

WOMEN'S ROLES AND NEEDS IN CHANGING RURAL ASIA WITH EMPHASIS ON RICE-BASED AGRICULTURE

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ABSTRACT

This paper describes the importance of agriculture, rice production and women's roles in rice-based agriculture. It also discusses major threats to rice-based agriculture and consequences on poor rural women, among others, natural disasters and climate change, and increasing male out-migration. It also presents examples of technologies which can benefit women farmers. Finally, it presents examples of strategies in addressing the needs of women in research and technology development and extension.

Key words: women, rural areas, rice-based agriculture, climate change, migration

INTRODUCTION

Importance of agriculture, rice and the role of women in agriculture

Agriculture is the mainstay of economic activity in the rural areas, which provide the population with household and national food security. However, the share of agricultural sector to gross domestic product (GDP) in all countries has decreased due to economic transformation. Majority of the population in Southeast and South Asia live in the rural areas and will continue to depend in the agricultural sector for economic growth for poverty alleviation despite the fact that the sector's relative share in the economy has decreased. The food supply of urban consumers will depend on the agricultural production from the farming population, both men and women. In countries like Bhutan, Cambodia, Lao PDR, Myanmar and Nepal, which continue to derive more than a third of their GDP for agriculture also in India, Pakistan and Vietnam, which derive a quarter more of their GDP from agriculture, women make a substantial contribution to the agriculture sector (Table 1). The proportion of economically active female to total female population ranged from 15- 81% within Southeast Asia; 49 -98% in South Asia. In other countries in Asia, 69% of the total

female population was engaged in agriculture. In Thailand and Vietnam, the proportion of female and male engaged in agriculture is almost equal. However, in Cambodia, Lao PDR, Sri Lanka, India, Bhutan, Nepal, Bangladesh, Nepal, Pakistan and China, the number of women employed in agriculture as a percentage of the economically active population is higher than that of men. It is evident that those countries, which are low and medium achievers in human development and gender related development, have larger share of women in agriculture. Southeast countries such as Bangladesh, India, Pakistan and Nepal region are poor performers of human and gender development. High human development does not necessarily translate to an equal share of benefits of men and women. Persisting indifference to rural women's contribution to agriculture and the constraints on women's access to productive resources might impede achieving food security goals (FAO 2004).

Rice is the dominant staple food for South and Southeast Asia, except in northwestern India and Pakistan where rice is a commercial crop. The annual total harvested area for rice is about 43 million hectares or 28% of the world's total for Southeast Asia and 58 million ha or 38% of the world's total for South Asia. Including China, approximately 90% of the world's rice is produced and consumed in Asia. In countries where per

Table 1. Percent of agriculture in GDP, economically active in agriculture as a percent of total population, food security status, human development index and gender inequality index

Countries	Percent of agriculture in (GDP)	Economically active in agriculture as a percent of total population		Human development status	Gender Inequality Index
	2006	Female	Male	HDI	
		1990-99	1990-99	2004	
Southeast Asia					
Malaysia	15.2	15	21	59 (Medium)	53
Thailand	12.5	50	52	76(Medium)	61
Philippines	21.9	27	47	83(Medium)	66
Indonesia	19.4	42	41	111(Medium)	91
Viet Nam	38.7	70	71	112(Medium)	89
Cambodia	55.6	78a	69 a	130(Medium)	105
Myanmar	57.3	70a	78 a	132(Medium)	
Lao PDR	61.2	81a	76 a	135(Medium)	109
South Asia					
Sri Lanka	22.9	49	38	96(Medium)	80
India	29.3	74a	59 a	127(Medium)	103
Bhutan	42.0	98a	92 a	134(Medium)	
Nepal	50.6	98	91	140 (Low)	119
Bangladesh	29.4	78	54	138(Medium)	112
Pakistan	26.0	66	41	142 (Low)	120
Other Asia					
Japan	6	5		9 (High)	13
South Korea	8			28 (High)	30
China	26.9	76	69	94 (Medium)	83

Sources: ADB (2006); FAO (2004)

capita income is US\$500 or less, rice accounts for 20-30% of gross domestic product (GDP), 30-50% of agriculture value added and 50-80% of consumed calories (Hossain 2007). Hundred of millions of poor smallholder men and women farmers and landless workers in Asia depend on rice not only for food but for employment and income as well. Aside from dominating production and consumption side, rice is also inextricably woven into the social, economic, cultural and spiritual fabric of their lives.

The significant roles of women in rice-based agriculture had been recognized since the 1990s, through the Women in Rice Farming System (WIRFS) Network based at the International Rice Research Institute (IRRI) in collaboration with the National Agricultural Research and Extension Systems (NARES), which is under the umbrella of the Asian Rice Farming Systems Network (ARFSN). This network addressed women's concerns in specific major rice ecologies by: a) quantifying the economic (labor and income) contributions of men and women in rice – based farming systems and participation in decision-making in

household and farm-related matters; b) identifying gender differential needs and constraints in increasing productivity capacities such as access to and control of resources (education, land, credit, agricultural inputs, technologies, extension, training and agricultural-related information); c) identifying, testing and validating rice and rice-related technologies which can directly benefit women from poor farming and landless households; d) enhancing women's knowledge and skills (technical and managerial) required by new technologies; e) assessing gender-differentiated impact of technologies. Thus, the network generated research with gender-disaggregated farm-household level information and "women-friendly" technologies in specific rice ecologies under the ARFSN.

