



MODULE 12

Gender in Crop Agriculture

Overview

CROP AGRICULTURE, GENDER, AND PATHWAYS FROM POVERTY

The proposition that *agriculture, including crop production, is the only realistic driver for mass poverty reduction and rural development in most of the developing world*, and perhaps particularly in sub-Saharan Africa, is now accepted by many academics, international development organizations, and national governments (Lipton 2005; World Bank 2007) (box 12.1).

A further proposition, emphasized in a recent *World Development Report* (World Bank 2007), is that *farming is a key pathway out of poverty for women*, and that women's prospects for taking this path improve when they have better access to resources. Because of their limited access to essential production resources, such as land, labor, and inputs, women's role in crop agriculture is often restricted to producing subsistence food crops with low potential to generate income. The prospects for women to expand their incomes through alternatives such as seasonal migration or labor markets outside agriculture are limited. Women's mobility is usually more constrained by social and cultural norms, and women play a central role in raising and caring for children.

An important element of development strategies that rely on agriculture is to enable women to improve food production and—depending on the context—to move beyond subsistence production into higher-value and market-oriented production (World Bank 2007). Women, more than men,

spend their incomes on food, with consequent improvements in household food security, nutritional security, and especially the development of children. In Guatemala the amount spent on food in households whose profits from nontraditional agricultural exports were controlled by women was double that of households in which men controlled the profits (World Bank 2007).

As a means of understanding agriculture's present and prospective role in development and poverty reduction, developing countries can be grouped into three broad categories: agricultural-based economies, transforming economies, and urbanized economies (World Bank 2007). Farmers (including women) in each category face different challenges in improving their living conditions. This Module focuses on agricultural-based economies, in which many poor women rely on agriculture for their livelihoods and in which improvements in crop agriculture can yield the greatest impact. This Module and accompanying Thematic Notes also examine the role of gender in high-value and organic crop production.¹

CROP AGRICULTURE AND EARLIER DEVELOPMENT TRENDS

To understand changing perceptions of crop agriculture and its role in development, a review of earlier development trends and policies is important. A major principle in the development of crop agriculture has been to raise the yields of a selected number of staple food crops. This effort,

Box 12.1 Shared Views of Agriculture as a Driver of Poverty Reduction and Rural Development

Food and Agriculture Organization: “There has been a shift in the general trend of giving low priority to agriculture as compared to industrialization. A new recognition is growing in many parts of the world of the crucial role of the agricultural sector for increasing export earnings, generating employment and improving food security.”

World Bank: “Rural poverty is as diverse as are the rural poor in their livelihood strategies, but in most of the poorest developing countries agriculture is the main source of rural economic growth. That is why improved agricultural productivity and growth are central to the Bank’s strategy.”

International Fund for Agricultural Development: “Investment in agriculture is the key to meeting the MDGs [Millennium Development Goals] given that 75 percent of the world’s poorest people, living on less than a dollar a day, live in rural areas and depend on agriculture and related activities for their livelihoods.”

Department for International Development, United Kingdom: “Agriculture should be placed at the heart of efforts to reduce poverty . . . [as] there is a mass of evidence that increasing agricultural productivity has benefited millions through higher incomes, more plentiful and cheaper food, and by generating patterns of development that are employment intensive and benefit both rural and urban areas.”

Sources: DFID 2005: 1; FAO 2007a; IFAD 2007; World Bank 2003: xv.

originating on a wide scale for developing countries in the middle of the twentieth century, led to vast increases in food supplies in many Asian countries (Tripp 2006).

The 1960s represented a time of great hope for agriculture in developing countries. This decade marked the beginning of what became known as the Green Revolution in Asia, the principal manifestation of which was the distribution of short-stawed, fertilizer-responsive varieties of wheat and rice. For a few years it looked as if the strategy of supplying appropriate varieties and complementary fertilizers, pesticides, and other inputs could end rural poverty and chronic food shortages (Tripp 2006). Eventually it became

evident that these new packages of technology were not spreading evenly among farmers; they mostly benefited farmers in favored environments with access to productive soil and irrigation facilities. Evidence emerged that widespread adoption took place in countries and regions that invested in infrastructure development and input and credit supply while supporting and stabilizing the prices of cereal crops (Gabre-Madhin, Barrett, and Dorosh 2003).

Attempts to address this imbalance and replicate Green Revolution experiences in less-favored regions led to the conclusion that farmers in “complex and risk-prone” areas (Chambers 1997) were unable to benefit from standardized technology packages and that alternative processes of technology development were required. The poverty levels of many farm households precluded any reasonable hope that they could take advantage of technologies requiring a significant financial investment (Tripp 2006).

Market orientation was and remains another important driver for crop agriculture development, resulting in improved crop varieties (notably hybrids) with uniform yields and crop characteristics and a dependence on external inputs and technologies. In market-oriented crop production systems, access to production resources is crucial, which poses potential gender inequalities. These inequalities are widened even further because very few improvements in farm technology have been devised to overcome women’s constraints. Efforts to intensify agriculture by promoting large-scale farming and commercial crop production for export, farm mechanization, improved seed, fertilizer, and pesticides have been linked mostly to cash crop production, from which men are more likely to benefit. On the other hand, where surplus staple crop production is sold, local food and seed markets are flourishing. These types of markets are often dominated by women (Smale and others 2008).

RETHINKING CROP AGRICULTURE DEVELOPMENT STRATEGIES

Crop agriculture faces a new set of challenges. The persistence of poverty reveals the need to reconsider development strategies to improve equity and access. The environmental costs of previous crop production strategies are another important consideration. So-called second-generation problems with Green Revolution technologies have been observed. For example, evidence is at hand that rice yields in Asia are reaching a plateau (Horie and others 2005). Serious questions are being asked about natural resource degradation and the long-term sustainability of some intensive

cropping systems (Murgai 2001; Oluoch-Kosura and Karugia 2005).² The use of agricultural methods that rely heavily on external inputs has caused 38 percent of agricultural land to be lost to soil erosion and depletion. Although soil erosion is a common effect of various land-use practices, 70 percent of annual erosion is estimated to occur on land used for agricultural purposes (Crucefix 1998).

The recent Millennium Ecosystem Assessment (2005) delineated the negative impact of intensive agriculture on vital ecosystem services and biodiversity—outcomes that were not considered sufficiently in the past. A growing body of evidence shows that the poor depend and will continue to depend on biodiversity as an important livelihood resource (Ash and Jenkins 2007), whereas modern crop production is based on only a few plant species (Gruère, Giuliani, and Smale 2006).

Climate change and its potential consequences for agricultural production also require urgent attention in strategies for crop agriculture development. The role of crop diversity is an important element to consider in developing such strategies.

New methods of plant breeding have also affected current crop production strategies, and their impact on gender in crop production is not yet established. For example, the private sector has invested substantially in developing genetically modified (GM) crops, such as Bt maize, with a clear commercial focus. Bt maize contains an endotoxin from *Bacillus thuringiensis* that protects plants from insect pests such as corn borers. Disease-resistant crops, herbicide-tolerant crops, biofortified crops,³ and renewable energy crops are just a few additional examples of new technologies that are available or under development.

All of these factors make it important to reconsider how and why crop production technologies are developed. Although market orientation remains an important driver of new crop technologies, new niche markets are emerging for organic and fair trade products, among others, which could offer an opportunity for women to participate.

Innovation in agriculture now gives greater emphasis to processes that depend on local resources, including knowledge and skills, natural resources, and social structures. The realization that most technologies need to be adapted not only to local agroecological conditions but also to individual socioeconomic farm circumstances is an additional justification for promoting innovations based on local resources and skills, and the development of such resources and skills certainly offers an opportunity for empowering women as well as men farmers and their communities (Tripp 2006). It

is important to recognize that this strategy does not entail a wholesale rejection of external inputs to improve productivity, but rather the increased recognition and reinforcement of complementarities and a thorough analysis of resource availability and needs in subsistence and commercial production systems.

The Thematic Notes that accompany this Module demonstrate the extent to which using local resources is vital for improving crop agriculture. The first two Thematic Notes focus on gender in relation to soil and seed, two of the primary natural resources essential to crop production. A central theme of these Notes is the role of human and social capital in the knowledge-intensive management of agricultural technology. The Notes also identify potential complementarities between (1) local and external inputs and (2) knowledge and institutions. The third Thematic Note focuses on gender and crop protection, because crop protection is another knowledge-intensive area with high potential to improve crop productivity.

WHY IS GENDER A VITAL CONSIDERATION IN CROP AGRICULTURE?

Addressing gender is crucial in crop agriculture for reasons discussed in the following sections.

Women play vital but unrecognized roles in crop production, household food security, and household nutrition

The need to increase food production is clear. Growing populations and declining agricultural productivity are leaving millions without secure sources of food. Yet advances in food production are constrained by the “invisibility factor”—in other words, by women’s major but largely unrecognized roles in agriculture.

Although detailed statistics are not available and figures vary depending on the geographical context, it is fair to say that women supply a large proportion of the agricultural labor and in some societies produce up to 80 percent of the food crops (FAO 2007b). Failure to recognize this contribution is costly. It results in misguided policies and programs, forgone agricultural output and associated income flows, higher levels of poverty, and food and nutritional insecurity (World Bank 2007).

It is widely understood that gender and household food security are fundamentally linked. Many cultural and regional differences exist in women’s involvement in crop

production, but rural women are the main producers of the world's staple crops—rice, wheat, and maize—which provide up to 90 percent of the food consumed by the rural poor. Women sow, weed, apply fertilizer and pesticides, and harvest and thresh crops. Their contribution to growing secondary crops such as legumes and vegetables is even greater. Grown mainly in home gardens, these crops provide essential nutrients and are often the only food available during the lean seasons or when major crops fail (FAO 2007b). Yet women often have the least access to means for significantly increasing output and yields.

Women's contributions to crop production are not just qualitatively but quantitatively invisible as well. Statistics on women's yields, women's technology adoption rates, and women's uses of inputs are rarely reported, which proved problematic in developing this Module (the importance of gender-disaggregated data is discussed in Module 16).

Women manage complex, species-rich production systems

Women tend to manage complex production systems with multiple functions, purposes, and species. These systems are not designed to maximize the productivity of any single crop but to ensure overall stability and resilience among the crops that are produced. This agricultural reality is often overlooked when yields of a single crop are taken as a criterion for evaluating the performance of crop production. Given the increasingly severe weather events caused by climate change, criteria such as crop stability and resistance may be valued more highly in the future.

Women have limited access to agricultural services and inputs, are more likely to lack assets, and grow more subsistence crops

Women farmers are more likely to be asset-poor subsistence farmers. In sub-Saharan Africa it has been calculated that agricultural productivity could increase by up to 20 percent if women's access to such resources as land, seed, and fertilizer were equal to men's (DFID 2007), yet women still face serious constraints in obtaining essential support for most productive resources, such as land, fertilizer, knowledge, infrastructure, and market organization (these issues are discussed in detail in other Modules). The ease of obtaining agricultural services and inputs is even more important in light of women's heavy workloads and time constraints outside of agriculture.

Although rightly contending that the effectiveness of development strategies hinges on reaching African smallholders,

agricultural experts seldom recognize that most of Africa's smallholders are women (World Bank 2007)—as seen by the costly errors that have arisen from ignoring the fact that women smallholders may face different constraints than men do, and that such constraints are therefore an important part of the problem. The Agriculture for Development Policy Brief (World Bank 2008: 1) states, "The design of many development policies continues to assume wrongly that farmers and rural workers are men. The important role of women in agriculture in many parts of the world calls for urgent attention to gender-specific constraints in agricultural production and marketing. Mainstreaming gender in agricultural policies and programs is essential for development success."

Beware narrow assumptions about women's "food security first" agenda

Women's engagement in farming is commonly associated first and foremost with a food security agenda. Although this statement is certainly true, such a narrow view will limit women's engagement with commercially oriented crop production and will do nothing to help women achieve their broader livelihood goals (NEF 2006). In many situations, women combine both food production and commercial agriculture, although often on a small scale. The gender division of activities in crop cultivation can be quite complicated, with different fields being cultivated for different purposes by men and women or family groups, especially in sub-Saharan Africa. Women often manage the home gardens, and small-scale crop production can contribute significantly to women's incomes as well as to household food security. Women often grow "minor" crops with limited or no market value. However, it is important to realize that women have the potential and the right to participate in more commercially oriented crop production. Local markets offer a good opportunity to earn income through small-scale sales of staple crops and vegetables. Often these opportunities are only seasonal.

Crop production is the primary employer of women in most countries

Crop production is still the primary source of employment for women in most developing countries, particularly in sub-Saharan Africa and Asia. Almost two-thirds of rural women are from low-income households. Women-headed households are the poorest among these, making up more than 35–40 percent of all heads of household in some parts of Asia (Balakrishnan and Fairbairn-Dunlop 2005). Box 12.2

Box 12.2 Women in Agriculture and Crop Production: Indicative Statistics

Although statistics on women's role in agriculture are not widely available—a failure that the Food and Agriculture Organization, in conjunction with other United Nations agencies, is seeking to address—it is nevertheless possible to glean some indicative data from the literature and databases:

- In Southeast Asia, women provide up to 90 percent of the labor for rice cultivation.
- In sub-Saharan Africa, women produce up to 80 percent of basic foodstuffs, both for household consumption and for sale.
- Women perform from 25 to 45 percent of agricultural field tasks in Colombia and Peru.
- Women constitute 53 percent of the agricultural labor in Egypt.
- Fewer than 10 percent of women farmers in India, Nepal, and Thailand own land.
- An analysis of credit schemes in five African countries found that women received less than 10 percent of the credit awarded to men smallholders.
- Only 15 percent of the world's agricultural extension agents are women.

Source: FAO 2007c.

presents some indicative statistics on women's importance in agriculture and crop production.

Women are not only vitally involved in crop production—their role is expanding. Development strategies will be compelled to address gender concerns very explicitly because the number of women involved in and responsible for crop production in developing countries appears to be growing so rapidly. Known as the “feminization” of agriculture, this sociodemographic trend is causing temporary as well as permanent shifts in women's responsibilities and tasks. An important factor behind this trend is the migration of young men in search of more lucrative employment off of the farm. The depredations of HIV and AIDS in sub-Saharan Africa have also encouraged this trend. In some areas the feminization of agriculture has altered the availability of labor for producing crops, which in turn may alter cropping patterns, tasks, and crop technology preferences (see Thematic Note 4, Module 7). An example from Bolivia (box 12.3) gives indications of these trade-offs.

Box 12.3 Bolivia: Adjusting Local Agriculture to the Loss of Rural Labor

In Sucre, Bolivia, the labor-intensive harvest and preparation of quinoa coincides with a seasonal migration of laborers to the nation's cotton-, sugarcane-, soy-, and wine-producing areas. In areas significantly affected by this migration, women often remain in charge of the farm but face an increasing lack of labor to process quinoa for home consumption and sale in local markets. It has been argued that if quinoa can be made a commercial crop, generating sufficient income to obviate the need for migration, then sufficient labor may become available for postharvest processing.

