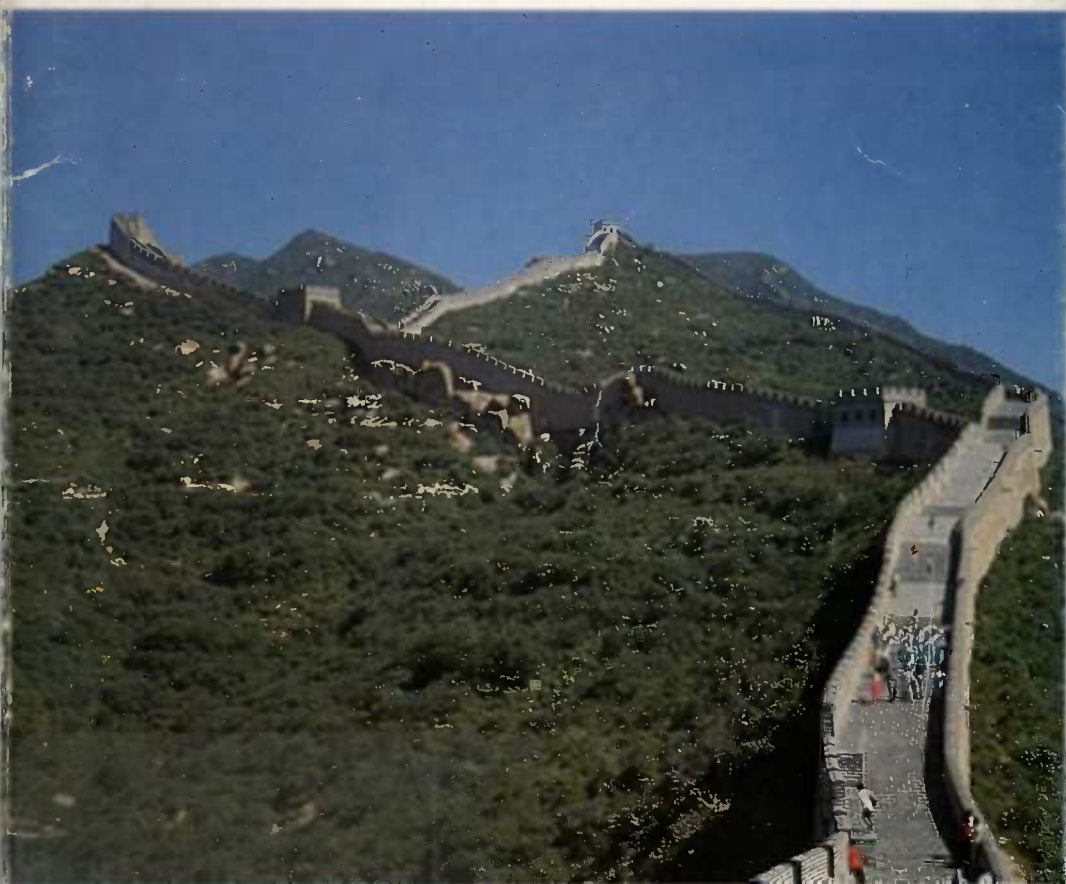


RURAL DEVELOPMENT AND SOCIAL FORESTRY

LESSONS FROM CHINA

N.G. Hegde



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Dedicated to

**Laxmibai and Ganapa Hegde,
My parents from whom I learnt my first
lessons of community development**

Narayan Hegde

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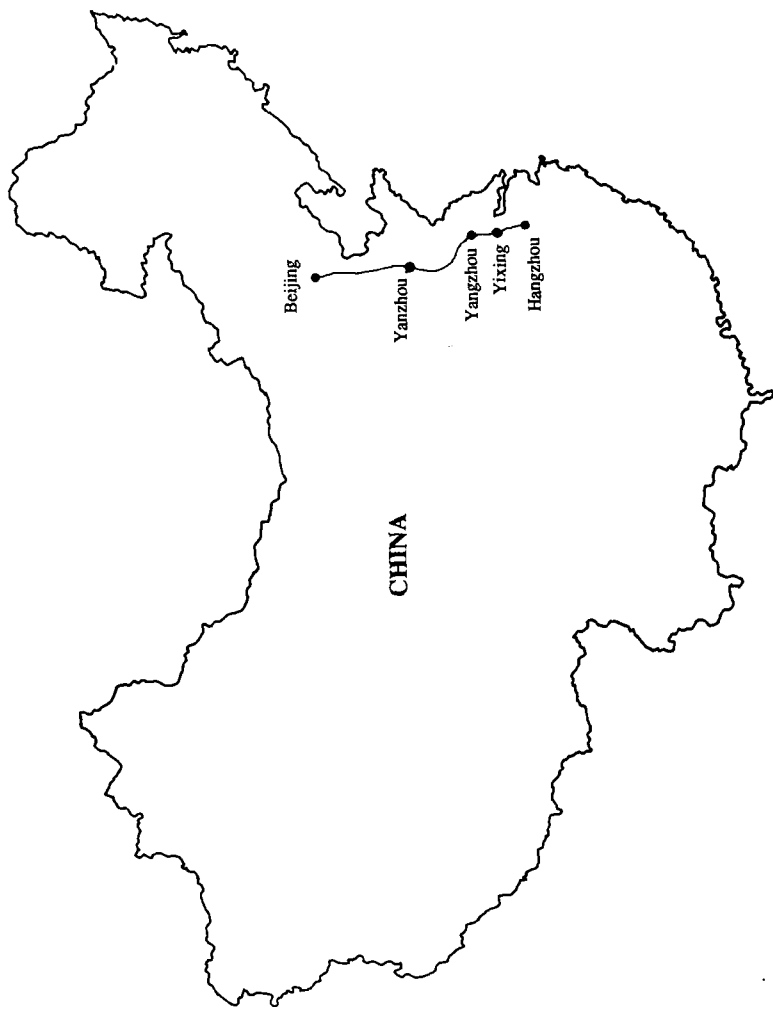
FOREWORD

I had a unique opportunity in 1988 to study the rural development and social forestry programmes in China. The trip involved rail and road journey covering 3500 km between Beijing and Hangzhou. This part of China is located in warm temperate to sub-tropical regions, well-advanced in agriculture and afforestation.

As a common Indian, I was ignorant about China, particularly the well managed programme of family planning, food production and industrial development. With this impression, I thought that some of the successful developments in rural China should be documented for the benefit of Indian farmers. I hope this book will be a source of motivation to adopt several useful programmes in India.

I am grateful to Dr. Manibhai Desai, President, BAIF, for providing me an opportunity to accompany him to China, and to the International Development Research Centre (IDRC), Ottawa, for the travel grant. I am thankful to Dr. Cherla B. Sastry, Senior Programme Officer, IDRC, and Chinese Academy of Forestry for organising this tour. I express my sincere thanks to Mr. Zhu Zhao Hua, Deputy Director of Chinese Academy of Forestry and the famous Paulownia Scientist, who was our host from Beijing, till our departure at Hangzhou, for all the trouble taken to educate me about rural China. My sincere thanks to the Council for Advancement of Peoples' Action and Rural Technology, New Delhi, for partially funding this publication. Many thanks to Mr. Vinayak Kelkar for providing me with some of the photographs taken by him and Mrs. Nalini Murlidhar, Mrs. Usha Hegde, Ms. Tinku Dhar and Mrs. Neema Bhujad for editorial assistance.

N.G. Hegde



Map of China

OUR GREAT NEIGHBOUR CHINA

China is unique in many ways. Today she has the largest population in the world, and the third largest in terms of area, next to USSR and Canada. Her 960 million hectares of land covers a length of 5500 km in north-south and 5000 km in east-west direction. India is quite close to China, both physically and culturally, but majority of the people in both these countries know very little about each other.

In general, China and India are put in one category, while grouping the nations on the basis of population and economic growth. Of course India claims her superiority in advancement of science and industries. But China supersedes India in agricultural production and overall



China -- our friendly neighbour

Table 1: LIVESTOCK POPULATION AND OTHER ECONOMIC INDICATORS IN DIFFERENT COUNTRIES

Details	INDIA	CHINA	USA	USSR	CANADA	WORLD
Cattle (M)	197.854	62.885	109.639	120.500	11.827	1264.621
Buffaloes & Camels (M)	74.533	20.134	-	0.570	-	153.004
Sheep & Goats (M)	153.383	159.019	12.194	149.436	0.779	1621.754
Total Livestock (M)	425.769	242.038	121.833	270.506	12.606	3039.379
(Av. of 1984-86)						
Human Population (1989)	813.4	1110.8	246.3	289.3	26.5	5162.4
Population Density/ 1000 ha (1989)	2736	1191	269	130	29	395
Total Land area (M ha)	328.726	932.641	916.660	2227.209	922.097	13078.873
Area under agriculture (Av 1983-85)	168.55	100.89	189.92	232.26	46.55	1474.99
Area under forest (M ha)	67.33	134.53	265.19	929.00	326.13	4081.90
Permanent pastures (M ha)	11.90	285.69	241.47	373.60	26.23	3159.85
Rural Population (% in 1990)	72.0	78.6	25.9	32.5	23.8	57.4
Av. Cereal crop yield kg/ha (1984-86)	1590	3891	4618	1625	2299	2552
Fertilizer use (kg/ha in 83-85)	43	176	101	102	49	86
Area under irrigation (% of total in 1984-86)	26	44	10	9	2	15
Net trade in milk products (T) (1984-86)	-47580	-86454	+259831	-259562	+167005	-

M - Million. Source: World Resource Institute -- World Resources -- 1988-89

economic development, as shown in Table 1. Lower population density only 43% of that in India, higher food crop yields by 150% and better management of natural resources have helped China in building economic stability in rural areas. It is only in China, that the rural people have higher per capita income compared to that of the people living in cities. People are generally conservative and do not like to interfere in political and international issues. But at the time of crisis, when they need to assert, they do so in large numbers, with great force and generally do not like to look back. Revolution is not new in China and every time a large number of people have sacrificed their lives. The Chinese in general, like to work quietly and probably do not respond favourably to frequent changes, but when they decide to adopt a new system or technology, the change is massive and almost total.

Rice is the staple food in China. Fish, frogs, snails, ducks and pork are the major sources of animal protein. Steamed white bread is a popular snack for breakfast in certain urban parts of China. The Chinese eat this with respect and love because it was the major source of food provided to people at the work camps, during the cultural revolution. Consumption of milk is insignificant. The Chinese are known for their hospitality. Their meal consists of a variety of dishes, ranging from four to forty delicacies depending on the status of the guests and the occasion. Many people believe that tasting a new dish would add one more day to life.



The famous Tian'anmen Square

Mushroom, Soyabean curd and bamboo shoots are the vegetarian delicacies. Soup marks the end of the meal whereas a meal starts with soup outside China, even in Chinese restaurants.