There is much evidence from these studies that both men and women contribute to rice-based farming systems. Poor rural women play important roles in rice-based farming systems as unpaid family workers, hired laborers, income earners, savers of expenditures and major caretakers of family

health and nutrition. In Asia, the prevailing rice cultivation practices demand heavy manual labor inputs and drudgery, particularly on women. However, gender roles in Asia vary by region, agro-ecological system, type of farming systems, crops grown, interlinks with livestock and fish production, and opportunities for off-farm occupation for family members. Female participation increases with poverty and in unfavorable rice environments. Based on the micro-level studies of the WIRFS network, women's contributions in rice production ranged from 27-84%. Female labor participation is higher than men in Thailand, Nepal and India. Women's labor contributions were highest in rainfed rice ecologies in eastern India, which suffer from abiotic stresses (drought, submergence/floods and salinity) and where majority of the women are illiterate. Women from the upper castes do not work on the fields while women from the lower castes work on their fields as well as exchange and hired laborers in other fields (Table 2). Except for land preparation, irrigating the fields and spraying chemicals, women dominate rice operations. Women are also repositories of indigenous knowledge of crop and natural resource management. Post harvest activities such as seed cleaning, selection, storing seeds

for the next cropping season, dehusking the grains, cooking rice or preparing rice into products for home consumption or for sale are women's domain. They add value to rice by preparing them into products for sale and consumption, use rice by-products and biomass for livestock and for other livelihood uses to save on expenditures. Preparing the meals and allocating food for their family members are women's responsibilities. In rice-based farming systems, rice is grown during the wet season. However, in rainfed areas farmers grow non-rice crops after rice, raise animals, grow fruits in their homesteads and raise fish in small ponds. Women contribute significantly in these activities since these are also sources of independent income. Home gardens and urban periphery vegetable gardens also depend on women's labor. In Bangladesh, women's contributions to the production of fruits and vegetables in the homestead, along with poultry and livestock raising, vegetable and fish cultivation, tree planting and crop processing, bring in a substantial share of the total family income. Aside from farm and marketing responsibilities, rural women continue to have the primary responsibilities for domestic activities including the hard physical tasks of water, fuel and fodder collection and

Table 2. Labor inputs in rainfed rice production (days per hectare)

Country	Villages	Total	Male	Female
India	Chandpur, Faizabad District	187	16	84
	Mungeshpur, Faizabad Sariyawan, Faizabad District	132	33	67
		211	45	55
	Khanpur, Faizabad District	210	24	76
Nepal	Naldung, Nagarkot (midhills)	269	42	58
	Mohana, Rantnagar (lowland)	101	50	50
	Baghmara, Rantnagar (lowland)	95	45	55
Indonesia	Jakenan, Central Java Sumber, Central Java	161	54	46
		178	59	41
Thailand	Ban Sai Khram, South	104	45	55
	Ban Don Paw Daeng	102	46	54
Philippines	Carosucan, Sta.Barbara	133	73	27
	Tampac, Nueva Ecija	188	68	32
Cambodia	Kandal and Takeo	167	54	46
Vietnam	He Thu District	105	45	55
Laos	Khok Nghai, Xaythani District	161	54	46
	Ak-sang, Phonethong District	178	59	41

Source: Paris 2000

gathering wild foods. Several technologies (yield increasing, drudgery reducing) were tested by women who were also given training and capacities to organize themselves in formal associations. For the first time, multi-disciplinary teams of scientists (social scientists, agronomists, agricultural engineers) addressed the technology needs not only of men but also of women who are actively engaged in rice production and processing (Paris 2000).

THREATS TO RICE-BASED AGRICULTURE AND CONSEQUENCES ON POOR RURAL WOMEN

Over the past four decades, rice production has more than tripled in Southeast Asia and more than doubled in South Asia due to the expansion of irrigation and the adoption of modern varieties with higher yield and shorter growth duration. However, the potentials for further gains through this pathway are limited. Despite the expansion of irrigation, today about 55% of the rice area in South and Southeast consists of a diverse set of rainfed environments compared in East Asia including China, about 95% of the rice is grown under flood-irrigated conditions. The production area and yields of rice is declining. From 1970-1990 to 1990-2005, annual growth in rice production declined from 3.4 to 2.6% in Southeast Asia and from 2.7 to 1.7% in South Asia. In the irrigated areas of Asia, the yield gains from the adoption of new technologies have been almost fully exploited, and in many areas, intensification of rice production has led to the overexploitation and degrading of soil and water resources. It is projected that over the 2005-2015 period, the absolute increase in population will be 200 million in South Asia and 70 million in Southeast Asia, which was about 15% of the base population in 2005. The demand for rice is projected to increase by almost the same proportion over this period (Hossain and Barker 2007). Thus, the potential additional supply of rice will have to come from the vast rain fed rice environments in Asia, where women have traditionally been contributing significantly in many aspects. However, there are emerging changes, which are affecting rice production and roles of women in rice-based agriculture. Among others, these are abiotic stresses, which are further

aggravated by natural disasters and climate change and increasing out-migration of labor from agriculture, which is becoming the pathway out of poverty.