Source: Jonathan Hellin, International Maize and Wheat Improvement Center, personal communication, 2007.

A potential advantage of migration is that it provides additional cash to invest in crop agriculture and facilitate a move from subsistence to more commercially oriented agricultural systems. These shifts can offer new opportunities for women but can also imply cultural changes and a redefinition of gender roles in crop production. Gladwin and others (2001) observe that in “most parts of Africa, women consider farming for food as part of what makes them women and gives them a gender identity.” In other situations women themselves are the ones who migrate in search of employment, which again has significant consequences for crop production. These intrahousehold socioeconomic changes are important to understand and consider in any crop production intervention.

KEY GENDER ISSUES

The following discussion describes the key gender issues in crop agriculture and the potential benefits of addressing them.

Gender and crop choice

As pointed out earlier, cash and export crops are frequently regarded as “men's” crops and subsistence crops as “women's” crops.⁴ The standard explanation for this division of crops by gender is that women are responsible for feeding the family and thus prefer to grow subsistence crops for the household, whereas men are responsible for providing cash income and thus raise cash and export crops.

In general, however, it is difficult to tell whether women grow lower-value subsistence crops because they have different preferences and concerns or because they cannot access the land, inputs, credit, information, and markets that would permit them to do otherwise (Doss 1999). In Ghana, for instance, women farmers view maize production as a productive, income-generating activity yet refrain from growing maize because they lack the capital to purchase the required inputs (fertilizer, herbicide) or hire someone to plow the fields. Instead they continue cultivating cassava and yams, which require fewer external inputs. Moreover, the majority of women consider maize cultivation to be a risky enterprise because the crop is sensitive to drought (Adjei-Nsiah and others 2007; see also Thematic Notes 1 and 2).

Cultivation not only of different crops but also of different *varieties* of the *same* crop may also vary by gender. Maize, for instance, may be grown as a cash or subsistence crop. High-yielding maize varieties were introduced in many areas to generate a marketable surplus, but many of these varieties had different processing, cooking, and storage characteristics than the local varieties. The high-yielding varieties were often promoted as cash crops. Consequently in many places local varieties are considered “women’s” crops, and high-yielding varieties are considered “men’s” crops (Badstue and others 2007). To the extent that high-yielding varieties are grown for cash and local varieties for food, this gender-variety pattern may persist. However, as high-yielding varieties that meet the consumption preferences of smallholder farmers are developed, the distinctions between subsistence and cash varieties may become blurred. For instance, both hybrid maize and local maize can be viewed as either subsistence or cash crops, depending on a farmer’s circumstances and market opportunities. A case study in Tanzania (FAO 2008) showed that groundnut yields would determine whether the crop was controlled by men or women. If the groundnut harvest was good, men sold the produce in the market; if it was not, control would remain with the women.

Gender differentiation also occurs with respect to combinations of crop species and varieties. Commercial systems feature homogeneous varieties of a single crop species, whereas traditional cropping patterns are much more diverse. As noted, women tend to manage complex and species-rich production systems designed to ensure overall production stability and resilience. Some traditional crops determine the social status of men and women and are linked closely to traditional knowledge and culture. They are also integral to social capital because of their important roles in ceremonies and traditional meals. In this sense,

changes in crop diversity can alter social capital formation and power relations (Howard 2003).

The loss of crop diversity could also threaten poor people’s ability to adapt their agricultural enterprises to climate change. A recent study by Cline (2007), which reinforces the likely negative impact of global warming on crop agriculture, indicates that the combined effects on agriculture are likely to be seriously unfavorable in developing countries, with the most severe losses occurring in Africa, India, and Latin America. These rapidly emerging issues need to be taken into account in designing interventions in crop agriculture. Understanding women farmers’ production strategies with respect to crop stability and resilience will enable agricultural research and development interventions to strengthen farmers’ capabilities to adapt to climate change and improve family food security.

Gender and crop management tasks

In most parts of the world, men and women tend to work at different tasks. Numerous time allocation studies have examined which household members perform which farm tasks (for example, see Hirschmann and Vaughan 1984; McSweeney 1979; Pala 1983). These studies often identify some tasks as men’s tasks and others as women’s tasks. For example, in Kenya women reported that men were responsible for building the granary, and women were clearly responsible for hand digging, harvesting, and transporting the crops (Pala 1983). Although many tasks may be viewed as exclusively women’s or men’s, in practice the divisions are blurred, and both men and women are involved. Relatively few tasks are done only by men or only by women (Doss 1999).

That women throughout Africa tend to provide more labor for agriculture than men—and almost always provide more total labor—has implications for technology adoption. Even if they know they can increase productivity, women may be unable to increase the number of hours that they spend working. Simple comparisons of hours worked do not capture issues related to the type of work being done and the energy expended. The value of time will vary by season and task; thus, people will be interested in saving the time that is the most costly (Levi 1987). However, to the extent that the tasks vary by gender and the value of women’s time is lower, farmers may be more inclined to adopt technologies that save men’s time.

The gender division of labor appears to change in response to changing economic opportunities. As noted, when men leave agricultural communities in search of

higher earnings, women assume many traditionally “men’s” tasks. Men usually move into traditionally “women’s” crop activities when those activities are perceived as having become more productive or profitable. Women in Burkina Faso traditionally picked shea nuts, for example, but now that sales of shea nuts are profitable, men are becoming involved, often with the assistance of their wives. Another factor behind changes in labor allocation for different tasks is the adoption of new technologies. For instance, the mechanization of “women’s” tasks may cause men to take greater control of those tasks. The extent to which these changes benefit or disadvantage women and men is not always clear, and it is difficult to predict a priori what changes will occur (Doss 1999).

Seasonality further influences labor allocations. Compared to Asia, where irrigated agriculture is much more common, in Africa the seasonal demands for labor are more pronounced, because crop agriculture is mainly rain fed and the growing season is relatively short. In Africa, 50–70 percent of the labor is required within a four-month period; comparable figures for Asia are 40–50 percent (Delgado and Ranade 1987). If this seasonal demand coincides with migration by men, women’s burden of labor becomes even higher and negatively affects overall crop production, because women will have to prioritize labor allocation between food and cash crops.

Research and extension systems can become more effective in developing sustainable crop production systems if they adopt a gender perspective that heightens their understanding of the distinct roles, needs, and opportunities of different household members (see also Module 7).

Gender and knowledge differences

Men and women can accumulate very distinct and rich sets of agricultural knowledge and skills as a result of gender divisions in the tasks they undertake, such as seed management and conservation and pest and disease management. Many studies show that men and women have different preferences and criteria for choosing among crops and varieties and performing such activities as selecting seed, cultivating, harvesting, and processing (Howard 2003). Because women tend to manage complex farming systems, they have developed multiple assessment criteria for crop system performance, encompassing risk minimization, vulnerability, and other objectives that must be considered in promoting innovations.

Local knowledge of men and women farmers is an important asset in innovation and technology development,

especially for such key crop production issues as seed management, plant breeding, crop protection, and soil fertility management. Understanding gender differences in local knowledge and recognizing the contribution women can make in this field are important, because women are more frequently involved in traditional farming practices. Knowledge difference can reveal important opportunities to contribute to crop improvement or crop and variety selection (see the discussion of farmer innovation in Thematic Note 1 and seed management in Thematic Note 2). Knowledge differences must also be understood to improve the effectiveness of any technology dissemination or extension process (see the discussion of integrated pest management in Thematic Note 3).

Gender and access to information, organizations, and markets

Information—appropriate information, given and received on a timely basis—is critical to the development and use of technical innovations and improvements, yet women frequently cannot obtain such information. Agricultural research and development, including extension services, have been dominated by men and have largely ignored women’s role in crop production (Jiggins, Samanta, and Olawoye 1997) and have not focused on women’s needs for technology and information. Social norms and cultural practices can prevent women from participating in development interventions or information campaigns. Using more appropriate information channels is one way to address this situation (see Thematic Note 3). Another strategy is to provide more relevant information by specifically addressing gender aspects of crop production.

Over the last two centuries, societies have invested considerably in complex institutional arrangements to advance technological innovation in agriculture. Many of these institutions have overlooked women and have marginalized women farmers in terms of technology adoption. Gender-responsive actions should enable women farmers to take greater advantage of extension systems and increase the accessibility of new agricultural technologies and innovations. Organizational innovations, such as participatory research, farmer-extension linkages, and strengthening the linkages between formal and local seed systems, can improve women’s livelihood outcomes by ensuring that technologies meet their needs. These issues are discussed in greater detail in Thematic Notes 1 and 2, which describe potential complementarities between formal and informal organizations (see also Module 7).

Markets will continue to influence the choice of crop species and varieties in important ways. Markets can offer opportunities for women as well as men, and crop interventions must not fail to consider this point (examples include assessing the export potential for women's crops or facilitating women's participation in niche markets for organic or fair trade produce). Markets are also important for providing agricultural inputs. Because women so often lack the economic resources or mobility to reach input markets, improving access to local markets can be particularly important for them (see also Modules 5 and 8). For example, as discussed in Thematic Note 2, local seed markets are an increasingly important means for women to obtain improved crop species and varieties and exchange knowledge. Flourishing food markets for local consumption can render distinctions between cash and subsistence crops less obvious, and local markets give women an opportunity to become involved in crop commercialization.

KEY AREAS FOR INTERVENTION

Soil—specifically *soil productivity* and *fertility*—is a key asset for resource-poor women and men. The degradation of soil through overuse and erosion can severely limit people's livelihoods. Because sustainable soil management is fundamental to the future of crop agriculture, Thematic Note 1 discusses interventions specifically designed to help women sustain soil productivity.

Diversity—both in the types of crops grown and in the genetic makeup of specific crops—is another important asset, especially for resource-poor farmers. Farmers may select crops and varieties of crops that make it possible to pursue a greater range of livelihood strategies (which may vary by gender among household members), enhance household food security, and minimize risk. For example, the failure of one variety or crop may be mitigated by the survival of others. Strategies to understand and conserve genetic diversity must not overlook the fact that women often have different means of accessing and exchanging seed (Thematic Note 2).

Women and children are often directly or indirectly involved in *crop protection*, and their limited access to information about safe pesticide use imperils human health and poses an environmental hazard. Twenty to forty percent of the world's potential crop production is lost annually to weeds, pests, and diseases (CropLife International 2007). Crop protection strategies that may be particularly relevant to women are discussed in Thematic Note 3.

For each of these key areas for intervention, the following points should be kept in mind:

- Women and men, depending on their cultural and social backgrounds, perform different roles and have varying responsibilities in agriculture—in crop production as well as crop management. A better understanding of these differences will help to address the prevailing gender issues.
- In making decisions about their livelihoods, men and women have different perceptions of what is important. Men and women base their decisions on information from different sources.
- The unequal power relationships between rich and poor, men and women, must be understood to achieve equitable development and full participation of women.
- Interventions must be developed based on a comprehensive understanding of the needs that women and men identify to improve their situations. The strategic interests of women and the most disadvantaged groups need to be addressed to improve overall crop production and reduce poverty.

The adoption and use of new technologies and inputs are strongly affected by who controls and owns a given crop. Failure to understand and address these and other socioeconomic dimensions of crop production means that interventions are bound to fail. All interventions that aim to enhance the productivity of crop agriculture must take explicit account of gender. The principal concerns are well known; many are discussed specifically in this volume. As a matter of course, women farmers must have access to information, credit, and other inputs, as well as the organizations through which markets are accessed and policies are influenced. Years of experience confirm that these things are still easier said than done. At the same time, it is critical to acknowledge the “feminization” of agriculture (particularly in sub-Saharan Africa) and overcome the bias of associating women's farming exclusively with a food security agenda. Recognizing women's involvement in commercial crop production and ensuring that they benefit from research, extension, credit, land tenure rights, market access, and other elements of production, innovation, and participation still requires a significant organizational shift in many agricultural services. Without such a shift, it will be difficult to broaden the base of women farmers who can adopt crop technologies, and thus it will be difficult for agriculture to contribute to poverty reduction, environmental

sustainability, and economic growth as envisioned in many countries.

MEASURING CHANGE: GENDER-SENSITIVE MONITORING AND EVALUATION INDICATORS

It is important to be able to measure the impact that crop and soil initiatives have on men and women beneficiaries,

their families, and communities. Table 12.1 gives some ideas for indicators and sources of verification, though clearly modifications are required for each program.

Depending on the country or region, it may be relevant to also consider ethnicity and caste alongside gender (both as comparative indicators and when collecting data), because women of lower castes or ethnic minorities are usually in the most disadvantaged situation.

Table 12.1 Monitoring and Evaluation Indicators for Gender and Crops	
Indicator	Sources of verification and tools
Over a set period, an increase of x percent in household incomes from crop-based activities among women-headed households and poor households in program areas	<ul style="list-style-type: none"> Household surveys Project management information system Socioeconomic data from statistics office
Changes over x -year period of project activities in household nutrition, health, education, vulnerability to violence, and happiness, disaggregated by gender	<ul style="list-style-type: none"> Household surveys, before and after Project management information system School records
Number of local farmers involved in fair trade production and marketing groups, disaggregated by gender	<ul style="list-style-type: none"> Sales records of group
Number of women and men holding management or treasurer positions in natural resource management groups	<ul style="list-style-type: none"> Bank account records Committee meeting minutes
Number of farmers using zero tillage, mulch, cover crops, and new innovations to decrease labor needs and increase soil fertility, disaggregated by gender	<ul style="list-style-type: none"> Agricultural extension records Interviews with stakeholders Observation
Changes in soil condition in farmland, before and after program activities (such as nutrient levels, percentage of ground cover)	<ul style="list-style-type: none"> Department of Agriculture surveys Farm records Participatory monitoring by villagers or herders
Number of women and men actively involved in participatory research and innovations	<ul style="list-style-type: none"> Agricultural extension records Interviews with stakeholders Observation Participatory monitoring
Percentage of men and women farmers who have access to high-quality, locally adapted seed	<ul style="list-style-type: none"> Agricultural extension records Interviews with stakeholders
Percentage of men and women farmers who implement seed saving and participate in local seed supply systems	<ul style="list-style-type: none"> Agricultural extension records Interviews with stakeholders Program records
Seed type preferences, disaggregated by gender and ethnicity	<ul style="list-style-type: none"> Agricultural extension records Interviews with stakeholders Seed sales records
Number of men and women participating in community seed bank management	<ul style="list-style-type: none"> Committee meeting minutes Program and project records
Number of women and men participating in training on integrated pest management	<ul style="list-style-type: none"> Training records
Awareness of safe practices for handling agricultural chemicals and access to appropriate protective equipment, disaggregated by gender and ethnicity	<ul style="list-style-type: none"> Focus groups Observation Posttraining assessment Stakeholder interviews
Adoption of recommended practices and technologies among men and women farmers, before and after program activity	<ul style="list-style-type: none"> Case studies Interviews of farmers Sample surveys

(Table continues on the following page)

Table 12.1 Monitoring and Evaluation Indicators for Gender and Crops (continued)

Indicator	Sources of verification and tools
Gender differences in workload as a result of introduced practices or new technology for crop production	<ul style="list-style-type: none"> • Case studies • Gender analysis (such as comparative time clocks of men's and women's activities) • Participatory rapid appraisal • Sample surveys
Percentage of women and men community extension workers and professional agricultural extensionists	<ul style="list-style-type: none"> • Department of agriculture records • Project records
Numbers of years of formal education of farmers, disaggregated by gender	<ul style="list-style-type: none"> • Household surveys • School attendance and examination records
Level of satisfaction among women and men with access to and quality of extension and training services	<ul style="list-style-type: none"> • Interviews of farmers • Sample surveys
Women or other disadvantaged groups actively participating in management committees and boards of producer groups and cooperatives	<ul style="list-style-type: none"> • Committee meeting minutes • Interviews with stakeholders • Local traditional authorities (such as a chief or local council) • Program and project records

Source: Authors, with inputs from Pamela White, author of Module 16.

