Gender Equity in Science and Technology for Development

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Gender Equity in Science and Technology for Development

Gender Working Group, United Nations Commission on Science and Technology for Development

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Chapter 4 Women spearhead food security

Science and technology an asset?

Shimwaayi Muntemba and Ruvimbo Chimedza¹

Historically, women have evolved systems of relating to and managing the resource base and have developed technologies to assist them. Their science and technology (S&T) was locally oriented and location specific. Their knowledge base provided them with diverse ways of meeting their food needs. Disruptions to this knowledge base have threatened household food security. In addition, gender relations at the household, institutional, and national levels; approaches of modern S&T; land dispossession; and structural constraints that resource-poor communities face have all converged to undermine food security. However, a ray of hope may be seen in the shifts occurring within governmental organs, among nongovernmental organizations (NGOS), and within poor communities themselves.

We define food security as maintaining desirable nutritional levels (quality) and staving off the pangs of hunger (quantity). We focus on the household, while acknowledging the importance of sufficient food stocks at the national level. Food security means desirable consumption levels not only for families and households, but also for their most vulnerable members — young girls, the elderly, and women. Food security depends on who controls access to available food at the household level. Central to the issue of household food security, then, are issues of gender and intergenerational equity.

There are two ways to get food - producing it (physical access) and buying it (economic access). At the heart of physical access is the question of who controls the means of production.

¹ We thank Perpetua Kalala, an intern at the International Development Research Centre and a member of the Gender Working Group Secretariat, for her assistance in obtaining necessary background information that was not readily available in our countries of residence.

Resource-poor farmers often have limited land; most women neither own nor have direct rights to use land. Food security implies agricultural systems that ensure high yields and sustainable productivity. Labour and S&T are critical to ensuring this productivity, but must also protect and enhance the resource base. Food security includes knowledge of good land and crop "husbandry." Gender and intrahousehold relations determine access to and control over these factors, and their control has implications for availability of food stocks at the household level. In most cases, women have limited access but no control.

Economic access is the ability of people to purchase food from national stocks or other sources. It depends on the availability of opportunities for off-farm activities or wage work. Factors such as access to credit, mobility, and location of markets all affect the ability of rural families to raise their incomes. Economic access, then, must be seen within the broad context of rural development.

For the urban poor, formal and informal employment opportunities are essential, but economic access is related to gender. Women, although central actors in food provision, have less access to income-generating activities. Household food security is thus compromised. In much of the Third World, policies reinforce this prejudice.

Households experience food insecurity as a result of several factors:

- "Hunger months" within the normal agricultural cycle (Richards 1932; Agarwal 1992b);
- + Natural calamities such as droughts, leading to famine;
- + Human-caused crises such as civil wars;
- Severe ecologic degradation that diminishes land productivity; and
- + Policy-led choices about what crops to grow and where.

However, there need not be "hunger months" if sufficient levels of productivity can be reached. The effects of natural calamities need not be disastrous if nations have sufficient reserve stocks, and households have the income to purchase food. However, coping with normal shortfalls and disaster-driven calamities reveal relations among household members within the context of gender. Gender and intergenerational equity are challenged as households cope with food deficits. Women make most of the adjustments, as they and girl children are the first to forgo most of their nutritional needs. Although technologies have been developed or enhanced in response to recurring calamities, they do not build on existing technologies, allow for local participation, or reach the major custodians of food security – women.

As the ranks of the hungry increase, food security has become an issue of basic human rights. The United Nations (UN) has focused global concerns over food security. Initially, efforts of such agencies as the Food and Agricultural Organization (FAO) of the United Nations and UN commissions on women, S&T, and gender were unintegrated. However, from the 1970s, some issues began to converge. Interlinkages between gender, enduring food security, S&T, and a healthy environment have emerged. In this paper, we examine what changes various UN declarations have brought about in terms of shifting access and control of the means and factors of production; in changing policies and attitudes; and in empowering the most vulnerable social groups and households.

Food security is closely linked to environmental issues and its sustainability. Some countries have attained short-term food security by importing, but others look to increased domestic production. In many countries, smallholder producers meet the bulk of national food needs through sale of their surpluses. However, the land and water resource base, on which rural production depends, have been coming under mounting stress: desertification, deforestation, soil erosion, and sinking water tables are widespread and this stress has further challenged food security.

Relation of food security to sustainable livelihood security

Lasting food security is based on sustainable livelihood security. Sustainable livelihood security is defined as (Advisory Panel on Food Security, Agriculture, Forestry and Environment 1987):

> Adequate stocks and flows of food and cash to meet basic needs. Security refers to secure ownership of, and access to, resources and income-earning activities, including reserves and assets to offset risk, ease shocks and meet contingencies. Sustainable refers to the maintenance or enhancement of resource productivity on a long term basis. A household may be enabled to gain sustainable livelihood security in many ways through ownership of land, livestock, or trees; rights to grazing, fishing, hunting or gathering; through stable employment with adequate remuneration; or through varied repertoires of activities.

