



MODULE 10

Gender and Natural Resources Management

Overview

In the future, the natural resources needed to sustain the human population will exceed available resources at current consumption levels.¹ Unsustainable and uneven consumption levels have resulted in an increasingly stressed environment, where natural disasters, desertification, and biodiversity loss endanger humans as well as plant and animal species. The challenge of reversing the degradation of natural resources while meeting increasing demands for them involves significant changes in policies, institutions, and practices (FAO 2007a). Effective programming and policies require understanding and addressing the gender-specific relationships to natural resources use and management and highlighting the linkages between natural resources, cultural values, and local knowledge. Addressing the gender-specific aspects of natural resources will provide policy makers with information for more effective natural resource use and conservation policies and will provide guidance for equitable access to natural resources. Here, one must assess the gender-differentiated impacts of environmental changes, including biodiversity loss, climate change, desertification, natural disasters, and energy development.

KEY ISSUES IN NATURAL RESOURCES MANAGEMENT

Natural resources provide a range of goods and services—food, fuel, medicines, fresh water, fisheries, and air and water regulation—that support life on Earth. The rural poor in developing countries remain the most directly dependent on

natural resources for their food and livelihood security. Subsistence farmers, fishers, hunters and gatherers, and agricultural wage workers (more than 1.3 billion people) depend on the availability of usable land, water, and plant and animal species for their livelihoods (FAO 2004). Thus, the agricultural livelihoods of poor rural women and men depend on the condition of natural resources, particularly livelihoods of people living on fragile lands (World Bank 2005).

Over the past 50 years, ecosystems have changed more rapidly than in any comparable period of time in human history, largely because of the need to meet rapidly growing demands for food, water, timber, fiber, and fuel (MEA 2005). Now climate change, caused largely by fossil fuel use, further threatens ecosystems. One strategy to mitigate climate change and reduce fossil fuel dependence emphasizes increased use of bioenergy from crops, which is likely to put more pressure on land, water, and species diversity. These changes contribute to the degradation of natural resources, which exacerbates poverty for some groups of people, especially people living in marginal environments (box 10.1). This Module identifies and addresses five major challenges facing sustainable natural resource management and gender:

- Biodiversity conservation and adaptation
- Mitigation of and adaptation to the effects of climate change and variability
- Bioenergy
- Natural disasters
- Land and water degradation and desertification.

Current changes in biodiversity are the fastest in human history, with species becoming extinct 100 times as fast as the rate in the fossil record; 12 percent of birds, 23 percent of mammals, and 30 percent of amphibians are threatened with extinction.

- The expected increase in biofuel feedstock production may lead to increased rates of genetic erosion.
- Global fish stocks classed as collapsed have roughly doubled to 30 percent over the last 20 years.
- An increase in so-called dead zones, where marine life can no longer live because of the depletion of oxygen caused by pollutants like fertilizers is expected.
- Annual emissions of CO₂ from fossil fuels have risen by about one-third since 1987.
- Eleven of the warmest years since records have been kept occurred during the last 12 years.
- In the twentieth century the average temperature increased by 0.74°C, sea level increased by 17 centimeters, and a large part of the Northern Hemisphere snow cover vanished.

- There are 20 to 30 percent of plant and animal species that are in danger of extinction if the temperature increases 1.5 to 2.5°C.
- Only very large cuts in greenhouse gases of 60 to 80 percent can stop irreversible change.
- Globally more than 2 million people die prematurely every year because of outdoor and indoor air pollution.
- If present trends continue, 1.8 billion people will live in countries or regions with absolute water scarcity by 2025, and two-thirds of the people in the world could be subject to water stress.
- Unsustainable land use and climate change drive land degradation, including soil erosion, nutrient depletion, water scarcity, salinity, desertification, and the disruption of biological cycles.
- In the first half of 2006, 174 disaster events occurred in 68 countries, affecting 28 million people and damaging property and assets valued at more than \$6 billion. Annual economic losses associated with such disasters averaged \$75.5 billion in the 1960s, \$138.4 billion in the 1970s, \$213.9 billion in the 1980s, and \$659.9 billion in the 1990s.

Sources: IPCC 2007; MEA 2005; www.unep.org.

Addressing these natural resource challenges requires an understanding of their underlying causes. According to the Millennium Ecosystem Assessment (MEA), the main drivers of change include the following:

- Climate change led by the burning of fossil fuels
- Habitat and land-use change, primarily due to the expansion of agriculture
- Overexploitation of resources, especially overfishing
- Deliberate and accidental introduction of invasive alien species
- Pollution, particularly nutrient loading, leading to a loss of biodiversity, agricultural productivity, and increased human health problems.

Understanding and changing natural resource tenure and governance as well as unequal patterns of access to and control over natural resources lie at the heart of reversing natural resource degradation. These issues are crucial to addressing the gender dimension of natural resources.

In addition, efforts aimed at reversing natural resources degradation must consider other factors, including the following:

- Sociodemographic trends, including growth, migration, and diseases such as HIV and AIDS
- Economic trends, including economic growth, disparities, and trade patterns
- Sociopolitical factors, ranging from equal participation in decision-making processes to conflicts
- Technological change that leads to increases in crop yields and agricultural intensification practices, with severe consequences for natural resources.

Climate change, biodiversity loss, land and water degradation and desertification, and natural disasters share many common causes. Because a worldwide consensus recognizes the acceleration of climate change, efforts to mitigate and adapt to climate change promise to have major consequences for natural resource availability and use. Many of

the solutions and problems of natural resources degradation lie in agriculture. Agriculture, heavily dependent on natural resources, also provides environmental services such as carbon sequestration. Agriculture occupies 40 percent of the land surface, consumes 70 percent of global water resources, and manages biodiversity at the genetic, species, and ecosystem levels (FAO 2007a). Agriculture contributes to soil erosion, agrochemical pollution, and climate change, accounting for about one-third of greenhouse gas emissions (World Bank 2007). Land and water degradation, shrinking biodiversity, and climate change threaten the viability of farming in various settings. Because of gender-differentiated roles and responsibilities in natural resources management, interventions must address the specific needs and opportunities of rural women and men, particularly the poorest, to reduce inequalities, stimulate growth, and reverse environmental degradation.

