

## **The Role of Education and Research in Enhancing Rural Women's Income and Household Happiness**

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*"If you are planning one year ahead, plant rice,  
If you are planning ten years ahead, plant trees,  
If you are planning a hundred years ahead, educate the people".*

- An old Chinese proverb

I first met J.P. in 1964 when he joined as Member Secretary of the Education Commission (1964-66). He saw in education the pathway to social justice, self-reliance, economic growth, and modernization of agriculture and industry. What impressed me most in our first meeting was his total dedication to the cause of promoting an open system of education which will offer scope to every child, rich or poor, to develop fully his or her mental potential. He had an open mind as well as infinite patience when it came to hearing others. No wonder the report of the Education Commission contained the stamp of his vision and convictions. For example, his passionate devotion to the cause of introducing flexibility in the educational system to suit diverse economic, ecological and social conditions is reflected in concepts ranging from the neighbourhood school to open university.

J.P.'s concern about the high incidence of illiteracy and "drop-outs" and "left-outs" from the education system among the economically and socially handicapped sections of the population led him to conclude that unless education makes sense in economic terms, the situation will not change. Thus he became an ardent advocate of vocationalisation of secondary education. When I was in the Indian Council of Social Agricultural Research, he actively participated in work relating to the development of "Krishi Vigyan Kendras", where farmers and fishermen can learn the latest technical skills purely through work experience. In learning by doing, J.P. saw a method of overcoming the handicaps arising from inability to read and write, characteristic of a considerable proportion of small and marginal farmers and landless labour families and more particularly of rural women.

While his contributions to education and national development have been many and varied, J.P. will always be remembered by all who came to know him for his humanism. His conviction that new technology without an understanding of its potential impact on society may become a curse rather than a blessing led to the Indian Council of Agricultural Research and the Indian Council of Social Science Research setting up a Joint Panel to examine the social implications of new farm technology. J.P. felt that social scientists should not just be engaged in studying the causes for the failure of new development projects but should show how to ensure their success. He was a totally positive person, always wanting to do constructive work, rather than spend his time in a cynical analysis of other people's faults and in making doomsday predictions. His great ability to synthesize all the worthwhile points made in any meeting in a lucid and concise

manner made him one of the best persons to have as chairman of committees and conferences.

When I called on him a few days prior to his death, he got up from his bed and began to discuss with great feeling the details of a seminar he had planned on the education of children belonging to scheduled castes. He said that what he wanted out of the seminar was not an academic treatise but a practical blueprint for action. Unfortunately, the Seminar could be held only after his death but I am glad it was conducted in such a way that J.P. would have approved.

When I received the invitation to deliver this lecture, I accepted it immediately because of the opportunity the occasion will provide to recall the message and meaning of J.P.'s life and work. J.P.'s interests were many and varied and picking one theme out of the many with which he was emotionally and intellectually connected, for treatment at this first lecture instituted in his memory became difficult. I finally chose the role of education and research in enhancing rural women's income and thereby the happiness of economically poor households because this is a topic which J.P. and I had discussed on several occasions. Also, it is my conviction that only when women are enabled to participate in an equal measure with men in national development that effective remedies can be found for the major socio-economic maladies facing our country such as rapid population growth, under the mal-nutrition leading to a possible stunting of physical and mental development in children, under and unemployment and extensive eco-destruction.

### **Women and Development**

The VI Five Year Plan (1980-85) includes for the first time in the history of planning in India a separate chapter on "Women and Development." The VI Plan document states "excessive mortality in female children resulting in persistent decline in sex ratio, low rate of literacy and low economic status stress the need for greater attention to the economic emancipation of women." The plan document further states that "the major thrust of the VI plan in the field of welfare of women is their economic upliftment through grater opportunities for salaried, self and wage employment. For this purpose, appropriate technologies, services and public policies will be introduced. The technological package will include imparting new skills and upgrading existing skills. The service package will pay attention to training and credit needs and to marketing. The public policy package will include measures in the area of ownership rights, enforcement of wage laws and employment impact assessment with reference to the employment of women in development projects. Women's organizations will be assisted to grow in effectiveness. Specific attention will be paid for the removal of socio-economic biases resulting in the neglect of female children and women. Measures for the improvement of health and nutritional status will be strengthened. Programmes relating to education, health, nutrition and employment would no doubt go a long way in the removal of social disabilities facing women. However, the improvements in the socio-economic status of women would depend to a large extent on the social change in the value system, attitudes and social structure prevailing in the country."

The VI Plan document also mentions “poverty persists under conditions where the human resource is undervalued and material resources are overvalued. The primary objective planned development should, therefore, be the provision of work opportunities to all. Education, employment and development should become catalysts of each other and should lead to the improvement of the equality of life in both rural and urban areas.” How can we give operational content to these sentiments under conditions of widespread indifference and inertia in most government department as well as in society in general on the whole question of the involvement of women in development ?

The analysis made by the Registrar General of the 1981 census data has clearly shown that the only positive correlations observed between success of family planning programmes and any other factors is female literacy. We recognize that population stabilization is essential for national survival and we know that education of women which is the key to their economic emancipation is a must for this purpose. The available data, however, reveal a sad situation with regard to female literacy. Of the total number of adult illiterates in the country, women constitute of majority. In some States, the female literacy rate is as low as 4% (the corresponding figure for men being 28%). Even in the most progressive States there is a visible difference. There are sharp differences in the enrolment of girls and boys in elementary school. As many girls in the age group 6 to 14 are out of school as are in.

Averages often hide many ugly facts. If we examine States average literacy rates further, the position is very unsatisfactory with reference to scheduled castes in general and scheduled caste women in particular. There are 46 districts in the country (mainly in Andhra Pradesh, Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) where the literacy rate among scheduled caste women is less than 1%, going down even to 0.2% in some cases. At every level it seems that girls and women are neglected.