Gender and Soil Productivity Management

WHY CONSIDER SOIL PRODUCTIVITY FROM A GENDER PERSPECTIVE?

Healthy, fertile soils are integral to the goals of sustaining agricultural livelihoods, attaining food security, and fostering agricultural development. Because most high-quality agricultural land is already in production, the marginal benefit of converting new land diminishes. In West Asia and North Africa, at least 87 percent of suitable land is already farmed; in South Asia, the corresponding figure is 94 percent (FAO 2006). Natural resources such as land and water are increasingly scarce, and their quality is declining. Growth in food production will depend primarily on further intensification of agriculture, mostly in high-potential areas (FAO 2005a). Yet unless considerable care is taken, intensification can exact a heavy toll on soil health, fertility, and productivity.

A recent report on how to meet the first Millennium Development Goal of halving hunger by 2015 argues that *improving soil health is the first entry point* for correcting soil nutrient imbalances, improving agricultural productivity, and thus reducing hunger, particularly in Africa (UN Millennium Project 2005: 13). Soil fertility is an important component of soil health, along with organic matter content and microorganism populations. Another critical entry point for improving soil productivity and reducing hunger is *the adequate, location-specific choice of crops and crop management practices*.

As population pressure increases in many areas, especially sub-Saharan Africa, traditional fallow and crop rotation systems no longer maintain and restore soil fertility. When soils become less productive, crop yields stagnate or decline, and farmers become more dependent on external inputs to maintain crop productivity. Although soil fertility losses are particularly worrisome in Africa (box 12.4), they are also severe in tropical Asia and Latin America, where soil nutrient losses are high in agricultural systems compared to

natural ecosystems (Hartemink 2004). Other factors, such as soil erosion and climate change (leading to more severe weather events), have further depleted soils and heightened the need for more holistic soil management approaches.

Women—especially if they are the main providers of staple food crops—are particularly affected by declining soil fertility. Men often control the best land with the best soil to produce commercial crops, and women more often farm marginal land. They have limited or no access to external inputs such as fertilizer. Often they have less access to land itself, because inheritance laws and other legal and cultural norms favor men (see also Module 4). When women own farmland, their plots are generally smaller than those owned by men. In Mexico, for example, women own less than 20 percent of all farmland (Korinek 2005), and in 2000, 56 percent of women farmers owned less than 2 hectares, compared to 35 percent of male farmers (White, Salas, and

Box 12.4 Africa: Consequences of Unproductive Soils

Agricultural production is the main source of economic activity in sub-Saharan Africa, where the declining health and productivity of the soil indicate that it is rapidly losing its value as a critical agricultural asset. Not only can less food be grown on unproductive soils, but the production of cash crops for export is endangered. It is essential that agricultural production and soils be managed in sustainable ways, so that the present generation is fed and soil conditions can improve to support future generations.

Source: “Sustainable Land Management and Soil Productivity Improvement in Support of Food Security in Sub-Saharan Africa,” www.fao.org.

Gammage 2003). In this respect women face a complex challenge: they have to produce their crops on poorer soil, often on smaller areas, and with fewer or no inputs.

EVOLVING APPROACHES TO GENDER-RESPONSIVE SOIL FERTILITY MANAGEMENT

Developing countries' approach to soil fertility management has evolved considerably over the last 50 years. Researchers have shifted from an almost exclusive focus on inorganic (chemical) fertilizer toward a broader range of approaches and nutrient sources (NEF 2006). At least in the research community, the value of integrated nutrient management—"the judicious manipulation of nutrient stocks and flows" (de Jager, Nandwa, and Okoth 1998: 37)—is now widely accepted.

The high climatic risks, uncertain markets, and poor infrastructure characteristic of many low-potential, isolated zones have challenged the economic wisdom of using high levels of external inputs and placed a premium on technologies that rely relatively little on such inputs (IFAD 2002). Many recognized alternatives to inorganic fertilizer are available. The use of animal manure, agroforestry, legumes, living mulch, compost, and other technologies that enhance soil fertility is traditional in many farming systems, especially systems that are managed and controlled by women. In other contexts, such technologies have been promoted actively (Uphoff 2002). The value of conservation agriculture has been established in many locations, with important lessons to be drawn (FAO 2005b).

Low-external-input strategies to improve soil fertility are often labor and knowledge intensive, however. Consequently they may be difficult for resource-poor farmers to adopt, given their limited access to labor and information, especially in remote areas where few formal institutions exist to strengthen human and social capital.

Despite the recognized importance of low-external-input strategies, chemical fertilizer remains the basis of soil fertility management in many farming systems and most intensification trajectories (NEF 2006). Chemical fertilizer is central to most extension messages, and the use of nitrogenous fertilizer continues to increase rapidly in the developing world (van Dam 2005). For a host of economic and logistical reasons, however, resource-poor farmers, including women, cannot apply fertilizer at high rates. The cost of fertilizer can represent a high proportion of the total variable cost of production, an investment that poor farmers can ill afford where there is a risk of crop failure (FAO 2006). Fertilizer is often sold in quantities too large for poor

women to buy. Fertilizer may be considered too risky to buy, especially when it will be used to produce food crops with little possibility of generating cash income. Even when farmers can afford fertilizer, they cannot always obtain it. Access is often directly limited by inadequate infrastructure and transport facilities.

Conventional soil improvement technologies based solely on the use of external inputs have widened the divide between better-off and resource-poor farmers. External inputs require cash and access to markets, so women engaged in subsistence agriculture have benefited least from their introduction. The vulnerability of resource-poor households often makes them averse to risk and discourages them from pursuing new activities or adopting new practices and technologies (ICAD 2004). The introduction and promotion of low-external-input technologies, which would rely on resources that are more easily available to women in small-scale production systems, could improve their soil fertility management capacities and address disparities between better-off and less-favored households, because these technologies are better suited to the latter.

As mentioned earlier, improving soil productivity is a key to improving food security. Women may benefit from improved crop production by selling surplus in the local market. Enhanced crop productivity could thus be a starting point for livelihood diversification. Increased soil productivity also increases returns to labor, which is especially important for labor-constrained women, because it may free time for additional activities. Zero-tillage systems, cover crops, and mulches, for example, can significantly improve soil productivity and at the same time reduce labor for weeding. These alternatives are often context specific; mulching, for instance, is more appropriate for small-scale farming.

Women farmers often apply different criteria to assess soil productivity, because they are more concerned with the overall output of the cropping system (often a mixed cropping system). Mixed cropping systems may yield as much or more food as monoculture systems, and often they are designed to foster overall crop stability and system resilience. Agricultural research and development interventions can be better targeted if they take these local strategies for managing soil productivity into account. Combining fertilizer use with other soil productivity management strategies, such as mulches, cover crops, or intercropping, could further improve the stability and resilience of cropping systems, characteristics that are gaining importance in light of the potential negative effects of climate change.

POLICY AND IMPLEMENTATION ISSUES

It takes time to improve soil productivity. The results of investments in soil productivity are usually not seen in the first years. The lag time between investment and results means that farmers may face a trade-off between meeting their immediate needs (which may lead to nutrient mining) and ensuring the longer-term sustainability of their land (DFID 2002). It also means that land tenure is a major influence, both on the maintenance of soil fertility and on the ability to intensify farming sustainably. Because women so frequently lack secure access to land, they may be reluctant to invest in soil improvement. “Secure access” to land refers not only to having legal title to the land but also to having the power within the household to make and influence decisions about how the land will be used. A possible scenario, for instance, is that men household members will start managing a formerly unproductive field once the women have invested labor and resources to enhance its soil productivity.

Extension systems continue to direct information on soil improvement largely to men (see also Module 7). The imbalance between men and women extension staff reduces the effectiveness of extension services for women farmers, and the apparent failure to focus on women’s crops and production systems renders many extension messages meaningless for them. Because fertilizer recommendations are usually designed for monoculture systems, they are difficult for women to apply in mixed cropping systems.

Extension systems supply limited information on alternatives to chemical fertilizers, partly because research systems

still have limited capacity for studying the synergistic effects of soil amendments (such as manure and compost) and inorganic fertilizers (DFID 2002).

In some countries the withdrawal of subsidies for inorganic fertilizer has reduced its availability for resource-poor farmers, including women. An alternative policy could be to adopt “smart” (targeted and time-bound) subsidies that increase the possibility that poorer farmers will use fertilizer, especially by making small packages of fertilizer available at a reasonable price (DFID 2002).

GOOD PRACTICES AND LESSONS LEARNED

Actions to address key gender issues in managing soil productivity can be clustered into three categories: (1) the use of chemical fertilizer; (2) the use of low-external-input technologies, including synergistic effects of fertilizer and other practices; and (3) the appropriate choice of crops and crop management practices to enhance soil productivity. The actions and corresponding lessons are discussed in the sections that follow.

Chemical fertilizer use in gendered crop agriculture

The use of chemical fertilizer needs to be considered from a regional perspective (table 12.2). The African continent (including North African countries and South Africa) has consistently represented only 2–3 percent of world fertilizer consumption; the share for sub-Saharan Africa (excluding South Africa) is generally less than 1 percent (FAO 2005a).

Table 12.2 Regional Disparities in Chemical Nutrient Consumption, 2002/03–2003/04

Region	Nutrients (000 tons)		Change (%)	Percentage of world total
	2002/03	2003/04		
Africa	4,278	2,924	–0.7	2.1
Central Europe	4,086	3,528	–0.9	2.5
East Asia	50,612	51,751	1.0	36.3
Eastern Europe and Central Asia	3,660	3,887	1.1	2.7
Latin America	13,230	13,191	–1.0	9.3
North America	22,022	22,024	1.0	15.4
Oceania	3,162	3,233	1.0	2.3
South Asia	20,882	20,937	1.0	14.7
West Asia	4,607	5,678	1.2	4.0
Western Europe	15,142	15,436	1.0	10.8
World	141,681	142,589	1.0	100.0

Source: “IFADATA Statistics,” www.fertilizer.org.

Note: Bold faced entries are regional totals.

The regional averages hide considerable variation among countries. Whereas fertilizer use is increasing rapidly in southern Africa (Crawford, Jayne, and Kelly 2005), it is stagnant or declining elsewhere in Africa. The majority of Africa's farmers (many of them women) are smallholders with less than 2 hectares (Altieri 2002), and they grow most of their basic food crops with virtually no or minimal fertilizer. For example, 72 percent of millet, approximately half of all food legumes, and nearly all yams and cocoyams are produced in this way (Altieri 2002). In Tanzania and Uganda, the average use of chemical fertilizers is less than 1 kilogram per hectare per year, which implies that most land is never fertilized (Wynen and Vanzetti 2002).

Overall trends in fertilizer consumption can be summarized as follows (FAO 2006):

- Fertilizer consumption has increased substantially, although not consistently, in countries with rapidly increasing exports of agricultural commodities, such as Argentina and Brazil.
- Structural adjustment programs implemented to correct financial imbalances in certain developing countries in the 1980s and 1990s negatively affected fertilizer use among small-scale farmers.
- In countries where centrally planned systems, with their heavy support to agriculture and planned allocations of fertilizer, were superseded around 1990 by market-oriented systems, fertilizer consumption fell abruptly.
- In the few developing countries where governments continued to support fertilizer use, sometimes despite pressure to the contrary, fertilizer consumption continued to increase.

Unfortunately, no systematic national or global data sets compare fertilizer use by gender. Indirect evidence for the unequal use of inorganic fertilizer can be obtained by analyzing fertilizer use by crop species where data are available. According to FAO:

In Latin America seven crops (maize, soybean, sugar cane, beans, wheat, coffee and rice), plus vegetables and fruits, account for 88 percent of the total fertilizer consumption. A substantial proportion of the fertilizer is used on agricultural cash and commodity crops for the domestic commercial market and export. Although statistics are not available, it seems that little fertilizer is used in the subsistence/small-scale farming sector. In SSA the main crops to receive fertilizer include maize, millet and sorghum. In South Asia and Southeast Asia about 60 percent of fertilizers are used on cereals. In South Asia, crop production is oriented towards supplying domestic

demand, whereas Indonesia, Malaysia, Thailand and Viet Nam are also important exporters.

FAO (2006: 55)

The data suggest that the larger share of fertilizer is applied to commercial crops, which indicates that women use only a small proportion on their staple crops.

Many reasons account for women's limited use of fertilizer. As mentioned earlier, because fertilizer is mainly sold in large quantities, it is a big investment, especially for cash-constrained women. Women usually have less access to transport and find it more difficult to carry bags of fertilizer home. In remote rural areas, fertilizer is not usually readily available, and thus it is especially difficult for women, who have fewer opportunities to leave the village, to obtain. All of these constraints reveal strategic entry points for interventions that could improve women's use of fertilizer.

It is also important to emphasize that fertilizer is usually promoted in conjunction with other technologies, especially improved crop varieties. The long-term sustainability of such "packages" depends on the continued availability of their components. Box 12.5 illustrates the problems inherent in this approach and demonstrates why it is vital to address gender inequality in access to assets and services.

Alternative crop management practices for improved soil productivity

For resource-poor farmers engaged mainly in subsistence production, low-external-input technologies are usually a more affordable way to improve soil productivity. Crop rotations, improved fallows, agroforestry systems, integrated soil and water management practices, and the choice of suitable crops are some of the options. It is important to emphasize that the crop management practices described in this section as a means to enhance soil productivity *do not exclude* the use of external inputs. The use of these practices and the use of external inputs can be complementary, depending upon the resources and socioeconomic situation of each farmer.