One of the most significant habits in China is not to drink raw water without boiling. This was probably introduced with the green tea. People, even in villages, drink green tea without milk and sugar, which is inexpensive. Therefore, people keep hot water readily available in thermos flasks. Since hot green tea is a substitute for water, many of the water-borne diseases are under control. Hot water is provided in thermos even in the railway compartments. On the contrary, the daily practice in Indian villages is to use hot water for bathing and raw water for drinking. Any attempt to reverse this practice can bring down the incidences of water-borne diseases. Wells are the main source of drinking water in interior areas.

Rural Energy

Although China tops the world in tapping hydraulic resources to generate 680 million kw electricity, the power has not reached many rural households. The point to be noted here is whether it is the right policy.

In India, we want to achieve distinction by electrifying all the villages in the states. But in reality, the government would have spent millions of rupees to develop the infrastructure and appoint the manpower to operate the rural energy distribution. However, with all these expenses, the energy supply in rural areas, remains frequently interrupted, undependable and uneconomical, while the metropolitan cities like Delhi, Madras and Bangalore are facing power shortage and load shedding. Why can't we plan the distribution, based on the availability and develop alternative sources of energy particularly for rural areas which can be economical and dependable. This remains a matter of political decision.

Coal is the major source of cooking energy in villages. China has established an excellent coal distribution network with processing facilities in rural areas. Generally the coal powder is distributed to village industries, where it is converted into round bricks suited for the standard size stove (Chulha). Such coal powder bricks burn uniformly with minimum smoke and dust pollution without wastage. Briquetting is done in villages itself, as a component of the rural industry. Wood is another important source of fuel in rural areas.

Housing

Providing housing for the growing population is a major task in China. In large cities like Beijing, more than 90% of the families live in government-owned apartments. The area provided is generally small and the rent is highly subsidized. Only recently, the government has liberalised the housing policy to allow the public who can afford to buy flats, built by the government. However, most of the officials working for the government cannot afford to buy houses in the cities. In rural areas, almost all the farmers have built their own houses. In the past, the houses were of mud walls and thatched roofs, but after the policy reforms in 1979, increased farm income has enabled them to build new houses with brick walls and tiled roofs. The Government does not give any subsidy or direct help to the villagers to build their houses.

To control the housing and other problems in cities, the government has banned the migration of rural people to big cities. It is necessary for a new family to obtain a permit before moving to large cities. In cities like Beijing, the Government has built guest houses and hotels for the visitors from other cities and villages, who come for official business and sight seeing. Such hotels have a dual tariff for the local guests and foreigners.

Family Planning

Birth control is another important programme, being enforced more



Government owned apartments at Beijing

effectively in cities. It is necessary for eligible couples to take written permission of the government before they get married. Permission is also needed before they desire to have a child and permission is not granted to have a second child, particularly in cities. Breaking this rule can subject the family to serious economic hardships, as the government will withhold salary increments and several concessions available for the family. People in cities follow the policy of having only one child very rigidly. But in rural areas, farmers have serious objections towards this policy, as they need additional manpower to carry out agricultural operations. It seems the government's attitude is mild in this regard.

Living

Life in China is much better in rural areas, as compared to that of cities. The salary structure is such that the earning of an average farmer is atleast 2.5 times more than a professor or a middle level officer in the government.

The bicycle is the most popular mode of transport, followed by the government-owned bus transport system. In Beijing city, an estimated number of six million bicycles run every day. Motorcycles have been introduced recently, but the number is very small, because of high cost and government restrictions on the sale of fuel. The vehicle owners, including government departments, get coupons for limited quantity of



Spacious houses in villages



... Firm on single-child family

petrol every month and with great difficulty, they can buy coupons for additional quantity at a higher cost. Government-owned petrol pumps are few in numbers and operate only during office hours. It is difficult for individuals to afford a car. The government imports cars for official use and to lease for taxi service for the tourists.



Popular mode of transport -- the bicycle

REVOLUTIONS AND POLICY REFORMS

Revolutions and reforms which have occurred in China from time to time have greatly influenced the life style and improved the economic status of the people, although millions of countrymen had to sacrifice their lives. In 1949, the 'Great Cultural Revolution' led by the Chairman Mao Tse Tung gave equal status to men and women. All were made to dress alike - in trousers and shirts and share the work equally in community farming. This was in the beginning, when every member of the family got an opportunity to work at an ensured wage or food. At this time, bans were imposed on religious and cultural celebrations and people were forced to spend their time in working for the community.

In 1967-68, another cultural revolution took place under the leadership of Chairman Mao against the bureaucracy in the government. People agitated against the government officers and the leadership directed the officials to close their offices and move to the villages to help people in improving their productivity. This revolution lasted for 2-3 years when most of the officials stayed in the villages to understand the village problems and started searching for suitable solutions. The Chinese believe that this has helped agricultural and forestry scientists to a great extent to understand the problems of managing the natural resources. After this revolution, scientists were able to introduce appropriate technology which helped in boosting agricultural production.



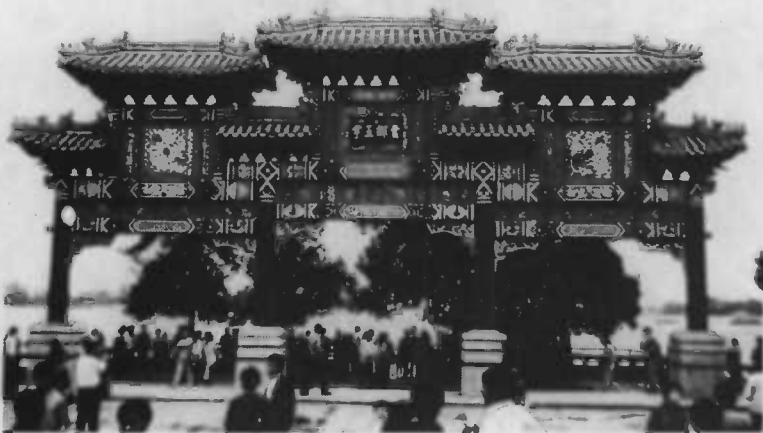
Equal status for men & women -- even clothing

Uniform crop stands, superior crop varieties, well managed irrigation systems and optimum use of chemical fertilizers are the symbols of transfer of technology at the grass root level in China.

Another important revolution was in the farm policy reforms in 1979, which was more peaceful than the previous revolutions. This reform was in support of open policy and individual management of the community resources. After this reform, the Chinese government decided to lease the agricultural lands among the villagers for management. A share of the land was taken back by the authority after the demise of any family member and an additional piece was given after the birth of a baby.

Of course there are many villages where the farmers are continuing the old system of community farming voluntarily and share the benefits proportionately. This was the beginning of a great economic revolution in rural areas. With individual land ownership, people started working hard and produced more to increase the profitability.

As a result, farmers living in villages are better off than the elite, living in cities in China. After the change in the policy, the Chinese government has allowed private housing, industrialization with foreign collaboration, participation in cultural activities and promotion of tourism.



New policy -- a gateway to Chinese culture

With the tight economic policies and controlled industrial growth, China was so far able to control inflation and maintain a balance between the rural producer and the urban consumer. With the expansion of the industrial production through private sector and outside investment, it is yet to be seen as to how this balance can be maintained, with a close check on the inflation. Today the productivity and economy of China are strongly rural-based and it is indeed a pleasure to see the cheerful faces of the rural folk who are able to speak on equal terms with the urban elite and government officials.

Many ideal lessons of rural development and forestry from China are certainly worth testing in other developing countries.

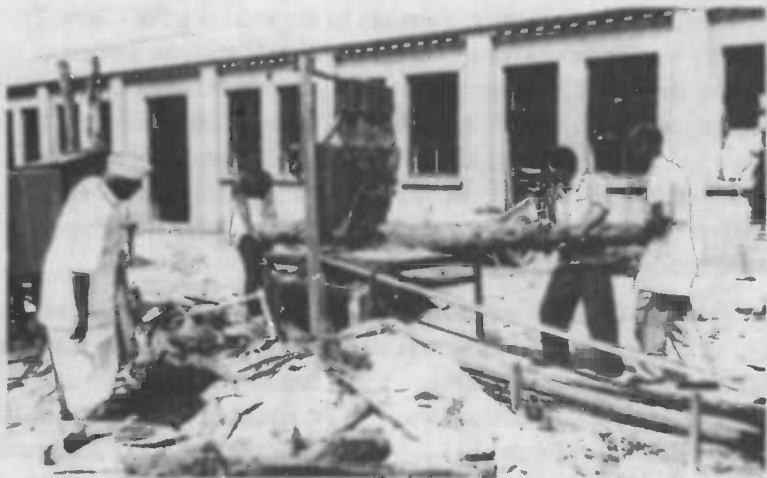


Transfer of technology -- a success story

RESOURCE MANAGEMENT

RURAL INDUSTRIES

While agriculture is the major source of income and employment, small scale rural industries promoted by the government are playing a significant role to create additional employment and income for the villages. The income generated from such industries is used for carrying out development activities. The village administration is controlled by a manager, who is appointed by the Communist Party, from the party cadre. He administers the village activities, including the industries, and serves as the link between the Party and people. In most of the villages, about 10% of the land is set aside for industrial development.



Small scale rural industry -- a unique feature of rural China

Once the production unit is established, the facilities are auctioned to individuals for management. The villagers bid for it and the highest bidder is offered by the management. Generally, fresh bidding is made once in 2-3 years and the persons who have a good reputation in managing the business will be given preference for operation.

Some of the industrial units popular in rural China are:

- * Printing
- * Food Processing
- * Livestock farm
- * Poultry and Fishery
- * Animal feed production
- * Lamp bulbs and tubes
- * Wood processing
- * Agricultural implements and spare parts.
- * Printing press

A committee set up by the villagers, looks after the needs and scope of the industry and takes suitable decisions. In most of the villages, the surplus from the industry has been the main source for the development of infrastructure and common facilities for the villagers.

WATER MANAGEMENT AND FLOOD CONTROL

Efficient water management seems to be the ancient art of China. This country has the record for creating an artificial canal, the longest of its kind in the world, running into 1800 kilometers between Beijing and Hangzhou, known as the 'Grand Canal'. This canal was built about 1500 years ago, to meet several objectives such as irrigation for agricultural fields, control of floods, promotion of water transport and fishery. The concept of joining the Ganges and Kaveri rivers in India is quite small in comparison to the 'Grand Canal Project'.

Frequent floods in major rivers were controlled in a similar way in China. The Yellow river, which is 5000 km long, was once responsible for eroding 1600 tonnes of soil every year and the river bed was rising by 10 cm every year. In certain locations, the river bed had risen by 8-10 metres above the ground and the river was changing its course quite frequently. Therefore it was known as the 'River of Sorrow' for millions

of people living on its banks. As part of the flood control measures, several canals were dug to divert the river water for irrigation. Hong Chi canal is one of the largest canals on the Yellow river. To prevent soil erosion, tree plantation has been carried out systematically with species like *Metasequoia glyptostroboides* and *Populus tomentosa*. Along the slopy edge of the bank, a bushy legume, *Amorpha fruticosa* has been established.