The 35 years since independence have witnessed a phenomenal growth in facilities for education in the country. Also, several steps have been taken to help the children of economically and socially handicapped sections of the population to derive benefit from the available educational opportunities. Incentives for women teachers, separate facilities for girls, provision of scholarships, books, cloths and midday meals are some examples. High-level committees have been set up from time to time to examine the special needs of first-generation learners and to suggest methods of minimizing school drop-outs and ensure the attainment of the educational goals enshrined in the constitution.

Several innovative educational procedures have been introduced in different parts of the country to meet the needs of special categories of the population. Some examples are the “Meadow School” of Tarabai Modak, the Mobile Schools for children of Gujjars started in Jammu and Kashmir and whole family educational system introduced for migrant labour by Mobile Creches. There are numerous examples of this kind in different parts of the country. What we have to learn is the conversion of the unique into the universal. We are yet to institutionalize good and effective approaches and coalesce small droplets of isolated activity into a mass movement.

## **1. Women and Rural Development**

Rural Development involves integrated attention to maximising benefits from the developmental assets of the area and minimizing the adverse impact of the developmental liabilities. Agriculture, including crop husbandry, animal husbandry, fisheries and forestry, is the most important source of rural income and employment. In its projections on "Agriculture: Towards 2000", FAO makes the following assessment of the current situation in the Third World on the position of women in activities connected with food and agriculture.

"Women play crucial roles in the production, storage and processing of food in most societies. They make up one third of the work force in most societies. They make up one third of the work force in developing countries. Women often have well-defined specializations in food production and are increasingly becoming principal farmers and breadwinners in countries where men migrate in search of work, or where divorce and separation are common. Fuel gathering, with its potentially devastating impact on the environment that sustains agricultural production, is often a woman's chore.

Despite their importance to agricultural production, women face severe handicaps. They are, in fact, the largest group of landless labourers, with little real security in case of break-up of the family through death or divorce, inheritance laws and customs discriminate against them. Land reform and settlement programmes usually give sole title and hence and security needed for obtaining production credits – to the husband. Agricultural development programmes are usually planned by men and aimed at men. Mechanization, for example, alleviates the burden of tasks that are traditionally men's responsibility, leaving women's burdens unrelieved or even increased. The excess burden of work on women (the "double day" of the farm work plus house work) also acts as a stimulus to have many children so that they can help out with chores from an early age. Extension workers, almost exclusively male, aim their advice at men and men's activities and crops. In some regions, this bias may depress production of subsistence food crops (often women's crops) in favour of increased production of cash crops (often men's crops) so that family nutrition suffers."

All these problems have been known and discussed for a long time. However, the identification of maladies has seldom been followed by the application of appropriate remedies. There is hence a growing gap between that we know and what we practice. The Department of Science and Technology through the Centre of Science for Villages in Wardha has brought out an excellent compilation of technologies which are available for reducing drudgery and improving productivity in the traditional women's occupations. In a series of articles entitled "Try asking the women first", Dr. Anil Agarwal of the Centre for Science and Development has pointed out with concrete examples how national programmes in biogas development, social forestry and drinking water supply would have been more successful if women had been involved both in the planning and implementation phases of the concerned projects. The extensive surveys contained in the report of the National Committee on the Status of Women as well as all recent reports,

whether it relates to, poverty alleviation, leprosy control, blindness prevention or eco-development of the Himalayas have a common refrain, namely the education and active participation of women alone can help to realize the goals we seek. These reports contain practical suggestions on what can and should be done. Thus, the report on poverty alleviation indicates how the District Rural Development Agencies can help women to take advantage of institutional credit through specific attention to project formulation and training in the requisite skills including producer-based marketing. We need a cadre of credit officers-women and men-who are trained in institutions like the Institute of Rural Management, Anand and the National Institute of Rural Development, Hyderabad in methods of preparing economically viable projects for women based on local resources, preferences and marketing opportunities.

Today, poor family has an economic stake in not sending the girl child (also, frequently boys) to school. Can we create an economic stake in sending the child to school? A “Food for Learning” project was recommended for this purpose by the Expert Group on Poverty Alleviation of the Planning Commission. It may be difficult to find resources for such programmes on a national scale. To start with, can at least something be done for the children of families with no assets – either land or livestock? Studies have shown that under the Employment Guarantee scheme of Maharashtra, a majority of women reporting on work sites belonged to scheduled castes owning no land. These are the very people who often suffer from the introduction of new technology. What we need are technologies which can help to achieve diversification and not displacement of labour use. If a rice transplanting machine is developed, it will save women from a back-breaking job. At the same time, it is likely that such a machine will render millions of women jobless. Perpetuation of human drudgery cannot be a long term or acceptable method of employment generation. Can simultaneously with steps for reducing drudgery, measures be taken which can provide new sources of employment involving the preparation of value-added products from local raw material? Can we integrate emerging technologies like micro-electronics and biotechnology with traditional skills so that we are able to achieve a blend of the desirable features of both and at the same time avoid technological obsolescence?

Since agriculture including crop husbandry, animal husbandry, fisheries and forestry, is the major source of income and employment in addition to food in rural areas, I will like to deal with in some detail the approach of the International Rice Research Institute to imparting a rural woman user’s perspective in agricultural research and development.

### **Women and Agriculture: historical perspective**

Some historians of agriculture believe that it was women who first domesticated crop plants and thereby initiated the art and science of farming. While men went out hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest from the point of view of food, feed, fodder, fiber and fuel. This view is strengthened by the fact that women have been traditionally seed selectors. Even today, this tradition has continued in many parts of the developing world.