Achieving food security challenges us to create an environment that enables and facilitates an increase in productivity and in the incomes of those who are poor in resources. Sustainable livelihood security requires the reversal of the trends to marginalize the poor as a prerequisite to food security.

Sustainable livelihood security automatically raises gender issues, because it requires that we answer the questions who owns what, and who controls what. Various studies in Asia, the Middle East, Africa, and parts of Latin America (FAO 1990a) show women as the majority of agricultural workers (70% in Asia and 30–90% in Africa), as livestock tenders and managers (in the Middle East), and as food producers (73% in sub-Saharan Africa, Colombia, and the Caribbean). In all cases, women are the hewers of wood and drawers of water. The quest for sustainable livelihood security enables us to address issues of their rights to ownership and use of the means and factors of production. It challenges governments to come up with policies and action plans to make enduring food security a reality, in both rural and urban areas.

Sources of food security

Agriculture

Food security is intimately tied to sustainable agriculture. Three production systems dominate world agriculture:

- Industrial agriculture, which is capital and input intensive, is practiced in temperate zones of Europe, North America, Australasia, and their enclaves in the Third World.
- "Green Revolution" agriculture is more widespread in Asia and in parts of Latin America and North Africa. Resourcerich farmers in these areas enjoy the benefits of this system.
- Resource-poor agriculture uses rain-fed systems and is practiced in diverse, complex, and vulnerable conditions. Farmers tend to be resource-poor in all ways except perhaps in terms of human resources. This type of agriculture predominates in much of sub-Saharan Africa and in the hinterlands of Asia and Latin America. This system also includes the agriculture practiced by the urban poor.

Gender plays an important role in agricultural production systems, and questions pertaining to food security must consider such gender-determined factors as who enjoys property rights; who has control; who has access to what; and who does what work. Ownership of land eludes over 90% of women in resource-poor agriculture systems. The majority of the 70% landless people in Asia are women. In parts of Africa and the Caribbean where women have traditionally held land rights, they have been losing these rights progressively to men.

In many countries of Asia, Africa, and Latin America, privatization of land has accelerated the loss of women's land rights. Titles are reallocated to men as the assumed heads of households even when women are the acknowledged household heads. Women's knowledge, which is critical to S&T and food security, becomes irreparably disrupted or irrelevant as a result of the erosion or denial of their rights (Muntemba 1988; Okuneye and Nwosu 1988).

Equally important is the quality of land. In some countries, peasants are being forced onto poor quality land as better areas are allocated to cash crops. The problems of the (mainly) women who are left to produce food crops in marginal areas are compounded by land and water degradation, particularly through soil erosion and deforestation.

Soils have also been affected negatively by the inappropriate use of fertilizers. To increase production, chemical fertilizers have been sold to farmers without information on possible adverse consequences of overuse and how to minimize them. In 1987, Muntemba interviewed a peasant woman farming on the central plateau of Zambia. This head of a household of seven described the acidification of her land due to overuse of fertilizer. Her urgent appeal was for information on technology to help her reclaim her source of livelihood, and she was prepared to sell her cattle to make this possible.

Control of land is the most basic requirement for food security. However, its productivity is imperative. In resource-poor systems, producers have to manage not only with land of poor quality, but with a scarcity of resources. Historically, such producers have experimented with and implemented innovations to match their food requirements to supply, without undermining the productivity of their resource base. Swaminathan (1981) succinctly captured a critical element in S&T when he wrote, "Agriculture starts moving forward only when appropriate packages of technology, services and public policies are introduced in a symbiotic manner."

Fisheries

Fish and other aquatic products provide about 6% of the protein consumed by the world's population; they account for about 17% of all animal protein. In some countries, however, over a third of people's animal protein comes from fish, and in some African countries the proportion is half or more (Advisory Panel on Food Security, Agriculture, Forestry and Environment 1987). Fisheries are also important as a source of employment and income necessary for food security. Fishing for sale and trade is often dominated by men, whereas women concentrate on fishing for domestic consumption (Muntemba 1977). However, women's fish-processing activities for local and urban markets have been a major source of income in some countries (Steady 1985).

Fish farming is proving to be another cost-effective source of food. Because fish farms can be established at a relatively low cost and are easy to manage, they can be maintained as a small-scale activity. Fish farming can be a means to rehabilitate ecosystems and exploit agriculturally less-productive soils. Thus, some individual farmers and countries are making use of their wastelands in this way. Additionally, because fish-farming is a low-cost operation, it is lesssusceptible to gender biases.

