issues in Chinese Education III	1988	88/10/13 to 91/01/13	4,500	Social and economic sciences	Shanghai
880039	Tea Information Services	1988	88/05/20 to 91/05/20	203,255	Agriculture	Zhejiang
880064	Jojoba		88/10/12 to 90/10/12	73,810	Forestry	Yunnan
880093	Geographic Information System (GIS) - Dongting Lake	1988	88/10/13 to 91/10/13	213,050	Information	Beijing
880100	Bamboo Technology Utilization	1989	89/04/25 to 92/04/25	39,367	Forestry	Zhejiang
880123	Urban Energy Consumption and Air Pollution Network	1988	88/11/17 to 90/11/17	57,550	Energy	Beijing
880327	Indoor Air Pollution	1989	89/06/29 to 92/06/29	122,260	Environment	Shanghai
880329	Byssinosis	1989	89/05/31 to 92/10/31	100,700	Health care	Guangdong (Guangzhou)
880385	Childhood Diarrhoeal Disease	1989	89/05/09 to 91/05/09	72,620	Health care	Tianjin
881009	Written Languages of China	1988	88/07/27 to 90/07/27	25,000	Social and economic sciences	Beijing
881020	Earthquake Dam Safety	1988	88/12/01 to 91/11/30	206,170	Geology	Beijing
881026	Low-Cost Travel Modes in Ningbo	1989	89/04/26 to 91/05/26	86,250	Social and economic sciences	Zhejiang (Ninbo)
881041	Fire Resistance Evaluation for Housing	1989	89/03/30 to 92/03/30	108,380	Energy	Tianjin
881061	Seismic Micro-Zoning	1989	89/04/24 to 91/10/24	138,000	Geology	Beijing
890042	Regioinal development plan for Xinjiang (China)		89/06/10 to 91/04/13	130,000	Social and economic sciences	Xinjiang
890056	Internal Trade	1989	89/07/25 to 91/07/25	40,700	Social and	shanghai

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890077	Preliminary Scientific Research Plan for the Qomolangma Nature Reserve	1989	89/09/07 to 91/05/07	228,980	Environment	Tibet
890159	Determinants of Contraceptive Use and Effectiveness	1989	89/12/22 to 90/12/22	77,190	Health care	Jiangsu (Nanjing)
890173	Educational Strategy to Reduce Contraceptive Failure in Urban	1989	89/12/07 to 92/12/07	224,990	Health care	Shanghai
890206	Farm Forestry	1990	90/04/01 to 93/03/31	1,128,670	Forestry	Beijing
890239	Fish Nutrition	1990	90/02/08 to 93/02/08	172,500	Agriculture	Guangdong
890277	MINISIS Resource Center II	1990	90/04/01 to 92/03/31	93,790	Information	Beijing
890289	Pyrethroid Poisoning II	1990	90/09/11 to 92/09/11	80,742	Health care	Beijing
890325	Integrated Agricultural Development	1990	90/06/01 to 93/05/31	198,050	Agriculture	Guizhou
891013	Foreign Trade	1989	89/07/27 to 90/07/27	58,600	Social and economic sciences	Beijing
900074	Farm Forestry Training Program	1991	91/01/15 to 93/01/15	168,372	Forestry	Beijing
900229	Hepatitis C Epidemiology	1992	92/03/24 to 95/03/24	61,900	Health care	Shanghai
901009	Expansive Soils	1990	90/06/29 to 93/06/29	23,000	Energy	Beijing
901034	Integrated Fish Farming II	1991	91/01/01 to 93/12/31	574,700	Agriculture	Jiangsu (Wuxi)
901026	Written Languages of China - Ph II	1991	91/01/30 to 93/01/30	200,500	Social and economic sciences	Beijing
901027	Technology Import and Transfer	1991	91/05/07 to 94/05/07	114,790	Social and economic sciences	Jiangsu
910013	Epidemiologic Methods and Computer Applications Training Course	1991	91/04/11 to 91/10/11	29,988	Health care	Shanghai
910032	Environmental and Community Control of Dengue	1991	91/06/21 to 94/06/21	192,675	Health care	Hainan
910130	Rice Economy	1991	91/11/12 to 93/11/12	215,950	Agriculture	Zhejiang (Hangzhou)
910176	Macroinvertebrates	1991	91/11/12 to 93/11/12	99,830	Environment	Hubei (Wuhan)
910179	Reservoir Fisheries Research	1991	91/10/18 to 93/04/18	90,000	Agriculture	Hubei (Wuhan)
910226		1992	92/03/24 to 95/12/31	230,977	Enbironment	Beijing
910284	Rural Economic Survey: Hebei and Liaoning	1992	92/01/30 to 93/01/30	74,770	Social and economic sciences	Beijing
910285	Nutrition Survey Training	1992	92/10/07 to 93/12/07	62,104	Health care	Beijing
910294	Farm Forestry Training Center	1992	92/04/20 to 95/04/20	235,780	Forestry	Beijing
910308	MINISIS Resource Centre III	1992	92/04/01 to 95/03/31	199,950	Information	Beijing
911028	Growth and Change in Medium-Sized Cities	1992	92/01/01 to 93/12/31	50,100	Social and economic sciences	Beijing
911037	Rapeseed III	1992	92/04/01 to 95/03/31	283,860	Agriculture	Beijing
911045	Cooperative Development (Yunnan, China)	1992	92/04/08 to 93/10/08	48,117	Social and economic sciences	Yunnan
920401	Pre-primary Education II	1992	92/09/04 to 96/06/04	117,530	Social and economic sciences	Beijing
920814	Institutions in Support of Technical Change	1993	93/03/01 to 94/08/31	28,000	Social and economic sciences	Beijing