Women have played and continue to play a key role in the conservation of basic life support systems such as land, water, flora and fauna. They have protected the health of the soil through organic recycling and promoted crop security through the maintenance of varietal diversity and genetic resistance. In many hill and remote areas of developing countries, such as the Himalayan region, agriculture is largely in the hands of women, since men tend to go to towns and cities in search of salaried jobs which can augment family income. Therefore, without the total intellectual and physical participation of women, it will not be possible to popularize alternative system of land management to shifting cultivation, arrest gene and soil erosion, and promote the care of the soil and the health of economic plants and farm animals.

Women also tend to look at problems in their totality – from the sowing of a crop to its ultimate utilization either as food, feed, or raw material for industry. Since they are usually in charge of marketing, they generally possess a clear understanding of market preferences and prejudices. Therefore, for an economically and ecologically sustainable agriculture, the involvement of women farmers and farm- women (agricultural labour with or without assets) in the process of modernization of farming practices and village industries is absolutely essential.

In addition to working as farmers and farm labour, women shoulder the responsibility of rearing children and looking after the home. Thus, the triple burden of child rearing, farm work, and household during has fallen on them since the time the domestication of crop plants took place about 12,000 years ago.

The role of women in agriculture has changed dramatically in developed countries after the advent of science and technology in farming practices. Gradually, farm men and women have been drawn away from the routine operations of farming and absorbed in the industrial and services sectors. This has usually led to (a) reduction of drudgery, (b) improved productivity, (c) enhanced income, and (d) diversified and flexible opportunities for productive and remunerative employment in both rural and urban areas. In most developed countries, mechanized agriculture is operated and managed by a small number men; very few women remain in the agricultural sector except in food processing industries and backyard livestock and vegetable production. Japan is an exception. Women there account for just over 60% of the total agricultural labour force and provide about 40% of labour in rice cultivation. They operate and maintain farm machinery and play important roles in farm decision-making. Thus, diversification of income earning opportunities rather than unemployment has been the result of modernization of agriculture in developed countries.

In contrast, the experience of developing countries has been uneven. Modernization of agriculture has provided women with better income-earning opportunities in some area but has displaced them from their traditional roles in others. The latter is particularly serious when job destruction is not accompanied by job creation in other activities, either within a diversified agricultural sector or in non-farm employment.

Such a negative impact on employment could cause much distress particularly to families where the total family income is small and hence needs to be supplemented by the earnings of both husband and wife. Lack of employment opportunities for women belonging to families with few or no assets—either land and / or livestock—leads to malnutrition and under-nutrition among children and women who suffer most from inadequate purchasing power of the family. In several developing countries, the female child suffers particular discrimination, resulting in imbalance in the male-female population ratio. Therefore, there are strong linkages between the welfare of an entire family and the ability of women to enhance total family income.

Another aspect of this problem relates to technologies for tasks carried out or managed by women. In many countries and particularly in Africa, East and Southeast Asia, women play major roles in farm and financial management. Moreover, many of their agricultural roles require considerable skills, for example, in seed selection, storage and pre-germination testing, organic recycling, the identification and control of pests, pathogens, and weeds, and post-harvest technology. Nonetheless, many of the jobs undertaken in rural areas by women involve much drudgery and result in little income. As men's decision-making roles are more publicly visible, government policy makers, scientists, and manufacturers of agricultural machinery have generally tended to neglect women's technology services. Their numbers in scientific and extension services are generally small. Consequently, they continue to remain as unskilled workers with uncertain income.

*The challenge hence lies in integrating brain (technology), brawn (physical work), and bank (credit and other resources) in a mutually supportive manner so that both men and women can play an active role in improving the productivity, profitability, stability and sustainability of major farming systems.*

How can this be done?

## **II. Research and Training Needs**

The following three aspects merit careful consideration:

### **A. Impact of new technologies on women – specific occupations:**

A careful study of the impact of new technologies should be undertaken in selected farming areas taking the family as a unit. Families with assets (land/ or livestock) and without assets (landless labor dependent entirely on wage earnings) should be considered separately for measuring the impact of new technologies. Within the family, the impact of women with reference to both employment and income should be studied separately so that household data can be disaggregated for analyzing the impact of new technologies on women. The impact should be measured in terms of the additional jobs created and the jobs made redundant and thus lost following the introduction of new technologies, both at the production and post-harvest phases of major farming systems.

### **B. Technologies for women:**

There is need for compiling *an inventory of opportunities* opened up by new technologies available for women belonging to (a) farming families and (b) landless labor families. What are the practice suggestions scientists with regard to the technologies available for women and particularly for those seeking wage employment? A catalogue of the opportunities, either present or potential both at the production and post-harvest phases, should be prepared. It will be useful if scientists could indicate whether the technologies developed by them for reducing drudgery and increasing the energy input-output efficiency ratio could lead to a diversification of labor use and income or only to the displacement of women wage laborers from their traditional occupations. Since women will benefit greatly if there is flexibility in the timing, duration and place of work, there is particular need for examining what efforts, if any, have been made by scientific institutions to introduce flexibility in time and place in jobs for women. Such inventories should be part of an on-going dialogue between scientists and user so that research priorities reflect user's needs.

### **C. Women in technology development and transfer:**

Based on an inventory of opportunities for new avenues of employment opened up by science and technology, there is need to review methods of promoting the greater involvement of women, both in technology will have to be carefully reviewed and appropriately modified and expanded. In particular, steps, must be taken to provide women with managerial and organizational skills so that they themselves can operate new technologies such as those relating to biofertilizers, seed production, pest surveillance, biomass utilization, crop-livestock, and crop-fish integrated production systems.

### **D. Studies on delivery systems:**

The delivery production inputs like seeds, fertilizer, and credit as well as new knowledge and skills often tends to have a sex bias in favour of men. Hence, the knowledge and skills transfer mechanisms adopted by extension agencies and the input supply procedures adopted by both government and non-governmental organizations need carefully study. Similarly, the price support and marketing systems as well as they steps taken to improve the other links in the production-consumption chain will need examination from the point of view of their relevance to women farmers, farm managers, and farm workers.