Household incomes

The increasing numbers of landless people in Asia and parts of Africa and Latin America and the growing rate of urbanization mean that problems of economic access to food are becoming acute. At the height of the food crisis of the 1980s in Africa, it was noted that there were enough food stocks in the world to feed the planet's populations, but only those with economic power could obtain food. Even in countries in crisis, the rich never go hungry. During the famines of Bengal in 1943, Ethiopia in 1973, and Bangladesh in 1974, the amount of food consumed per capita was no less than in previous years. Those who died did so because they could not obtain food (Agarwal 1992b).

As landless people turn to wage work, the gender factor also comes into play. Women seem to generate less income than men even though they work as hard or harder. Studies from India and Kenya reveal that the family income of female-headed households is 50% less than that of male-headed families (FAO 1990a). Increasingly, as wage employment opportunities decrease and wages become inadequate, many turn to other nonfarm activities. West African women can be seen in capitals away from their own countries trading various wares and providing services, especially foodrelated. Regional cooperation and liberal laws governing cross-border movement have made this possible. As entrepreneurs, women have become increasingly innovative, adopting and adapting tools to increase their output. A visit to any West African capital will reveal a diversity of food-processing technologies.

Wildlife resources

For resource-poor households, "commons" have been a good source of food security. In Zambia in 1976, many farmers denied that they experienced "hunger months" in their agricultural cycle, because they relied on food gathered from the forest at these times (Muntemba 1977). Collected tubers supplied them with starch and carbohydrates, wild vegetables and leaves were gathered for relishes, and fruit was picked. The onset of rains brought other wild foods rich in protein, such as flying termites, caterpillars, and locusts (Chimedza 1993). To many poor households, wild foods remain an integral component of food security. Yet proponents of modern S&T have regarded some of these resources as pests.

Collection of wild foods for domestic consumption has been the responsibility of women. They have developed precise knowledge of the biodiversity and chemical composition of local plants to avert any danger of poisoning, and have passed this knowledge to younger generations in informal but systematic ways. This chain of knowledge has been disrupted as poor farmers and other rural dwellers are forced into foreign ecosystems.

Many communities in developing countries have been moved, sometimes several times, to make way for development projects, sometimes during the most inconvenient period in the agricultural cycle. Colson (1971) followed the fate of people moved from the neighbourhood of the Kariba Dam, constructed on the Zambezi River to provide electric power to Zambia and Zimbabwe. In the first few years of resettlement, a significant number of these people were killed and many others suffered from various forms of food poisoning because they were dealing with an unfamiliar ecosystem.

Gender issues in the S&T of food security

Women's roles have been pivotal in achieving food security for their families and communities, but their efforts are beset by structural and societal constraints. In this section, we explore the processes that have undermined women's knowledge systems and frustrate their participation in modern S&T systems.

Women's knowledge

Women relate to the various sources of food security as part of their daily work. They manage soils and other land-based resources and have accumulated intimate knowledge of their ecosystems, developing strategies for managing change. Women have amassed valuable knowledge in such areas as plant genetics, pest management, and soil conservation. For example, in Zimbabwe, women farmers do not buy seed to grow basic foods: millets, sorghum, peanuts, groundnuts, and sweet potatoes. They *select* seed, looking for particular traits, such as stability, disease resistance, drought tolerance, palatability, and storage potential.

Women have determined which plants to grow where to control pests. They are particularly well informed about intercropping, mingling plants that complement each other, and have developed ways of storing produce from one agricultural season to the next. Their role in conservation and utilization of plant genetic resources is valuable. Women continue to develop genetic diversity. Through their creative practices, they preserve cultivars that are environmentally sustainable and socially acceptable.

However, this knowledge base has been upset be development factors and processes that include forced population movements to unfamiliar ecosystems; breakdowns in the transmission of knowledge, resulting from disruption in social organization; intergenerational breakdown as younger people leave rural for urban areas; and new systems of education that require physical absence from traditional sources of knowledge. In some cases, the break from the familiar base has not led to positive adjustment and innovation, as producers attempt to follow technological practices without sufficient scientific support.

Women and S&T

New technologies have not built on women's rich knowledge base. The social (colonial) and cultural (male) milieux in which technology and modern science were introduced in the colonies did not acknowledge the existence of practical S&T among the conquered. For a long time, researchers failed to recognize that, in most African and Asian smallholder agriculture, women have been the key actors in foodtechnology development.

In many quarters, it is now accepted, although not yet acted on, that technology can be of sustainable use if it is compatible with prevailing systems, management skills, acceptable cultural practices, and the prevailing socioeconomic resource base. If these factors had been taken into consideration, women, as custodians of local knowledge and food-production technology, would have been strengthened by new S&T. Sustainable agriculture and food security demand strategic interaction between traditional and modern systems.

The shift of agriculture to men's control

Official colonial and postcolonial agricultural policy viewed men as "the farmers," thus marginalizing women. New technologies were accompanied by the introduction of cash crops, which, destined for the market, were regarded as farmers', and therefore men's, crops. Often, because these crops were not native, they were outside women's knowledge base.