KEY GENDER ISSUES

Improving natural resource management practices and protecting the environment require reducing poverty and achieving livelihood and food security among rural women and men. The following are some of the key gender issues in natural resources management interventions.

Rural women and men have different roles, responsibilities, and knowledge in managing natural resources

Rural women's and men's different tasks and responsibilities in food production and provision result in different needs, priorities, and concerns. Although rural women's and men's roles and responsibilities vary across regions and cultures, they often follow similar gender divisions of labor. In most regions men use natural resources in agriculture, logging, and fishing for commercial purposes more than women. In crop production in many regions of the developing world, men tend to focus on market-oriented or cash crop production, whereas women often work with subsistence crops, minor crops, and vegetable gardens. Women often grow a wider diversity of crops. In some cases men and women perform complementary roles—for example, men clear land, women plant and tend crops, and men harvest and market crops. However, observers have come to learn that these gender patterns are neither simplistic nor static. For example, women often work with their husbands in producing cash crops. In Kenya women grow green beans for the European market, and in regions where men migrate, women

take over household cash crop production. Also, gender divisions of labor vary substantially by age, race, ethnicity, and marital status. Consequently, their water use and management will vary accordingly. For example, men use water for irrigation systems, whereas women may not have access to irrigation systems for vegetable gardens and subsistence crops. In livestock management men often care for cattle and larger animals, and women care for smaller animals such as poultry and small ruminants. In many instances women also have responsibility for collecting fodder for animals, often depending on common property resources that are threatened in many cases.

Because women (and sometimes girls) are often responsible for providing their households with the basic necessities of life—food, fuel, and water—they rely heavily on natural resources. Men seldom have responsibility for collecting and using natural resources for household use. Earlier development efforts assumed that women's fuelwood collection and use led to deforestation, but it is now known that the major problems related to biomass collection include women's and children's exposure to indoor air pollution and heavy workloads for women and girls. Environmental degradation increases women's time for labor-intensive household tasks, such as having to walk longer distances for the collection of fuelwood and water. Decreases in agricultural production and household food security create additional health problems related to their increasing workload. Although both rural women and men play a critical role in natural resources management, women's use, conservation, and knowledge of resources play a key role in shaping local biodiversity. Also degradation of natural resources can alter gender responsibilities and relations in households and communities.

Gender differences exist in rights and access to natural resources, including land, trees, water, and animals

In most societies women typically have fewer ownership rights than men (Rocheleau 1996). Women frequently have de facto or land-use rights as compared to men's de jure or ownership rights. Women often have use rights that are mediated by their relationships with men. Thus, when women are widowed or divorced, they may lose these rights, as in recent cases of land grabbing from AIDS widows in southern Africa. How men and women use resources reflects gendered access. For example, women may collect branches and limbs from trees, whereas men may have rights to harvest trees, but for both men and women, insecure land

tenure reduces incentives to make the improvements in farming practices necessary to cope with environmental degradation. Without secure land rights, women and men farmers have little or no access to credit to make investments in improved natural resource management and conservation practices. Poor rural women lacking secure land tenure often depend on common property resources for fuelwood, fodder, and food and, therefore, for the well-being of their households. The depletion of common property resources poses a severe threat to the livelihoods and food security of poor rural women and men. Women household heads remain at a particular disadvantage in terms of access to land, water, and other natural resources. A key point is that gendered relations and responsibilities in terms of natural resources are dynamic and subject to change.

Access to new technology, information, and training related to natural resource management remains highly gendered, with most of the related initiatives targeted to men

Despite numerous efforts to mainstream gender, many governments, nongovernmental organizations (NGOs), and development agencies find these efforts particularly difficult in the agriculture and natural resource arenas. For example, extension personnel in agriculture and natural resources frequently speak only to men, often erroneously expecting that the men will convey information to their wives. Until gender is successfully mainstreamed, women's groups, organizations, and networks can increase women's access to knowledge, information, and technologies (Agarwal 2003; Enarson and Meyreles 2004; Sachs 2007).

Degradation of the natural resource base can result in new forms of cooperation, conflict, or controversy between men and women or different ethnic groups

When natural resources become insufficient to support the livelihoods of the population, drastic measures result, such as men's or women's out-migration. Men's out-migration leaves women to assume men's traditional roles and responsibilities, increasing their work burden, but leaving them without equal or direct access to financial, social, and technological resources (Lambrou and Laub 2004). In some instances of severe drought, women migrate to secure extra income for their families (Alston 2006). The intrahousehold reallocation of labor can lead to a decline in agricultural production and in turn result in food insecurity and an overall decrease in financial assets (FAO 2005).

Women are still absent from the climate change and natural resource-related decision-making processes at all levels

Equal participation in community-based decision making remains a complex and difficult goal to achieve, especially in the contexts of highly unequal gender and class relations. At the local level, more natural resource projects and interventions emphasize community-level participation. Careful and thoughtful planning in relation to gender must be exercised in the design of participatory projects. Community-level participation often leaves women's voices and concerns unacknowledged. Even when women attend meetings or events, they may not feel free to voice their opinions, or their opinions and needs may not be taken seriously (Agarwal 2003; Prokopy 2004). Community participation often favors local elites, usually men, but sometimes elite women's concerns directly conflict with and override poor women's access to resources such as fuel and water (Singh 2006; Sultana 2006). Despite attempts to mainstream gender at the national and international levels, few women participate. Gender is rarely a central issue in policy initiatives. Men tend to dominate in the newly emerging decision-making and policy arenas of climate change and bioenergy. Women's limited participation in decision-making processes at international and local levels restricts their capacity to engage in political decisions that can impact their specific needs and vulnerabilities (Denton 2002; Masika 2002).

GENDER IN SUSTAINABLE LIVELIHOODS FRAMEWORK

The Module applies a gender in sustainable livelihoods (SL) framework (see the *Sourcebook* Overview for more details on this framework). This framework conceptualizes the following elements as key in the livelihood strategies of the rural poor: assets, markets, information and organizations, risk and vulnerability, and policies and institutions.