It has been the general experience so far that if the target group with regard to the size of farm holding in agricultural research and development programs is the small farmer, then all farmers-whether big or small-derive economic benefit from new technologies. The reverse however, will not be true. Similarly, it is my conviction that if the target group with regard to sex in agricultural R & D efforts is women farmers and farm workers, then all members of the farm family-men, women, and children-will benefit. The reverse may not always be true, as the experience gained so far generally suggests. Hence, we need to give a fresh look at our agricultural and rural development strategies and programs.



### **III. Generation of Technologies for Women-Specific Occupations**

Most research programs have both a short and long time perspective. In the short terms, the aim is to bridge the gap between current production and actual need for basic staples and thereby ensure the availability of food for all the reasonable prices. In the long term, the aim is to promote sustained agricultural advance coupled with economic benefits to all regardless of sex or social status. Some success in the first objective has been achieved in most countries of Asia and Latin America, as per capita food grain production has increased during the past 15 years. It is therefore time to look more deeply into questions of equity as judged by the relative benefits which flow to men and women, whether farmers, farm labor, or consumers. What should centers do in this regard?

There is no simple or single answer to this question. The role of women, both as users and beneficiaries of new technologies, varies widely and is influenced greatly by religious, cultural, economic and ecological factors. Therefore, a universal prescription with regard to research policies will be irrelevant and even harmful. There are however, there broad areas of activity which merit the attention of R & D agencies. These are:

- A. Sensitization
  - B. Studies and Surveys
  - C. Scientific strategies and programs
- I will like to deal with these briefly.

#### **A. Sensitization:**

“Knowledge leads to unity: ignorance to diversity.” Where there is no awareness, it is futile to expect action. Hence, the first step is to arouse human consciousness of the existence of the problem.

There is need to take a specific look at the implications of technologies under development for women managers and laborers. High yielding varieties are clearly labor using but we do not know how different components of such technologies affect employment. For example, many labor displacing technologies though designed to relieve seasonal bottlenecks, may result in an increase of total annual employment. Similarly, we know that women play a major role as farm managers but we do not know enough about what this means for technology development and adoption. Hence, issues relating to both research coverage and impact in terms of sex need careful study. A starting point for stimulating thought and action and for strengthening the users’ perspective in research policy making is an organized effort in sensitizing policy makers and funding organizations to such issues. The VI Five Year Plan of India by introducing for the first time in the planning history of the country a chapter on “Women and Development” has shown how the sensitization process can be initiated.

#### **B. Studies and surveys:**

Once there is appreciation of the concerns, the need for collecting precise data and for gaining meaningful insights into the problems arises. A carefully designed malady-

remedy analysis will be necessary for assessing alternative and priorities in technology development and transfer. For this purpose, social science institutions need to be linked up with national and international agricultural research systems. Much work on women and other types of users takes place in universities. The development of effective networks involving agricultural researchers and social scientists can help to guide scientists, extension workers, and developmental administrators on methods of combining efficiency and equity in technology development and transfer.

There is need to develop a problem-solving approach using multidisciplinary research teams and a variety of complementary research methods. The standard surveys should be supplemented with low-cost, rapid and imaginative ways of collecting reliable and relevant data. There is also an urgent need for developing methods of studying the problems of men and women without assets (either land and/ or livestock). A careful study followed by an objective analysis of the data collected is essential for rational decision-making by those engaged in the development and transfer of new technologies.

Suitable survey techniques will have to be developed which can help to reveal not only the consequences of new technologies on women specific occupations but also the constraints responsible for the inadequate transfer of relevant technologies to women. Efforts of banking institutions in the identification of credit-worthy occupations for women need study and monitoring. Public policy issues such as those relating to land and property ownership rights, credit supply, personnel policies of R & D institutions, etc. need particular attention. Above, all, it is necessary to study the organizational and institutional aspects of input delivery and producer-oriented marketing.

### **C. Scientific strategies and programs:**

It is essential that each research institute carefully considered its research priorities and programs from the user's perspective. For this purpose the following questions will have to be asked:

1. Will technologies under development result in a reduction in drudgery and improvement in productivity and income?
2. Will they be labor displacing or will the result in labor diversification?
3. Will they result in equal benefits to both men and women or will they have built-in seeds of sex discrimination?
4. Will they provide some flexibility in relation to timing, duration and place of work for women?
5. Will they help to make unskilled labour become skilled?
6. What steps are necessary to ensure that women managers and labor benefit from new technologies? Social scientists and management experts should work with biological scientists to determine:

- The package of technology most beneficial to users, taking account of sex-related differences in seeds and constraints
- The package of services including the delivery of knowledge credit, and inputs with reference to their relevance and benefit to women users.
- The package of government policies in agrarian reform, rural development, credit and marketing essential for conferring equal benefits on men and women farm managers and labor.

Unless socially sound technological packages are coupled with appropriate packages of services and government policies, with fruits of scientific work will not automatically accrue either to men or women. Appropriate women's organizations can help both to promote attention on the special problems affecting women and to ensure the flow of benefits to them.

#### **IV. Inventory of Technologies for Women in Rice Farming System**

Women play a pivotal role in rice cultivation in most countries is given in Table 1. The role of women in farm management decisions in Nepal is indicated in Table 2. In order to understand what scientists can do to reduce drudgery in women-specific occupations and to provide opportunities for more remunerative and skilled work for rural women, a questionnaire was circulated among scientists of IRRI (Annexure 1). Based on the replies received, the following indicate inventory of opportunities for women farmers and laborers was compiled.