On a site near Yang Zhou, a plantation of *Metasequoia* planted in 1973, at 2 x 3 m spacing, had attained 18 m height with a DBH of 16 cm. In 1983, after ten years, the first thinning was carried out to retain 60% of the trees. The second thinning will be carried out at the age of 18 years and the final felling will be done probably when the remaining trees reach an age of 25 years. The yield from the first thinning was about 15 cubic m/ha and at the time of visit, these 15 year-old plantations were carrying a biomass of about 120 cubic m/ha.

AGRICULTURE

Chinese farmers make best use of the available water resources for growing multiple crops. They have adopted flood irrigation, using pumpsets or a variety of hand tools to lift water from the canal. They grow two crops in a year.



Water management -- an ancient Chinese culture

Rice is the staple crop in China. This is followed by wheat, soyabean, maize, pulses, groundnut, sesameum, etc. The cropping intensity of the area under agriculture is more than 100%, with an average annual production of 3891 kg of food grains per hectare as compared to 1590 kg in India. Mixed farming in China is popular and this fits in very well with the intensive agriculture by the hard working rural families. After harvesting food crops, ducks are let in the field to pick the fallen grains. Thus wastage is almost nil.

Every person in the farming family irrespective of age and educational status, is committed to hard work in the field, from dawn to dusk, always with a cheerful face. It is very difficult to see any barren land during the cropping seasons, even to the extent that cultivation starts from the embankment of the road itself. Cattle, buffaloes and horses are the main sources of farm-energy. It is quite common to see the ploughing being carried out by a pair consisting of a horse and a buffalo. Often, a



An effective control of soil erosion



Canal bank plantation

member of the family substitutes for an animal in carrying the farming operations as is the practice in India. Tractors are quite common in rural areas, mostly for transportation.

Farmers have to sell a portion of their production to the government at a fixed price and the rest can be sold in the open market.

China has certainly the supremacy as far as crop production is concerned. The government plays a major role in the supply of superior



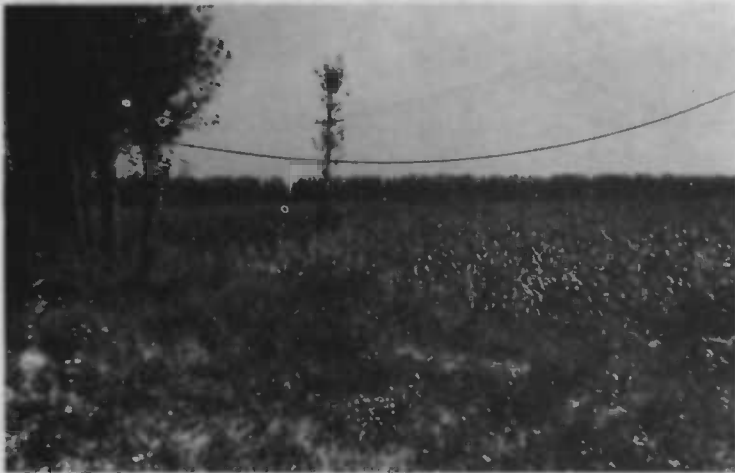
Cropping starts where the road ends

quality seeds of improved varieties, fertilizers and pesticides, followed by field visits of the agricultural extension staff to advise the farmers. Chinese schools declare vacation during the crop sowing and harvesting seasons, particularly for paddy crop. This facilitates the children to help their parents. The annual income of an average agricultural family has increased from Y 1500 in 1967 to Y 15,000 in 1987 (Y.1 = Rs. 4), which has been attributed to the policy reforms.

A TYPICAL VILLAGE IN CHINA: TA LANG FA

Like thousands of other villages in China, Ta Lang Fa has a population of 1600 in an area of 260 ha. Out of this, 140 ha are under agriculture and about 100 ha wastelands are used for various purposes. The main crops grown in the village are corn, wheat and water-melon.

In the year 1950, wheat and corn were grown with an average yield of 750 kg per ha. However, after the policy reforms in 1979, several improvements have taken place. The crop yields have now gone up to 6 t/ha. The land available in the village was equally distributed among all the villagers on lease basis. As per the terms of the lease, villagers cannot sell the land allotted to them but can sub-let to others. The annual land rent is around 5% of the average crop yields, which is waived during the years of crop failure. In most of the villages, the average land available per



Shelterbelt plantation -- after the policy reforms

head is around 0.2 to 0.4 ha. Some of the important reasons for the increase in the crop yield over a period of 20 years were:

- * individual ownership;
- * better shaping of land;
- * high yielding varieties;
- * fertilizer use; and
- * availability of irrigation facilities.

While shaping the land, entire agricultural fields were divided into blocks of 20-30 ha each, surrounded by roads. A shelterbelt of 2- rows of trees was established between the roads and field. The major tree species used for such plantation in this village was *Populus tomentosa*. Different tree species used for shelterbelt in other parts of China were:

Populus euroamericana (Hybrid poplar)

Paulownia tomentosa (Paulownia)

Paulownia elongata (Paulownia)

Robinia pseudoacacia (Black Locust)

Casuarina equisetifolia (Casuarina)

Texodium distichum (Texodium)

Cunninghamia lanceolata (Chinese Fur)



Tress bring prosperity to the village

The planting of saplings was carried out by the government. These trees have been established with 100% success and looked after very well by the farmers who have their land adjacent to the trees.

On about 30 ha of wastelands, poplar trees have been established. Turkey farming is being tried with 400 birds in the interspace. These birds are supplemented with only 35% of the normal feeds. Two women or children can take care of 400 birds and earn a monthly wage of Y. 100. This experiment is still under observation and the profitability is not yet known.

The village administration has also set up a few small scale industries which are operated on contract by the managers with a profit margin of about 30% of the turnover.

Adjacent to this village, a forest park has been established on 110 ha sandy wasteland, by planting Robinia and other tree species at a distance of 5 x 4 m.

EXPERIMENT IN ECOLOGICAL FARMING

Liumi Ying is a small village with a total area of 160 ha and 912 people, located 50 km away from Beijing in Ting Shen province. It has recently received the "Ecological Environment Award" from the United Nations for successfully demonstrating the recycling of village wastes for increasing the productivity of the village resources.



Ecological farming has transformed Liumi Ying

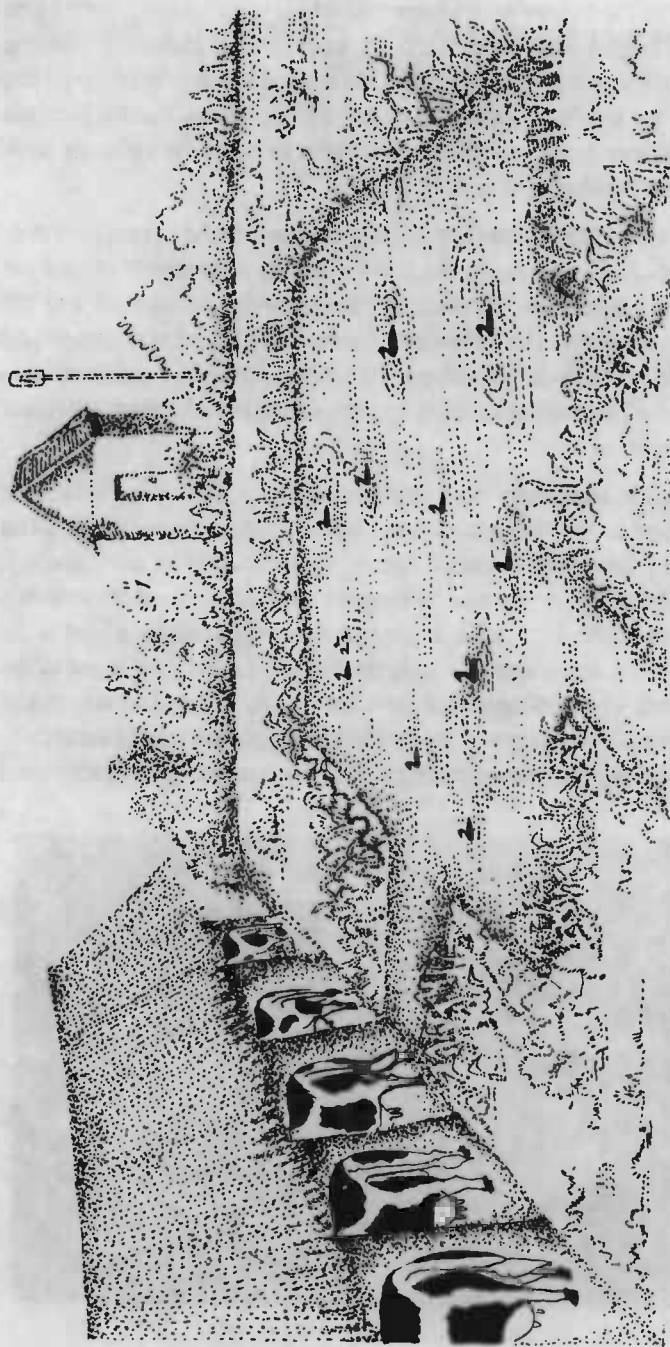
In 1950, food crops such as rice and wheat were yielding only 2 t/ha and the villagers were earning a daily wage of Y.1. However, with the increase in the cost of agricultural inputs and reduction in the crop yields, the wage rate fell down gradually to Y. 0.1 in the 1970s. Further increase in the fertilizer doses was neither beneficial to boost the yield nor were the farmers capable of investing in it.

They also realised that crop production alone could not support their livelihood. At this stage, in the late 1970s, the department helped the villagers to initiate an experiment on ecological agriculture and the farmers were advised to follow environmentally sound agricultural and household practices in the village. To facilitate this, farmers decided to continue the community farming system, instead of adopting individual management.

Livestock husbandry was introduced as an additional source of income, both at the community level and individual homesteads. 10 ha was allotted to set up livestock farms, which included cattle, poultry, ducks and fishery. A community biogas plant having fixed dome with a capacity to produce 25 cubic m gas/day was supported by a herd of 50 Holstein cows, maintained for milk production. Liumi Ying is one of the few villages where villagers consume fresh milk. The biogas was stored in additional floating type of holders and used for cooking in community kitchen, which also runs a restaurant. The digested slurry was partly used



Ducks peck at the fallen grains



Ducks for Sewage Treatment



Fixed dome biogas -- a part of the composite farming

to feed the fish ponds, spread over 3 ha and the remaining portion was carried in tankers to apply to the agricultural fields. Near the biogas plant, where the digested slurry was allowed to flow with a part of the sewage water, a duck farm has been set up, to make best use of this wastage. Duck farming, to reduce the time required for purification of sewage water, can be a viable activity in rural and semi-urban areas.