The framework adopts a *people-centered approach* that places at the center the agricultural livelihoods of rural women and men and the natural resources management strategies they adopt. The SL framework also requires a *holistic approach* that integrates scientific, technical, and economic aspects with social and human dimensions. This Module applies the SL framework to natural resources management to highlight key gender concerns in programs and projects, and aspects of the framework will be applied in the different Thematic Notes as appropriate. To refrain from repetition, each component of the framework—assets, markets, information and organizations, risk and

vulnerability, and policies and institutions—will not be discussed in detail in each Thematic Note.

Assets

Rural women and men combine a range of assets to achieve their agricultural livelihood outcomes. Assets critical to rural women and men—not only for securing food and a livelihood for their household but also for the conservation and sustainable use and management of natural resources—include the following:

- *Natural resource assets:* land, water, forests, biodiversity
- *Financial assets:* credit, capital, and income
- *Physical assets:* technology, in particular labor-saving technologies
- *Information assets:* local knowledge, formal education, access to information.

A rural household with a large range of assets at its disposal will better cope with shocks and stresses, such as droughts. Poor rural women and men have very limited access to assets. Socially constructed gender roles and relations also influence women's and men's access to assets and the benefits obtained from these assets. Gender-based inequalities often result in women's and girls' limited access to assets, which generates implications for natural resources management conservation. Women face a variety of gender-based constraints as farmers and managers of natural resources. In many societies discriminatory customary and social practices curtail women's rights to land; women generally receive the most marginal lands. Insecure land tenure reduces rural women's and men's incentives to improve natural resources management practices and conservation. Without secure land rights, women and men farmers have little or no access to credit, which is essential for making investments in improved natural resources management and conservation practices. Consequently the technological advances yielding substantial gains in agricultural productivity over the last few decades have often bypassed women farmers and reduced their productivity.

Markets

Access to markets varies by gender and location. Women tend to sell in local markets where they find demand for traditional varieties of crops. Men tend to sell uniform and exotic varieties in export markets. These gender differences in market access vary by location. Local trade can improve rural women's and men's livelihoods by providing them with a source of income and, at the same time, an incentive to manage, use, and conserve a variety of local indigenous plants.

However, women, in comparison to men, continue to face many challenges in accessing and benefiting from markets. They face illiteracy, lack of market information, and transport to markets. At the national and global levels, unfair terms of trade still disadvantage poor farmers, including women. For instance, the World Trade Organization's Trade Related Intellectual Property Rights Agreement (see Thematic Note 1) poses direct challenges for poor farmers, particularly women, in accessing seeds for food production. Trade negotiations rarely consider women's and men's different knowledge and skills. They often neglect their use of assets in determining their livelihoods, and they overlook the potentially differential impact of their provisions on poor rural women and men.²

Information and organizations

Evidence from different regions shows that women often face more obstacles than men in accessing agricultural services and information as well as in participating in organizations. Men relatives often mediate women's access to information, markets, and credit. Fewer women than men participate in farmers' organizations and commercial networks. Furthermore, agricultural extension services and technology development frequently target men, wrongly assuming men will convey information to women (Lambrou and Laub 2004). Because few women own land in their own names, they rely heavily on common property resources. As women and men use and manage natural resources in different ways, their full and equal participation in community-based decision-making processes remains critical for safeguarding local natural resources.

Risk and vulnerability

Degradation of natural resources disproportionately harms poor rural women and men and sometimes is the principal cause of poverty. In turn, poverty can lead to the overexploitation of natural resources. Rural poor people rely the most directly on natural resources and are the most vulnerable to changes in ecosystems. Significant differences between the roles and rights of women and men in many societies lead to increased vulnerability of women with the deterioration of natural resources. In some instances deterioration of natural resources results in the renegotiation of gender roles. To design ways to mitigate the negative impacts on rural women and men, one must understand the context of their vulnerability.

Vulnerability depends on the types of resources women and men rely on and their entitlement to mobilize these resources. (Those with limited access to resources will have the least capacity to cope with the impacts of natural

resources degradation and are thus the most vulnerable.) Natural resources degradation and natural disasters impact rural peoples' ability to manage and conserve natural resources. These have differential impacts on rural women's and men's livelihood strategies, which also vary according to age, ethnicity, and socioeconomic status.

Policies and institutions

To understand the agricultural livelihood and natural resources management strategies of women and men at the household level, these strategies must be placed within the broader political, socioeconomic, and environmental context. This involves analyzing the current and potential impacts of policies, processes, and institutions on rural women's and men's livelihood strategies and outcomes. The political and institutional context includes the following:

- *Policies:* environmental, economic, energy/bioenergy, and trade agreements
- *Legislation:* such as land rights and intellectual property rights
- *Incentives:* such as for growing cash crops or improved varieties that could replace local varieties or for growing biofuel feedstock
- *Institutions:* extension services that promote technology developments and external innovations
- *Culture:* such as cultural norms and practices that may influence women's and men's access rights and cultural values that may influence gender-based decision making on crop, livestock, and fish selection and management.

Policies and institutional changes in sectors other than natural resources and agriculture include economic and energy development, demographic trends and migration patterns, incidence and impact of disease, and conflicts. Policies, processes, and institutions *have different impacts* on women and men's access to and control over livelihood assets.

BENEFITS FROM GENDER-RESPONSIVE ACTIONS

Benefits from gender-responsive actions can be placed in several overarching categories.

General:

- Overall improvement is seen in natural resources management, use, and conservation and increased agricultural productivity.

- Rural women and men maximize their contributions to household food security.
- Understanding and addressing the gender dimensions of environment and energy programs ensure effective use of development resources.
- Gender relations improve and the social acceptance of women in decision-making positions increases.
- By identifying gender-differentiated opportunities and constraints, project implementers make better-informed decisions and develop more effective environmental and biodiversity conservation interventions.
- Intrahousehold relations improve with an increase in women's control over household resources.
- Women's market participation increases as they become more active and successful in negotiations and trade.