##### **A. Technologies already developed:**

The following improved technologies are relevant to the traditional occupations and skills of women employed in rice farming systems at the production and/ or post-harvest phases. They will generally need to be adapted to the specific physical, biotic, and socio-economic conditions of different regions within countries. In some cultures these technologies could well be used by men or women: the important point is not to assume automatically that they should be used by men, for in many cases there are strong social reasons which suggest they could be utilized more effectively by women.

##### **(1) Variety characteristics: Criteria for breeders and technology transfer programs.**

Women often share or have complete responsibility for the selection and purchase of seeds, and for seed storage and pregermination tests. They are also involved in cultivation and do most of the drying and husking. Livestock, which and fed rice by-products, are often exclusively cared for by women. It is therefore important to consult women about criteria to be used in the breeding of new varieties and to involve women in programmes for the transfer of improved varieties. Women's needs, skills, knowledge, and views need to be taken into account with respect to:

- varietal characteristics, both desirable and undesirable;
- seed quality of new varieties, and methods of obtaining and ensuring good quality seed (e.g., selection of best panicles, storage of the panicle, row-sowing of seeds from each panicle separately to test the seed purity);
- varietal identification;
- interaction with weeds, insect pests and pest predators and soil conditions;
- tolerance of drought, floods, temperature, solar radiation;
- drying and storage characteristics of grain, and relation to milling recovery;
- quality of by-products (e.g., suitability of straw for animal feed, roofing, fuel requirements); and
- cooking and eating preferences.

## **(2) Seed production:**

Since women have been traditionally seed selectors, they have a natural advantage in organizing scientific seed production programs. Seeds of rice varieties are either not universally available, too expensive or of poor quality, or contain mixtures (or all of the above). Rice lends itself well for quick seed increase: multiplication factors of 500-1000 (grams seeds harvested/ gram seed transplanted) are possible.

## **(3) Soil fertility and fertilizer management:**

In areas where organic manure is commonly used, it is generally made and carried up the hillside to the fields by women but it is usually incorporated by the men who do the ploughing. Women tend to apply mineral fertilizers less regularly than men. Women tend to apply mineral fertilizers less regularly than men. Women's knowledge and skills therefore need improving with respect to:

### **(a) Diagnosis of soil deficiencies:**

Women need training;

- to recognize common nutritional disorders of rice such as nitrogen, phosphorus and zinc deficiencies, by crop observation and the use of soil testing kits;
- To assess the fertilizers requirements needed to correct such deficiencies;
- To determine the most suitable source of these nutrients (various types of chemical or organic fertilizers, used alone or in combination; rotations with legumes, green manure crops or fallow; fish deposits) taking account of relative costs and returns, technical efficiency, availability of nutrients and the availability of labor and special skills needed for fertilizer application; and
- To provide biofertilizers like azolla and blue green algae in order to increase the use of home grown inputs.

### **(b) Compost and farmyard manure (FYM):**

In areas where compost and FYM are already commonly used technology development and transfer programs are needed to improve women's knowledge of and skills in the production processes, handling storage and use of compost and FYM.

Sex-related constraints in the efficient use of these organic fertilizers need to be identified. For example, in the Himalayas women carry FYM up to the hill fields over a period of 2-4 weeks (due to labor bottlenecks and a desire to spread this very hard work over time) while the men later incorporate it when ploughing. The manure remains in piles in the fields for this period, and suffers nutrient loss. The use of women's reciprocal labor groups for carrying the manure of the day the field is to be ploughed could be possible solution worth experimentation.

### **(c) Azolla**

Azolla production could provide new employment opportunities for women. Its labor-intensive processes include maintenance, multiplication, harvesting, transporting (from multiplication place to the farm), inoculation, and incorporation. Except for incorporation, all other processes can be performed by women. Maintenance and multiplication of azolla need a lot of care and patience, and woman can do this efficiently. Azolla technology considerably reduces the weed problem but the alternative employment created will compensate for labor displaced from weeding.

Related points are:

- Training will be needed, especially for maintenance, multiplication, and incorporation of azolla;
- Azolla nurseries will be needed to ensure a continuous supply of azolla starter. Given sufficient demand for azolla as fertilizer and as feed, a commercial starter market could develop in each village or in a group of villages.

### **(4) Raising of community nurseries:**

Women could be trained to raise community nurseries. Such nurseries will help to provide healthy seedlings of the most appropriate variety to small farmers for timely transplanting. Women can also raise DAPOG nurseries for use in mechanical transplanting. Landless women could rent or acquire small areas of land for this income-generating activity.

### **(5) Integrated Pest Management (IPM):**

A number of women's farming activities particularly qualify them to play an important role in IPM: women often select, purchase and store seed; monitor and report pests and diseases while weeding; take part in decisions on crop rotations that break pest and disease build-up, etc. IPM depends for its success group endeavour on the part of the entire village community and women could organize such community cooperation.

#### **(a) Monitoring of pests and diseases**

This requires regular field monitoring visits. Women are better placed than men to do this since they are present in the fields for extended periods for weeding. It may be necessary for women (or men) to make additional weekly visits for monitoring in between the weeding operations. This will especially be the case

in irrigated areas where each weeding is often done within a few days, with hired labor supplementing family labor.

Women will require training in

- the sampling and identification of pests and diseases, their patterns of build-up and the types of damage inflicted. Where local names for common pests and diseases are not in general use, suitable names should be coined and popularized through extension and training programs.
- the diagnosis of tungro disease in ratoon, volunteer and other rice stands outside the normal cropping season.