Biogas slurry to enrich fish ponds

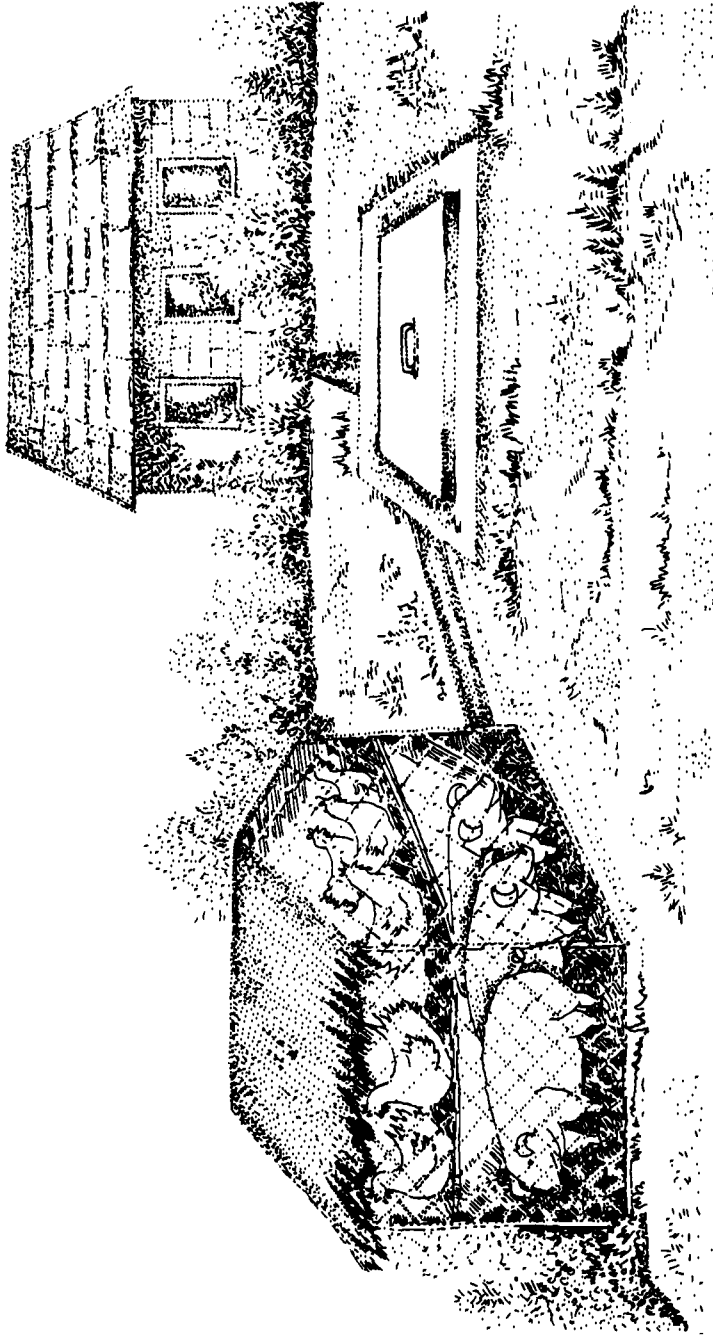
In addition to the slurry, fish ponds were fortified with chicken manure and other feeds. Several varieties of fishes were maintained in the pond, which grew on a variety of feeds, such as dung, poultry manure, water weeds and other feeds. Desilting of the fish ponds as well as the biogas plant was carried out once in 2 years and the silt was used as manure for crop production.

One of the important reasons for the successful operation of the community biogas plant was the management of both livestock farm and the gas unit by the same establishment, as an industry. With this concept, it is worthwhile considering management of biogas plants in India by private agencies with necessary support from the government to meet the initial establishment. The unit can purchase cowdung from the farmers and sell gas and manure under the supervision of the government.

Apart from the community farms, individual families were also maintaining livestock and poultry in their backyards. A two-tier cage was built to house 4-6 poultry birds on the top and 1-2 pigs on the ground. Some of the families had also maintained 1-2 goats for meat. The poultry droppings, which fell on the ground was consumed by the pigs. Excreta of the pigs was let into a small fixed dome type biogas plant of about 200 litre capacity. This gas was used for cooking food and most of the families had solar heaters to heat water for bath. Solar cookers were also introduced in the recent past, but are not in use, mostly because the



Goats -- an additional source of income



Efficient recycling of Bioenergy

cooking with biogas was more convenient. All these facilities were provided by the village administration out of the surplus, from smallscale industrial establishments. The income from livestock industry and agriculture had risen significantly over a period of 5 - 6 years. The livestock unit produces 17000 poultry layers, 35,000 broilers 1,15,000 ducks, 150 parent stock of pigs, 1,00,000 litres of milk from 60 milking cows and 20,000 kg fish every year.

The annual crop yields of this village have crossed 6 t/ha. Liumi Ying is now self sufficient in all respects and sells 900 tonnes of surplus food grains to the government. The contribution of various sectors to the income of the village community is as below:

Sources	Contribution (%)
Agriculture	20
Small scale Industries	30
Livestock and Poultry	38
Horticulture, forestry and others	12
	100

Out of the 240 families in the village, atleast 10% have an annual income of Y. 10000 and an average per capita income of over Y 2600 per year. The villagers worked on various projects and the wages were based on the skills. In 1987-88, the lowest wage paid was Y. 8 while the skilled workers earned upto Y. 14 per day. Despite this rise in wages, there were adequate savings with the village administration to subsidise TV sets and construction of new houses.

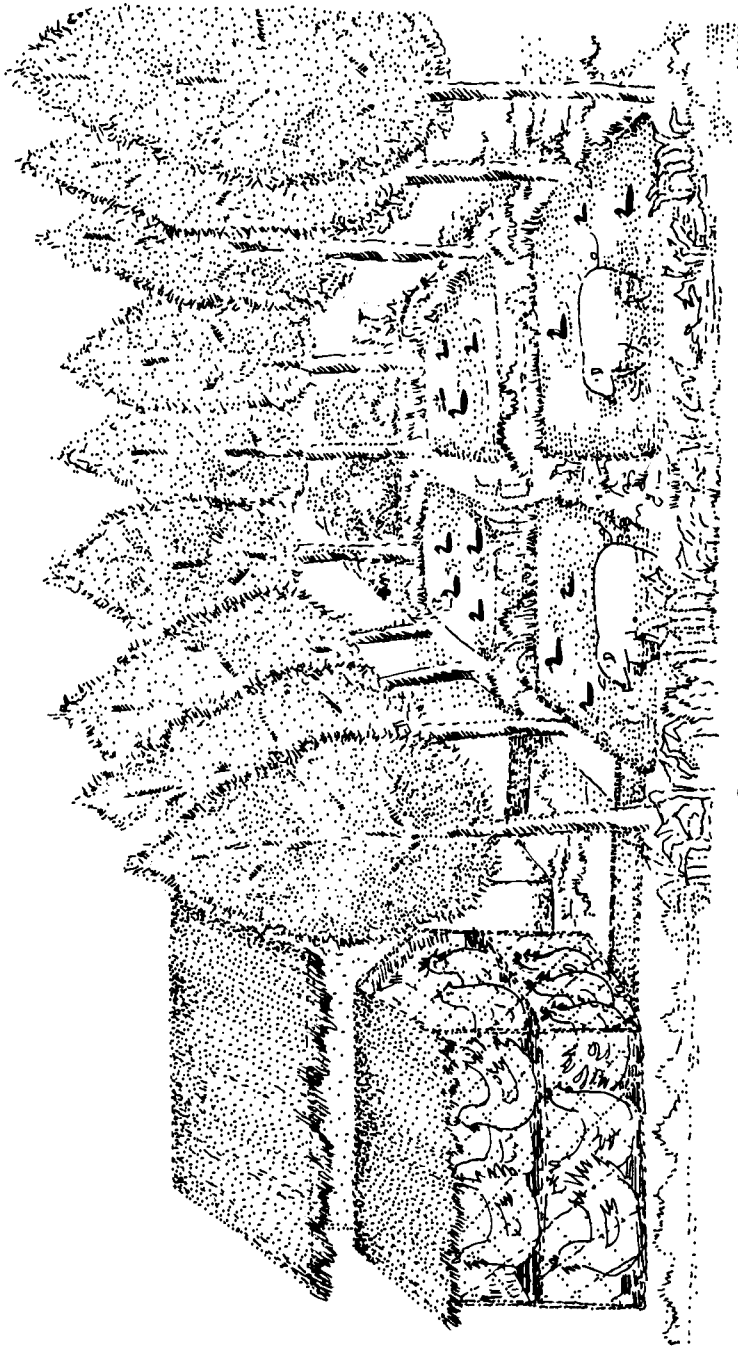
Tree planting has been undertaken on a massive scale, along the roads, canals and on field bunds. A community nursery raises seedlings of useful trees for distribution.

Income generation from tree plantations will start during the next 3-4 years, which will further enrich the community.

Thus Liumi Ying has successfully demonstrated the 'Ecological Farming Model' and this is one of the wealthy villages in China.

RECLAMATION OF A QUARRY

In Wang Pe village a tile factory is in operation, under the village administration. This factory was collecting clay from a nearby plot and



Optimum use of Wastelands

over a period of few years, all the available clay was taken away, converting about 20 ha area into deep pits and sand heaps. Since then, this quarry has been responsible for environmental pollution in many ways. Observing this area, Mr. Sin, a progressive farmer of the neighbouring village decided to bring this land under mixed farming. He got this land under lease from the local government and borrowed Y.600,000 from a bank to develop this field. About 11.3 ha area covered under water in the form of pits was converted into fish ponds. Sand heaps were levelled and developed into agricultural fields. An apple orchard was established over 8 ha and the interspace was used for growing food and fodder crops.

In 6-7 years, a livestock farm with 50 cattle and 200 pigs was established and the preparations were in progress to establish a poultry farm. Mr. Sin was feeding sweet potatoes to pigs and poultry while the foliage was fed to cattle. The poultry manure was an additional feed supplement for pigs. The pig manure and cow dung were fed to the fish ponds. The silt from the fish ponds was removed every year and used as manure for crop production. The pigs were brought to the fish pond, during the warm part of the day to provide favourable conditions, needed to maintain steady their performance.

Poplar trees were grown on the pond bunds to increase the income and to keep the pond water cool. Paulownia and poplars were planted on field bunds as shelter belts. Thus the available resources were utilised to the maximum extent, on a sustainable basis. This project has provided year round employment for 50 persons and improved the micro-climate in the village. Mr. Sin hopes to repay the loan within a short period. It is an unusual case in China, where an individual farmer has come forward to take a bank loan to enter into a new business. The project has been an eye-opener for the farmers and government officials in the region.