Cash crops also compete with food crops and receive priority in terms of land and capital investment and labour. Although men have been assumed to be responsible for cash-crop production, the input of women's labour remains high, actually increasing in households that use low technology. Men take full responsibility for marketing, and they control agricultural income. This income is not necessarily used to improve food technology or significantly increase access to food. An important element in improved food technology and economic access to food is who controls the income. Women do not.

Lack of local participation in S&T

To make a sustainable contribution to food security, S&T must start with local communities, building upon their existing knowledge and practices. S&T must use the local communities' capacities and strengthen them to meet the challenges of sustainable livelihood security. This approach identifies useful elements of both local and mainstream S&T, combining them to produce effective solutions. It uses both human capital and local natural resources to allow development of more location-specific, and therefore relevant, solutions through collaborative efforts by women at the grassroots level, modern scientists, and technologists.

Currently, scientists and technologists, tied to their laboratories, set research agendas and develop technologies without consulting the end-users. Often, they do not know in what social context the technology will be applied and whether it is men, women, or children who will apply it. To find lasting solutions to the challenges of sustainable livelihood and food security, a reversal must occur, placing the people and not technology at the centre.

The origins of technology, who owns it, who controls it, and whose interest it serves are relevant questions. Over half of all scientific research is carried out in developed countries by multinational companies and international research centres. Even scientists working at research centres in developing countries tend to be removed from the situation for which they are producing the technology, and technologies are seldom modified to suit local conditions.

Dissemination of modern technology

The dominant route for technology development and transfer puts women at the end. Extension workers, most of whom are still males in most countries, have been responsible for the transfer of technology from international or national centres to the end-users. Generally, they direct information about innovations at men who selectively pass it along to women, often in diluted forms. Where women have been contacted directly, they have received unclear and incomplete messages. Assuming limits on women's capacity to absorb information, extension workers leave out points that they (not the women) consider too technical.

Because of sociocultural barriers, male extension workers sometimes find it difficult to reach women farmers on an individual basis. Most women farmers contact extension services through groups and get little individual attention (Rathgeber 1990). Admitting the error of this approach, E.R. Nyirenda, an agricultural officer in charge of a training institute in Zambia, remarked, "The exclusion of women was a great mistake made by the Department [of Agriculture]. Agricultural production could have increased enormously if women were taught the modern technical know-how" (Muntemba 1977).

An additional problem lies in inadequate links between technology developers and extension workers. Technologies are developed without consultation with those who deliver it to end-users. Some national research institutions have attempted to establish links with extension workers, but frequently such efforts come at the end of the research cycle when it is too late to benefit from their suggestions. The absence of linkages among these key actors compounds the problem of matching technology to local conditions and results in the development and dissemination of inappropriate technologies.

Purpose and target audience for S&T

Much of today's technology is supply-led. It is developed and ascribed to a problem that is described in terms of its already-defined solution. Technology comes first, then it is applied to a problem. In the transition to enduring food security, however, technologies are required that farmers will use, not ones that are abstractly effective in reaching certain production goals. Desirable technology, which reflects concrete situations, can only be developed with the full participation of the end-users.

Driven by the profit motive, technology is largely designed for large-scale commercial farmers who produce primarily for markets. Because they control better-quality land, the focus of innovations has been on improving crops produced on good soil with abundant water supplies. Little attention has been paid to problems associated with rain-fed agriculture on marginal soils. Although not strictly profit-motivated, by focusing on industrial agriculture, international research centres have also tended to neglect rain-fed agriculture, the system in which most women are involved.

Control of technology

Modern technology is completely owned and controlled by powerful multilateral companies based in the North. Although ownership and control of knowledge are protected through patents, most local knowledge is open to international piracy. Knowledge and the material for technology development have been expropriated from the South without compensation. Companies from the North collect plant genetic material from the Third World and use it to develop new varieties protected through patent law. It is estimated that 25% of all genetic material in North American wheat comes from Mexico. Most areas of Europe could not grow tomatoes commercially if they did not contain genetic material from the South. That technologies relying on material from the South are protected whereas local knowledge, of which women have largely been custodians, is not is an area of concern (Brouwer et al. 1992).

Policy to regulate technology

Multinational corporations and international research centres have continued to dominate in the development and transfer of agricultural technology in developing countries, particularly those in Africa. No alternatives have been suggested, even when negative effects have been observed, because policymakers have been conditioned not to think in terms of alternatives. Heads of local research institutions and senior civil servants play key roles in policy formulation without consulting those affected by the policies. Policymakers support the production of export crops to generate revenues. In many cases, they do not fully appreciate the problems facing smallholder producers, particularly women. Thus, they often support technologies that are inappropriate for small-scale production, especially growing food.