#### **(b) Post management practices:**

Women (and men) will require training to improve their knowledge of and skills in:

- different pest and disease management practices, including the use of seed resistant varieties, crop rotations, synchronous planting within a region, chemical and biological pesticides;
- the relative effectiveness and costs of these different practices, including labor implications and side benefits or hazards;
- the assessment of economic thresholds for selecting between alternative or complementary methods of controls; this would be in the context of improved monitoring of farm expenses and computation of farm income. (In countries like the Philippines where women have financial control, it is crucial that women should be informed of the economic and technical viability of IPM methods.)
- how to apply chemical and/or biological pesticides. The weight of the sprayer is sometimes put forward as an excuse for training only men, despite the fact that the women usually have to fetch the water for the sprayers. Ultra-low sprayers can be easily handled by women.
- safety in pesticide use, transport, handling, storage and disposal. Women are more concerned and responsive to safety training than men, especially when children are at risk.

#### **(c) Biological pesticides:**

Important opportunities exist for involving women in the development and transfer of plant derivatives such as neem seed oil, cake and crude extracts for pest control. Ripe neem fruits are collected, depulped and processed by women and children in several parts of India. Simple processing technology is already in use and has no harmful side-effects.

Greatly expanded production by women of neem oil and cake for crop protection and dried neem leaves for protecting stored grain from insect attack and spoilage could be an important seasonal activity, particularly as a means of supplementing the income of landless women and their families. Women farmers could also be taught how to use neem and other plant products for pest control in the field and in storage.

#### **(6) Integrated weed management:**

Given women's predominant role in weeding, applied research on weed problems will require on-farm trials involving women. The technical aspects of this work will not be affected by sex-related factors. However, the implementation of appropriate weed control practices will be affected by women's knowledge of and skills in:

- the identification of weeds and their interactions with water levels, soil moisture, soil type, land preparation, planting dates, other crops in rotation with rice (i.e., to identify the weed's habitats; where they are and why);
- the technical effectiveness and cost of herbicides used in connection with manual uprooting at the second weeding;
- the opportunity cost of women's labor, affecting the choice of different methods of weed control, e.g., herbicide; manual weeding; line seeding (by drills or transplanters) to facilitate weeding; appropriate water levels; azolla production or dense transplanting, to suppress weed growth; and additional crops in the rotation to break the build-up of rice-specific weeds;

- women's preferences for alternative crops In the rotation, taking into account nutritional needs, and eating and cooking habits;
- the development of improved tools, such as the rotary weeder, which are suitable for women's physique;
- correct choice and use of herbicides.

### **(7) Water management:**

Increasing attention is being given to improving farmer's participation in water allocation and distribution, irrespective of sex. However, in practice, farmer's water management associations often have no or few women members, even in areas where women are landowners and/or play important roles in the cultivation and management of rice farms.

Senior administrative and training staff of irrigation schemes should play a major role in the ensuring that women are (i) appointed to farmers' irrigation associations, and (ii) are given the technical, managerial and leadership training needed to overcome social prejudices against women and to ensure that they are treated with respect and as equals by men farmers and junior extension staff. Separate training courses for women should not be necessary.

### **(8) Drying:**

The following techniques could solve some of the difficult problems facing women in drying grain in unreliable weather:

- salvaging rice from submergence and wetting in rains and cyclones by immersing wet panicles in 5% NaCl solution. This inhibits sprouting, discoloration, mold development, and spoilage;
  - when drying rice sheaves, covering the panicles with the straw of the succeeding bundles in an overlapping manner to protect the grain from different solar radiation, dew, mist, and drizzle;
- practising synchronous planting and harvesting and using uniform plant population densities to ensure more even drying the field.

### **(9) Agricultural machinery:**

A number of machines are now available to increase efficiency, lower costs, and reduce drudgery. They are popular among male farmers. However, they are not so often used by women farmers, partly for social and institutional reasons, and partly because they are too heavy to be operated easily by women. In Japan, farm machinery are widely used by women. Testing programs are needed too assess their suitability for women and, where necessary, to make appropriate design changes. Social and institutional constraints to women's use of agricultural machinery require investigation and feasible solutions. Technology transfer programs should give special training to women in the operation, maintenance, and simple repairs of the equipment.

Specific examples of technologies are:

#### **(a) For production**

- manual transplanters, row seeders, row weeders (generally too heavy for women who need a higher design);
- ultra-low sprayers (suitable for use by women); Tapak-tapak pump (probably suitable for use by women; it could open up opportunities for women's dry season vegetable production in rice fields or at the homestead); and
- reapers and threshers (the IRRI axial-flow thresher has increased the use of female labor in harvesting- threshing activities in the Philippines. The traditional manual threshing methods were too demanding on their physical strength).

#### **(b) For domestic work**

- rice husk fuelled stoves for cooking and parboiling;

- charcoal production from straw and husk; and
- biogas cooking stoves.

**(10) Extension:**

Extension services should:

- upgrade the skills of extension workers in these improved technologies for women;
- expand recruitment of female extension agents;
- depending on the appropriateness for specific cultures, train male and female extension staff to work with both men and women farmers and compare their relative effectiveness in this;
- improve women's awareness of new production and post-harvest technologies;
- set up village-based training courses with men and women farmers, involving practical field work;
- train women in accounting, bookkeeping, and management skills;
- help organize farmers and irrigation authorities where communal action is required. For example, introducing pest control measures such as synchronous planting or a rice-free cropping season; and
- develop a two-way dialogue between extension personnel and farmer. Women (and men) farmers need encouragement and "training" to extract or demand the information they need from the extension staff.

**B. Technologies in the assembly line:**

The following technologies which are now being developed could provide new opportunities for increasing women's employment and income, and reducing their drudgery.

**1. Hybrid rice seed production:**

Women already play an important role in the production and processing of hybrid seeds, for example, in China (rice) and India (cotton).

Although these jobs can also be done by men, it appears that women are particularly careful and efficient in doing the work. They need training in:

- seed production process, i.e., clipping of flag leaves, dispersal of pollen by "rope pulling" or the "stick" method; and
- cleaning of hybrid seed and its testing for viability.