Biodiversity:

- Understanding rural women's and men's roles and traditional knowledge of local biodiversity management, practices, and uses results in the development of innovations that meet farmers' real needs and priorities.
- Development interventions that recognize property rights of rural women and men over their knowledge systems and practices lead to the equal sharing of project benefits as well as increased biodiversity conservation.
- More effective biodiversity conservation interventions result from attention to gender-differentiated opportunities and constraints in agrobiodiversity management.
- Biodiversity conservation increases through recognizing the intellectual property rights of rural women and men.

Climate change:

- Households that are better equipped to cope with the impacts of climate change or extreme weather events can better use, manage, and conserve natural resources.
- Efficient, cost-effective, and relevant interventions take place.
- Gender analysis helps clarify the specific and often different needs, vulnerabilities, and coping strategies of women and men, so that they can be more adequately addressed in response to the impacts of climate change and variability.
- Programs create opportunities to transform gender relations and empower women.

Bioenergy:

- Access to more efficient technologies and modern energy sources reduces the health and safety problems associated

with energy acquisition and use. Such access lifts rural women and men out of poverty and enables women and girls to live more productive and healthy lives.

- The time burden of women and girls of walking long distances, carrying heavy loads, and collecting fuel in dangerous areas is reduced.
- Access to more efficient technologies for household use can reduce health and safety problems associated with indoor air pollution (UN-Energy 2007).
- Women who have access to modern fuels face a lighter cooking burden, which frees up time for educational, social, and economic opportunities.
- Involving both men and women smallholders in bioenergy production offers the possibility of improved incomes and livelihoods.

Natural disasters:

- Gender analysis helps to clarify the specific and often different needs, vulnerabilities, and coping strategies of women and men to better respond to the impacts of disasters.
- Gender-responsive actions better equip households to cope with and recover earlier from the impacts of disasters.
- Postdisaster recovery efforts present opportunities to transform gender relations and empower women.

Land and water degradation and desertification:

- Affected households cope better with the impacts of desertification and more effectively manage and conserve natural resources.
- Promoting the participation of women and men farmers in restoring ecosystem health facilitates the reestablishment of soil and land productivity.
- Strengthening the capacity of rural women and men in dryland management enhances management of local

natural resources and protects the environment from further stresses.

- Increasing women's access to information and extension services strengthens their ability to cope with and recover from dryland degradation.

MONITORING AND EVALUATION

Monitoring and evaluation of natural resources management projects provide means for learning from past experience, improving project formulation and implementation, planning and allocating resources, and demonstrating results as part of accountability to key stakeholders (World Bank 2004).³ By measuring change in the status of women and men over a period of time, gender-sensitive indicators assess progress in achieving gender equality. Researchers have little experience in the area of gender-sensitive indicators in the management of natural resources. To select an indicator, the cost of collecting and analyzing data against the quality and usefulness of the information in decision making must be weighed. The indicator should be relevant to the needs of the users, clearly defined, sex disaggregated, and easy to understand and use (FAO 2007b). Both quantitative and qualitative indicators prove useful (see also Module 16). Examples of gender-sensitive indicators appear in the Thematic Notes in this Module on biodiversity, climate change, bioenergy, natural disasters, and land and water. However, Table 10.1 provides some example indicators across the range of topics.

Depending on the country or region, it may also be relevant to 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 10.1 Monitoring and Evaluation Indicators for Gender and Natural Resources Management

Indicator	Sources of verification and tools
Percentage of women and men actively participating in natural resource management committees (including bank account signatory roles)	<ul style="list-style-type: none"> • Bank records • Committee meeting minutes • Interviews with stakeholders • Local traditional authorities (such as a chief or local council) • Program and project records
Over a set period, an increase of <i>x</i> percent in incomes from land-based activities (such as agriculture or forestry) among women-headed households in program areas	<ul style="list-style-type: none"> • Household surveys • Socioeconomic data from statistics office
Number of women and men in climate change planning institutions, processes, and research (including disaster preparedness and management) at the professional and lay-community levels	<ul style="list-style-type: none"> • Institutional and university staff records
Average number of hectares of land owned by women- and men-headed households	<ul style="list-style-type: none"> • Land registration department records
Changes in productive hours spent by, or earnings of women and men, from, household-level agroprocessing, fisheries-, or forest-based enterprises in comparison with baseline (or as percentage of household income)	<ul style="list-style-type: none"> • Case studies • Sample surveys
Community satisfaction (disaggregated by gender) with changes in natural resources management	<ul style="list-style-type: none"> • Interviews, before and after • Group interviews or focus groups
Number of women and men receiving training in natural resources management or innovative agroforestry techniques	<ul style="list-style-type: none"> • Program and project records • Training records
Number of men and women producing bioenergy crops	<ul style="list-style-type: none"> • Agricultural department statistics • Agricultural extension records • Cooperative records • Household surveys
Percentage of men and women farmers who have access to high-quality, locally adapted planting material	<ul style="list-style-type: none"> • Agricultural extension records • Interviews with stakeholders
Number of households headed by men, women, or couples benefiting from intellectual property rights	<ul style="list-style-type: none"> • Natural resources management committee records and meeting minutes
Number of women and men receiving environmental services payments for protecting watersheds or areas of high biodiversity	<ul style="list-style-type: none"> • Forestry or Natural Resources Management Department records • Global Environmental Facility records • Protected area management committee records and meeting minutes • Protected area management contracts
Percentage of men and women owning and using energy-efficient technologies and low-carbon practices	<ul style="list-style-type: none"> • Household surveys • Interviews with stakeholders

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

Gender and Biodiversity

Biodiversity provides the basis for ecosystems and ecosystem services upon which all people depend.¹ Biodiversity in agriculture, forestry, and fisheries underpins agricultural and bioenergy production (FAO 2007a; MEA 2005). Sustainable use and management of biodiversity result in global food security, environmental conservation, and viable livelihoods for the rural poor. For poor rural households, in particular, biodiversity remains a key livelihood asset, because these households are the most reliant on local ecosystems and often live in places most vulnerable to ecosystem degradation. A wide portfolio of genetic resources proves crucial to adapting and developing agricultural production systems and for regulating local ecosystems to meet the food needs of future generations. The challenges of environmental degradation, including desertification and climate change, underscore the need to

retain this adaptive capacity. Today the fundamental cause-and-effect relationship between biodiversity degradation and poverty has been recognized. Indeed, biodiversity makes a vital contribution to meeting the UN Millennium Development Goals and will increase in significance in the coming decades (FAO 2007a).