Links between policymakers and extension workers are also weak. Without sufficient feedback, policies do not promote technologies that are suited to local situations. In many cases, they actually create an environment that favours the dissemination of technologies that are harmful to ecological systems. For example, government policies in many African countries have supported plant protection methods that are harmful to the environment in the long run (Gata 1992). The exclusion of women from the policy formulation and monitoring has contributed to negative results.

Impact of inappropriate technology

In Africa, some development change agents have criticized the appropriate technology approach. They have raised the questions: appropriate for whom? who benefits? and why do African women now need appropriate technology? Originating in the North, "appropriate" technology continues to be designed with little or no consultation with, let alone participation from, end-users. Because the technology is not designed, owned, or controlled by its users, it cannot contribute significantly to sustainable livelihood security, including food security.

Most externally driven technologies have ignored the existing gender-based division of labour and have not accounted for the physical, social, and cultural differences in various localities. Research has revealed that female labour becomes displaced with mechanization, because men as the focus of technology take over the related tasks. Technologies have made men's work lighter, while in many cases actually increasing women's work burden. For example, many water and sanitation programs have introduced water pumps designed for the physique of male users. The fact that women and girls are responsible for fetching water in many societies does not appear to have been considered. Therefore, many pumps remain unused, while women continued to walk long distances to fetch water from rivers and wells (authors' observations).

In theory, the search for appropriate technology has inherent merits because it views technology as a social process. Thus, its intention is to facilitate access to, use of, and control over technologies in food production and processing by resource-poor women, making "women's projects" its key target. However, the promoters of such technology, including — sometimes mainly — women from the North, did not consider women as farmers. The cook stove gained much attention, although its value could not be understood by women farmers. According to one woman farmer (in 1976):

Men have always been going for agricultural training. Very few of us went between 1964 and 1970. Never before that date. What they taught us cannot help us much. Our friends [men] were taught piggery, how to use tractors, etc. We were taught how to make scones, how to cook and with what tools. How can that help us with our farming?

Research approaches

In the last two decades, international and national research institutions have made special efforts to address the problems of smallholder producers who depend on rain-fed agriculture in marginal areas. Inclusion of social scientists on research teams is a positive step toward making such research more people-centred. However, these efforts have not adequately integrated women farmers in the research cycle, because of the approaches adopted.

The "farming systems research" approach was a direct response to the need to focus on smallholder agriculture under varying conditions. This method recognized the importance of location specificity in the development of solutions. It promotes technologysharing as opposed to technology transfer. Participatory methods in particular have the potential for putting local knowledge in its rightful place. In addition to learning from and appreciating the local physical and social situation, researchers start with local resources and capacities and, together with end-users, develop technologies that meet the needs of communities.

Participatory research empowers resource-poor farmers because it gives them a sense of ownership and control over technology. In Nepal, for example, a local farmer took over the work of a scientist after the latter had left (Biggs 1989). The farmer pulled together a team of colleagues to test varieties of a particular tree species for use in intercropping. The project was a success. The formal scientist had used a consultative approach, but the participatory approach of the farmers deepened their sense of ownership of the results. In Zambia, farmers in Luapula and Lusaka provinces had been testing various methods of agriculture and pest control. When the Adaptive Research Planning Team from the national central research station focused on this area — perhaps because of the farmers' efforts — they found a rich source of scientific knowledge. The team drew on some of the farmers' experiments and built on their results.

More emphasis on beginning with the local resources would shift attention back to women farmers, as custodians of a large body of local knowledge.

Constraints persist

Policies that militate against food security seem to persist despite governments' continuing expression of support to smallholder farmers. Although government structures, policies, and attitudes have been the major factors causing the marginalization of women, social organization has also played a decisive role. The last few years have seen shifts in attitudes; however, national intent remains confined to declarations, decrees, expressions of sympathy, acknowledgement of women's worth, and political rhetoric.

In Asia and Latin America, governments have lauded the roles of women's groups and farming families in bringing about the Green Revolution. In Africa, at the height of the food crisis of the 1980s, government organs were urged to invest in women's activities. Women were specifically mentioned and their problems addressed in some national plans.

At the international level, relevant organizations within the UN system have been calling on national governments to acknowledge women. At the World Conference on Agrarian Reform and Rural Development (FAO 1979), participants recommended the establishment of "special recruitment and training schemes for women extension workers" (IV.A.ii); expansion of extension services "to specifically include those tasks involving women" (IV.A.iii); and the promotion by governments of "collective action by rural women to enhance their opportunities to participate in activities on an equal footing with men" (IV.C.iii).

In 1984, the Advisory Committee on Science and Technology for Development (UN 1984, para. 69) stated, "Where new technologies displace women, alternatives, including retraining where necessary, should be included in the project proposal."