As mentioned, low-external-input technologies are often based on local practices that have been adapted in light of additional knowledge and skills. Recognizing the beneficial effects of legumes on soil productivity, women farmers often grow legumes in combination with other crops such as tubers and cereals, but this practice requires, among other resources, farmers' time and knowledge. Because the lack of labor is often cited as a major constraint to the adoption of low-external-input technologies, it is essential to match the

Box 12.5 Ghana: Nuances of Success among Men and Women Farmers

The Ghana Grains Development Project is one of the few African success stories of long-term donor support to strengthen national research and extension for food production. Ghana is also one of the few African countries with sustained increases in per capita food production. The Ghana Grains Project focused primarily on increasing the output of maize and cowpeas through the development and adoption of well-adapted varieties and management practices for each of Ghana's agroecological zones. Graduate-level training was provided to about 50 scientists, nearly all of whom returned to the project. Annual maize production rose from 380,000 tons in 1979, when the project started, to more than 1 million tons by the project's end in 1998. Maize yields increased by 40 percent, from 1.1

tons per hectare to 1.5 tons. The project's bottom-up approach integrated farmers in all stages of the research and included a socioeconomic assessment of the technology. Large-scale extension programs to promote the varieties and practices, supported by Sasakawa Global 2000 (a nongovernmental organization [NGO]), enabled more than half of all maize farmers in Ghana to adopt improved varieties, fertilizer, and planting methods by 1998. After fertilizer subsidies were removed, fertilizer use dropped to 25 percent, challenging the approach's sustainability. Adoption was significantly lower among women farmers (39 percent) than men (59 percent), reflecting differences in access to assets and services, and especially the biases in extension.

Source: Canadian International Development Agency, personal communication 2006, cited in World Bank 2007.

labor demands of such technologies carefully with household labor availability. These issues are especially important for women farmers who have specific seasonal labor-use patterns and who have no recourse to assets and services (World Bank 2007).

Some low-external-input technologies require no more labor than current practices. Others, such as conservation tillage, are attractive precisely because they save labor. In some cases (such as stone bunds for soil conservation), the initial labor investment for establishing the technology is high, which can limit adoption if the work coincides with peak labor periods. In Burkina Faso, for example, stone bunds contribute to soil and water conservation, promoting higher yields and, eventually, higher returns to labor. Nevertheless, 48 percent of women involved in their construction claimed that the bunds added to their workload, and only 12 percent said the bunds lightened their work (Atampugre 1993).

A further criticism of the application of low-external-input technologies is their highly context-specific nature, which means that they must be adapted to particular agroecological and socioeconomic conditions. Although much of the responsibility for local adaptation is ultimately borne by farmers themselves, these technologies clearly imply an even greater burden for national agricultural research systems (Sumberg, Okali, and Reece 2003). A shift to participatory innovation development—a process that combines local and external knowledge and skills—is required, supported

by training and capacity building among researchers, extension staff, and participating farmers. The shift to participatory development of innovations has important positive consequences for the development of human and social capital, as seen in the following examples. For a range of cultural and socioeconomic reasons, women often must be specifically approached and encouraged to participate in such initiatives.

The examples also indicate the wide range of options available for integrated soil fertility management. Farmer-led research initiatives (Budelman and DeFoer 2000; DeFoer and Scoones 2001) have demonstrated the promise of complex responses to nutrient scarcities that include organic as well as inorganic nutrient sources. Rather than favoring one approach over the other, observations in the field indicate that farmers are interested in experimenting with organic and chemical fertilizers to better attune responses to local needs, a process that inevitably requires an integrated approach.

Involving women in soil fertility management innovations. It is widely acknowledged that the sustainability of projects and programs to develop technology is linked closely to the participation of the target audience. Such participation is especially important in projects that rely on the traditional knowledge of women farmers to develop soil fertility management innovations. Many promising experiences in promoting farmers' innovations in soil management have been

described, but two projects funded by the Netherlands offer examples that are especially pertinent for working with women farmers: (1) Promoting Farmer Innovations (PFI) and (2) Indigenous Soil and Water Conservation in Africa (ISWC). These projects, which operate in several African countries—including Burkina Faso, Ethiopia, Tanzania, and Uganda—aim to establish multistakeholder platforms for technology development and encourage women’s participation.

For instance, in all of Ethiopia, research and development related to land husbandry have usually ignored the potential of women’s knowledge and innovation. Women’s domestic work has low status in Ethiopian society, and their productive work in agriculture is seldom acknowledged. As a rule, women in rural families do not regard themselves as farmers and would not present themselves as innovators in land husbandry. This situation is not unique to Ethiopia. Among farm families in Kenya, Tanzania, and Uganda, the PFI also found that women did not come forward to show and explain their own innovations; instead, men household members assumed this task, even though they did not understand the innovations as well as the women did (Critchley, Ong’ayo, and Njoroge 2001).

Many factors can explain women’s lack of self-esteem with respect to their farming activities: traditional beliefs and attitudes regarding women’s role in rural society; women’s low levels of formal education; the limited mobility of women compared to men, who often migrate to towns or other countries to seek work; and women’s poor access to external information. In Ethiopia ISWC endeavored to recognize women’s innovation in land husbandry as a means of changing perceptions of this activity, including the perceptions of the women themselves, and of increasing the women’s self-confidence and capacity to contribute to development. The first steps were to gather evidence of innovation by women farmers (box 12.6) and to make these accomplishments more widely known through training, tours, and exchange visits.

Promoting the use of legumes as mulch and cover crops. The use of legumes to improve soil productivity is well established in traditional agricultural systems and in technologies developed more recently by researchers. Projects promoting the use of legumes as green manure have often achieved limited impact, however, because they ignored farmers’ multiple criteria for selecting suitable legume species. Women in particular resisted adopting species that people could not eat, even if they were the best choice for improving soils. Failing to involve men and women farmers in the selection of appropriate legume species may limit a project’s impact. An example from Malawi (box 12.7)

Box 12.6 Ethiopia: Women’s Innovations in Soil Fertility Management

A village study in Eastern Tigray, Ethiopia, revealed that women in different wealth classes pursued different types of innovation. Poorer women could take fewer risks, but this did not mean that they were less innovative—in fact, the opposite may have been the case. Poorer women felt that it was too risky to borrow money and preferred to find ways of using their current resources more efficiently. In improving soil fertility, for example, they tried to use animal manure whenever possible, but poorer households had few or no livestock and little access to this source of natural fertilizer. Some women who headed poorer households found alternative means of fertilizing their land, such as allowing animals of relatives or friends to graze their land in return for the dung. Many women used cooking ash as fertilizer; one, who had a particularly large amount of ash from kilning pottery, finds it to be an excellent soil enhancer. These practices are not new to the area, but they indicate women’s efforts to maintain soil fertility with the slim resources available. It is likely that a deeper study of fertility management would reveal innovative means developed especially by poorer women. Many of these women are reluctant to respond to the “encouragement” (through credit) of using artificial fertilizers, because they fear they will be unable to repay their debt if the rains fail.

Source: Haile, Abay, and Waters-Bayer 2001.

emphasizes the importance of placing farmers at the center of research and extension to improve the adoption of legume-based technologies.

Choosing new and more profitable crops

Soil fertility is only one component of overall soil productivity. Many more possibilities are available to enhance soil productivity. The selection of appropriate crops, in combination with soil-improving practices, is one alternative, as seen in Bangladesh (box 12.8).

The Bangladesh case highlights the importance of promoting innovations that mesh with the livelihood strategies of women across wealth categories, especially poorer and landless women whose prospects for participation may

Box 12.7 Malawi: Gender Dimension in Legume-Based Soil Improvement Technologies

Legumes are uniquely suited for enhancing soil productivity and providing nutrient-enriched grains and vegetables for farmers with few resources. Yet the substantial barriers to diversification with legumes, including their establishment costs and moderate yield potential, indicate a need for long-term engagement and farmer-centered research and extension.

A case study in Malawi illustrates that experimentation with legumes and their adoption can be fostered among even the most resource-poor smallholders. Multieducational activities and participatory research involving farmer research teams were carried out within 80 communities. Over five years, more than 3,000 farmers tested legumes and gained knowledge of their contributions to child nutrition and soil productivity. Legume systems expanded on an average area of 862 square meters in 2005 (772 square meters for women and 956 square meters for men, indicating a gender dimension to legume adoption). Farmers chose edible legume intercrops such as pigeon peas and groundnuts over the *Mucuna* spp. green manure system. Women in particular preferred the edible species to meet their combined goals of food security and soil improvement.

Source: Kerr and others 2007.

Box 12.8 Bangladesh: Homestead Vegetable Production

In the Saturia region of Bangladesh, credit and training were provided for women to grow vegetables on small plots on or near their household compounds. The improved vegetable varieties, which could be purchased from a local NGO, included tomatoes, okra, Indian spinach (*pui shak*), red amaranth (*lal shak*), radishes, eggplants, amaranth (*data*), kangkong (*kalmi shak*), mung beans, and sweet gourds. Because the vegetables were cultivated on homestead land, it was easier for landless and land-poor households to participate, and their vegetable consumption increased.

A recent impact assessment found that the technologies were relatively easy to adopt. They required very little land and only a small cash investment. Women did not need to move beyond the homestead. The nutritional benefits for the household were high. Women could coordinate vegetable cultivation relatively easily and flexibly with their many other household tasks. The technologies were unlikely to increase vulnerability, because they were grown on homestead land where security was easily ensured. Nor were any other crops likely to be displaced, as homestead land is rarely used for cropping. Women and their families liked the fact that they could produce vegetables within the homestead without risking the harassment and loss of reputation they would suffer from working outside it.

Source: Hallman, Lewis, and Begum 2003.

initially appear bleak (Adato and Meinzen-Dick 2007). It also shows the potential for empowering women beyond the initial bounds of a project. In areas where market infrastructure is available, vegetable sales could empower women in the sense that earning money could increase their decision-making power within the household. In some areas it could create opportunities for women to move into public space, such as the market, to sell produce themselves. Women who become members of groups involved in NGO-sponsored development projects gain self-confidence from their solidarity with the group and the added status of being part of an outside organization.

Although the rapid expansion of horticultural crop production appears to hold considerable promise for poor people who depend on agriculture, including women, the

experience in Bangladesh shows that if interventions based on new and more profitable crops are to succeed among women, the interventions must operate on a scale that is accessible to them. Experiences from large-scale vegetable production, for example, are not only different but are probably more suited to (men) farmers with far greater resources. The production of horticultural crops increases the returns on land about 10-fold compared to returns for cereal crops (World Bank 2007). It generates considerable employment in the field—horticultural crops require about twice the labor input per hectare of cereal crops—and generates more off-farm jobs in processing, packaging, and marketing. Women hold many of these new jobs, although they often work under unfavorable conditions (see also Module 8).

Yet the possibilities for resource-poor farmers to invest in large-scale production of horticultural crops are limited. Horticultural crops are management intensive, a variety of crops are grown, the cash outlay is large, and the use of chemicals is heavy (inflicting considerable harm on the environment; horticultural crops account for 28 percent of global pesticide consumption; World Bank 2007). Horticultural enterprises are risky because of pest outbreaks and volatile prices. Fruit production requires an investment of several years to recoup costs. The production of high-value horticultural crops for export leads to labor shortages, which force women to reduce the time devoted to independent income-producing activities or crops under their own control, with potentially negative impacts on food security.

Organic production, with the corresponding practices to maintain soil fertility and soil health, may be a potentially more benign alternative to conventional, high-value horticulture. The organic food movement has been endorsed by FAO, which maintains in a recent report (FAO 2007) that organic farming fights hunger, tackles climate change, and is good for farmers, consumers, and the environment. Organic farming is now regarded less as a niche market within industrial countries and more as a vibrant commercial agricultural system practiced in 120 countries on 31 million hectares of cultivated land and 62 million hectares of certified wild harvested areas. The organic market was worth \$40 billion in 2006 and is expected to reach \$70 billion by 2012. The strongest benefits of organic agriculture are its use of resources that are independent of fossil fuels, are locally available, incur minimal agroecological stresses, and are cost effective (FAO 2007). Some have argued that women farmers, who already rely on few external inputs, may be well positioned to become organic producers and benefit from the rising interest in organic produce.

A report from the International Institute for Environment and Development in the United Kingdom (Datta and Kar 2006) examined 14 NGOs promoting ecological agriculture in Bangladesh. Most of the NGOs ran programs that encouraged poor women to grow vegetables using organic fertilizers and pesticides on homestead land. This practice was extended to larger farms, generally controlled by men landowners. Farmers received environmental education and training along with financial and technical support. The training in organic agriculture had a significant impact on homestead farming and commercial farming. The awareness of organic agriculture rose significantly, particularly among women, who used organic fertilizer and actively promoted these technologies outside the project boundaries.

Despite the promise of organic production practices, it must be remembered that organic agriculture shares many of the attributes of low-external-input agriculture. It is labor intensive and knowledge intensive and requires a range of local inputs, such as manure and compost, which are not always available. Yields of organic crops are often lower than yields of nonorganic crops. Conventional farming inputs, such as chemical fertilizers and pesticides, are easily available, and farmers can use credit to purchase them. Landless and smallholder farmers depend on sharecropping, which forces them to maximize short-term benefits from conventional farming, depend on the immediate returns gained from using chemical inputs, and forego the longer-term benefits from organic farming.

Finally, obtaining organic certification is a costly process that requires a good amount of organization, even among farmers with considerable assets. The successful establishment of organic production systems will therefore require targeted services and infrastructure, including transport and markets, especially if women and the poor are to benefit.

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

The following guidelines and recommendations apply to practitioners:

- The lack of gender-disaggregated data on the use of fertilizer and other soil productivity technologies mirrors the lack of attention given to this subject and makes it difficult to analyze the impact of interventions from a gender perspective.
- Experiences thus far have focused either on using fertilizer to address short-term soil fertility problems or on the development and promotion of low-external-input technologies. Although the complementarity of these approaches is mentioned in the literature, there is little evidence of their combined use in farmers' fields. The judicious use of affordable doses of inorganic fertilizer, combined with other soil fertility technologies, may offer good prospects for women to improve overall crop production. A better understanding of the synergistic effects of soil amendments (such as manure and compost) and inorganic fertilizers is essential—along with improvements in research and extension capacity to develop and promote combined technologies.
- Support is needed for research to adapt existing methods of fertility management to specific agroecological zones and to cropping systems managed by women in those

zones, and for extension to promote these techniques in ways that include women. Research on fertility management technologies that specifically addresses women's resource constraints and livelihood strategies has been limited.

- Land tenure is a major influence on the maintenance of soil fertility and on the ability to intensify farming in a sustainable way. Given that farmers must have secure access to land if they are to invest in it, soil productivity initiatives must be accompanied by initiatives to secure women's access to land (see Module 4).
- Women's empowerment through participatory approaches to technology development is critical. Although projects seek to involve men and women, in practice women's participation in soil improvement projects is often limited. A systematic effort is often needed to increase women's participation.