Yet genetic resources are being depleted at unprecedented rates. As mentioned in box 10.1, species extinction is happening 100 times as fast as the rate in the fossil record: 12 percent of birds are threatened with extinction, as are 23 percent of mammals and 30 percent of amphibians (www.unep.org; box 10.2). The main factors contributing to biodiversity loss include unsustainable technologies, destructive land-use practices, invasive species, overexploitation, and pollution (FAO 2005).² Climate change, driven by fossil fuel use, changes species ranges and behavior

Box 10.2 Current Trends in Biodiversity Loss

- Biomes with the highest rates of biodiversity loss in the last half of the twentieth century are the following: temperate, tropical, and flooded grasslands and tropical dry forests (more than 14 percent lost between 1950 and 1990).
- Wide-ranging areas have seen particularly rapid change over the last two decades: the Amazon basin and Southeast Asia (deforestation and expansion of croplands); Asia (land degradation in drylands); Bangladesh and parts of the Middle East and Central Asia, and the Great Lakes region of Eastern Africa.
- Based on recorded extinctions of known species over the past 100 years, extinction rates are approximately 100 times greater than those characteristic of the fossil record.
- Genetic diversity has declined globally, particularly among domestic species. A third of the 6,500 breeds of domesticated animals are threatened with extinction because of small population sizes.
- Globally approximately 474 livestock breeds are classified as rare, and about 617 have become extinct.
- Roughly 20 percent of the world's coral reefs have been destroyed, and an additional 20 percent have been degraded.
- Some 35 percent of mangroves have been lost in the last two decades in countries where we have adequate data.

Sources: FAO 2003, 2005; MEA 2005.

(www.unep.org). Unfortunately, one key solution to climate change, the replacement of fossil fuel use with bioenergy, also threatens genetic diversity (see Thematic Note 3). Additional influential forces include agricultural development approaches that favor high-yield and uniform varieties of crops, the heavy use of agrochemicals, and the depreciation and devaluation of diversity and accumulated local knowledge (FAO 2003, 2007a; MEA 2005).

Poor rural households that depend heavily on biodiversity in forests, on common lands, and on their farms use diverse domesticated and wild plants for fuel, food, and building materials. Current policies and economic systems often fail to incorporate the values of biodiversity effectively (www.unep.org). To limit these losses and address the multidimensional problems of biodiversity loss and ecosystem degradation, we need policies and programs that cut across sectors and encompass the technical, economic, and social spheres. The human and social dimension of biodiversity loss requires an understanding of its relation to poverty, as well as the gender-specific relationship to natural resources management.

KEY GENDER ISSUES

Rural women and men play important roles in biodiversity management, use, and conservation through their different tasks and responsibilities in food production and provision. Consequently they have different needs, priorities, and knowledge about diverse crops, plants, and animals. As natural resource managers, they influence the total amount of genetic diversity conserved and used. Women are typically involved in the selection, improvement, and adaptation of local plant varieties, as well as seed exchange, management, and saving. They often keep home gardens where they grow traditional varieties of vegetables, herbs, and spices selected for their nutritious, medicinal, and culinary advantages (box 10.3). Women, therefore, play an important role in maintaining biodiversity, working against the decrease in biodiversity caused in part by men favoring cash-oriented monocultures, as in the Mexican Yucatan (Lope Alzina 2007). Women are also the primary collectors of wild foods that provide important micronutrients in diets, are vital for the survival of their households during food shortages, and may also provide income. In the Kalahari Desert, fruits, gums, berries, and roots gathered by the Kung women provide 60 percent of the daily calorie intake. In the Lao People's Democratic Republic, women gather 141 different types of forest products (Momsen 2007). Women possess extensive, often unrecognized, knowledge of the location

Box 10.3 Cameroon and Uganda: Indigenous Vegetables

In Cameroon and Uganda, indigenous vegetables play an important role in both income generation and subsistence production. Indigenous vegetables offer a significant opportunity for poor women and men to earn a living, as producers and traders, without requiring a large capital investment. The indigenous vegetable market provides one of the few opportunities for poor unemployed women to secure a livelihood. Despite the growth in exotic vegetables, indigenous vegetables remain popular in rural areas, where people consider them more tasty and nutritious.

Source: FAO 2005.

stock, and wild plants for achieving household food security and nutritional well-being, especially among the rural poor. However, women's roles and knowledge are often overlooked or underestimated in natural resource management and related policies and programs (Howard 2003).

Local knowledge serves as a critical livelihood asset for poor rural women and men for securing food, shelter, and medicines.³ The different tasks and responsibilities of rural women and men have enabled them to accumulate different types of local knowledge and skills (FAO 2005). Some studies have expressed concern that local knowledge is disappearing; women do not pass this information on to their daughters, and men no longer pass it down to their sons. Especially in women-headed households (because of HIV and AIDS and migration), changing dietary habits lead to the erosion of women's knowledge of processing, preparation, and storage and lead to the erosion of plant diversity, family food security, and nutritional well-being (Howard 2003).

The type of knowledge farmers possess varies by age, gender, roles and responsibilities, socioeconomic status, and environment. Access to or control over resources as well as education, training, information, and control over the benefits of production also influence the type of knowledge rural women and men have. Experience-based local knowledge interweaves with cultural values and develops and adapts continuously to a gradually changing environment. Rural women's and men's local knowledge, skills, and innovations raise the issue of recognition and protection of farmers' rights.

Markets

Men tend to sell their crops in national or export markets (for uniform, exotic varieties), whereas women tend to sell in local markets where they find demand for traditional varieties (box 10.3). Trade can improve rural women's and men's livelihoods by providing them with income and, at the same time, an incentive to manage, use, and conserve a variety of local indigenous plants. However, women, in contrast to men, face challenges in accessing and benefiting from markets. For example, in the Bamana region of Mali, men have appropriated women's vegetable gardens to establish market-gardening enterprises based on nontraditional foods (box 10.4), which has led to a decline in nutritional well-being.