SALINE SOIL RECLAMATION IN MING CHENG COUNTY

Soil salinity was the major problem affecting the agricultural production and rural employment in Ming Cheng County till last 15 - 20 years. This area received only 600 mm rainfall and in the absence of irrigation, crop production was not remunerative. During those days, the farmers of this area were going to the cities for begging and searching for wages, after sowing their fields in the rainy season. They returned for harvesting the crop, if anything had grown. They again went back to the towns, if the

crop yields were not adequate to feed their family. After the reformation in agriculture in the 1960s, a multipronged approach was adopted by the government to improve the land productivity of this area and today a great transformation has taken place, with the conversion of salty fields into orchards of apple, pear, jujube (ber) and grapes. Agricultural fields, once barren, now produce 2-3 tonnes of peanut and wheat per ha every year.

The reclamation of saline soils was carried out through the following steps:

1. Digging of open trenches to facilitate better sub-surface drainage;
2. Cultivation of green manure crops;
3. Cultivation of Tamarix and other salt loving bushes for fodder and fuel purposes;
4. Growing salt tolerant crops like cotton;
5. Digging open wells to pump water for irrigating the fields;
6. Growing tree species like Salix, Melia, which can tolerate salt.

Amorpha fruticosa, a leguminous shrub was introduced along the drainage channel to prevent soil erosion and produce fodder and fuel. After reclaiming the soil, Paulownia was introduced in the fields, where the moisture availability was better. In sandy fields, where ground water



Jujube for saline soil reclamation

resource was poor, *Ziziphus jujuba* (ber) was planted, spaced at 10 x 3 m. Farmers generally grew groundnut and wheat in the interspace. As the trees prevented the wind velocity, crop yields were better, even without any irrigation. Ber fruits were harvested and sun-dried for exporting as dry berries. Looking now at this prosperous area, it is difficult to imagine the poverty which existed in this county two decades ago.

SERICULTURE

In the sub-tropical regions of China, mulberry plantations have been established along the water canals and the leaves are individually picked for feeding silk worm. Generally five crops, each of 28 days duration are taken in a year. Quality of the spring crop is better and fetches Y. 17.5 per kg while the other crops fetch only Y. 11.5 per kg. Silk worm rearing is a cottage industry in this part of China.

Maintaining 27°C in the shade and keeping the larvae free from diseases are the two critical factors affecting the silk production. China has mastery over the processing and printing of silk, to retain their supremacy in the world market.

MUSHROOM PRODUCTION

Mushroom can be produced not only under controlled conditions, but also in bamboo plantations, on bamboo wastes. It is a delicacy as well



Mulberry on canal banks to support Sericulture

as a nutritious food item, which may contain 19 different types of amino acids. Before the liberation, mushroom in China was consumed only by the emperors. Now, it is exported on a large scale and also used in Chinese medicine for treating high blood pressure, cancer and weight reduction. Certain mushrooms work as antifungal agents and are used for treating certain diseases.

Dried mushrooms of *Dictyophora indusiatae* fetch US \$ 1200/kg in the international market. This is grown on bamboo wastes such as dried roots and shoots in addition to other materials like sugarcane waste, sawdust, etc. This material is made moist and the culture is sprinkled to facilitate the fungal growth. The red tip of this mushroom is poisonous and should therefore be removed before drying or direct consumption. In Southern China, a large number of farmers are engaged in bamboo based mushroom production.



Mushrooms in Bamboo plantations

FORESTRY RESEARCH AND DEVELOPMENT IN CHINA

RESEARCH AND DEVELOPMENT

The forestry research and development programmes which receive top priority in China are being implemented through a three tier system. At the national level, basic and applied research programmes are conducted through the universities and forestry research organisations under the Chinese Academy of Forestry. At the province level, the development research is being carried out and the forestry extension work is undertaken at the county level.

Chinese Academy of Forestry (CAF)

CAF was established in 1958, which now has set up a wide research network throughout the country, and the following Regional and Scientific Institutes:

1. Research Institute of Forestry, Beijing;
2. Research Institute of Wood Industry, Beijing;
3. Research Institute for Resource Information Services, Beijing;
4. Research Institute of Scientific & Technology Information (Library), Beijing;
5. Research Institute for Forestry Economics, Beijing;
6. Forestry Analysis Centre (Technical Services);
7. Research Institute of Chemical Processing, Nanking;
8. Research Institute of Resource Insects;
9. Research Institute of Subtropical Forestry, Niyang;
10. Research Institute of Tropical Forestry, GuangZhou;

11. Experimental Bureaus-
in Mangolia desert, for Sand Fixation;
in Tein Shin, for Subtropical Experimental Trials;
in Dhai Shin Tan for tropical forest trials.

Aims of Afforestation Programmes

All the research activities are coordinated by CAF, and the development and field extension programmes have been undertaken by the Department of Forestry. While implementing afforestation programme the government has kept several social objectives, and some of them worth mentioning are:

- * Farm land shelter belts to control soil and water erosion;
- * Supply of wood and medicinal herbs;
- * Economic development of mountain areas;
- * Protection and preservation of native fauna and flora;
- * Supply of 50 million cubic meters of round wood per year;
- * Creation of rural employment;
- * Developing recreational environment; and
- * Forest produce to meet international trade.

The fifth National People's Congress in March 1984 adopted the resolution on carrying out Voluntary People's Afforestation Campaign and March 12 was declared as the 'National Tree Planting Day'. As part of the afforestation drive, the Chinese Government encourages farmers to set up family tree farms or collective tree farms.

In 1949, the forest cover in China was only 8.6% of the total land area. Since 1978, a series of policy changes have been introduced and about 800 million farmers have been involved in the development of forests. During the period of 1949-81, 27 M hectares were brought under forest cover to raise the area under the forest cover to 12%. Of 115.28 M ha forest area, 97.847 M ha are classified as closed forests, while the other area falls under open forests.

During the period from 1978 to 84, 20 M ha of barren hills were allotted to 50 M farmer families for private cultivation and 50.67 M ha of barren hills were contracted to farmers for planting trees.

In the course of this afforestation drive, 175000 collective forestry

farms have been set up with a total area of 16.667 M ha. In addition to this, 4065 state forestry farms with a total area of 46 M ha. have been developed. After 1978, 4.67 M ha of hilly areas were brought under afforestation through arial seedling. During the last 40 years, on an average 0.87 M ha were brought under afforestation every year and a target has been set to double it. In 1983 alone, 5.8 M ha were planted. The break up of the area under different type of forestry is given in Table 2.

Table 2: Area Under Different Types of Forests in China

Type of Forest	Area covered million (M) ha	Percent of the total Forest
Protective Forest	10.00	9.1
Timber Forest	80.63	73.2
Fuel Forest	3.69	3.4
Forest for special uses	1.30	1.2
Economic Forest	11.28	10.2
Bamboo Forest	3.20	2.9
Total	115.28	100.0

While the annual requirement of wood in China is 100 M cubic m, about 50% is used as domestic fuel. It is estimated that about 0.5 M ha forests are cleared every year. As a forest conservation measure, China has started importing logs from Canada and United States to meet a part of their timber requirement.

AGROFORESTRY

Since 1950, the Chinese Government has started establishing shelterbelts in the western part of North-East China and the efforts are being continued to cover the entire country. So far 40% of the farm lands have been covered under agroforestry.

The benefits of shelterbelts were:

- * Reduction in wind speed by 20%;
- * Drop in surface water evaporation by 10-20%;
- * Rise in relative humidity by 5-10%;

- * Prolonged frost free period and reduction in frost damage;
- * Increase in crop yields;
- * Conversion of deserts into agricultural fields.

In northern China, the species used for shelterbelt on 6 M ha are Poplar and willow. On most of the areas, I-1214 variety of poplar has been planted. This was introduced from Italy. Other species used for shelterbelt were *Populus tomentosa* -- which grows slowly in the beginning, but makes good quality timber, and *Populus euroamericana* a hybrid suitable for cold region. In addition, several species of Paulownia, Casuarina and Pinus were used for establishing shelterbelts, along the sea coast.

While implementing a new programme or promoting new technology, the Department of Forestry invites village leaders for demonstration and seminars and the benefits are highlighted. This is further followed by training of village level technicians, which will help to implement the programme effectively.

In most of the counties, the Forest Department has set up farmers' training units, where the seedlings of forestry species are raised for selling to the villagers. Price fixed for these seedlings will meet the cost of maintaining the nursery. The species selected for raising the nursery are based on the recommendations made by the Chinese Academy of Forestry.



Poplars -- an important tree for agroforestry



Roadside trees owned by farmers

Road Side Planting In Cities

China has undertaken an intensive programme of avenue plantation both in urban and rural areas. However, their selection of tree species is confined to a few fast growing species. In Beijing, the following species were extensively used for avenue plantation, along the major roads.



Urban forestry -- an effort to green the cities

Populus tomentosa: Poplar is the widely used tree species on avenues in central part of China. This grows straight without many side branches and reaches a height of 15-18 m in 4-5 years. In recent years, *Populus euroamericana* has replaced this species, because of faster rate of growth.

Paulownia tomentosa: Small size leaves, lighter coloured bark and slightly slow in growth.

Paulownia elongata: broad leaves, dark bark, grows faster than *Paulownia tomentosa*. Three year old trees have attained 6 m height with 10 cm DBH.

Ginkgo biloba: This is an important avenue tree in Beijing, grows straight with clear bole. Ginkgo belongs to the family *Pinaceae* and the only living fossil. It is a dioecious species and hence both male and female trees are required to be planted for production of fruits. Kernels are edible and also have medicinal value. It is one of the expensive food items in China.

Sophora japonica: commonly known as Chinese locust has dark narrow leaflets. The pods are long lobular type. Its flowering season is spread over two months, with pleasant fragrance.

Robinia pseudoacacia: known as Black Locust, is planted to grow into trees or to develop into umbrella shaped bushes and livehedge in rural areas. Trees flower profusely, during the spring.

Salix babylonica: Commonly known as weeping willow is another important avenue tree, particularly in water-logged areas.

Latines orientalis: known as 'Chinar' in India, it is one of the important trees, which grows quite large in size, though the rate of growth is slow. After the introduction of superior quality poplars, Chinar is becoming less popular. This species is grown mostly in southern parts of China.

Melia azedarach: A native species, known as China berry grows naturally without any effort in rural areas but this has been totally neglected, as other species grow faster.