921008	Biosorbents: Use of One Waste Product to Clean Up Another	1992	92/09/18to 95/03/18	123,068	Environment	Tianjin, Sichuan (Chengdu)
921300	Enzyme-Enhanced Poultry Feeds	1992	92/07/28 to 95/07/28	350,000	Agriculture	Jiangsu (Nanjing)
928010	Sustainable Economic Development Research Group (South China)	1992	92/12/10 to 97/12/10	668,810	Social and economic sciences	Jiangsu (10 provinces)
928012	Sustainable Resource Utilization in Tarim Basin	1992	92/08/28 to 93/08/28	43,020	Environment	Xnjiang
928022	Environmental Education in China	1993	93/05/13 to 95/05/13	149,930	Environment	Beijing
931101	The Regional Development of Education	1993	93/12/01 to 96/12/01	46,468	Social and economic sciences	Beijing
931151	RADASAT Remote Sensing Technology	1994	93/10/22 to 96/10/22	82,800	Remote sensing	Beijing
931203	Research on the Paths and Policies of Improving the Indigenous Technological Innovation Capability and Getting Sustainable Development in China	1994	94/02/17 to 98/02/17	111,390	Social and economic sciences	Zhejiang (Hangzhou)
931204	Gas Insultated Transformer: II-Utilization	1994	94/05/06 to 95/11/06	125,440	Industry	Sannxi

						(Xian), Beijing
938004	Technology Innovation & Sustainable Development: SMEs in China	1993	93/07/12 to 95/07/12	150,000	Social and economic sciences	Zhejiang (Hangzhou)
938013	Yangtse River Carp Genetic Diversity	1993	93/12/01 to 95/03/01	99,000	Resource	Shanghai
938016	Preventive Strategies for Reducing the Risks of Death Due to Pneumonia in Children in Rural China	1993	93/12/21 to 95/12/21	80,864	Health care	Beijing
938021	Rural Household Survey in Northeast China	1994	94/03/17 to 97/03/17	94,315	Social and economic sciences	Hebei, Liaolin
938022	Prospective Mortality Study of Smoking and Other Risk Factors for Chronic Disease	1994	94/04/25 to 97/04/25	112,970	Health care	Beijing
940200	Cigarette consumption, production and taxiation policy (China)	1998	1998-9-8	66,800	Social and economic sciences	USA
941201	Technology Transfer of Canadian Small and Medium-sized Enterprises (SMEs) to China	1995	95/01/26 to 96/01/26	39,470	Social and economic sciences	Shanghai
944004	TIVE Environment planning (China) Pre-project meeting TOOLs	1994	94/04/05 to 95/03/31	15,857	Environment	Canada
944005	Preparation of the Propasal "Essentail oil/China"	1994	94/04/06 to 95/03/31	5,010	Resource	Canada
944014	Changjiang basin management/China-project development	1994	94/04/15 to 96/03/31	76,797	Environment	Canada
948004	Financing Rural Health Services	1994	94/09/08 to 97/09/08	279,120	Health care	Shanghai
945006	South China sea marine science working group		94/04/19 to 96/03/31	42,955	Resource	Canada
948007	Tarim Basin Desertification and Water Management	1994	94/11/01 to 97/11/01	307,750	Resource	Xinjiang
948011	Biodiversity Conservation and Sustainable Development in Xishuangbanna Biosphere Reserve	1994	94/11/01 to 97/11/01	329,656	Environment	Yunnan
948012	Community-Based Natural Resource Management In the Mountainous Area of Guizhou Province	1994	94/12/09 to 97/12/09	199,820	Resource	Guizhou
951301	Cooperative Development (Phase II)	1995	95/10/25 to 97/10/25	39,630	Social and economic sciences	Yunnan (Lijiang)
954900	An intemational review of China Science and technology reform polcies	1995	95/05/31 to 97/03/31	173,658	Management	Beijing
958004	CBRM - Reclaiming Degrading Land (CHINA)	1995	95/07/27 to 99/08/31	277,099	Forestry	Beijing
968008	A Chinese National Strategy for International Science & Cooperation			86,110	Management	Beijing
970225	Strengthening strategic planning in the health sector in China		97/07/22 to 2001/07/22	368,330	Health care	Beijing
971302	Leaving the good earth-The transformation of rural China	1997	98/03/27 to 2002/06/30	237,550	Social and economic sciences	Canada
975018	Workshop on participatory forest management: implication for policy and human resource development, Kuming 7-12 May 1998	1997	98/03/31 to 99/03/31	9,965	Forestry	Beijing
978009	CBNRM : Community-Based Natural Resource Management in the Mountainous Area of Guizhou Province China (Ph II)	1998	98/02/00to 2001/01/00	225,130	Resource	Guizhou (Guiyang)
978010	Distance education (China)-content, technological and business definitions	1997	98/02/11to 99/08/13	150,000	Information	Canada
978012	CBNRM-Tarim Basin Desertification and Water Management (Phase II)	1997	98/03/31to 2002/04/03	221,570	Environment	Xnjiang