Climate change and abiotic stresses

Climate change is emerging as a new threat to crop agriculture in terms of excessive flood related inundation, shrinking cropping season, and temperature related yield loss and could mean extra hardship for farming activities, which are often carried out by women. Drought is one of the major constraints in increasing rice production. Due to drought, farmers suffer from crop loss or low yields. Pandey *et al.* (2007) revealed that farmers who are exposed to drought risk use different combinations of coping strategies. These are crop management adjustments, consumption adjustments, expenditure adjustments, credit, asset depletion, livestock nutrition and mortality, use of forest and forest products, seasonal migration, and relief support. The impact of drought tends to vary according to class, age, ethnicity, and gender as these factors determine people's vulnerability to drought. The impact of women and young children tends to be more than for others. This is due to their socio-cultural and economic position within the family and community. Prolonged malnutrition and increasing workload during drought adversely affect women's health, especially of pregnant and lactating mothers, infants and young children suffer adversely as a result.

The increase of extreme weather conditions (e.g. floods and cyclones) will put the burden of dealing with devastation and destruction on the women. They often lose the capacity to sustain their families' livelihoods resulting from loss of seeds, crops, livestock and productive gardens. As women have the responsibility for family care they are put under great stress. Paris *et al.*, (1996) in their initial studies on gender roles in rainfed villages in Faizabad, eastern Uttar Pradesh, India revealed that the demand for family female labor in rice production and processing, animal care, collection of animal fodder and fuel wood led to changes in cooking practices (fewer meals), less time devoted to child care and breastfeeding by lactating mothers. During periods of drought, the problem of looking for

food and collecting animal fodder were mainly borne by women.

To address the problems in increasing rice productivity due to abiotic stresses, scientists, IRRI (social and biophysical) have been working over the past years on the development and dissemination of appropriate technologies for rainfed areas, which suffer from abiotic stresses such as drought, floods, temporary submergence from heavy rains, and lodging of plants due to strong winds, typhoons and cyclones. Technology improvements include the development of varieties that reduce losses to drought through various mechanisms such as drought escape, drought avoidance, and drought tolerance. Given the growing season is short, and when drought occurs during the reproductive stage, such technologies are likely to be more effective in reducing production losses. New rice varieties which are tolerant to drought, submergence and salt affected rice environments and associated crop and water management technologies are currently being tested on experiment stations and on farmers' fields with strong participation of both men and women in eastern India and Bangladesh (Paris *et al.* 2007)

According to the report of Lambrou and Piana (2007) on gender and climate change, gender concerns have generally been neglected in international climate policy. The report proposes that: a) prioritizing women in programs for education and skills training can strengthen their ability to adapt; b) women's local knowledge systems are an important source of information for natural resource management in areas affected by climate change; c) gendered division of labor, particularly in poor households, mean women need to negotiate with men over key choices about mitigation or adaptation; and c) the Clean Development Mechanism (CDM) of the Kyoto Protocol can offer women access to a range of projects using new technologies in household energy, agriculture and food processing. The report proposed several policies to ensure that gender considerations are addressed in climate change agenda, namely mitigation, the CD, adaptation and capacity building.

Out-migration of labor from rural areas

A declining labor force (and in particular a declining male labor force) will be available for agriculture, particularly on small to medium farming enterprises, and the available labor force will be dominated by women. Positive trends in declining fertility rates had led to reduction in family size while improvements in population sex ratio present a mixed picture with potential for increased matriarchal households and stress on family labor in farm sector (United Nations 2001). The region demonstrates a decreasing trend in agricultural employment rates with increasing importance of non-farm work for income security; diversity marks agriculture and rural workers with a significant contribution by unpaid family workers (women and children).

Rural to urban migration still dominates migration flows in most Asian countries because of the high proportion of the population living in rural areas. According to the *2005 Revision of World Urbanization Prospect*, the global proportion of urban population increased from 13% in 1900 to 49% in 2005 and is expected to reach 60%, or 4.9 billion people, by 2030. While urbanization continues to be on the rise, rural populations are still significant and are currently growing. However, a gradual decline in rural population is expected reaching slightly less than the current 3.3 billion by 2030. In 2005, 71% of all rural dwellers lived in Asia, primarily in India, China, Indonesia and Bangladesh. At the same time, the Asian urban population has reached over 1.5 billion. This is projected to rise to over 2.6 billion by 2030. Past and projected population trends are illustrated in Figure 1. From 2005 to 2030 the Asian urban population is expected to rise by 2.12% annually. At the same time, rural populations are anticipated to decline by 0.2 % annually. What are the implications of labor out-migration on gender roles?