A final lesson is that more holistic soil productivity indicators are needed for monitoring and evaluation, especially with respect to the gender effects of soil management interventions. Until soil productivity management interventions are monitored and evaluated in a gender-disaggregated way, meaningful conclusions on the gender equality of interventions will be extremely challenging to obtain (see also Module 16). Men's biases in adoption do not necessarily mean that a particular technology is inappropriate

for women; better targeting and institutional and policy support may be needed to make the technology more accessible for women.

Soil productivity management interventions need to be monitored and evaluated within a wider livelihood context. Measuring short-term, single-crop productivity gains will not capture the full picture. Direct and indirect impacts of interventions, both quantifiable (such as yields, incomes, and labor requirements) and qualitative (such as system resilience and stability or women's empowerment), need to be taken into account. Productivity gains in one crop do not translate directly into increased household income, and benefits are not equally shared between men and women household members.

Furthermore, a need is present to develop monitoring and evaluation criteria that measure the contribution of soil productivity technologies to minimizing the risk of adoption for women farmers. Questions that elicit information on women's reliance on and contribution to different livelihood assets, such as labor, knowledge, and local natural resources, are important for understanding the potential impact on women. This list, although certainly not comprehensive, nevertheless indicates the importance of assessing technologies on the basis of criteria that extend beyond simple production data and of relinquishing the "one-size-fits-all" approach in developing and promoting soil management technologies.

Gender in Seed Production and Distribution

Seed is one of the most crucial elements in the livelihoods of agricultural communities. It is the repository of knowledge passed from generation to generation, and the result of continual adaptation and innovation in the face of ever-greater challenges for survival. The potential benefits from the use of good quality seed of adapted varieties by farmers can be enormous, and the availability of quality seed of a wide-range of varieties and crops to farmers can increase productivity, reduce risks from pest, drought and disease pressure, and increase incomes. Production increases through the use of adapted varieties in a given area can create employment opportunities related to processing, marketing, and other activities generated through quality seed production.

ASBP (2006: 6)

A farming community's food security depends heavily on its seed security. Women's need to ensure good supplies of their preferred varieties of seed can be particularly acute, because women are often the main growers of food to feed the family. Although both men and women farmers regard seed as a key resource for food and livelihood security, it is crucial to remember that *important socioeconomic and gender differences in seed diversity, seed security, and food security must be understood to target any seed interventions effectively* (FAO 2008b).

Farmers participate in multiple seed systems that help them produce and obtain the seed they need. These systems (box 12.9) can be divided broadly into formal and local (sometimes called "informal," "traditional," or "farmer") systems. Commercial farmers rely mostly on formal systems, which are responsible for the flow of improved and hybrid seed. Subsistence farmers tend to rely more on local systems. Local systems are responsible for flows of seed of traditional as well as modern varieties, which enter the system through different processes (Sperling and Cooper 2003). Farmers may mix seed from different sources if they lack sufficient seed or if they wish to experiment with or

modify a traditional variety. Farmers may incorporate improved varieties and expose them to local conditions and management, fostering their local adaptation. Local knowledge of men and women farmers is important because they manage different crop species and varieties and may participate in different seed systems for different purposes.

Although much attention has been paid to the development of formal, national seed systems, their contribution to noncommercial production systems remains limited. One widely recognized problem in many countries is the extended time between the initial identification of new varieties and their eventual release, seed production, and sale, which considerably delays adoption. In many countries local seed systems provide by far the largest share of seed for noncommercial crops. An estimated 80 to 90 percent of all seed used to produce staple food crops in subsistence systems comes from local seed systems (FAO 2008b; GTZ and CGN 2000).¹ In local seed systems, farmers themselves produce, disseminate, and obtain seed directly through their own harvested crops or through sale, exchange, or barter with others in the local area (ASBP 2006; Sperling and others 2004).

For resource-poor farmers, especially women, the local seed system is not surprisingly the main and most reliable source of seed (FAO 2008b; Pionetti 2006; Smale and others 2007), but medium-scale and better-off farmers also rely on seed from this source (FAO 2008b). An important reason for relying on local seed systems is that small-scale farmers, especially women, often grow a diversity of crops to minimize the risk of total crop failure and food insecurity (box 12.10). Another reason is that women in many societies are in charge of selecting and storing seed of many traditional food crops. Often these crops are valued for specific attributes: they are cheaper, available in small quantities, better adapted to local conditions, and easier to obtain, and they possess other qualities (for food preparation, ceremonies, or

Box 12.9 What Is a Seed System?

Seed systems are often large and complex. A seed system generally encompasses a large number of individuals, organizations, and institutions involved in different functions related to seed, such as plant breeding research and the subsequent multiplication, processing, storage, distribution, and marketing of seed. Seed systems, very broadly defined, can be categorized as informal (or traditional) or formal seed systems.

Individual farm households are the foundation for informal seed systems, in which each household performs numerous seed system functions on its own. The formal sector, by contrast, consists of public and private organizations with specialized roles in supplying seed of new varieties. Different types of seed from organizations and individuals in one stage of the seed chain will flow to the next stage through informal and formal channels. Rules and regulations, such as procedures for releasing new varieties of seed to the public, intellectual property rights regimes, seed certification programs, seed standards, and contract law influence the structure, coordination, and performance of the seed system.

Source: Maredia and Howard 1998.

other uses) that are integral to cultural traditions. Seed of most of these crops and varieties is not developed or supplied through formal channels.

Although the local seed systems are well adapted to farmers' specific production environments, they often face numerous constraints. Traditional varieties have been and continue to be lost for a variety of reasons (including conflict, drought, change in preferences, and research and extension campaigns promoting modern varieties). Interventions to strengthen local seed supply systems, such as establishing seed banks and breeding and multiplying seed, are gaining popularity among NGOs and public institutions that supply seed. Often such initiatives enable formal and informal systems to work in complementary ways. Farmers also express demand for seed of new and improved crops and crop varieties and for improved seed management and processing technologies, which can be supplied by the formal seed system.

Small commercial seed enterprises might be a good means of serving these markets, which may not be attractive

Box 12.10 South India: Seed and Crop Diversity in Women's Livelihood Strategies

Women farmers in South India frequently point out that they could not grow such a wide range of crops if they did not have the seeds "in their hands." One farmer articulated the issues as follows: "Where would we get small amounts of seeds for our traditional crops if we did not save them ourselves?"

Small-scale farmers need relatively *small amounts of seed for a large number of crop varieties*: 100 grams of sesame, 500 grams of black gram, 1 kilogram of finger millet, and a handful of roselle seeds. Women farmers also want to grow very specific crops in addition to staples such as sorghum or maize. There is no guarantee that formal seed agencies can provide seed for all of these crops. Thanks to their carefully maintained seed stocks, the women can maximize the number of crops grown on their land and achieve a varied and nutritious diet.

Source: Pionetti 2006.

to large private seed companies and poorly served by public seed agencies. Partnerships between public and private agencies (for example, a public research organization could supply seed for multiplication and sale to small, private entrepreneurs) may be another means of catering to these markets. Because women are responsible for selecting and saving seed in many traditional farming systems, commercial seed production presents good opportunities for including them as entrepreneurs, as contract farmers to multiply seed, and as marketers as well as employees.

KEY GENDER ISSUES

The following sections describe the key gender issues in crop agriculture and the potential benefits of addressing them.

Seed sources and access to information differ by socioeconomic group and gender

As mentioned earlier, an apparent gender bias exists in access to formal seed systems. Men, who are generally more involved in growing commercial crops, seem to access and benefit more easily from formal systems. Women, in turn,

rely more heavily on local systems to obtain seed for staple and minor crops. A resource endowment bias has also been observed. Resource-poor farmers—men or women—generally lack the cash to purchase seed of modern varieties from formal seed suppliers. In Bangladesh access to irrigation was a significant determinant of whether a farmer would adopt modern rice varieties (Hossain 1988). A study in Ghana revealed that farmers preferred different rice varieties depending on whether they would be grown under high-input or low-input conditions (Stirling and Witcombe 2004). Gender-responsive action in the local seed sector should increase the availability of adequate seed and thus increase food and livelihood security for resource-poor farmers—especially for crops that are less interesting to commercial seed suppliers.² Encouraging local seed banks, establishing small-scale seed enterprises, and facilitating local seed exchange through an enabling policy environment are some measures to consider.

Based on their different portfolios of crop species and varieties, men and women can contribute different knowledge of seed characteristics

Aside from multiplying and distributing seed, local seed systems are important sources of knowledge of seed characteristics and management. Gender differences in local seed knowledge and skills are an important asset for strengthening links between the local and formal seed systems. Given women's traditional roles in selecting and saving seed, they can be strategic partners for forming liaisons between formal and informal seed systems. The formal system can play a more significant part in developing and supplying seed if it adopts a gender perspective—in other words, if it succeeds in understanding and addressing the seed needs of different household members.

Women's role in local markets and small seed enterprises

Local markets are often a crucial link in local seed systems. Local markets bring in grain, which farmers can subsequently sort and use for seed. These local “seed-grain markets” differ from formal outlets selling seed that is specially produced as seed, on specialized fields, within the framework of a seed business enterprise.³ In many African and Latin American contexts, vendors of local seed and grain are to a large extent rural women. Farmers are sourcing less and less seed from their “classic” informal source (their own stocks) and depending more on local seed and grain markets (Smale and others 2007).⁴

Women increasingly participate in the formation and management of small seed enterprises (World Bank 2005). These more recent experiences need to be monitored and evaluated carefully to better understand their contributions and impacts on improved seed security and overall livelihood security. Applying a gender perspective to analyze and improve seed systems will help to overcome or at least reduce existing biases in access to, availability of, and use of adequate seed.

POLICY AND IMPLEMENTATION ISSUES

The following sections detail critical policy and implementation issues.

Public versus private seed enterprises

Seed provision is at an important crossroads in many developing countries. Donor support to public seed enterprises has diminished because these enterprises have been inefficient. Strategies for supporting the private seed sector are still evolving. A major challenge for public and private seed enterprises is to ensure repeated seed sales, because farmers may purchase seed once and then save it from their harvest. The emergence of a private seed industry is almost always based on sales of hybrid seed, which must be purchased anew each season or yields will decline, or on seed that farmers find difficult to save, such as vegetable seed. Seed of many other crops (particularly self-fertilizing crops with a low seed multiplication factor that are grown mainly for home consumption) is less likely to be available through a nascent private seed industry based on large, centralized seed enterprises—a vision that shows the formal seed sector's bias toward men and commercial farmers. Opportunities may present themselves for including such crops in small, locally operating seed enterprises with lower transport and overhead costs, however. The development of small, local enterprises could be a means for women to break into seed markets and supply the local and improved seed of crops and varieties that are neglected by large commercial seed companies.

Seed regulations and crop and variety protection

Numerous national and international policies influence the development and operation of formal and local seed systems. In many countries the regulatory and legal framework for the national formal seed system limits the development of local seed systems and directly affects women's position within them.

National seed regulations are usually based on international standards that are often incompatible with the reality of farmers' lives.⁵ They restrict the free exchange and marketing of seed. The combination of compulsory variety registration and seed certification, as practiced in countries in Europe and elsewhere, heavily constrains the efficient functioning of the formal seed sector (notably the development of small-scale seed enterprises) and the development of alternative seed systems (GTZ and CGN 2000). The same constraint arises from the implementation of strong intellectual property rights regimes (World Bank 2006) and arrangements restricting access to genetic resources (Louwaars 2007).

The development of small-scale seed enterprises and local seed markets requires an enabling policy environment. A clear recognition of the roles and contributions of men and women farmers to seed development and management will necessitate a review of farmer's rights, access and benefit-sharing regulations, and intellectual property rights.

GOOD PRACTICES AND LESSONS LEARNED

Past experiences highlight the need to look at both local and formal seed systems, their linkages, and the policy environment that affects them.

Interventions focusing on the local seed system

An analysis of the local system is the starting point for any strategy that aims to strengthen and build on the existing system. A blueprint approach to seed system development will not work; a thorough analysis of the limiting factors of each existing system is vital. Within a household, for example, interests or priorities with respect to seed management may vary by gender and age group. Within a community or region, wealth status or ethnocultural differences can affect knowledge, preferences, and access to critical resources such as seed (FAO 2008b). Projects operating at the community level must be aware that stakeholders are likely to have different needs and priorities (GTZ and CGN 2000). The identification of weaknesses or gaps in seed security will help to define activities that can improve household and community seed security. For example, community seed banks (box 12.11) and community seed fairs (box 12.12) both help to strengthen local seed systems. Managed successfully, they can foster seed exchange networks and establish local institutional mechanisms to supply seed, especially of traditional varieties, within a community. National seed security will improve when local seed security is increased.

Interventions strengthening the formal seed system

The formal seed sector's achievements have been summarized as follows:

Since the 1960s, scientific plant breeding that developed improved varieties suited to smallholders in subtropical and tropical areas—the green revolution—has been one of the major success stories of development. Initially spearheaded by semi-dwarf varieties of rice and wheat and improved varieties of maize from international agricultural research centers of the Consultative Group on International Agricultural Research (CGIAR), public breeding programs in developing countries have released more than 8,000 improved crop varieties over the past 40 years. In the 1980s and 1990s, improved varieties are estimated to have accounted for as much as 50 percent of yield growth, compared with 21 percent in the preceding two decades.

World Bank (2007: 160)

Because these achievements have not been uniform across regions or socioeconomic groups, formal seed systems must develop better strategies for developing and disseminating seed of improved varieties to reach resource-poor farmers.

Plant breeding interventions. Countless breeding interventions aim to address the nutritional and production constraints of resource-poor farmers and significantly improve household food security. Perhaps the most controversial of these interventions is the development of GM crops. Even more than conventional hybrids and other modern varieties, GM crops face significant barriers to dissemination and adoption. Most GM crops in developing countries are currently produced in large, commercial production systems, as they require inputs, knowledge, and management skills that are not available to all farmers. The private sector is the main force behind the development of these crops, and many questions arise about their suitability for poor, small-scale producers.

Attempts are being made—often by public organizations in collaboration with private enterprises—to develop GM crops that tolerate unfavorable crop production conditions common in developing countries, such as poor soils or drought. Vitamin- and micronutrient-enhanced crops, as well as crops that produce vaccines and other pharmacological products, are also envisioned in plant-breeding strategies to improve health and reduce poverty. Despite these efforts, numerous challenges remain in developing and approving GM crops that can be considered to benefit poor people. The accessibility and suitability of such crops, including the potential ecological and socioeconomic risks for resource-poor households, must be assessed further (see Thematic Note 3).