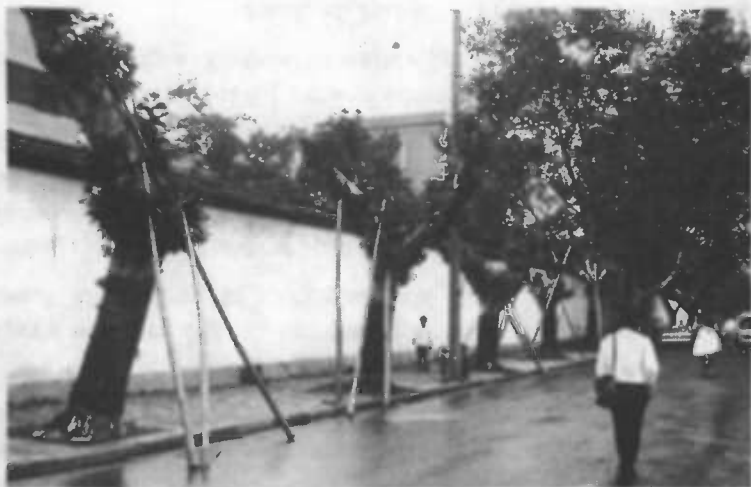
Chinese Furr (*Cunninghamia lanceolata*), Pine (*Pinus massoniana*) and *Metasequoia glyptostroboides* are the other species grown on roadsides, particularly in the subtropical region. *Populus euroamericana* is good for subtropical wet areas. *Pinus massoniana* is commonly used for

stabilizing sand dunes in tropical regions. African Mahogany (*Khaya senegalensis*) is a fast growing timber species, introduced in the tropical region long back.

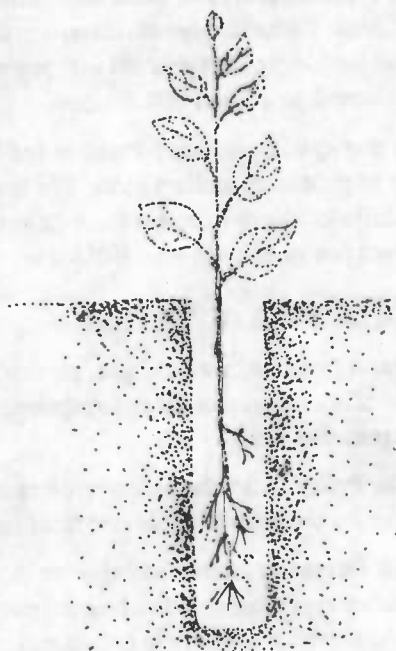
China has taken great care to maintain trees in both rural and urban areas. In 1978, a cyclone uprooted more than 40,000 in Hang Zhou city and the city administration successfully resettled almost all the trees. While replanting, the side branches were removed and the main trunk was covered with paddy straw rope to prevent the damage while pulling the trees to the original possession. Then the trees were propped with 2.3 bamboos to provide support, till need roots had established. It is very difficult to cite such examples in India. Certainly it is a challenge for our tree lovers.

Farm Forestry

Certain areas which are not suitable for agriculture are being brought under farm forestry. Some of the species grown under farm forestry in warm temperate region are -- Poplars (*P. tomentosa*, *P. euroamericana*) at 4 x 5 m spacing, *Paulownia tomentosa*, and *P. fortunei* at 5 x 6 m, *Metasequoia*, *Robinia*, *Ulmus changi*, *Catalpa bungii*, *Salix* and pine at 2 x 2 m and Chinese Furr, planted at 1 x 2 m spacing. For waterlogged areas *Taxodium distichum* is most widely used by planting at 2 x 3 m. *Tamarix chinensis* is a bush, grown in salty field for soil reclamation.



Resettling of uprooted trees -- cost no bars



Deep planting of Poplars



Roadside trees -- benefits shared by farmers

Deep Planting Technique for Poplars

To establish poplars in areas having low water table, a new technique has been developed in China. Under this system about 2 m deep pits are dug by drilling and poplar seedlings of one year old with pruned roots but with complete stem are planted, at a depth of 1.2-1.5 m.

While adopting this system, it is important to see that the species selected are capable of producing axillary roots. The new roots develop all along the soil profile to absorb nutrients from different layers of the soil, while the tap root can go deep in search of water.

SUCCESS IN PEOPLE'S PARTICIPATION

People's forestry was a great success in China, particularly during the last 10 years. Some of the important factors responsible for people's participation in afforestation were:

1. **Change In the Policy:** After the policy reforms in 1979, farmers were able to enjoy the income generated from tree plantations.
2. **Training and Demonstration:** Intensive training and demonstrations about various models and techniques were conducted by the Chinese Academy of Forestry in collaboration with Forestry Bureau in rural areas. Seedlings of outstanding provenances of different tree species were raised and distributed among the farmers at a nominal cost.
3. **Marketing Arrangement:** Good marketing networks were established, mostly through cooperatives to procure the produce from the growers at a remunerative price.

Famous Roadside Plantation at Shew Ying village

The roadside plantation programme was launched for the first time in China by planting trees in this village in Ta Shin county by the former President and Secretary General on the National Tree Planting Day in 1979. Saplings of *Populus tomentosa* and *Salix* were planted at 3 x 3 m spacing. Irrigation, fertilizer application and intercultivation were carried out, and protection from sheep was provided during the first three years. Sheep and goats are now allowed to graze in the plantation. At the end of 9 years poplars have attained a DBH of 16 cm, with an average height of 12-15 m. Compared to poplars, salix was slow, both in height and DBH.

SU SHEN COUNTY: TOP IN AGROFORESTRY

Su Shen county was recently honoured by the Forestry Bureau for its outstanding performance in adopting agroforestry and afforestation in China. The county, spread over 2700 km has 150,000 ha farmland with 1.6 million population. Out of this, about 20,000 ha have been brought under agroforestry with Paulownia. In addition, about 17% of the total land area has been brought under afforestation with Paulownia, Poplars and Robinia species. Before introducing Paulownia, some of the native species grown by the farmers were *Melia azedarach*, *Ailanthus altissima*, Ulmus and poplars. Now with new fast growing varieties of poplars and paulownias, old species have been neglected by both foresters and farmers.

This area receives about 800 mm rainfall spread from July to September with temperature ranging from 18°C to 39°C, with 240 frost free days. About 30% of the agricultural fields receive irrigation from canals and wells. With this, more than 200% cropping intensity has been achieved by the farmers. Corn, cotton, soyabean, wheat and tobacco are the main crops with an average annual production of 7 t/ha.

The afforestation programme was popularised in 4 stages: In the first stage one km long tree rows were established in east-west direction to reduce the wind velocity. During the second stage, intercropping with agricultural crops was introduced and it was further intensified during the third stage. During the fourth stage, block forest plantations were promoted on less productive areas.

Since 1979, the Government initiated several schemes to attract the farmers to take up afforestation, particularly under the agroforestry systems.

In Ning Ming county, about 18,000 ha barren sandy fields were brought under agricultural production, after establishing shelterbelts with *Fraxinus chinensis*, a bushy species, spaced 1 m apart distance within rows at an interval of 10 - 20 m. These hedges have helped in soil and moisture conservation, by reducing the wind velocity and enriched the soil by adding litter. The twigs of these bushes were used for making baskets and farm tool handles. The bushes were cut once in 3 years. This interspace was now used for growing soyabean, groundnut and wheat, with an annual production of 4 t/ha. Wax insects can be reared on *Fraxinus* bushes.



Soil erosion control by Fraxinus bushes



AFFORESTATION IN WATER-LOGGING AREAS

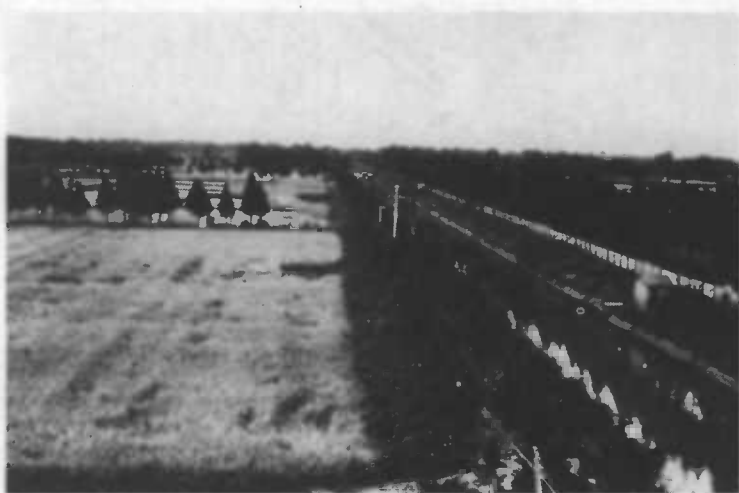
In Yang Zhou, the Forestry Bureau has demonstrated the reclamation of waterlogged areas through afforestation, using *Texodium distichum* species. The seedlings planted in 1976-77 spaced at 2 x 3 m, now after 12 years have reached a height of 15 m (maximum height 19.5 m) with a DBH of 16.6 cm (maximum DBH 30 cm).

In deep neutral clay soils, with water-logging conditions for over 6-7 months during the year, performance of *Texodium* was superior to *Salix babylonica* (weeping willow) and *Metasequoia glyptostroboides*. *Salix* is often attacked by insects, although it can establish very well under waterlogged conditions.

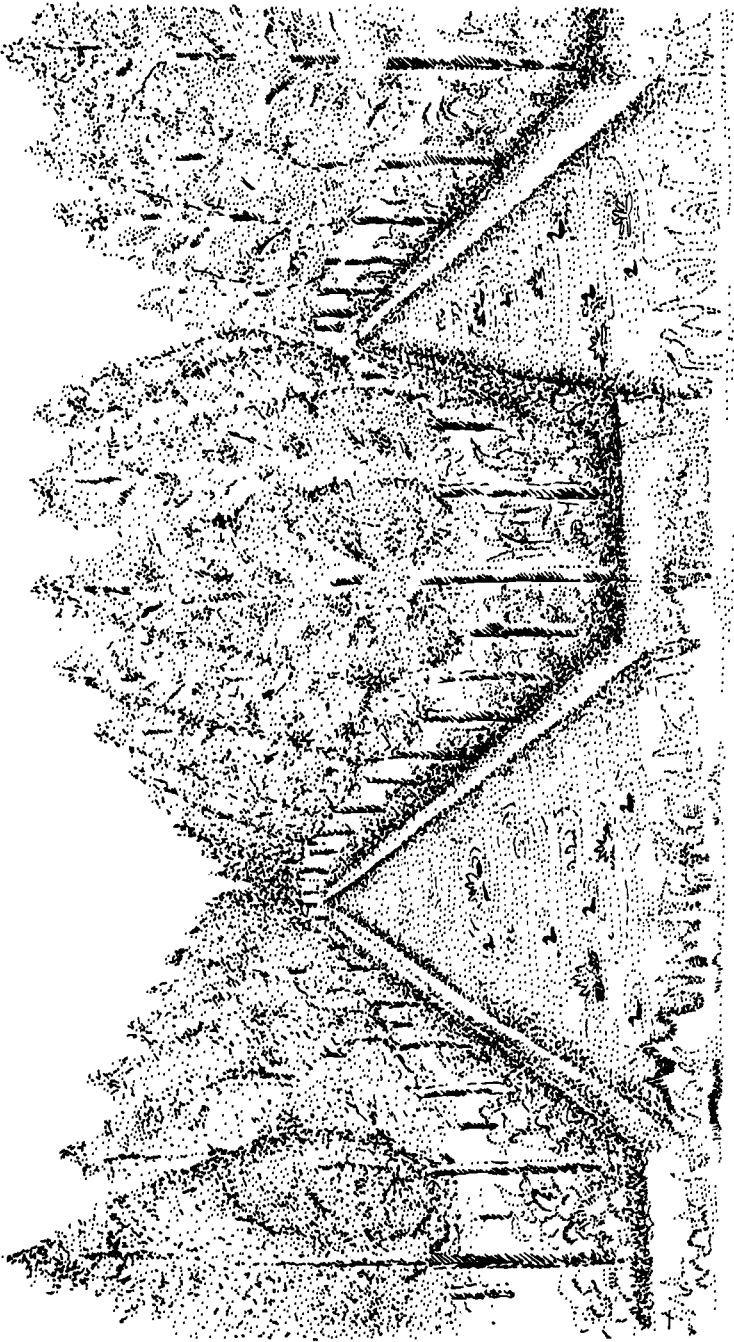
Texodium was introduced in sub-tropical part of China from the tropical regions of Carribean Islands. It can be grown in the tropics, where water is adequate, but it cannot withstand soils with high salts. This species can be propagated both by seeds and cuttings. With 2 x 3 m spacing, the first thinning will have to be carried out after 10 years. Its wood is used for construction of buildings and boats. *Texodium*, *Salix*, *Metasequoia* and Chinese Furr (*Cunninghamia lanceolata*) are the main species used for agroforestry in paddy fields.