In 2000, IRRI initiated micro-level studies on the incidence, patterns and impact of labor out-migration on rice productivity and gender roles in eastern India, north Thailand, central Indonesia, northern Philippines. These studies were further extended in Vietnam, Northeast Thailand and central Philippines in 2005. Synthesis of findings from the study in eastern

India revealed that migration of males is higher in rainfed than in irrigated rice ecologies. Men migrate on a short term (seasonal) or long-term basis. The females, particularly from the lower socio-economic status have higher illiteracy rates, low access to resources and suffer from social exclusion. Despite male absence and the constraints they face, the women left behind continue to bear the pressure to prevent loss or further erosion in crop yields and income at the same time maintain family food security. When their remittances are delayed they borrow from their friends and relatives, use up their savings, resort to “late sowing” of rice, employ sharing/exchange of labor and sell their animals. They resort to off-farm and non-farm work accepting lower wages compared to men. Among nuclear households, wives are compelled to take on supervisory roles and make decisions on farm-related matters, which used to be done by the male head of the household. In this situation, they become *de facto* female managers. Women from households with migrants showed higher Women Empowerment Indices (WEIs) on farm related matters than those women in households without migrants. Thus, they get empowered because of men’s absence. They participate in decision making at least by managing small budgets, their mobility is increased as they sometimes go to the market to sell their products even if they still rely on male relatives for major decisions (Paris *et al.* 2006).

Male labour out-migration has led to flexibility in gender division of labor in farm activities. In Vietnam, women are now in charge of tasks formerly performed only by men (e.g. spraying of chemicals, broadcasting fertilizer, irrigating the fields, hauling and marketing products) leading to major health risks, related to the unregulated use of chemicals and pesticides (Chi *et al.* 2007).

Poor and illiterate women will continue to be immersed in agriculture and will bear a heavy burden of farming tasks, with less access to other income opportunities than men. The elderly and the women left behind will face the challenges of maintaining rice productivity and family food security with less land, less water and less labor and will have to deal with unpredictable biotic and abiotic stresses, unless technological progress are made.

Rural women who are major contributors to household income and female-headed households in the economically disadvantaged and socially marginalized groups have to be identified as a subgroup of stakeholders. Efforts in involving de facto and de jure female heads of households actively engaged in rice farming in participatory research, village training and extension programs are now going on in several problem-oriented research projects in IRRI particularly in those rice ecologies where labor out-migration is occurring.

WAYS TO ENABLE POOR WOMEN TO BENEFIT FROM NEW TECHNOLOGIES

Whether technical change benefits women depends on their control over resources. Women in farm households who have some control over the income from land will benefit from any type of technical change in agriculture. Women hold the keys to family food and nutrition security and improved well-being of their children. Hence the development and ultimate adoption of technologies (crop, livestock, fisheries, water management, and agro forestry) in terms of new varieties, new breeds and management will benefit women. Social analysis-gender analysis – is important to increase understanding of the gender-based division of labor and gender differences in access to and control of resources and benefits. Reducing gender inequities and tapping women’s potential as agents of change are key strategies for reducing poverty, sustaining household food security and nutrition, and protecting the environment.

In the Philippines, women-friendly technologies, which were identified, tested and validated under WIRFS network, were found to benefit women (Table 3).

STRATEGIES IN ADDRESSING THE NEEDS OF WOMEN IN RESEARCH AND TECHNOLOGY DEVELOPMENT

More than twenty years of experience with research and development has shown that technology is not neutral. Women are vital to food security and family well-being and their need for labor-saving and income-generating technologies is acute. However, most research and development programs from the 1970s through the mid-1990s merely recognized

Table 3. Rice and rice-related technologies with positive benefits for women farmers

Description of Technology	Positive Benefits for Women Farmers
High yielding and short maturing glutinous variety	Increases land productivity; provides income during hungry period, before harvesting main rice crop Provides independent income from sale of glutinous rice cakes
High yielding and short maturing mungbean variety	Increases cropping intensity in rainfed lowlands; Provides the family with vegetable protein and additional income after rice
Post harvest machinery for processing rice Rice huller	Reduces drudgery of handpounding Increases volume of glutinous rice processed Saves time and provides flexibility in time use
Rice micro mill Rice flour mill	Provides additional income during the hungry months Empowers women individually and as a group
Rice husk stove	Reduces use of purchased energy Uses available rice biomass
Improved seed management practices	Increased grain yields by 10 percent and reduced the number and population of weed species in selected seeds
Integrated pest management	Reduces costs of pesticides Reduces/eliminates harmful effects of pesticides on human health and food in the natural habitat
Upgrading of poultry breeds Use of local crop byproducts as ingredient for swine ration	Provides women independent income Increases profitability of backyard swine production