Community seed banks help to meet the complementary goals of improving local food security and recognizing and maintaining the contributions of local crop diversity. Seed of traditional varieties frequently cannot be obtained in the market. Instead, rural people exchange seed within their villages or with people from neighboring villages. This kind of seed exchange is an important instrument for seed supply and diffusion; it is usually based on kinship, traditional relationships, and cultural practices. The establishment of a community seed bank empowers local people to select and multiply seed of traditional crops and varieties of their choice. By facilitating access to seed, especially among women, seed banks often encourage and sustain cultivation of traditional varieties and household seed security. The banks also help farmers to contribute and communicate their knowledge of seed storage technologies. Two examples of community seed banks follow.

- In *Paraíba, Brazil*, frequent droughts and farmers' small landholdings mean that families often cannot produce enough grain to use as food and to save as seed for the next year's crop. Genetic diversity has also been eroded by the preference for seed of commercial rather than local varieties. Commercial varieties are grown to meet market demands and are also used for distribution in government seed programs. Community seed banks help to reverse this trend through participatory, collective efforts to grow and supply seed. In addition to conserving biodiversity, the banks enable

farmers to be self-reliant by supporting the timely provision of seed.

- In *Jeypore, India*, interested households contribute a specific quantity of seed to the community seed bank. Seed is mixed with powdered neem (*Azadirachta indica*) and karanja (*Pongamia pinnata*) leaves to preserve it from storage pests. The village committee (*palli samithi*) forms the seed bank management committee, which consists of three men and women who share the responsibility of managing the bank. The bank records the names and quantities of seed required by needy farm families, and it distributes the seed. The involvement of women has strengthened the seed bank and the seed exchange system. The women perform vital tasks such as periodically monitoring seed quality. About 200 farmers (men and women) are actively involved in the program. The seed bank primarily stores seed of 15 traditional paddy cultivars, along with some millet, oilseed, and vegetable varieties. In 2000 about 700 kilograms of seed were handled.

Apart from their impact on food security, seed banks can improve socioeconomic conditions in rural communities, especially the status of women. By establishing self-help groups to operate seed banks, women can become more active in decision making and more self-confident, and can communicate more easily with government officials or outsiders. Men can become more supportive of women, and conflict between men and women can be reduced.

Sources: Authors; FAO 2002 (India example); FAO 2008a (Brazil).

Seed distribution interventions. Farmers like to experiment with new crops and varieties, and innovative distribution strategies could facilitate poor women's access to improved seed. Packaging seed in small and affordable quantities could be one way of increasing women's access. It is also important to recognize that seed of improved varieties and hybrids often gives the best yields when grown in conjunction with fertilizer and improved crop management strategies (following specific spacing, irrigation, and weeding practices, for example). The availability of these additional resources can be a crucial precondition for successful adoption of improved seed, yet many women lack access to cash and irrigated land.

A detailed analysis of available resources is therefore necessary before promoting such varieties among women.

Interventions strengthening links between local and formal seed systems

In developing countries, farmers' demand for seed is complex and diverse. It would be unrealistic or inefficient for the public, formal seed sector to attempt to meet total seed demand; nor would private, commercial seed providers be able to address all of the seed requirements of resource-poor farmers (Almekinders, Louwaars, and de Bruijn 1994).⁶

Box 12.12 Increasing Seed Diversity and Local Knowledge through Community Seed Fairs

Community seed fairs have shown positive results, especially for women farmers. Community seed fairs offer a venue for displaying and freely sharing seed of different crops and varieties. Seed fairs also offer a good opportunity for knowledge to be shared across generations, between farmers, between communities, and with research and extension staff, thus contributing to expanding farmers' social networks (FAO 2006). Experiences from a range of organizations indicate that these informal settings encourage women's participation.

In China, for example, participants in seed fairs promoted by the Center for Biodiversity and Indigenous Knowledge (CBIK) included 80–150 farmers, local agricultural technicians, officials, scientists from the Yunnan Academy of Agricultural Sciences, CBIK staff, and other guests. Often the share of women participants was as high as 70 percent, because women are closely involved in farming and are the key decision makers when it comes to choosing new varieties. Farmers in each area have their own seed exchange networks but rarely have access to new species and varieties from outside their network. The seed fairs, which were relatively new for participating farmers, served to improve the flow of seed and information within and among communities and to promote the conservation of a wide crop genetic resource base. Experts were invited to give speeches on topics of interest, such as marketing organic produce. Yao and Hani traditional healers took the opportunity to exchange knowledge about medicinal plants.

Sources: Authors; CBIK (China example): www.cbik.org.

A recent World Bank evaluation of the Seed Systems Development Project (SSDP) in Ethiopia, a project ongoing for over 10 years, rated its outcome as moderately unsatisfactory (DEReC 2007). The SSDP achieved its main objective of decentralizing and strengthening the government seed-producing agency (the Ethiopian Seed Enterprise), but it failed to achieve its secondary objective of promoting seed production by private firms and fostering local seed production by farmers.

Recognition is growing that stronger links between local and formal seed systems can lead to the development of an

Box 12.13 Decentralized Participatory Plant Breeding

Decentralized and participatory plant breeding approaches allow farmers to select and adapt technologies to local soil and rainfall patterns and to social and economic conditions, using indigenous knowledge as well. Participatory plant breeding and varietal selection have reduced the development and dissemination of new varieties in some cases by 5 to 7 years, which is half the time (10–15 years) taken by conventional plant-breeding programs.

In very poor areas of South Asia where rice is produced without irrigation (and where the Green Revolution never took hold), participatory plant breeding is now paying off, with strong, early adoption of farmer-selected varieties that yield 40 percent more grain in farmers' fields. The approach must be tested more widely in the more heterogeneous rain-fed environments of Africa, where involving farmers, especially women, in selecting varieties has shown early success for beans, maize, and rice. The cost effectiveness of the approach for wider use also needs to be evaluated.

Source: Adapted from World Bank 2007: 160–61.

integrated seed system in which formal and local actors each play a role. This approach does, however, require collaboration between the many actors involved—breeders, genebanks, and seed projects operated by the formal sector; farmers; and NGOs. Experience with participatory plant breeding initiatives offers some insight into the potential for fostering an integrated approach (box 12.13).

Traditional breeding approaches tend to focus on one characteristic (such as higher yields, more stable yields, or disease resistance). Although the results may be impressive with respect to that particular characteristic, farmers, especially women, may not like the accompanying changes in other characteristics (such as grain color, taste, and ease of processing). In this instance, the knowledge and criteria that men and women use in selecting seed and in their other crop improvement efforts offer the opportunity to strengthen links between local and formal seed systems.

Enhancing communication between local and formal seed systems. Food and livelihood security can increase significantly when shortcomings in local seed systems are resolved. For example, in areas of Bangladesh where CABI's Good

Seed Initiative used videos to outline techniques to improve rice seed quality, seed yield rose an estimated 10 percent. This initiative (supported by the Swiss Agency for Development and Cooperation) aims to strengthen farmers' ability to guarantee food security and improve their livelihoods. The approach, which combines local technologies with those developed by formal research organizations to help women produce quality seed, is now being tested in Africa. CABI, WARDA (Africa Rice Center), and their partner organizations in West Africa and Uganda seek to reach as many as 10,000 farmers. Additional videos will be produced locally as the value of the approach spreads.

Introducing new varieties into the local seed system. Farmers' experimentation with new varieties and the subsequent introduction of adapted and accepted varieties can potentially strengthen cropping systems by increasing yields, improving drought resilience, boosting resistance to pests and diseases, and capturing new market opportunities (Sperling and Remington with Haugen 2006), all of which could widen women's livelihood options. It is important to realize, nevertheless, that not all "improved" varieties will benefit farmers in all agroecological and socioeconomic situations. A careful gender-disaggregated analysis of demand for particular varieties is warranted. Sperling and Remington (2006) discuss key steps for ensuring that characteristics demanded by farmers are considered in introducing new varieties.

Local seed and grain markets, discussed earlier, can offer a good venue for introducing new varieties. These markets, which are frequently visited by rural women, have virtually no formal access to new varieties, to basic (foundation) seed as an input, or to seed quality control services. Even so, there are dramatic examples of how quickly new varieties (including beans in western Kenya and green gram varieties in eastern Kenya) can move through local markets, as farmers spread the word that the new varieties on offer really do perform.⁷

Because the buyers and sellers in local markets are frequently women, the opportunity to support both groups of women by linking new varieties to local seed and grain markets appears substantial. The following actions are necessary to further strengthen women's capacity and access in this context:

- Greater support needs to be given to increasing the quality of seed for the crops and varieties in greatest demand in the markets (these may be local varieties or new ones). Suppliers of large quantities of seed and grain to the market require training to produce better seed

(which does not need to be certified). Most training is concentrated in small community-based groups, often funded by development projects, but general knowledge on how to improve seed quality must be mainstreamed in farming communities.

- The capacity to produce high-quality seed is not enough; farmers and farmer groups require much more training in agroenterprise development. Seed enterprises need to yield profits on a continual basis. The commercial sector has shied away from selling seed of subsistence and open-pollinated crops because the profits are limited. To stimulate consistent demand for this kind of seed, communities must diversify seed production by crop and variety and, crucially, ensure that they have a sustained supply of new and appreciated seed.
- In reference to the point above, direct links need to be forged between those who breed new varieties and those who can multiply and distribute seed at a decent price. Right now, new varieties filter through to communities at an unacceptably slow rate. Research systems have to deliver new materials not only to seed parastatals and commercial producers but directly to important community-based nodes throughout a country.
- Traders and farmer groups need continued access to advice on quality control that is enabling and not threatening. A trader who becomes known for truly good seed should eventually be able to garner worthwhile price margins.

Encouraging the formation of small-scale seed enterprises.

The formation of small-scale seed enterprises—that is, farmer seed enterprises—meets dual objectives: to distribute and promote sustainably modern crop varieties and to establish a regular source of "clean" seed of local or modern varieties. Yet experience indicates that a certain level of resources (such as labor and land) is required to manage farmer seed enterprises successfully; the resource requirement could exclude or discourage women from participating. Some alternative strategies may be better suited to the limited resources controlled by poor people.

For example, the Malawi Smallholder Seed Development Project established by ActionAid in 1995 uses two seed production strategies. The less-poor farmers are encouraged to produce certified seed and operate independently, although they still face marketing problems, for which new approaches, such as the use of stockists, are being investigated. The poorer farmers (many of whom are women) are organized into community groups to produce and distribute seed on a communal basis using group revolving funds (box 12.14). The second strategy has provided encouraging

Box 12.14 Malawi: Community-Based Seed Production

Through the Malawi Smallholder Seed Development Project, groups of smallholders produce improved seed as a means of enhancing household food security. The project has organized 5,405 smallholders into 235 community-based groups to produce seed. Group members are selected through a participatory rural appraisal to identify and assess needs of poor households. The project's concentration on the poorest households has ensured that many more group participants are women, who also perceive greater advantages in belonging to groups than men do. About 70 percent of group members are women, and over 80 percent of the seed-producing groups are composed entirely of women. Women's groups are better organized and their revolving grants for seed production have higher repayment rates than those of men's groups. Women get higher seed yields, generate better savings, and sustain more cohesive groups.

Source: Musopole 2000.

evidence that women's skills and scarce resources can be mobilized to strengthen seed systems and enhance family seed and food security.

Interventions to foster an enabling policy environment

All of the initiatives discussed earlier could benefit from complementary efforts to foster a favorable policy environment, such as the development of seed legislation that protects breeders' rights, interventions that strengthen farmers' rights, and more flexible interpretation of seed laws to support local seed systems. To stimulate the private sector and at the same time support local seed systems for crops that are often ignored by the private sector, well-designed seed and intellectual property rights laws will need to go hand in hand with the recognition of farmers' rights—a balance that is not necessarily easy to attain. Policies for plant variety protection and intellectual property rights must also be gender sensitive. In some instances formal seed interventions and policies can be counterproductive, especially for women's participation in the seed system (box 12.15).

Box 12.15 Southern India: The Role of Gender-Sensitive Policies for Plant Variety Protection and Farmers' Rights

In the dryland farming systems of South India's Deccan Plateau, women's roles in maintaining seed and crop diversity enable rural families to cope with the region's many environmental demands. Here seeds and their management form an economy all of their own, whereby self-reliance in seed, crop diversity, and nutrition are closely intertwined.

But as seed increasingly becomes the "property" of private seed-producing enterprises, this self-reliance is undermined. Plant variety protection enables private companies to cover the cost of breeding new varieties, but it can restrict the scope for farmers to save their own seed through a mix of technological, legal, and economic strategies. These strategies include reducing the genetic variability of new crop varieties through pure line breeding methods; intellectual property rights regimes, such as breeders' rights and patents, which make it illegal for farmers to reuse seed; variety registration and seed certification schemes backed by economic rules; and gender-blind laws that provide no scope for enhancing women farmers' practices, choices, and concerns in the realms of biodiversity and seed production.

Source: Pionetti 2006.

KEY IMPLEMENTATION ISSUES

The guiding principle in any seed intervention is that seed security is a key component of food security. Women are the main food producers in farm households, and so their seed security—in other words, their access to reliable supplies of good seed—is of the highest priority.

A clear assessment of seed demand should be the first step in designing any seed-related intervention. The precise nature of the demand for seed will significantly determine the appropriate seed supply response. It is important to understand exactly why farmers seek seed off the farm:

- Are farmers (men and women) searching for new varieties (which may simply require an initial introduction of seed)?
- Are men and women farmers purchasing hybrids (which can be supplied by a commercial enterprise)?

- Do farmers have seed quality or management problems (which require specialized seed enterprises or extension advice to improve farm-level seed management)?
- Do seed purchases indicate a poverty-induced seed shortage (which will not be addressed by conventional seed provision)?

As formal and informal seed systems focus on different crop species and varieties and seem to serve different clienteles, they should be considered complementary. Both systems have strengths and weaknesses on which development interventions can be based. As seen earlier, women farmers are already active in local seed markets and informal seed systems, and they could make important contributions to emerging small-scale seed enterprises.

The formal seed system can enhance the quality and functioning of the informal seed system by, for example, implementing capacity-building activities addressing both men and women, strengthening community seed banks, and improving seed selection and storage.

These activities require multistakeholder interventions targeting the following actors (GTZ and CGN 2000):

- Individual farmers and farmers' groups, especially women farmers
- Small seed enterprises
- NGOs and development agencies
- Researchers and technicians of national systems
- Policy makers
- Public and private seed companies.

Seed policy should create a framework that enables public and private resources to be used to meet gender-specific demand for seed and that fosters an enabling environment for the synergistic development of the formal and informal seed system. This enabling policy environment will take into account such issues as secure tenure rights for women farmers and improved access to resources, such as inputs or irrigation.

Gender and Crop Protection

Some 20–40 percent of the world’s potential crop production is lost annually because of the effects of weeds, pests, and diseases (CropLife International 2007). New pest problems continue to develop. Attempts to control agricultural pests have been dominated by chemical control strategies, but the overuse of chemicals has adversely affected human health, the environment, international trade, and farm budgets. All of these concerns justify giving high priority to crop protection in development interventions.