FISH AND FORESTRY FARMING IN CHENG CHEN DISTRICT

A large area of this district remains submerged in shallow water. To make best use of such submerged areas, 2 m wide trenches were dug 1.4 m deep to store this water, leaving a land strip of 8 m width, free from water stagnation. The soil dug from the trench was spread on the land strip to raise the ground level further. *Texodium* was planted on the land strip with 2 x 3 m spacing and fish was introduced in the water trench. Further,



Texodium for waterlogged areas



Waterlogged areas for fish and forestry

water-lily was also introduced, as it did not affect the fish growth. Five years after establishing *Texodium* trees, sheep and ducks were allowed inside the plantation strips for grazing.

In this plantation, 9-year old *Texodium* trees had attained a height of 9.5 m and DBH of 15.5 cm, yielding about 120 cubic m wood per ha. Under this system, the productivity of the land in terms of income had increased by 30 times. With better management of the ponds, fish production had gone up and the income from fish yield per unit area was three times more than that of forestry. Therefore, this system was further modified to increase the area under fish production. For better growth and higher fish production, low temperature and increase in micro-vegetation were beneficial. Considering these factors, several alternatives were tried and 20 m wide forestry strip followed by 6 m wide fish pond strip was found to be ideal.

More than 1000 ha of waterlogged fields have now been brought under this system. Another spacing equally suitable is 60 m wide forestry strip followed by 25 m water strip. However, due to high temperature, the water may get heated and affect the fish production in the tropics. This system is worth trying in Nalkatha area of Gujarat and other marshy, waterlogged areas in different parts of India.

PAULOWNIA IN CHINA

Although Paulownia is native to China, systematic development started only after 1970. Paulownia was found naturally growing in the agricultural fields. During the early 70s, based on a taxonomy paper on Paulownia, a scientist from Argentina requested the Government of



Paulownia: hitherto neglected species

China for seeds of *Paulownia elongata*. It was at this stage that Chinese scientists started studies on this species.

Based on the paper prepared by Mr. Zhu Zhao Hua, a Forestry Scientist, a meeting was organised in 1977, by C A F to promote paulownia in China. Since then, all-round efforts have been made, including the identification of the germplasm, propagation, silvicultural trials, agroforestry, etc.

Paulownia grows very fast with straight clear bole upto 4-6 m. Its root system is fairly deep, atleast below 40 cm. Paulownia leaves contain 2-3% nitrogen on dry matter basis and a tree of 8-10 years would add about 40 kg litter every year. To improve the tree shape and timber quality, lopping of the side branches of the growing saplings is generally practiced and the foliage can be fed to livestock. Dried leaves are also fed to sheep and pigs, when alternative sources are not easily available.



Agroforestry regulates the temperature

In China, particularly in the southern and central parts, paulownia has been introduced under various systems such as road side planting, shelterbelts, agroforestry and agro-horti-forestry system. For alley cropping, the recommended spacing is 5 x 20 m. Chinese scientists believe that paulownia plantations help to maintain the temperature of the soil in winter by 1°C above the normal by acting as wind break. During summer, the new tender leaves emerge and provide partial shade and reduce the soil temperature and moisture loss in the field.

Paulownia wood fetches almost 40% more compared to poplars, because of its better grain quality and superiority in producing household furnitures. Under adequate moisture supply, paulownia trees can be harvested for timber after 7-8 years and can be allowed further for coppicing. Under intensive farm forestry, it is recommended to plant paulownia at 5-10 m spacing and harvest every 4-5 years. It is also



Agroforestry boosts the income

possible to increase the plant population and carry out thinning at an early stage, under agroforestry systems.

When paulownia is planted at 5 x 20 m or 5 x 40 m spacing, there was no reduction in crop yields. Chinese scientists have developed various models to plant paulownia with various crops like apple, groundnut and other crops. Generally for establishing an apple orchard, paulownia is planted at 4-6 m and apple is planted 2 x 3 m. Then after four years, paulownia trees are harvested to avoid competition with apple trees.

A 3 year old paulownia planted at 5 x 8 m, grows upto 8-9 m, with a clear, straight bole of 4 m, and a DBH of 16-18 cm. The diameter of the canopy will be about 4 m. with fertile soil and adequate moisture supply, similar growth can be achieved, even by planting at 5 x 4 m. till 3 years. But the subsequent growth and quality of the timber will affect due to competition if thinning is not carried out at a proper stage. Paulownia



Dr. Manibhai Desai with Mr. Zhu, Paulownia expert

requires adequate moisture (800 mm and above) and well drained deep soil. It does not grow well on clayey soils.

Paulownia is planted by using the seedlings raised in the nursery. The seedlings reach a height of 2.5-3 m in 5 months, which is the ideal size for transplanting. Generally, the state owned Forestry Institutes have the responsibility of raising the seedlings, required by the local farmers. Seedlings are generally transplanted during autumn.

While planting paulownia in wider rows wind direction should be taken into consideration so as to make use of the rows as shelter-belts. Under agroforestry introduction of paulownia would increase the Land Equivalent Ratio (LER) by 25-40%.

CAF has collected and tested more than 1000 paulownia strains and about 250 of them have been selected, through a preliminary evaluation. Out of this, three lines have been already selected for large scale



Paulownia with wheat

Paulownia at 24 years



*The timber industry --
the success behind
afforestation*

propagation and distribution, while three more strains are in the process of final selection.

In Chew Jong village in Central China, *P. elongata* planted at 5 x 20 m had attained an average DBH of 37 cm in 8 years. These trees had a clear bole of 0.5 cubic m thus yielding 25 cubic m of timber per hectare. On another site, paulownia trees planted in 1964 had attained a height of 21.3 m with a DBH of 1.0 m. The volume of the timber from each of these trees is expected to be about 5 cubic m.

Paulownia trees are cut about 20-30 cm below the ground so that maximum timber is harvested. The logs are shade -- dried before sawing. Wood is used as construction timber but it is preferred for indoor furnitures with its natural whitish cream shade and light weight.

In Chew Jong village food crops like maize, sweet potato, cowpea, rye, soyabean were grown under Paulownia during the hot season (kharif) and wheat in winter season, yielding 8 t/ha/year. Paulownia timber is sold in local market at Y. 550/m³, thus yielding timber worth Y 13,000. Food grains fetch Y.2400/ ha/year at Y. 300/tonne. The cost of establishing farm forestry in China is Y.1800 per ha, in which the labour component is Y. 1500.

Paulownia leaf eating caterpillar and witch's broom caused by a protozoa are the two major problems of plant protection. While system-



Export quality furniture from paulownia

atic pesticide application has been recommended to control the insect, no satisfactory control measures are available for the control of witch's broom, except the destruction of the affected parts.

Paulownia fortunei can tolerate tropical climate to some extent. This is worth trying in India. Other species of *Paulownia* are good for warm temperate region where the temperature goes up in summer but no frost is experienced in winter.



*Fruits, ornamentals and foodcrops in paulownia plantation
-- A model of Agri-Horti-Silvi system*

BAMBOO AND OTHER SUBTROPICAL FORESTRY SPECIES

Yixing city located in Jiangsu province is historically known for its pottery work. This town is also known for the industries in electronics, construction material, silk and textile. For the foresters, this town probably demarcates the beginning of a new climatic condition and thus brings a new set of species. From here towards the south, the climate changes to sub-tropical and thus a variety of bamboo species are grown.

Chinese Furr (*Cunninghamia lanceolata*) is the main timber species, while the other pine species -- *Pinus massoniana* was grown for extracting resin. Both these species are planted at 1.5 x 2 m or 2 x 2 m spacing. Other species grown in this region are: *Aleurites fordii*, *Ginkgo biloba*, Chestnut (*Castanea sativa*) *Paulownia fortunei*, *Melia azedarach*,



Monopodial bamboo -- exclusively chinese

camphur (*Cinnamomum camphora*) and Chinese tea *Camellia sinensis* and *Camellia oleifera*). Aleuritres seeds are used for extracting oil which is used in paint industry.

Monopodial bamboo -- popularly known as moso bamboo -- *Phyllostachys pubescens* Mezel is the most prominent bamboo species grown extensively in this region. This species plays an important role in providing employment for the people of this region.

The Research Institute for Sub-tropical Forestry, at Niyang near Hangzhou is a part of the CAF, which coordinates the research on bamboo through five Research Stations. This activity, partly funded by IDRC is engaged in germplasm collection, comprehensive management of the plantations, pest and disease control and post harvest treatment and utilization.



Moso bamboo -- an economically important species

CHINESE MOSO BAMBOO (*Phyllostachys pubescens* Mese)

Bamboo has been widely distributed in southern and central China. Out of the total bamboo population, about 50% are of monopodium type, having great economic importance in China. However, monopodial bamboo has not been fully exploited in other countries. *Phyllostachys pubescens* commonly known as moso bamboo is the major monopodial species, which covers 2.7 M ha in China. Before 1980, when China was facing timber shortage for rural housing, moso bamboo was the major source and its supply was regulated by the government. Even for producing almost all the bamboo articles and handicrafts moso bamboo is the raw material. Now, with the importing of timber, the pressure on bamboo supply has been slightly eased, but the farmers need to obtain permission before felling the culms. This restriction has been imposed to prevent over-exploitation of this species.