Hybrid rice seed production, units would need to be set up on a commercial scale, with quality controls and an efficient distribution systems Men or women could be involved in a managerial and training capacity.

**2. Driers and drying techniques:**

Several multipurpose driers have been developed for village and farm-level crop drying, using local materials (coconut and mud-rice husk bricks) and non-conventional energy (wind and agricultural waste, including rice husks).

The program is also working on methods to lessen the percentage of brokens at milling caused by the large moisture variance. This is of particular concern with the spread of new varieties which have a moisture variance of 40% compared with 15% for traditional varieties. This is a research area that will be of particular relevance to women since they are: generally responsible for husking or taking rice to the mill; encounter cooking problems posed by brokens; separate the brokens from the bran; and need to control moisture levels in storage.

**3. Agricultural machinery:**



There are a number of technologies currently under development which could potentially reduce women's drudgery and generate employment and income for women laborers. During the design and testing stages, their use by women should be taken into account.

Specific examples are:

**(a) For rice production**

- direct seeding of rice
- fertilizer placement machines
- machines for incorporation of organic materials (e.g., azolla mixers)
- grain drying
- biogas generation

**(b) For other productive work**

- simple milking machines to increase efficiency and protect animals from injury (common in hand milking)
- oil extraction devices to extract oil from sunflower, groundnuts, rape seed, coconut)
- simple machines for preserving food, fruits, vegetables

Although excellent work is being carried out by various agricultural engineering programs in Asia, relatively little attention has hitherto been given to women's post-harvest activities. Low-cost improved technologies which use local materials, renewable energy sources, and are easy to construct and maintain are needed for on-farm crop drying, winnowing, parboiling, husking, storage, handling, and transporting rice and other heavy crops during these operations in the home (e.g., devices similar to wheel- barrows), processing and preservation of other foods (vegetables, fruits, fish, cooking, and water provisioning,)

**4. Biomass utilization:**

Women already use rice straw, bran, and hulls for a variety of purposes. The quality of these products could be improved and their uses expanded with technologies now being developed. Some examples of the potential available for immediate farm-level experimentation are

**(a) Rice straw**

- as a source of manure, incorporated with animal dung;
- as a substrate for mushroom culture;
- as a source of animal feed, the quality to be improved by subjecting it to alkali digestion and enriching it with urea and molasses;
- for paper manufacture; and
- for biogas generation and subsequent composting;

**(b) Rice bran**

- for animal and poultry feed

**(c) Rice-hull or husk**

- for extraction of solar grade silicon for use in the manufacture of photovoltaic cells;
- as a source of activated carbon, an important material used for bleaching oil, glycerine etc. as carbon filter and also used in the manufacture of pharmaceuticals;
- as a source of Furfural. By distilling rice husk with dilute sulphuric acid, the pentose present in rice husk would yield three water molecules and furfural. Here also we get important by-products like methanol and acetone. Furfural is used in different forms for manufacture of cellulose acetate, nitro cellulose, shoe dyes, synthetic resins, etc.

### **(5) Mushroom culture:**

Methods of mushroom culture using rice straw as a substrate could be introduced to women. This would improve the family's nutritional balance and could be a valuable source of income to farm and landless women. A particularly attractive feature of this activity is that it lends itself to decentralized home production supported by centralized services in the distribution of spawn and compost.

### **(6) Fish-rice culture:**

Although fish-rice culture is traditionally practised by men and women in many Asian countries, especially China, India, Indonesia, and Thailand, new technologies have in recent years very considerably improved productivity and made aquaculture a highly profitable enterprise. These technologies are being developed in particular by the Freshwater Aquaculture Research and Training Centre (FARTC) in Orissa, India (belonging to the Central Inland Fisheries Research Institute which has 11 or 12 centers scattered throughout the country), the Inland Fisheries Research Institute, Agency for Agricultural Research and Development, Indonesia, and the Fresh Water Fish Research Station, Central Luzon State University, Philippines.

FARTC already has special programs for rural, particularly landless women. Farm women are also involved in the programs aimed at the farm family. These programs for women which deserve support within the WIRFS network and which could be expanded in India and other countries are:

- THE RAISING OF FINGERLINGS FOR SALE. In some cases women purchase the fry for rearing. The fry are fed on rice bran and oil cake (e.g., groundnut or mustard). One kg of fry at Rs. 10 can bring a return of about Rs.40-50. FARTC has also trained women to induce fish to breed by giving pituitary injections to the females. Women are often better at this than men.
- Making and repairing nets. This is a traditional women's activity in the above mentioned countries, as well as Bangladesh. FARTC has trained women in improved techniques for these activities and set up a women's cooperative near the Centre where women earn Rs. 10-12 a day. These activities could be adapted to other areas.
- Processing and marketing. In many Asian countries women are involved in these activities. For example, in India women do about 99% of fish marketing. There is considerable scope for improving the efficiency and hygiene standards of fish processing and marketing, from which both farm and landless women could benefit.
- The profitability of fish-rice systems can be further enhanced by adding duck and pig enterprises (if these are culturally acceptable and/or there is a market demand for these products). Women could also be trained to operate such enterprises.

### **(7) Livestock - rice systems**

These systems are traditional yet hitherto limited attention has been given to their integrated improvement. In many Asian countries the care of livestock is predominantly and sometimes completely women's responsibility. They cut fodder, use the rice hulls, bran and straw as feed (which they have often threshed and nearly always husked), make farmyard manure, water the animals, and make dairy products such as curd and ghee, etc. Any livestock - rice farming systems program must give specific attention to women's labor, skills, knowledge, opinions, needs, constraints, and potential in these areas.