Agriculture ranks among the three most hazardous occupations in developing and industrial countries, alongside mining and construction (World Bank 2007). The leading cause of injury on the farm is the improper use of chemicals. Poor awareness of safe practices for handling chemicals and a lack of appropriate protective equipment also contribute to injuries.

Crop protection strategies—the management of pests, diseases, and weeds—have changed dramatically over time. The intensification of agriculture alters agricultural practices significantly. For example, in intensive agricultural systems, more traditional and labor-intensive physical and biological crop protection measures are superseded by pest-resistant varieties and more capital-intensive use of pesticides.¹ In marginal areas, the generally small returns to these expensive chemical inputs make them difficult for farmers to use (IFAD 2002). The recent development of crops that are genetically modified to resist specific pests and diseases presents yet another crop protection alternative to farmers, but the benefits and risks of this technology are still poorly understood in many settings, especially with respect to gender differences.

Pesticides can increase agricultural productivity, but when handled improperly, they are toxic to humans and other species. Aside from the health concerns posed by pesticide residues in food, unintentional poisoning from exposure kills an estimated 355,000 people each year, two-thirds

of them in developing countries.² The costs of medical treatment, lost labor, and reduced long-term productivity can be high. Many farmers in developing countries overuse pesticides and do not take proper safety precautions because they do not understand the risks and fear smaller harvests. Making matters worse, developing countries seldom have strong regulatory systems for dangerous chemicals: pesticides banned or restricted in industrialized countries are used widely in developing countries. Farmers’ perceptions of appropriate pesticide use vary by setting and culture.

Additional negative environmental effects and socioeconomic costs include the debt incurred by farmers to purchase these inputs, the loss of local knowledge and practices once used to protect crops, and dependence on external sources of inputs.

As with so many capital-intensive technologies, the poor, including women and children, are the ones least able to benefit from their use. Recent research in India, for example, shows that small-scale and marginal farmers take loans from private finance corporations to purchase inputs and then, unable to pay their debts, become answerable to moneylenders (Mancini and others 2005). Ultimately farmers may be forced to sell their land to cover their debts, thereby losing their only economic asset. The same study also found marginal farmers to have a 10 times greater risk of severe pesticide poisoning than large-scale farmers.

A study by FAO, WHO, and UNEP (2004) broadly estimates that between 1 million and 5 million cases of pesticide poisoning occur each year, resulting in several thousand fatalities. Pesticide fatalities are overwhelmingly a developing country phenomenon. Although developing countries use just 25 percent of all pesticides produced, 99 percent of deaths from pesticide poisoning occur in developing countries. Children and women are especially at risk. In Egypt, for example, more than 1 million children who help to manage cotton pests are exposed to pesticides.

An agricultural production model is urgently needed that starts to internalize the external costs of pesticide use and incorporates the prevention of ill health, environmental contamination, and the conservation of biological capital into production processes and markets. This goal is specified in the Rio Declaration on Environment and Development. Agenda 21, Chapter 14, deals with promoting sustainable agriculture and rural development, and section I covers “Integrated pest management and control in agriculture” (UN 1992). The Agenda explicitly mentions women as a specific target group for interventions.

KEY GENDER ISSUES

The following sections detail the key gender issues in crop protection and potential benefits of addressing them.

Gender and pesticide exposure

It is important to gain a better understanding of how women are exposed to pesticides in agricultural production, as well as the differential patterns of pesticide use between women and men. Marginal farmers are often engaged in professional pesticide spraying and therefore subject to continuous exposure. Women and children are specifically at risk because they are frequently employed in mixing pesticides and refilling pesticide tanks (Rother 2000). Women and children also perform secondary activities that have been neglected in studies dealing with direct exposure. Extremely time-consuming operations such as weeding are often performed by women and children during the peak spraying season, when residue levels in fields are high (Mancini and others 2005) and can cause secondary poisoning. Women are also exposed to pesticides in the home, for example, by washing pesticide-soaked clothing and disposing of (or using) empty chemical containers.

Women’s involvement in piecework and seasonal labor, and the unfavorable conditions associated with such work (such as less training and protective equipment), increase their risk of pesticide exposure. Women are particularly vulnerable to pesticides at certain times of their lives, especially when they are pregnant. Growing evidence of associations between pesticide exposure, women’s reproductive health problems, and health problems passed on to offspring adds to the concern over pesticide poisoning in women (London and Bailie 2001).

Gender and knowledge of pesticide risks

Compared to men, women are usually less informed about safe pesticide practices and the dangerous side effects of

pesticide use. High levels of pesticide poisoning among resource-poor farmers, especially women, are often reported to be linked to low levels of literacy and education. In many cases, the husband is responsible for buying pesticide from the cooperative, market, or storekeeper, and no information is passed between the husband and wife about safe use—with the result, for example, that women reuse pesticide containers for storing or transporting their crops or cooking supplies. Often pesticide products are not labeled, but even if they are, many women cannot read the information. Although educating people in proper pesticide management is extremely important, education alone will not prevent poisoning. Other factors also require attention, including difficulties in obtaining protective gear, which may be costly, may not be supplied by employers, or may be inappropriately designed for hot climates (London and Bailie 2001; Mancini and others 2005).

Pesticide use is costly and unsuited to women’s cropping strategies

Pesticide use is capital intensive: the pesticide, sprayer, and protective gear all must be purchased. Women’s limited access to productive resources often makes them more reluctant than men to purchase inputs such as pesticides to use on their crops (which are usually food crops). The blanket recommendations commonly provided by extension units or displayed on pesticide labels may be inappropriate for women’s complex mixed-cropping systems. To benefit women, pest control mechanisms must be tailored to the pests encountered in staple and minor crop production.

Inconsistent benefits of alternative pest control technologies across socioeconomic groups

“The distribution of benefits from commercial genetically modified crops is uneven. Although these crops are now grown more widely in developing than in developed countries, to date the benefits have been uneven, concentrated in developed countries and a few commercial crops.”³ The challenge remains to develop and win approval for GM crops that are suited to the agricultural preferences and constraints of poor women and men. In the near term, the application of new molecular biotechnologies and new breeding strategies to crops that are specifically relevant to smallholder production systems in developing countries will probably be constrained for a number of reasons: the lack of reliable longer-term research funding, inadequate technical and operational capacity, the low commercial

value of the crops, the lack of adequate conventional breeding programs, and the need to select the relevant production environments (FAO 2004: 24).

POLICY AND IMPLEMENTATION ISSUES

Many governments have inadequate legislation overseeing problematic pesticides and herbicides. Where the legislative framework is in place, enforcement capability is often weak. The viability of occupational health and safety structures and functions in developing countries is also a primary concern. Agriculture tends to be excluded from many national labor laws and is not subject to any comprehensive international standard. Where regulations exist, they are often sporadically applied because of inadequate legal provisions, low levels of unionization, and insufficient labor inspection. As women form a large percentage of agricultural laborers, they are directly affected by this lack of oversight (see also Module 8).

The chemical industry heavily promotes the use of pesticides for crop protection. In developed countries, on the one hand, the industry markets “new-generation” pesticides that have high efficiency ratios (small doses achieve maximum results) and limited adverse effects on people and the environment. In developing countries, on the other hand, significant quantities of outdated pesticides remain in circulation, and extension agencies and pesticide sellers may not necessarily promote “new-generation” pesticides, which in any case are expensive. Instead, farmers buy older, cheaper, and more hazardous products. As much as 30 percent of the pesticides sold in developing countries do not meet international quality standards. FAO has recently expressed concern about the proliferation of cheap unlabelled pesticides in Africa (FAO/WHO 2001). Many are adulterated, unauthorized, or illegal.

The current drive for economic growth and agricultural trade promotes an approach to food production that emphasizes agribusiness, land consolidation, and contract farming (IIED 2003), in which pesticides play an established role. Although these production systems are important in some segments of the farming community, they do not address the specific circumstances and priorities of resource-poor women farmers, who risk becoming even more marginalized if agriculture increasingly presents alternatives that they cannot adopt. The discussion of GM crops needs to take this issue into account.

Experiences with crop protection in developing countries suggest policies and other interventions that could support crop protection strategies that do not further exclude and endanger the poor, especially women and children.

These strategies include promoting alternatives to hazardous chemicals; improving training and information for women and others in agriculture; and reducing access to dangerous agrochemicals.

Promoting alternative to hazardous chemicals

Crops can be protected from pests in ways that preclude the use of hazardous chemicals, including integrated pest management (IPM), organic crop production, the use of less toxic chemical products, and the promotion of GM crops (although the risks, costs, and benefits of this last option are still imperfectly understood in many settings).

Integrated pest management. IPM (box 12.16) has been implemented successfully across a wide range of crops and agroclimatic zones. Many aid and development agencies have adopted IPM as the model for the agricultural development they support, and the OECD Development Assistance Committee encourages its member states to support IPM.

IPM should go hand in hand with appropriate pesticide management to allow for pesticide regulation and control, including trade, and for the safe handling and disposal of pesticides, particularly those that are toxic and persistent. Cumulative evidence shows that farmers trained

Box 12.16 Integrated Pest Management Defined

The Systemwide Program on Integrated Pest Management of the Consultative Group on International Agricultural Research offers a concise synthesis of IPM principles:

Integrated Pest Management is an approach to enhancing crop and livestock production, based on an understanding of ecological principles, that empowers farmers to promote the health of crops and animals within a well-balanced agro-ecosystem, making full use of available technologies, especially host resistance, biological control and cultural control methods. Chemical pesticides are used only when the above measures fail to keep pests below acceptable levels, and when assessment of associated risks and benefits (considering effects on human and environmental health, as well as profitability) indicates that the benefits of their use outweigh the costs. All interventions are need-based and are applied in ways that minimize undesirable side-effects.

Source: SP-IPM In Brief, www.spipm.cgiar.org/Brief/spIPMbrif.htm.

in appropriate methods of pesticide use suffer lower exposure and can achieve higher net returns than those who are not trained.

IPM has shown positive results in a wide range of socioeconomic and ecological conditions (FAO 1999, 2000; FAO and World Bank 2000; Tripp, Wijeratne, and Piyadasa 2005). An important advantage of IPM is that it *builds on the knowledge of women and men farmers* about crop, pest, and predator ecology to increase the use of pest-resistant varieties, beneficial insects, crop rotations, and improved soil management. It combines local knowledge with external knowledge in the search for improved management strategies. The success of IPM depends largely on how well farmers understand and combine knowledge of biological and ecological processes with their farming experience to develop and select options that reduce losses to pests, increase agricultural productivity, manage risk, and meet the demands of local and global markets. As men and women often possess different types of knowledge, applying a gender perspective to IPM is integral for understanding farmers' perceived pest management needs.

IPM is thus knowledge intensive and builds on available human and social capital. By addressing women as well as men, IPM programs and projects can help to invest more equitably in developing human and social capital—two crucial assets for sustainable livelihoods. When women attended farmer field schools to learn about IPM, they reported that the schools helped them gain recognition of their personal skills and abilities. Mancini, van Bruggen, and Jiggins (2007) showed that the personal growth stimulated by participation in field schools was particularly relevant to women and confirmed the importance of increasing women's access to these and other educational programs.

Because IPM is not capital intensive, it is suited to family food production systems, including the production of traditional crops and varieties. Whereas pesticides are more commonly used in commercial production systems, IPM, if developed from a gender perspective, can contribute to increased food security.

Even in these cases, the wider promotion of IPM practices must overcome a number of limitations. IPM can be a time- and labor-intensive strategy, with potential constraints for women, who often lack surplus labor to invest in such initiatives. These factors are highly context specific and must be understood thoroughly before making any decision to promote IPM. For example, in some cases women have had to walk long distances to fetch water to prepare pesticides for cotton production, and switching to IPM based on biological pest control lightened women's labor.

Because IPM is knowledge intensive, it requires an intensive educational approach, which is more challenging to scale up (as farmer field schools and training-the-trainer approaches have shown) as well as demanding of human and financial resources (Feder, Murgai, and Quizon 2004).

The policy environment can also constrain expansion of IPM programs. Policies inhibiting the expansion of community IPM (Fakih, Rahardjo, and Pimbert 2003) include inequitable property rights over land and other natural resources (see also Modules 4 and 10), which commonly affect women more than men.

An important lesson of IPM projects in various countries is that women have continued to be underrepresented (Fakih, Rahardjo, and Pimbert 2003). Often IPM projects rigidly impose criteria for selecting participating farmers, which include the completion of lower secondary school, some farming experience, and the ability to communicate knowledge to others. Although useful in themselves—especially where ensuring the dissemination of knowledge is concerned—these criteria, if formally and rigidly applied, restrict women's access. Other external constraints on women's full participation in farmer field schools and training-of-trainer courses, as well as on their ability to be active farmer trainers, include the following (Nhat Tuyen 1997):

- In many cultures women need permission from their husbands or fathers to attend schools and courses, especially if all or most participants are men. In some cultures it is simply unacceptable for women to participate in group activities with men who are not their husbands or close relatives.
- It may be difficult to schedule activities so that they do not clash with the wide range of family support tasks for which women bear primary responsibility.
- The extent to which men farmers accept having women as part of a group or as trainers must be determined.
- Village leadership, including village administration and cooperative management, plays an important if not essential role in organizing IPM training courses. These leaders interpret and apply the selection criteria. If men dominate village leadership, as is often the case, this domination can easily lead to men's bias in selection.
- The trainers' role is critical in organizing training events in ways that meet the requirements of men and women farmers. When introducing a training course to local leaders, trainers often lack information about how gender operates in the local division of labor. For this reason, they do not have the capacity to negotiate fair representation of women in field schools or other training events, and

often trainers themselves are not convinced that equality of representation is important. The degree to which women have participated in field schools, until now, has depended on the perceptions and initiatives of individual staff and trainers.

- For these newer training approaches to succeed among men and women, a shift in attitudes must occur. The customary preference for working with men farmers must not be transferred from conventional research and extension approaches to new training approaches.

These constraints should be taken into account in future interventions. The IPM farmer field school literature provides a good starting point for reviewing ways of overcoming gender bias.