At the national and global levels, unfair trade disadvantages poor farmers, many of whom are women. New agreements under the World Trade Organization influence biodiversity and have gendered impacts. Gender-based inequalities in access to and control over productive resources have concrete consequences (Randriamaro 2006). Trade negotiations rarely consider women's and men's different knowledge, skills, and

Box 10.4 Mali: Changes in Agricultural Production, Gender Relations, and Biodiversity Loss

A case study of the Bamana region in Mali shows how men dismissed agrobiodiversity and the local knowledge held by women. The introduction of exotic vegetables for market production, mainly a men-driven enterprise, led to a shift from subsistence production of a wide variety of indigenous food plants to market gardening of a limited number of exotic food varieties. This process has led to a change in gender roles, with men taking over women's traditional vegetable gardens to establish commercial enterprises. Although traditionally responsible for growing local plant varieties for direct consumption, women were displaced to marginal lands. This has implications for women's contribution to the food security of their household (reduced income and food production for household consumption) and their social standing in the community. Moreover, women's exclusion from the garden realm may lead to changes in culinary patterns, a possible decline in nutritional status, and a reduction in local plant diversity and overall environmental stability.

Source: Wooten 2003.

uses of agrobiodiversity. The agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) poses direct challenges for poor farmers, particularly women, to access seeds for food production, food security, and nutritional well-being.⁴ Moreover, on the one hand, a shift toward production for the global market may be at the expense of local crop varieties for domestic consumption. On the other hand, globalization can give women and men small-producers the opportunity to target niche markets for fair trade or organic products and may go far toward protecting biodiversity (Momsen 2007).

Risk and vulnerability

The impact of biodiversity loss, particularly within common property resources, threatens household food security and livelihoods. These resources prove particularly important for poor rural women, who lack secure land tenure and depend on these common resources for fuelwood, fodder, and food and, therefore, the well-being of their households.

Commercialized agriculture often relies on the replacement of a wide range of locally adapted plant and livestock varieties with a relatively small number of uniform, high-yielding varieties, causing the erosion of local plant and animal genetic resources (FAO 1996).⁵ With the increased commercialization of agriculture, technological improvements have created farming systems that are highly dependent on external inputs such as agrochemicals, and these systems often bypass women. Because of their limited access to financial resources, women may have difficulty acquiring seeds, technology, and fertilizers as well as information and training. These processes have negative impacts on small farmers, especially women, who rely on a wide variety of genetic diversity as part of their environmental risk management strategy. In turn, this erosion of resources can also lead to the loss of local knowledge and sometimes to changes in gender roles (box 10.4).

Clearly, biodiversity loss entails different consequences for women and men in the performance of their productive, reproductive, and community roles (Lambrou and Laub 2004). Coping strategies such as the improved management of biodiversity should give options for poor rural women and men to reduce their vulnerability to the effects of biodiversity loss and to build the potential to react to further changes (box 10.5).⁶ Poor rural women and men farmers often spread risk by growing a wide variety of locally adapted crops, some of which will be resistant to drought or pests, and livestock breeds that have adapted to the local agroecological zone (FAO/IPGRI 1996). Diversification, an important

Box 10.5 HIV and AIDS—Rural Women’s and Men’s Coping Strategies

Millions of households across Africa have been affected by HIV and AIDS. Rural women and men may respond with a range of coping strategies. For example, in Uganda rural households change the mix of farm products, focusing first on subsistence production and then on growing a surplus to sell in markets (Armstrong 1993). Another strategy is to reduce land under cultivation, resulting in reduced outputs (FAO 2003). In Uganda women-headed households cultivate only 1.3 acre, on average, compared with affected men-headed households, which cultivate 2.5 acres, on average (FAO 2003). Some HIV- and AIDS-affected households have turned to livestock production as an alternative to crop production. Other households sell livestock to pay for medical bills and funeral expenses. A trend has been identified where households raise smaller livestock (such as pigs and poultry) because they are less labor-intensive and often readily available to women.

Source: White and Robinson 2000.

coping strategy adopted by poor rural households, will protect them against climate change, desertification, and other environmental stresses. Women, in comparison to men, are often more vulnerable to the erosion of biodiversity, because they experience gender-based inequalities in accessing assets critical to livelihood security (Lambrou and Laub 2004).

Women and men farmers’ full and equal participation in programs and projects dealing with biodiversity conservation, management, and use affects gender-responsive outcomes. Researchers and breeders often work in isolation from women and men farmers and are sometimes unaware of their needs and priorities beyond yield and resistance to pests and diseases.⁷ Moreover, extension agents and research organizations tend to consider many local varieties and breeds to be low-performing and inferior. National policies that provide incentives such as loans and direct payments for the use of modern varieties and breeds contribute to the loss of genetic diversity and affect traditional gender roles.

POLICY AND IMPLEMENTATION ISSUES

International policies and agreements regulate the management and use of biodiversity and agrobiodiversity.⁸ The

majority of these instruments do not highlight the potential gender-differentiated impacts of their provisions. Only the Convention on Biological Diversity (CBD) and the Global Plans of Action (box 10.6) recognize the key roles played by both women and men, especially in the developing world, in the management and use of biodiversity (Lambrou and Laub 2004).⁹ Unfamiliar with these policy instruments, extension workers, development agents, and farmers working on biodiversity and environmental conservation will find it challenging to understand their impact and to implement the relevant provisions in their daily work (FAO 2005).

The CBD advocates the fair and equitable sharing of genetic resource benefits. It also establishes a connection between sustainable conservation and development and the rights of indigenous peoples and local communities¹⁰ (FAO 2005; Lambrou and Laub 2004). The International Treaty on Plant Genetic Resources responds to the outstanding issues not covered by the CBD and formally endorses farmers’ rights (box 10.7) through a legally binding instrument at the global level. Observers have noted a growing trend toward the recognition and creation of indigenous rights over genetic resources and related knowledge (FAO 2005).

Despite the increased recognition of the linkages between gender dynamics and biodiversity management and use, little progress has been shown in translating these into programs and projects for agrobiodiversity management and conservation at the local level (FAO 2005). Rural women’s vital contribution to the management of biodiversity, agricultural production, and household food security remains misunderstood, ignored, or underestimated (Howard 2003).