Specific areas for improvement that are currently under development in three ARFSN sites (Indonesia, Philippines, and Thailand) are:

- development of dual-purpose (i) rice-legume rotations (for both grain and fodder, e.g. mungbean, soyabean, cowpea, pigeonpea, groundnut; some pigeonpea varieties can be ratooned for fodder after the grain is harvested), (ii) rice-cereal rotations (e.g., sorghum and maize), and (iii) rice-forage grasses;
- use of forage crops e. g., the fodder tree ipil - ipil (*Leucaena leucocephala*) and Napier grass (*Pennisetum purpureum*) grown on rice bunds or in the home stead for supplemental feeding (ipil-ipil will also provide fencing, windbreaks, and fuel);

- use of crop residues as feed (e. g., rice husk, bran and straw, after fortification with urea and molasses and alkali treatment to improve digestibility);
- combinations of different types of feeds, including molasses-salt-mineral supplements, their availability, and economic assessment;
- residual effects of pesticides and herbicides on crops or crop residues used for fodder, and on livestock watering places;
- use of animal manure for field and garden crops, after treatment;
- women's livestock management skills and problems, labor constraints, sources of technical information about improved management practices, feeds, knowledge of animal diseases and recommended preventive measures, access to veterinary services, marketing information and services, provisions to pay women directly for their livestock produce and not their husbands.

### **(8) Vegetable-rice systems:**

Women commonly cultivate backyard vegetable gardens throughout Asia. Since water is often a serious constraint, particularly in the dry season, vegetables could also be grown on the bunds of irrigated paddy fields. Vegetable production (which men rarely engage in) deserves more attention in research and development programs as an important means of improving family nutrition and providing women with some additional income.

Women would benefit from training in the use of organic materials and compost, and improving garden lay-out and methods of establishing nurseries.

### **(9) Sericulture-rice systems:**

Although sericulture is a traditional women's enterprise particularly in the slack rice cropping season, relatively little scientific attention has been given to improving sericulture within an integrated farming systems approach. Procedures are inefficient and time-consuming and in many places women are therefore only able to produce enough for family needs and cannot meet market demand.

### **(10) Apiculture:**

The introduction of apiculture in rice farming areas will be another source of nutrition, income, and home employment.

### **(11) Food processing:**

The following cottage industries could be developed by women for consumption and the market:

- making noodles from mungbean, a popular crop in rice-based systems;
- drying mushrooms;
- preparing bread and cakes from blended wheat and rice flour;
- making soya sauce, pickles, chutneys, jams;
- preparing puffed rice, and savorys using lentil, rice, and spices;
- a whole series of other products developed by the Central Food Technological Research Institute, Mysore.

### **(12) Biotechnology**

The emerging techniques in tissue culture and whole plant utilization will provide ideal opportunities for converting unskilled workers into skilled technicians. Suitable women's rural biotechnology associations should be promoted by the National Biotechnology Board.

The above is not intended to be an exhaustive inventory of opportunities for women in rice farming systems. They will however help to illustrate what all can be done provided there is the will to harness science and technology for helping rural women.

## VI. CONCLUSIONS

Some of the steps needed for imparting a women users' perspective in R & D work in the fields of agriculture and rural development are indicated in Table 3. While action on the above lines is feasible and should be taken, it is important to recognize that science is not a magic wand with which sex inequalities in workload and economic returns can be made to vanish. This should be emphasized clearly as otherwise false hopes will be aroused about the capacity of science and technology to remove deep-seated social maladies.

In the ultimate analysis, it is only the concern, commitment and concerted action of agricultural research systems and policy makers that can lead to meaningful results in imparting a women user's perspective in research priorities and strategies. To obtain a correct perception of priorities, there is need for direct interaction between scientists and women farmers and laborers. Scientists will have to listen and learn from resource poor rural women.

The greatest challenge before R & D institutions lies in motivating scientists and technologists to undertake a process of "listening and learning" through collaboration with poor women while developing their research priorities and strategies.

All this will call for a learning revolution. Such an education movement to be successful should aim not merely in assisting women to acquire new skills and to take advantage of development projects but more importantly aim at the education of men. Many of the current difficulties stem from the differing perceptions of men and women whether it be in family planning, or sanitation or social forestry or drinking water supply. The biogas and social forestry programmes will not succeed so long as men do not take interest in saving women from spending several hours a day in gathering fuel wood. The "Sulabh Sauchalaya" kind of sanitary toilet facilities will not spread so long as men are indifferent to women's needs in this respect. We will not have over 200,000 villages with out even one source of safe drinking water within a reasonable distance, if men were to fetch the water. Examples of this kind can be multiplied. The answer thus lies in a two-pronged strategy involving first, the social education of men and secondly, the promotion of organisations and institutional structures which can help themselves.

J. P. Naik was enthusiastic about the role that the Centre for Women's Development Studies can play in generating the requisite quantum of awareness, analysis, and action in relation to the role of women in development. I wish the Centre much success in making J.P.'s dream come true.

### ANNEXURE I

#### INTERNATIONAL RICE RESEARCH INSTITUTE Inventory of Technologies for Women in Rice Farming

1. Name of the Scientist and Department.

2. a) Technologies already developed

Description of new technology and its relevance to the traditional occupations and skills of women employed in rice farming systems at the production phase and/or post-harvest phase. Please describe each item of new technology separately.

b) Technologies in the assembly line

Potential impact of technologies currently under development by your group on women with regard to:

i) drudgery reduction

ii) income and employment generation; and

iii) new opportunities for quality of life improvement

3. What additional training programs and management and organizational skills will be needed for women to derive benefit for both already available to emerging technologies?

4. Please provide any other information which may be relevant to the goal of ensuring that the jobs destroyed by new technologies in traditional sector are more than compensated by the jobs created by the modernization process, so that labor diversification and not labor displacement is the outcome of our research designed to enhance the productivity, profitability, stability, and sustainability of rice farming systems.

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Signature