Source: Paris 2000

women's contributions to the development process and the effect of the process on them. As a result, new technologies often had detrimental consequences not only to the economic security and social status of women and their families but also to these programs' and projects' ability to meet national and regional development objectives. Women's work, particularly in rural areas, is arduous and time consuming. Women and children carrying heavy loads of wood and water, and women pounding grain, are familiar images. Increasingly, though, girls are also sent to school, studying science, and contributing to technology development. Technology has tremendous potential for enhancing women's welfare and their empowerment. Selling or renting technology or using it for better market access contributes to women's empowerment as her income gives her a stronger bargaining

position in household and community decision making. Three areas of technology research and adaptation can make substantial contributions to rural women's well-being and empowerment: agricultural production and post harvest processing, information technology, and energy.

There is an urgent need for research and priority setting to ensure that women benefit from modern agricultural technologies, rather than being disadvantaged by the implementation of technologies as what has often occurred in the past. Gender issues and concerns should be addressed in each stage of research and development R&D. Measures should be taken to ensure that modern agricultural technology will not undermine women's autonomy, but rather will help women to gain more autonomy. The following strategies are to:

- a) develop agricultural technologies which increase the returns to female labor, whether through decreased demand or increased labor productivity
- b) enhance women's technical knowledge and skills required in the adoption of improved varieties and crop management techniques

Along with R&D, other policies such as improving access to land and water for productive uses, changes in discriminatory laws that exclude women from land ownership, getting loans or opening bank accounts are needed and providing equal pay for women working in agriculture.

GENDER CONSIDERATIONS IN EACH STAGE OF R&D

1. Identification of needs and opportunities

Identify the roles and needs of rural women to reduce their drudgery and increase their returns to their labor. Ask who does what and to what extent (labor hrs/day/ha or hrs/day) men and women spend in different activities/operations on rice, non-rice crop, livestock, fisheries, agro forestry, etc. What constraints do women face in increasing their productive capacities? Define target groups.

2. Project design

Match the needs with already developed technologies or technologies which need to be developed (Technologies can be yield increasing, labor-saving, energy saving, reducing drudgery).

3. Implementation

Test and validate the technology needs with women farmers (Women should be involved as farmer-cooperators). Their criteria should be included in technology design.

4. Monitoring and evaluation

Include gender-related variables in monitoring and evaluation. Baseline studies should include gender-disaggregated labor data, income contributions (off-farm, non-farm, remittances) from men and women; returns to female and

male labor should be analyzed particularly returns to female family labor (imputed value of unpaid and exchange labor)

5. Impact assessment

Assess the impact of the introduced technologies/interventions on men and women from different socio-economic groups. (Indicators should be developed to assess changes and returns to female labor productivity, economic independence, income changes in empowerment, status, nutrition status, etc.)

TECHNOLOGIES THAT CAN BENEFIT WOMEN FARMERS

Based on women's constraints, several technologies can directly benefit women. These technologies are: yield increasing, drudgery reducing, labor-saving, energy saving, etc.

Yield increasing technologies (New varieties, new breeds)

In eastern Uttar Pradesh, India, abiotic stresses such as drought, submergence and soil salinity within a year resulted to crop loss or low productivity. Thus, scientists have been developing drought, submergence and salt tolerant rice to ensure that poor families have rice to eat and provide employment and income for the poor farming and landless households, especially women. Women often share or have complete responsibility for the selection and purchase of seeds, and for seed storage and pre-germination tests. They are also involved in the cultivation and do most of the drying and husking. Women often exclusively care for livestock, which are fed rice by-products. It is therefore important to consult women about criteria to be used in the breeding of new varieties and to involve them in programs 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 varietal identification, interaction with weeds, insect pests and pest predators, and soil conditions, tolerance to drought, submergence/floods, salinity, 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), post harvest qualities (easiness in harvesting and threshing by hand) and cooking and eating preferences.

However, in breeding for rainfed environments, farmer participatory varietal selection (PVS) is necessary to accelerate technology adoption. Thus, there is a need for understanding farmers' biophysical, social and cultural environment, farmers' needs as well as the traits which they look for in growing rice varieties for rainfed environments. PVS conducted in eastern India revealed that varietal preferences may differ in terms of socio-economic groups and gender. Both men and women agreed that a major determinant of varietal choice is the conscious attempt of farmers to match varieties with the landtype, adaptation to different user needs: food, livestock fodder, thatching, and cash. However, there were gender differences in rice variety preferences based on differences in gender roles in rice production and the use of rice as food and by-products. A study on the impact of participatory research in rice breeding on women farmers in eastern Uttar Pradesh revealed that participation of women in PVS, increases women's decision-making authority in varietal choice, seed acquisition and disposal and crop management. Since women from poor farming households in eastern Uttar Pradesh, India comprise a special category of users of technologies, they should be given skills and training on farm-related matters and to further enhance their crucial roles in accelerating the adoption of new varieties for fragile rice environments (Paris 2005).