GOOD PRACTICES AND LESSONS LEARNED

Experience shows that agricultural biodiversity management and related policies and programs have often failed to recognize the differences between rural women’s and men’s labor, knowledge, needs, and priorities. This negatively affects biodiversity, local knowledge, and household food security.

Community seed fairs in Tanzania

As part of the LinKS project, the Food and Agriculture Organization (FAO) organized community seed fairs in Tanzania to raise awareness about local crop diversity. The FAO provided learning opportunities for the rural communities (including the younger generations), researchers, extension

Box 10.6 Gender and Biodiversity in International Agreements

The Global Environment Facility (GEF), the financial mechanism for the Convention on Biological Diversity, helps countries fulfill their obligations under the CBD. Since 1991 the GEF has invested nearly \$7.6 billion in grants and cofinancing for biodiversity conservation in developing countries. The biodiversity portfolio supports initiatives that promote in situ and sustainable biodiversity conservation in protected areas and production landscapes as well as capacity building and knowledge dissemination (www.gefweb.org).

The Global Plan of Action on Plant Genetic Resources, adopted in 1996, provides a coherent framework, identifying priority activities in the field of in situ and ex situ conservation, sustainable utilization, and capacity building (FAO 1996). It develops activities and

measures to strengthen women's capacity to sustainably manage these resources (FAO 2005).

The Global Plan of Action for Animal Genetic Resources, adopted in 2007, presents the first internationally agreed-to framework to halt the erosion of livestock diversity and support the sustainable use, development, and conservation of animal genetic resources. The plan supports indigenous and local production systems and associated knowledge systems. In this context, the plan calls for the provision of veterinary and extension services, delivery of microcredit for women in rural areas, appropriate access to natural resources and to the market, the resolution of land tenure issues, the recognition of cultural practices and values, and the addition of value to specialty products (FAO 2007c).

Box 10.7 Farmers' Rights—Protecting the Knowledge of Indigenous People and Local Communities

Farmers' rights are based on the recognition that farmers play a crucial role in the management and conservation of plant and livestock genetic resources. These rights include the following:

- Protection of traditional knowledge relevant to genetic resources for food and agriculture
- Participatory decision making at the national level on matters relating to the conservation and sustainable use of plant genetic resources for food and agriculture
- The right to equitably participate in sharing benefits arising from the use of plant and animal genetic resources.

Source: FAO 2005.

staff, and organizations about the importance of crop diversity and local knowledge in food security. Women were the key collectors and savers of seeds. Seed fairs provided farmers with a meeting place where they could buy, sell, and barter seed, thus encouraging the conservation of crop diversity and the spreading of local seed varieties among women and men farmers. The seed fairs were organized on a local scale to make them accessible and affordable for the rural communities.

After exchanging seed varieties, community members discussed local practices. Seed fairs increased local networks, the appreciation of local knowledge, and the roles and responsibilities of farmers in managing agrobiodiversity. (See other examples in Module 12, in particular Thematic Note 2.)

Agroforestry domestication program

A program in Africa supported by the International Fund for Agricultural Development (IFAD) has helped women and men in the domestication, cultivation, and sale of indigenous fruit and medicinal trees. The first phase of the program ran from 1999 to 2003 in Cameroon, the Democratic Republic of Congo, Equatorial Guinea, Gabon, and Nigeria. Training on vegetative propagation techniques enabled many farmers to establish their own nurseries. As a result of project, average household incomes increased, and women and men farmers acquired new skills in propagation techniques, such as grafting and the rooting of cuttings. The program has been particularly effective in improving the livelihoods and status of women. Women's groups have established nurseries, enabling women to participate in income-generating activities. This has led to an increase in school attendance among children. The tree domestication program has also contributed to increased nutritional well-being at the household level, because the women also produce a variety of food for household consumption previously unavailable to them (IFAD n.d.).

Guidelines for policy development on farm animal genetic resources management

A joint FAO, South African Development Community (SADC), and United Nations Development Programme (UNDP) project in the SADC region developed policy guidelines that recognize women's roles in livestock management. Those guidelines assist SADC member states in designing policies and a legal framework for the conservation, sustainable use, and management of farm animal genetic resources. The guidelines stress the need for the effective participation of all stakeholders, with a particular focus on women who own or manage a substantial amount of the genetic resources. In highlighting the vital role that women play, the guidelines call for their full and equal participation at all levels of policy making and implementation. Furthermore, the project encourages the development of policies that provide incentives to farmers for the conservation and sustainable use of indigenous animal genetic resources, as well as for the protection of farmers' rights and indigenous knowledge.

The Philippines: indigenous knowledge systems and intellectual property rights

Funded by IFAD and implemented by the International Research Centre for Agroforestry between 2003 and 2004, this project aimed to provide technical assistance in documenting the ethnobotanical knowledge of the Subanen indigenous communities, especially that of women. The objectives included identifying and documenting traditional rice varieties and wild plants and animals, facilitating local participatory planning of natural resource management, and establishing property rights of local communities over their knowledge systems and practices. Men and women participated equally in learning new skills of technical documentation. The technical expertise of the Subanen members of the ethnobotanical documentation team, as well as of concerned women, was enhanced significantly. Technical assistance helped the communities ensure that documentation material that was produced guaranteed their intellectual property rights. A memorandum of understanding signed by the government on behalf of the communities and based on their specific requests and stipulations secured their intellectual property rights and options for obtaining benefits from any future commercial or beneficial use of their knowledge. The project also awakened a strong interest in local women in continuing the reproduction of threatened rice varieties for in situ conservation and documentation (IFAD 2004).