At the end of the UN's decade for women, women still appeared to be marginalized: "Also important are the dissemination of information to rural women ... using all available media and established women's groups; ... the participation of women farmers in research and information campaigns; and ... in technical co-operation among countries" (UN 1985b, para 181). In 1987, pushing for sustainable livelihood security, the World Commission on Environment and Development's (WCED's) advisory panel on food security called for a focus on women, a theme that was adopted and promoted by WCED (1987). At the Earth Summit in 1992, women were singled out in the search for solutions to global threats to environmental sustainability — a basis for food security (UN 1992a).

Some organizations, such as the FAO, have made it a policy to recruit as many women as possible and encourage national governments to do the same (FAO 1990b). The Consultative Group on International Agricultural Research (CGIAR) is urging international agricultural research centres to identify women scientists in the Third World and make use of their expertise (Gapasin 1993).

Systemic barriers

Despite these recommendations and many more, women's control over, involvement in, and access to S&T remain problematic. Established institutions seem to maintain barriers for a variety of reasons. First, S&T institutions and actors have inadequate accountability to those who bear the consequences of their decisions and actions. Second, S&T as a discipline is too narrowly defined; it seldom extends to the social consequences of technology. Third, mainstream S&T activities are generally planned and implemented in a top-down manner, omitting the views of end-users. Fourth, the nature of training for and the practice of S&T tend to isolate the field from the people and, because it is male dominated, communication with women is particularly constrained.

Shortage of gender-sensitive scientists

Gender-sensitive technology requires clearly set out research priorities and agendas. This calls for gender sensitivity at the policymaking and technology development levels. However, women's representation in these areas is extremely limited. In sub-Saharan Africa, for example, women constitute about 3.4% of professionals in agriculture (Winrock International 1988). The few women who are involved in research and technology development do not demonstrate much gender sensitivity. The figure is even lower at policymaking levels. Women continue to lag behind in training institutions, such as university and agricultural colleges. In sub-Saharan Africa, they constitute fewer than 18% of all students enroled in agricultural training institutions. The pattern is the same in most Asian countries (APPRO-TECH Asia 1992). In 1990 in Indonesia, women constituted only 16% of professionals in the Ministry of Agriculture; in Vietnam, only 24% of agriculture scientists working at major research centres were women. In the same year, fewer than 3% of the students enroled at the agricultural university in Bangladesh were women. Women have not established a critical mass necessary for bringing about change. Although creating this critical mass is desirable, however, it must be accompanied by gender sensitization if women are to make an impact.

The lack of gender-sensitive scientists presents a fundamental problem in that changes cannot be initiated from within the discipline itself. If such scientists took the lead in accepting and using local S&T, it would quickly gain recognition and, therefore, value. This would encourage more participatory approaches to technology development.

The process of establishing a new vision of S&T has led to various initiatives that recognize women's contributions. The collection of gender-disaggregated data on S&T undertaken by UNIFEM (1993a) for volume 2 of *The World's Women*, for example, is useful in presenting evidence of what women are doing. Many researchers are also documenting local knowledge systems and acknowledging women innovators. Such international recognition of women's achievements and the trend toward networking are helping to increase women's professional visibility in the traditionally male domain.

Inadequate support systems

Most smallholder producers in rain-fed agricultural areas have not benefited much from the new farming systems because of inadequate support. For example, where smallholdings require irrigation to sustain production using biological technologies, it has either not been forthcoming or men, the assumed market producers, have taken charge of them. A number of irrigation schemes have not only not benefited women, they have increased their labour input, further threatening food production and security.

Policymakers have paid some attention to women farmers as a result of donor pressure; some projects require that a portion of the funding be targeted at women. Women are often included in these programs haphazardly or as appendices rather than as an integral part of national development plans.

Some governments are taking positive steps to redress gender imbalances. However, results have not been encouraging, for lack of adequate support systems. For example, a presidential decree might call for equal access to the means and factors of production, processing, or credit by women, but it might not be backed up by legislation and structures to make implementation possible. For example, such a decree in Kenya in 1988 prohibited disposal of land without consultation with spouse or other female family members. It has failed to have the desired effect, because it is not yet enacted in legislation.

Inequitable allocation of resources

Public investment in agriculture, particularly smallholder agriculture, remains low. At a meeting in April 1994, 22 ministers of agriculture from east and southern Africa ranked agriculture sixth on a list of priority areas for resource allocation and the smallholder sector received one-fifth of the resources allocated to agriculture (Rukuni 1994). In 1990, the agricultural loans disbursed by the Agricultural Finance Corporation of Zimbabwe amounted to 200 million ZWD,² of which only 17% (34.5 million ZWD) went to smallholder producers; of that portion, less than 5% went to women farmers (AFCZ 1991).

Government institutions spend less time on research on resource-poor agriculture systems and subsistence food crops. The bulk of funded research is on cash crops, generally grown by farmers who already have substantial resources. Despite its potential for improving resource-poor systems and food production, the thrust of research has been on crops destined for the market. Those for domestic consumption are frequently ignored by plant breeders. Food security will require policies and approaches that increase food production by rural and urban women.