The monopodial bamboo produces long suckers which spread away from the mother culm and produce new shoots at 30-100 cm away.

The new shoots grow very fast and in about 60 days reach the normal height of 18 m with a DBH of 8-10 cm. However these new culms need three years to complete the growth phase.

For making bamboo mats for painting, the culms should be allowed to grow atleast for one year. Culms of 2-3 years old are good for making



Bamboo generates rural employment

bamboo baskets and other articles, while 6 year old culms are used for housing and furniture making.

Bamboo shoot is a delicacy in the Chinese diet and hence fetches a premium price. However, for bamboo shoot production, there are other monopodial species such as *P. dulcus* and *P. praecox*, which are managed specially for maximizing the tender shoot production. On an average, a hectare of bamboo plantation managed for shoots yields about 15 tonnes every year, which can be sold at Y. 3-4/kg. However, better managed *P. praecox* plantations yield up to 30 t/ha/year and as this species sprouts very early during the season, the shoots fetch a premium price. This species can be grown in the tropics.

Ideal Agroclimatic Requirements

Monopodial bamboos being subtropical species, may not attain maxi-



Bamboo handicrafts, beyond imagination

mum size in the tropics. It can tolerate a temperature in the range of 10°C to 40°C, but cannot withstand frost. A cold rest period is most essential for profuse shoot production and vigorous growth. New shoots sprout in the spring and availability of adequate soil moisture at that period is another critical requirement. Moso bamboo grows well in the sub-tropics with an annual rainfall of 1300 - 2000 mm, fairly distributed to maintain high humidity and adequate soil moisture in the spring.

Soil is another critical factor for optimising the production. Loamy soil with a minimum depth of 1 m, having a soil pH in the range of 5 to 7, with good drainage facilities is ideal for its growth. It cannot withstand saline and waterlogging conditions. As the fertility status of the soil further affects the growth, application of 75 kg nitrogen per ha, every alternate year has been recommended, wherever necessary.



Bamboo handicrafts -- an eye on export market

Planting

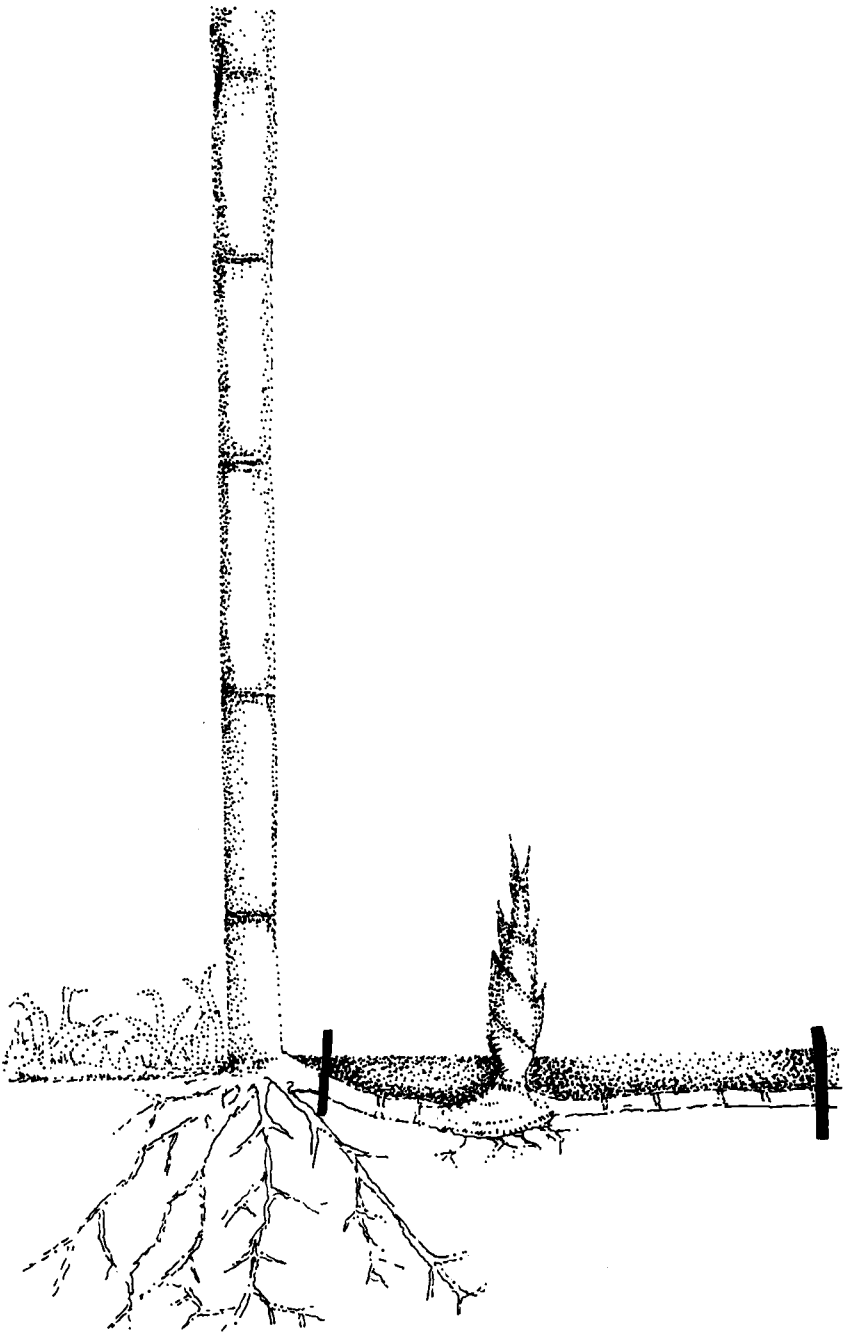
It is recommended to dig pits of 1 x 1 x 1 m size spaced at 3 x 4m. The pits should be filled with FYM and good quality soil up to 75 cm, before planting. In areas where soil fertility and moisture supply are not adequate, wider spacing is recommended. Initially, the plantation is established with a population of 900 clumps/ha but in due course, the new suckers will cover the entire field and it will be difficult to identify the mother culm.

Planting Material

Moso bamboo can be established either through seeds or the sprouted rhizomes, collected from the mother culm. As the plantations established from rhizomes grow fast and yield high, it is the most common method followed in China. Sprouting rhizomes with 30-40 cm long shoot towards



Moso bamboo attains full size in 2 months



Bamboo sprouts for planting

the mother culm and 60 cm towards the far end should be separated from the ground for planting. These rhizomes can be maintained further for a while in the nursery or planted directly in the field. In many bamboo growing areas, special mother plantations are established to supply planting material. A mother will produce 2-3 rhizomes within one year of its establishment.

Seedlings raised from seeds are weak and take 6-8 years to mature. As moso bamboo flowers once in 60 years, availability of good quality seeds is a major problem. There are some plantations of this species which have never flowered during the last 200 years.

Aftercare

Mulching of the interspace in the newly established as well as old plantations is recommended to facilitate soil and moisture conservation.

Bamboo plantations are ideal for growing mushrooms without making any special arrangements to maintain required temperature and humidity.

Locust and leaf eating insects are the common pests but these are economically not important. Dry top is the common disease of moso bamboo which can be easily controlled by chemical methods.



*Dr. Manibhai Desai and Mr. Zhu with the Director,
Bamboo Research Station (Centre)*

Harvesting of the bamboo is done before the onset of winter, at the ground or slightly below the ground level using a saw. Generally, it is difficult to notice old crowns in well maintained bamboo plantations. Harvesting in a new plantation can be carried out from the third year, at the rate of 300-400 culms per year.

An ideal plantation should maintain a stand of 4500-5000 culms and surplus stand is the deciding factor while carrying out the annual harvest. However, on poor sites, the stand should be restricted to 2500-3000 culms to maintain the quality.

The average annual yield of bamboo plantations ranges from 5 to 20 tonnes, depending on the soil productivity and management. In China only about 5-6% of plantations yield about 20 t/ha. In general, the bamboo yield will be high once in two years and hence, the average yield of two years should be taken for presenting the yield data.

A good size bamboo weighing 13-15 kg, fetches Y 5 in local retail market. However the bulk is sold on weight basis. Generally, the large size fresh bamboos fetch Y 500 /t while the medium size bamboos fetch Y 300 /t at site. This gives an annual income of Y .6000 per ha, against an expense of Y 2000-3000. In addition, farmers do sell some tender shoots to boost their income further.

The annual income from the plantations maintained exclusively for bamboo shoots, using other species may go up to Y 200,000 per ha. Even with the moderate management, bamboo shoot production is highly profitable.

Moso bamboo can be tried in Northern parts of Shivalik hills and other hilly regions of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal and North Eastern Territories in India.

SUMMARY

Some of the important lessons from the visit to China, worth adapting in India are:

1. Use of boiled water for drinking;
2. Multipurpose water management system, to improve food production and control floods;
3. Reclamation of water-logged area by combining fish farming with forestry;
4. Sabbatical leave for agricultural scientists to work in rural areas to develop suitable solutions to solve rural problems;
5. Ecological farming to recycle agro-wastes and to improve agricultural productivity;
6. Involvement of school children in tree planting by suspending classes for one to two weeks during the planting season;
7. Promotion of shelterbelt plantation on field bunds, riverbanks and tank banks;
8. Promotion of fast growing bamboo for timber and shoot production;
9. Introduction of Paulownia species in hilly regions of North India and development of technology for processing of wood for furniture and other value added products;
10. Establishment of infrastructure to supply seedlings and other inputs;
11. Development of marketing network for profitable handling of forestry produce;

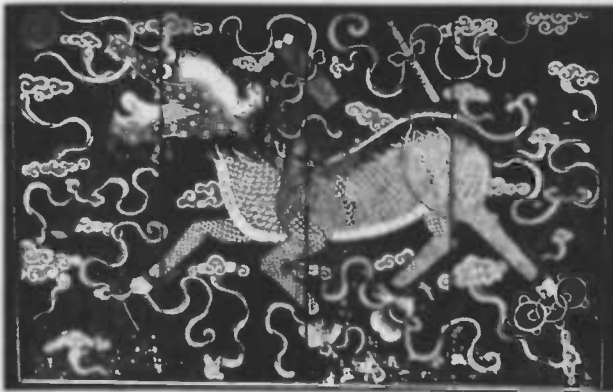
12. Reclamation of mined areas through mixed farming;
13. Promotion of mushroom in tree plantations;
14. Promotion of small scale rural industries.

The most important factors responsible for such successful rural development programme in China are --

- Policy changes at right times;
- People motivated to earn more;
- Suitable infrastructure developed by the community.

China has shown a way.....

A way worth following by other developing countries.



THE CHINESE PHILOSOPHY

This wall painting has a prominence in the palace of the great Chinese philosopher Confucius.

The animal depicted in the painting possesses as much as it can, yet it is still looking up at the sky with a sad face longing for the moon. The essence of this philosophy is that contentment is the secret of happiness.