Other approaches to reduce hazardous chemicals. Other approaches to reduce pesticide use are the promotion of less toxic pesticides, the promotion of organic farming (discussed in Thematic Note 1), and the development of pest- and disease-resistant crops, including GM crops. Scientists, development practitioners, civil society organizations, and politicians have long debated the benefits and constraints of genetically modified crops. Recent conclusions with respect to these issues have been summarized as follows:

The scientific consensus is that the use of transgenic insect-resistant Bt crops is reducing the volume and frequency of insecticide use on maize, cotton and soybean (ICSU [International Council for Science]). These results have been especially significant for cotton in Australia, China, Mexico, South Africa and the United States. The environmental benefits include less contamination of water supplies and less damage to non-target insects (ICSU) . . . As a result of less chemical pesticide spraying on cotton, demonstrable health benefits for farm workers have been documented in China. . . . and South Africa. . . . Herbicide use is changing as a result of the rapid adoption of HT [herbicide-tolerant] crops (ICSU). There has been a marked shift away from more toxic herbicides to less toxic forms, but total herbicide use has increased. . . . Scientists agree that HT crops are encouraging the adoption of low-till crops with resulting benefits for soil conservation (ICSU). There may be potential benefits for biodiversity if changes in herbicide use allow weeds to emerge and remain longer in farmers' fields, thereby providing habitats for farmland birds and other species, although these benefits are speculative and have not been strongly supported by field trials to date. . . . There is concern, however, that greater use of herbicides—even less toxic herbicides—will further erode habitats for farmland birds and other species (ICSU). . . . Scientists agree that extensive long-term use of Bt crops and glyphosate and gluphosinate, the herbicides associated with HT crops, can promote the development of resistant insect pests and weeds.

FAO (2004, Section B, Chapter 4: 68–71)

Aside from their environmental consequences, GM crops have important socioeconomic consequences. The adoption of Bt cotton can be cited as an overall success for increasing yields, improving farm incomes, and significantly reducing pesticide applications, but these effects have varied depending on the context (World Bank 2007). Some farmers in India experienced losses following the adoption of Bt cotton. In some parts of India, Bt cotton yields less than traditional cotton varieties. The reduced yields, together with rising seed costs, increased farmers' indebtedness.⁴

The distribution of benefits from commercial GM crops has been uneven, concentrated in industrial countries and a few crops. The largest share of GM crops is found in highly commercial production systems (FAO 2004), and the strong commercial interest of the private sector largely determines the kinds of GM crops and traits that are developed. A few promising initiatives aim to develop and promote GM crops with traits that are relevant for developing countries. New Rice for Africa (NERICA), a high-yielding, drought- and pest-resistant type of rice developed specifically for African conditions, is one example. IFAD has provided \$2 million to WARDA to promote the use of NERICA in West Africa and is now designing a series of grants to accelerate NERICA seed multiplication activities in Côte d'Ivoire, the Democratic Republic of Congo, and Guinea (IFAD 2007). The lack of gender-disaggregated data on the adoption and benefits of GM crops makes it impossible to draw gender-specific conclusions, apart from pointing out the gender-specific constraints encountered with other interventions in crop protection and in plant breeding more generally (see Thematic Note 2 on seed systems, for example).

Improving training and information for women in agriculture

Only safe, correct management will minimize the negative consequences of pesticides for human and environmental health and foster their sustained, positive impact on crop production and farmers' overall livelihoods. Given rural women's generally poor access to information and extension exposure, it remains a challenge to convey messages about safe pesticide use to them. Government, the chemical industry, and NGOs have undertaken various campaigns to promote safe pesticide use, but their lasting impact on women's knowledge and on resulting levels of pesticide poisoning is not well documented.

Some of the innovative communication strategies developed in IPM projects could help to convey this important message to rural communities, specifically to women. Aside

from the farmer field schools and training-of-trainers initiatives described earlier, these strategies have included radio programs, audio cassettes, and local “resource centers” with exhibits and educational material, including videos of local people’s experiences with IPM, comic books, leaflets, and posters. These alternatives might be better alternatives for reaching women.

Important subjects for an awareness campaign include the following:

- *Delineating the links between chemical exposures, the effects on human health and the environment, and gender differences in risks and impacts.* In most communities, people are unaware of their routine, even daily, exposure to toxic chemicals in the workplace, at home, and in the general environment. Raising awareness of the immediate health risks of toxic chemicals used in agriculture in developing countries is an intervention that informs work at all subsequent stages of the policy process.
- *Explaining the different toxicity classes of pesticides and the meaning of their corresponding labels.*
- *Describing the physiological effects of pesticide poisoning (short and long term).* Interesting lessons may be learned from participatory self-assessments of pesticide poisoning among men and women farmers (box 12.17).

Providing access to information, knowledge, and technology that promote new and less hazardous methods of using pesticides is another approach that has shown benefits. Box 12.18 describes how the development of appropriate equipment for applying seed dressings helped to reduce

pesticide exposure and its ill effects among women in eastern and southern Africa.

One must emphasize that educational strategies alone cannot protect farmers from the harmful effects of pesticides. Sherwood, Cole, and Murray (2007) note that research financed by the Novartis Foundation—the single largest study ever conducted on pesticide safety concerns—concluded that it was unrealistic to expect poor people in developing countries to manage pesticides safely. Major causes of poisoning in developing countries are the improper labeling, storage, and use of chemicals. Unintentional poisonings account for an estimated 50,000 deaths of children aged 0–14 every year.⁵ Sherwood, Cole, and Murray (2007) report that the Novartis Foundation study concluded that “any pesticide manufacturer that cannot guarantee the safe handling and use of its products should withdraw those products from the market”—a scenario difficult to envision in countries where government and industry capacity to enforce standards is severely limited (see the next section). Other factors, including the lack of appropriate protective gear (discussed earlier), the lack of facilities for washing, and the lack of health services, favor the continued unsafe use of pesticides (London and Bailie 2001; Mancini and others 2005).

Reducing access to hazardous chemicals through regulation and enforcement

Access to the more dangerous agrochemicals could be reduced by strengthening and enforcing laws against exposure to hazardous chemicals. Although regulation and

Box 12.17 Farmer Self-Monitoring of Pesticide Use in Cotton in India: A Tool to Create Awareness

In 2003 the Integrated Pest Management Program for Cotton in Asia (a joint effort by the European Union and Food and Agriculture Organization) designed a participatory project to assess the frequency and severity of acute pesticide poisoning among cotton growers in Andhra Pradesh, India. Through farmer field schools, the program educated farmers about the adverse effects of pesticides on human health and the environment and presented sustainable alternatives to pesticide use. The assessment of acute pesticide poisoning was conceived as a complementary activity to be undertaken in three

Source: Mancini and others 2005.

villages that had farmer field schools. The idea was to measure the health effects of pesticide exposures in real time (over the course of the cropping season) through direct documentation by farmers. Because previous studies focused on men farmers who applied chemical products, this effort concentrated on women as respondents (for themselves and for their men relatives). The assessment’s primary aim was to raise farmers’ awareness of the seriousness of the pesticide poisoning occurring in the villages. It also aimed to quantify the problem through direct reporting by farmers.

Box 12.18 Tanzania and Zambia: Testing a Seed Dressing to Reduce Pesticide Problems

Women in small- and medium-scale farming suffer the worst health problems from pesticide use because they spray the fields themselves, usually without safety precautions. To assist them, the United Nations Industrial Development Organization (UNIDO) has developed a new way to coat seed with a minimal amount of pesticide (“seed dressing”). Seed dressing has proved to be one of the most effective and economic forms of protection. It can control a wide variety of fungal and bacterial diseases, in addition to soil-borne insects and nematodes. The much lower amount of pesticide used also greatly reduces the environmental and human health impacts.

Seed dressing is already used in many areas, but it is usually restricted to large-scale farmers who can afford

Source: UNIDO 1995.

the large, expensive, imported machines that are required. UNIDO developed a mobile seed dressing applicator to meet the needs of women in small-scale farming, initially focusing on Arusha in Tanzania and Lusaka in Zambia. Men and women were trained to use the seed dressing equipment and to handle treated seed safely. Trials of the technology were conducted from 1992 to 1994, and the groundwork was laid for commercial implementation. Farming women were very pleased with the new approach, which would not only enable them to increase their yields, food supply, and incomes, but would also dramatically reduce their exposure to pesticides and reduce pollution in the local environment.

enforcement have no explicit gender component, men, women, and children alike would benefit if countries strengthened and enforced the pesticide regulatory framework to conform to best practice as laid out in the FAO Code of Conduct on the Distribution and Use of Pesticides (FAO 2003). The cooperation of the private sector is crucial to the success of such efforts.

Highly hazardous pesticides (Class I) are still common in many smallholder farming systems. Because patents on many of these products expired long ago, chemical companies can market them at bargain prices, which are attractive to farmers. Farmers are also reluctant to stop using them because the pesticides are often highly efficient, and farmers do not know about their serious health and environmental risks. Farmers may also believe that yields will fall if they stop using these chemicals, especially if no alternatives are introduced. Restricting access to highly hazardous pesticides appears to have no measurable negative effect on rural economies, aside from a decline in pesticide sales (Sherwood, Cole, and Murray 2007). Farmers identify alternatives, “proving that these pesticides can be substituted by switching to non-chemical pest control or less toxic pesticides. The latter are usually more expensive than highly toxics, but judicious use leads farmers to use them economically” (Sherwood, Cole, and Murray 2007: 32). Sherwood and coworkers also report that knowledge-based methodologies, including farmer field schools, successfully assisted growers

in abandoning highly hazardous chemicals without suffering reduced yields. They conclude that “despite the claims of governments and industry, the problem with eliminating highly toxics never has been a lack of alternatives, but rather the political will to place the interest of the public over those of influential private actors” (Sherwood, Cole, and Murray 2007: 33).

There is growing recognition, based on ever-more evidence, that Class I pesticides negatively affect health, especially of women and their unborn babies. The rapid physiological changes experienced by women during pregnancy, lactation, and menopause render them more vulnerable to toxins. Exposure to pesticides can cause miscarriage, premature birth, birth defects, and low birth weight (WHO 2006). A substantial portion (up to 33 percent) of a woman’s chemical burden can be passed on to an unborn child during gestation and to a baby through breastfeeding.

In light of this and other evidence, FAO encourages the early withdrawal of highly toxic pesticides (FAO 2006). Use of such pesticides is prohibited or severely restricted in OECD countries, and in line with the International Code of Conduct, FAO would like to see them banned at the earliest date in developing countries, where it is virtually impossible to guarantee their safe use. A growing number of developing countries, including China, Thailand, and Vietnam, have already prohibited the use of methyl parathion, monocrotophos, and several other Class I pesticides.

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

Pest control is undoubtedly essential for commercial and subsistence farming systems to meet the growing demand for food and contribute to other development goals, but evidence is mounting that the sole reliance on pesticides to achieve such objectives is unsustainable. The high environmental and human costs of pesticide use must now be taken into account, along with the considerable gender effects of pesticide use, which despite their seriousness have been largely ignored.

The strategies discussed in this Module to reduce the use of harmful pesticides can be promoted in parallel. To succeed, they will need supportive policies, and they will also need to be devised with a full understanding of women's circumstances. Several actions must be considered:

- *Government and institutional support:* Alternatives to pesticide use must be promoted actively. Structural factors that encourage the inappropriate and unnecessary use of pesticides—including direct or indirect subsidies; pro-pesticide biases in research, extension, and training; or credit linked to pesticide use—should be removed. Research and extension services require institutional support to conduct work with a clear gender focus.
- *Technical solutions:* Farmers require solutions to their crop protection problems that take account of gender-specific needs. Researchers must work with farmers, recognizing gender divisions of labor, to develop appropriate solutions. This collaboration is particularly important in the promotion of genetically modified crops, because no gender-disaggregated data on risks and benefits are currently available.
- *Farmer participation:* Participatory field schools or their equivalents are good channels for providing information on safe crop protection strategies to farmers, for strengthening many good farmer practices, and for recognizing farmers' expertise. A focus on the gender differences in expertise for different crops and production systems is important. Farmers who use pesticides need to acquire the knowledge and confidence to use sustainable alternatives.
- *Explicit inclusion of women:* Unless women are specifically identified and included in project planning and implementation, and encouraged to assume leadership roles, they are likely to remain invisible. Training, information, and extension to reach these women are essential, or else they will continue to bear many of the consequences of unsafe pesticide use.
- *Messages developed to reach women:* Pest control messages have conventionally been targeted at men farmers,

a bias that must be addressed to ensure that women benefit from information campaigns. Messages designed to improve women's awareness, knowledge, and skills with respect to safe pesticide use must be designed to overcome the barriers that are often raised by women's lower socioeconomic status, more limited education, and other constraints. The use of alternative communication channels should be explored.

NOTES

Overview

This Overview was written by Sabine Gündel (Consultant) and reviewed by Ira Matuschke, Mary Hill Rojas, and Catherine Ragasa (Consultants); Regina Laub (FAO); Maria Hartl (IFAD); Robert Tripp (ODI); Eija Pehu (World Bank); and Niels Louwaars (WUR).

1. Although there is not scope in this Module to discuss urban agriculture, recent studies document its benefits among women who are responsible for family food provision (Anosike and Fasona 2004; Ba Diao 2004). Women use urban agriculture as a primary strategy to maintain livelihoods and protect household income through subsistence production. Urban agriculture requires an investment of household resources, such as land, labor, and capital, that can motivate women to go beyond acquiring food for domestic use. Urban food enterprises represent an avenue through which unskilled and uneducated women potentially gain entry into the business milieu (Hovorka and Lee-Smith 2006).

2. For a discussion of broader natural resource management issues in relation to gender, see Module 10.

3. For example, crops with greater amounts of micronutrients that promote human health, such as betacarotene, iron, and zinc.

4. Among many examples, see Adato and Meinzen-Dick (2007).

Thematic Note 1

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1. See also International Center for Agricultural Research in the Dry Areas, “Contributions from Seed Programs and Projects,” *Seed Info: Official Newsletter of the WANA Seed Network* 33, www.icarda.org.

2. Examples of such crops include self-pollinating crops (common beans, groundnuts, rice), vegetatively propagated crops (potatoes, sweet potatoes, cassava), and crops with limited seed demand (indigenous vegetables, forages, open-pollinated maize) (Scott and others 2003).

3. Louise Sperling, “Finding the Seeds of Recovery Close to Home,” *CGIAR News* (March), www.cgiar.org.

4. See also *ibid*.

5. N. P. Louwaars, “Seed Laws: Biases and Bottlenecks,” www.grain.org/seedling_files/seed-05-07-2.pdf.

6. Niels P. Louwaars, “Seed Laws: Biases and Bottlenecks,” *Grain* (July): 3–7, www.grain.org/seedling_files/seed-05-07-2.pdf.

7. See note 3 above.

Thematic Note 3

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1. Pesticides are chemicals, including insecticides, herbicides, and fungicides, that are used to control insects, weeds, and other pests and diseases.

2. “Global Occupational Health,” <http://globalhealthedu.org/Pages/Default.aspx>.

3. “Brief 37-2007: Executive Summary Global Status of Commercialized Biotech/GM Crops: 2007,” www.isaaa.org.

4. “Indian Cotton Farmers Betrayed,” press release, www.i-sis.org.uk.

5. World Health Organization, “What Happens When Children Live in Unhealthy Environments?” Fact Sheet 272, www.who.int/mediacentre/factsheets/fs272/en.

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