Thus, plant breeders are now more conscious in involving women farmers as many as possible in soliciting criteria for rice varietal selection, as evaluators of lines included in varietal trials on farmers' fields, as cooperators of farmer-selected lines which they test on their own fields and as evaluators of the new lines for quality traits. Plant breeders now realize that women's knowledge and criteria – particularly, for post harvest and cooking and eating quality- are important considerations in developing rice varieties particularly for rice ecologies, which suffer from abiotic stresses.

Improving quality of seeds through improved seed health practices

Women in the household are responsible for seed management. In both South and Southeast Asia, the new replacement rate in rice cultivation is very low – from 10 to 20%. A study in Bangladesh found out that about 80% of the farmers kept the seed from their own harvest, about 10% purchased or exchanged it with their neighbors, 5% got it from NGOs and the remaining 5% is supplied by the public sector (Hossain 2004). In this informal process, seeds can be contaminated with disease and lose vigor and viability unless properly addressed. In one of the many subprojects of the Poverty Elimination Through Rice Research Assistance (PETRRA) conducted in Bangladesh, husbands and wives were trained on how to practice seed health improvement. After the training, they grew selected and unselected seeds in their fields. Results showed that their yield increased by 10%, germination increased 20% and seed rate decreased 35%. Fourteen thousand farmers (men and women) in 52 upazilas in 16 districts participated in the training. Village women were included in two ways: training in specific technologies in which they were actively engaged and training in the overall production system, so that they could contribute more to decision-making. This latter emphasis was seed as pro-active development for women. Several successful women-led projects included promotion of seed-drying tables and video-centered learning (experience of using village women to further extend technology). Similar training programs are given to men and women in projects under the Consortium for Unfavorable Rainfed Environments (CURE). Farmers lack confidence on the quality of seed supplied by the public sector. Private-sector companies do not market rice seed because of government regulation on seed pricing.

Food processing (adding value to crops)

To reduce women's drudgery in processing rice into flour and enhance income opportunities to improve their livelihood, a portable rice flourmill was introduced to women in partially irrigated villages in the Philippines. This technology, which was introduced in Bangladesh, is

managed by self-help groups in Bangladesh, which is being coordinated by WAVE Foundation an NGO based in the southern part of Bangladesh. The majority of the women who participated in the evaluation are landless and victims of domestic violence and widows. The result showed that using this machine increased their income substantially. Moreover, their social status within the village improved due to their increased capability to uplift their economic status, despite their personal problems. The portable rice flourmill was instrumental in giving them economic independence resulting to improved self-respect and self-esteem. Resources should be provided to reach large numbers of poor women in Bangladesh who can earn income by processing rice into other food products.

Labor-saving

Development of machineries that facilitated the use by women can contribute to limiting the gender division of labour in many regions and alleviating some of the labour constraints experienced by rural women, hence, improving the well-being of the woman farmer, and others in her household who are dependent upon her care. An example of a technology is the plastic drum seeder for wet seeding crop establishment of rice, which decreases seed rates, reduces labor requirements and increases rice yields. This technology is rapidly increasing in South Vietnam, Bangladesh and irrigated areas in eastern India. An impact assessment of this plastic row seeder in South Vietnam revealed that progressive farmers who had more frequent contact with extension workers, who had better-educated wives and who used low seed rates were more likely to adopt row seeders. More than half of the poor women from farming households who worked as wage laborers in hand weeding and gap filling were displaced by this new technology. The poor and landless women fare the worst due to lack of alternative job opportunities and increases in debts. In order to mitigate the anticipated negative impact of row seeders on poor women, extension agents and non-government organizations should facilitate the formation of women's groups and cooperatives, thereby enabling them to have access to and control of this equipment, and provide custom services to other farmers (Paris and Chi 2006). Other

labor saving technologies, which may have different effects on different categories of women, are direct seeding, herbicide use, harvest and threshing machines and post harvest processing machines (Paris 1998).

Energy-saving

Low-cost, reliable sources of energy for processing, cooking, and lighting can provide a great leap forward for meeting rural women's practical needs for less burdensome work, improved health, and more time. In rural areas, energy from biomass is used for cooking and heating; and energy from human and animal labor performs other tasks. At the household level, the major use of biomass is for cooking, but food processing, especially milling and hulling, is the most arduous work. Biomass is now declining as a resource and electrification is limited. To reduce dependency on carbon sources, increase power, and reduce women's labor burden, reliance on wind power, micro-hydropower, and solar photovoltaics is growing. These small, flexible energy sources also offer entrepreneurship potential, for example, in supplying lamp parts in Bangladesh. Energy for lighting, from photovoltaics and batteries, contributes to public safety—a particular concern for women and girls. In the 1980s, fuel-efficient stoves were introduced in developing countries to reduce women's labor, conserve fuel, and decrease pollutants causing poor health. Acceptance was slow: engineers' designs did not meet women's needs, and women often lacked independent funds with which to buy them. Now, as engineers work more closely with women and local artisans, modified stoves fitting women's criteria are becoming acceptable.