Lessons from the field

It appears that most countries are caught up in a top-down syndrome: we know, you learn; we have, you lack. However, in the last few decades, changes have occurred, partly as a result of the failures that litter the development scene. In the late 1970s and early 1980s, some organizations within the UN system shifted from being informed by failures to being guided by successes. In 1981, for example, the then

² In February 1995, 16 Zimbabwean dollars (ZWD) = I United States dollar (USD).

Rural Employment Policies Branch of the International Labour Organisation's (ILO's) World Employment Programme commissioned a study that focused on successful initiatives for improving the working conditions of rural women in Africa and Asia (Muntemba 1985). Twenty-five projects were identified; the following four illustrate how a local group, an NGO, and a government initiative have contributed to food security.

Increasing agricultural productivity through cooperation

In central Zambia, a group of village women responded to "conscientization" seminars by forming a cooperative to focus on increasing their crop yields (Stjernstedt 1985). By the end of the second year, cooperative members began realize impressive returns from the sale of produce and could generate and control enough income to meet household needs. Elements contributing to the success of this project included:

- A tenurial system that enabled women (married or single) to secure land to grow crops under their own control.
- An enabling political climate. The political party in power had a women's section (Women's League) charged with reporting women's aspirations to the central body. Village women used this avenue to obtain leadership training to help them in aspects of group organization and operating the group's credit facility.
- Available credit. Although the district had been producing food for the market much longer than other parts of the country, capital accumulation, especially by women, remained low, impeding access to more productive technology. With the support of the Ministry of Agriculture, women were able to secure a credit facility.
- Access to more efficient technology. The district had been exposed to modern technology since the 1910s, but it had benefited men. To increase output and because women's labour remained critical in the agricultural system, men taught women in their families how to use the machinery and modern methods. When the cooperative was formed, women were able to use some of this technology.
- Availability of markets. Clearly, women's first priority was household food security. However, group solidarity enabled them to demand that enough food be reserved from the family plot (under their husbands' control). To meet their

secondary aim of income creation, they sold fresh produce in the nearby town, Mumbwa. They also marketed maize (grown commercially) alongside the family produce, with the clear understanding that the cooperative would get all the proceeds from these sales.

This case demonstrates the successful implementation of the *Nairobi Forward-Looking Strategies* recommendation: "Women's participation in programmes and projects to promote food security should be enhanced by providing them with opportunities ... to receive training in leadership, administration and financial management" (UN 1985b, para. 179).

Empowerment to achieve livelihood security

The Working Women's Forum (WWF) acknowledged powerlessness as an acute malaise afflicting rural and urban poor women in India and reinforcing their vulnerability (Azad 1985). This NGO aimed to increase the collective power of self-employed slum women, peasants, and fisherwomen to allow them to operate in the market and negotiate with money lenders, middlemen, and landlords for access to land and credit. In 1984, WWF had mobilized over 16 000 petty traders, 5 000 rural workers, 1 500 Agarbathi rollers, and 2 000 beedi workers. The income of these women buys 60% or more of their household needs including food. In addition to joining a union, the women were extended credit through the Working Women's Credit Society. The success of this project has been facilitated by several factors.

- The organizational structure, which allows groups to elect their own leaders who work with WWF officers to identify the services, tools, and training they need in their various occupations and pass the information along to WWF's head office. Leaders act as guarantors for the borrowers and are responsible for collection of repayments and subscriptions.
- Reinforcement of a sense of belonging through activities that build solidarity, such as support in times of need and visits to each other's workplace.
- Availability of credit.
- Access to more efficient, more productive, and less labourintensive technologies, such as grinding machines for sellers of rice-cakes, push carts for vendors, and solar dryers for fish sellers. Women are able to obtain this equipment on credit.

 Conscientization seminars addressing such issues as civil rights, physical abuse, and dowries. These helped women place their struggle within the broader context of inequity, oppression, and gender relations.

The approach WWF adopted in helping these workers was to adapt technology to the women's own activities rather than the other way around. It practiced what others were warned against at the Nairobi conference: "Appropriate food processing technologies ... should be designed and introduced ... in a manner that ensures women's access to the new technology and to its benefits and does not displace women from means of livelihood when alternative opportunities are not available" (UN 1985b, para. 184).

Livestock production for food and income

Another of WWF's rural activities — the Livestock-for-Landless Project to allow women to establish milk production and sales enterprises — demonstrates the value of NGO-government collaboration (Azad 1985).

"We do not starve any more," reported women who, before the project, had earned 60 rupees³ a month, working 8–10 hours a day. With cattle obtained through the scheme, they made up to 100–200 rupees a month. Success was made possible by:

- An open organizational structure that enabled women to express their needs freely;
- WWF solidarity with the poor in negotiations for a credit facility with a local national bank;
- Availability of a market for the milk they produced through a local dairy farm;
- ◆ Support from the national government through the Indian Council of Agricultural Research — Scientists visited the area for rural orientation training. Then, they offered training to 60 members in simple technology of animal husbandry. The trainees shared the information with their colleagues in the project. Thus, a nonofficial, nonintimidating extension system was created. A veterinarian was always present to advise on the health of cows before they were purchased.