Information technology (IT)

Due to gender blind technology development programs, women and girls usually have fewer opportunities than men to access information, and to learn how to use new technologies. Hence, they are at a disadvantage in making informed choices around crop selection, food production and marketing. Lack of information also limits their influence in their communities and their ability to participate in decision-making. Information technology (IT) has a

strategic link with poverty reduction. The Internet, email, and wireless mobile phones top the list of new tools. IT can directly empower the poor by offering access to services historically unavailable to them because of high cost or lack of infrastructure, particularly in rural areas. Buying, selling, or renting IT equipment to others is a source of income. In Bangladesh, Grameen Telecom makes loans to those who wish to buy wireless phones and rent them to neighbors. "Phone ladies" benefit from rents and timely access to ICTs constitutes the basis of the redefinition of traditional gender norms and supports a media of information, understanding and knowledge in which women's interests, opinions and rights are taken into account. Considering that women's knowledge in production methods, plant selection and biodiversity is an important resource for sustainable agricultural development, supporting women to retain, document and disseminate their knowledge is an important challenge. Linking women farmers with open markets, using effective, appropriate and cost-efficient information and communication technologies (ICT) can promote skills development among resource-poor farmers, thus enabling them to improve their economic prospects and quality of life. The mobile phone is an example of an information technology, which is increasing exponentially among women as well as men because it is appropriate to the circumstances of people in many developing regions. Cellular phones are also a portable market research tool in allowing producers to find and compare current market prices for their products, eliminating the middleman, and ensuring greater profits for their product (FAO 2004).

EXTENSION STRATEGIES THAT CAN EFFECTIVELY REACH RURAL WOMEN

Experience has shown that when the use of a new technology starts to produce income, whether it is a newly profitable crop or new processing equipment, it is often taken over by men. Care in developing the technology in ways that empower women so they could control it is essential. Gender-sensitive germplasm and crop management technologies will also expand the range of crops and focus on cash, subsistence crops and local varieties. It will take into consideration all phases of

agronomic management and post-harvest duties that are often neglected. The following are gender considerations for extension strategies to effectively reach rural women.

Farm level

Take into account cultural context and spatial restrictions on women's works.

Agricultural programs designed to increase women's income and household nutrition must take into account the cultural context and spatial restrictions on women's work as well as patterns of intra-household food distribution and most importantly women's criteria for technology adoption. The latter often favours males, which can give rise to micronutrient deficiencies in women and children, which impair cognitive development of young children, retard physical growth, increase child mortality and maternal death during childbirth. If the current male biases in agricultural research and policies persist, modern agricultural technologies will most likely widen the gender gap further. This will affect the health and well-being of women and children, environmental sustainability, and income levels in developing countries. The creation of new forms of integrated agricultural research and extension systems, and income-generating programs targeting women/women groups remains therefore a challenge for research and development and national agricultural research and extension institutions.

Tap and strengthen women's organization.

Women farmers' access to membership and leadership positions in rural organizations (e.g. cooperatives, agricultural producers' organizations, farmers' associations) is often restricted, by law or custom, which restricts their access to productive resources, credit, information and training and their ability to make their views known to policy makers and planners. However, progress in these aspects has improved for the past decade. Formation of women's groups also led to access to micro credit for income generation and technologies. The micro credit, through the Grameen Bank, for poor women borrowers in Bangladesh contributed to women's empowerment and improvement in their status within the family

and society. This credit scheme proved women's ability to pay repayments. The last decade has witnessed an incredible growth in the number and spread of self-help groups (SHGs) or women's micro-finance groups dealing with income generation through micro-credit in Bangladesh, India, Nepal, and Pakistan. Through the SHGs, women's income became a permanent component of household income and weakened patriarchal gender relations, reducing women's dependency on the male provider. However, there are criticisms that the SHG strategy has increased women's workload and made them more vulnerable to stress. It suggested that the concept of SHGs be extended to mass based organizations of women, the vast majority of whom are legitimately concerned with lack of food, housing, potable water and employment (Sujaya 2006). In cases where women are the main producers, it may be effective to establish women-only producer organizations or cooperatives.

Institutional level

Mainstream gender concerns in programs/projects in institutions.

Mainstreaming is important because inequalities in the access to development resources and opportunities hamper economic efficiency and sustainability. Gender mainstreaming requires a planning process that promotes the well-being and empowerment of both women and men. Gender should be mainstreamed at the earliest possible point in the project or program cycle, as it can fundamentally affect the entire project/program concept and structure. It is not a one-time exercise during the project or program planning phase, rather an integral part of the entire planning and implementation process and continues throughout the life of the project or program. However, before this takes place, statement on policies, which address gender issues/concerns within organizations, should be in place. For example, in IRRI policies are now in place and gender concerns are included in IRRI Strategic Plan from 2007-2015 (IRRI 2006). The project "Poverty Elimination through Rice Research Assistance (PETRRA) had a strong gender strategy before the project was implemented (Paris, 2001).

Mainstream gender concerns in agricultural curriculum.

The general lack of awareness of different gender roles and needs in the curricula and training of extension workers who can relate to women farmers, excludes women from training and the benefits of extension services. Women extension workers are still often trained only in home economics and do not have the skills to provide training. Re-designing agricultural training curricula to include women's concerns is an important component of mainstreaming women's concerns in agricultural education. The M.S Swaminathan Research Foundation (MSSRF) and the Centre for Studies on Gender Concerns in Agriculture of the Kerala Agricultural University developed course modules for undergraduates in agricultural universities titled "Gender Issues in Agriculture and Rural Livelihoods". Its aim is to sensitize the students on gender issues in rural India (Sujaya 2006).

Enhance women's leadership roles as managers and researchers in R & D and extension and provide support for young female scientists to pursue their careers in science.

Although the number of women pursuing scientific careers is increasing in Asia, female researchers still tend to be underrepresented in senior scientific positions. Women's roles in research are important at all levels from the farmer to the scientist. But if the number of female scientists, researchers and technicians is to increase then more training opportunities are essential. IRRI has made considerable efforts to increase the number of women undergoing degree and non-degree training. There is a need to enhance the capacities of women to enable them to take up leadership in their organizations, so that they will be able to address the problems of poor women in their work. They can also mentor the next generation of women scientists, managers and leaders through influencing the policies and practices that affect women. For the past five years, IRRI has been providing the course "Leadership Training for Asian Women in R & D and Extension" to professional women engaged in research, development and

extension organizations dealing with rice (IRRI 2005). Based on the testimonies of the participants, particularly from South Asia, the course has helped them tremendously in balancing their work and family, gained confidence in communication and to have a better appreciation of the contributions of their work in improving the lives of rural poor, especially the women. Young women scientists particularly in developing countries should be provided with support to enable them to pursue their careers by giving them opportunities to present their research in international and national forums. There should be a mentoring program to enable them to enhance their skills and knowledge from senior scientists.

Exchange collaboration programs for young scientist are also going on between IRRI and other countries. For example, young staff members from Rural Development Administration (RDA), Korea visited IRRI in a collaboration exchange program to enable young scientists to enhance their skills on gender analysis, participatory research and methodologies for social science research.

Increase women agricultural extension agents.

Only 15% of the world's agricultural extension agents are women. Women's access to education (80% of rural women in eastern India are illiterate) and extension are limited due to lack of access to membership in rural organizations, which often channels or gives inadequate attention to women farmer's needs in terms of crops and technology. Providing extension advisors with expertise in marketing, food processing and post harvesting. This will allow them to enhance the knowledge of women who often dominate in small scale processing and retailing in developing countries. This can be achieved by conducting demonstrations of improved post harvest handling practices, for example, in the local marketplace, where women gather to sell their goods or to shop for food. In Bangladesh women's/village-based small enterprise development has been headed by women, although women were considered by extension workers to be 'unreachable' (FAO 2004)

Training farmers as trainers will also provide an opportunity to share their experience and knowledge. In particular, women

can play an important role in training other women. In Bangladesh, the project Poverty Elimination through Rice Research Assistance (PETRRA) has tested several approaches to rapidly disseminating farmer-validated technologies and to ensure that they respond to women's needs – not only to men. These are women-led extension on seed drying and storage, women-led group extension on rice-potato-rice cropping technologies, family approach to extension on rice and seed production and farmer-to farmer extension on seed health improvement. Women-to women and family approaches reached poor women effectively. Varied learning tools for women such as color photographs, educational videos by women for women, educational entertainment were also tested. Women who participated in these projects said that they benefited from the training not only in terms of production and income, but also in recognition, saving money, making sound decisions, managing crops better, among other benefits. Despite social barriers and low levels of formal schooling, women could be effective change agents if given equal opportunities as men in giving training and access to support services (Paris *et al.* 2005). In a policy dialogue held in Dhaka, Bangladesh, several gender-responsive policies were suggested, one of which was to channel agricultural credit through women rather than men (Hossain *et al.* 2004).

CONCLUSION

Despite the importance in agriculture, there are threats in increasing household and national food security, which can lead to negative consequences on women. Thus, rural women will play even greater roles in sustaining household food and nutrition security. However, the greatest challenge lies in implementing gender –sensitive policies for equitable access to resources and opportunities for men and women engaged in agriculture. Women who are left behind to manage their households and farms should be deliberate participants of extension and training programs dealing with rice technologies. They should be empowered to make sound and timely decisions on farm-related matters. Thus, they should be given adequate and timely information; knowledge on new varieties and their associated crop and natural resource

management practices and be involved as cooperators in participatory experiments conducted in environments which suffer from natural disasters and climate change. International and national agricultural research and extension institutions can contribute immensely in addressing the needs of women engaged in agriculture who hold the key to household and national food security, poverty alleviation and the welfare of the future generation.

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