³ In February 1995, 30 Indian rupees (INR) = 1 United States dollar (USD).

• Conscientization seminars that have enabled women to withstand overtures from male relations wishing to undertake selling on their behalf.

Adopting and adapting technology for food processing

Fisherwomen in Sierra Leone adopted, adapted, and experimented with fish-processing technology until more efficient, cost-effective, and durable equipment was developed (Steady 1985). Initially, the women used simple methods such as open smoking, solar drying, grilling, frying, and salting to preserve their fish. They began using a simple smoking oven. In the 1950s, fishermen from Ghana introduced fishing and processing technology that the women adapted to create a much more efficient oven that allowed them to handle bigger catches and take advantage of a growing urban market within Sierra Leone and in neighbouring Liberia.

In the 1980s, the Federal Republic of Germany supported a government project to introduce a more efficient oven. Women were attracted to it because it reduced fuel consumption by 60%; repair costs were lower, resulting in an overall saving of 160–200 leones a month in operating costs; it saved time; it was easier and safer to use; and it lasted twice as long as the type they were using. Despite the need for two people to handle a drying tray, the overall performance of the new style of oven has been significantly better and has resulted in higher incomes for participating households. The adaptation of this technology was possible mainly because:

- Women acted collectively in experimentation and in bargaining with shrewd fishermen on the one hand and more sophisticated women from towns and Liberia on the other.
- Women interacted with neighbouring communities and were willing to learn from them.
- The project staff worked with the women to produce an acceptable design. In consultation with the women, they developed a prototype oven for experimentation and demonstration. The women were able to alter the design so that the final product was the result of interaction between them as "beneficiaries" and project staff.
- Local materials and human resources were used, reinforcing a sense of ownership of the technology by the village women.

Government efforts

In some countries, governments have initiated measures to increase access to and control over factors of production by the producers themselves. For example, the Africa Party for the Independence of Guinea and Cape Verde (PAIGC) began by tackling ideological conflicts to make reforms equitable (Urdang 1979). Its approach comprised the following steps: teaching about ideological conflicts; promoting changes in the gender-determined division of labour in households; socializing production at the household level; and, finally, moving on to structural reorganization. By 1978, there were indications of a social reorientation and agricultural systems were being reshaped.

India presents an interesting case regarding the use of S&T. Once a country of famines and food imports, government policy after independence was aimed at establishing food security, at least at the national level, through investment in S&T. Steps were taken to strengthen the scientific base of productivity. A team of scientists was mobilized and research centres strengthened, laying the ground for the Green Revolution.

India has a large population of landless people and, therefore, food insecurity among the poor. It has recorded national food surpluses, while many of its citizens are chronically hungry. The Green Revolution technology has had negative social, economic, and environmental impacts, but the country also sets an example of sufficient productivity founded on a solid S&T base. Perhaps the social questions raised by this national S&T success story demonstrate innate shortcomings of today's S&T.

In the Philippines, the government has invested in women's scientific education (Gapasin 1993). As a result, the country boasts one of the highest proportions of women physical and natural scientists (50%) in the world.

Recommendations

We have described the paradox that lies in the fact that the number of those threatened by food insecurity is increasing despite international pledges to "end hunger." Although national governments acknowledge the need for food self-sufficiency, most of the poor continue to be marginalized as assets, information, and technology pass into the hands of the financially and politically powerful.

Male-dominated power structures fail to relate to women at a time of acclaimed acknowledgement of the latter's contribution to

agricultural, specifically food, production. At the household level, women lack access to productive technology. At the institutional and national levels, policies continue to discriminate against women in terms of access to and control over land, trees, technology, credit, markets, and so forth. Determining how to build on and use women's knowledge base so that modern S&T can benefit from it and strengthen women's efforts remains a problem..

Establishing food security calls for strategies in which grassroots communities own, control, and play effective roles in technological choices and development. We recommend the following:

- A reversal of the trends that marginalize women to achieve food security and improve gender relations. To do this, national governments must allocate 10% of their national budgets to food production, storage, and processing technology as defined in consultation with rural and urban women — the end-users.
- Appropriate organs within the UN system, especially FAO, CGIAR, and UNIFEM, should set up a 5-year grant to enable researchers from five developing countries to work with NGOs and communities to develop and test people-centred, women-friendly, research methods, specifically geared toward empowering resource-poor female food producers.
- International and national research centres should set specific annual targets for the recruitment of women scientists so that a critical mass is reached by the year 2000. These scientists should be trained in gender issues so that they bring gender sensitivity to food technology.