Nepal and India: gender, genetic resources, and indigenous minorities

The International Development Research Centre (IDRC) carried out an action research project on agrobiodiversity management among three ethnic groups in the eastern Himalayas, with a special focus on gender. The three groups were the Rai of east Nepal, the Lepchas of Sikkim and Kalimpong, and the Chekasang and Angami of Nagaland, India. All three research teams received training workshops in gender analysis and writing skills. In Nepal the team built on six years of community development experience in participatory plant breeding to undertake an action research project to develop seed technologies for maize. The IDRC provided interested farmers with rudimentary plant-breeding skills (field isolation, plant selection, cob selection, storage practices). The organization provided timely technical action for maintaining seed purity in the course of the crop cycle and was successful in generating new seeds for the coming season. The organization also initiated similar activities with 50 farmers in an adjacent community. After a visit to eastern Nepal, two agricultural scientists from neighboring Sikkim and Kalimpong started a similar initiative with 20 farmers in Kalimpong, focusing mainly on the development of a disease management strategy for ginger, based on best practices from farmers.

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

Rural women's and men's vulnerability to biodiversity loss must be understood, so planners can design ways to mitigate the effects of decreasing biodiversity. This implies an understanding of the following issues:

- Rural women's and men's different local knowledge of indigenous plant, fish, and livestock biodiversity uses and practices, including their cultural values and belief systems that influence their traditional knowledge and biodiversity management practices
- The livelihood constraints and opportunities of rural women and men who are managers and users of biodiversity and, in particular, the gender-based inequalities in accessing and controlling critical livelihood assets such as land, credit, technology, and information, as well as participation in farmers' organizations and other decision-making processes
- The different ways rural women and men use biodiversity management practices to secure a livelihood in the

face of environmental stresses such as floods and droughts and other shocks such as HIV and AIDS

- Strategies to improve farmers' involvement and benefit sharing, in particular, the issues of farmers' rights and obtaining prior informed consent, which should be considered within a legal and ethical context¹¹
- Eliminating incentives for uniform varieties and supporting rural women and men in accessing information about their rights to plant genetic resources (FAO 2005)
- Gender-sensitive participatory plant breeding, which contributes to the conservation and sustainable use of plant and animal genetic resources;¹² as women and men use and manage agrobiodiversity in different ways, their full and equal participation in decision-making processes is critical for safeguarding local biodiversity.

Often the most appropriate solutions to local problems and needs combine traditional and scientific methods. This fusion enhances the adoption and acceptance of the new

methods by the local community and provides methods that reflect the actual needs of women and men.

MONITORING AND EVALUATION

The following are examples of gender-sensitive indicators for biodiversity (FAO 2007b):

- Percentage of men and women farmers who have access to high-quality, locally adapted planting material
- Number of households headed by men, women, or couples benefiting from intellectual property rights
- Ratio of men's and women's income from production of high-value horticultural crops
- Ratio of the number of livestock owned by men and women
- Amount of credit and microcredit available to women and men for improving livestock enterprises.

Gender Dimensions of Climate Change

Global climate change is one of the greatest environmental challenges facing the world today. In the twentieth century the increase in global average temperature reached 0.74°C, the average sea level increased by 17 centimeters, and the Northern Hemisphere experienced a considerable decrease in snow cover (IPCC 2007). Eleven of the warmest years since records have been kept have occurred during the last 12 years, representing an accelerating warming trend. The Intergovernmental Panel on Climate Change (IPCC)¹ projects additional global warming over the twenty-first century from 1.8 to 4.0°C.² According to the IPCC's Fourth Assessment Report, climate warming is unequivocal, evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising sea levels. Long-term changes in climate include widespread changes in precipitation, ocean salinity, wind patterns, and extreme weather events. Extreme weather events resulting from climate change include droughts, heavy precipitation, heat waves, and the intensity of tropical cyclones (IPCC 2007).

The increase in greenhouse gas³ concentrations accounts for most of the observed increase in global average temperatures since the mid-twentieth century.⁴ The international response to climate change focuses on mitigation measures that aim to reduce greenhouse gases and enhance carbon sinks. Carbon sinks are the natural ability of trees, other plants, and the soil to soak up carbon dioxide and temporarily store the carbon in wood, roots, leaves, and the soil. However, in recent years many observers recognize adaptation strategies as critical elements in reducing the vulnerabilities to climate-induced change to protect and enhance the livelihoods of poor women and men (Soussain, Burton, and Hammil 2003). Even if we stabilize greenhouse gas concentrations, climate change will continue for centuries, and the ability of the most vulnerable to adapt will remain a serious issue (IPCC 2007).

Climate change poses a serious risk to poverty reduction and development, with adverse impacts expected on the environment, human health, food security, economic activity, natural resources, and infrastructure.⁵ Global warming will have profound effects on agriculture, forestry, grasslands, livestock, and fisheries and, thus, on food security (FAO 2007). The IPCC assesses that 20 to 30 percent of plant and animal species are in danger of extinction if the rise in global average temperature exceeds 1.5 to 2.5°C. The sharpest impact of a changing climate will be the rise in incidence and severity of climate-related disasters such as increased flooding, particularly in Asia, as well as fiercer storms and prolonged droughts (see Thematic Note 4). The IPCC's Fourth Assessment Report warned that global warming would cause widespread food shortages in the developing world (Harvey 2007; IPCC 2007).⁶

Although industrial countries' use of fossil fuel and industrial processes contributes inordinately to greenhouse gas concentrations, people living in developing countries are most likely to suffer the consequences of climate change (box 10.8). This uneven distribution of the impacts of climate change occurs both between and within countries. Least-developed countries prove the most reliant on rain-fed agriculture and natural resources and are the most vulnerable to climate change. These countries generally lack the necessary adaptive capacities, such as a stable economy, infrastructure, technology, information dissemination system, and equitable access to resources. Poor people tend to live on marginal lands that are most subject to droughts or floods and are most likely to be affected by small changes in climate variability. Because of gender-based inequalities in accessing critical livelihood assets such as land, credit, technology, information, markets, and organizations, women have more exposure to these risks.⁷

Box 10.8 Examples of Projected Negative Impacts of Climate Change

- A rise in sea level exposes many communities to severe flooding from storm surges.
- A decline in water availability may leave billions of people facing water shortages, especially in the Middle East and Indian subcontinent.
- In the tropics and subtropics, even small temperature increases can impact crop production.
- Desertification (in particular in parts of Africa, Asia, and the Middle East) and depletion of forests (in particular in the tropics and subtropics) lead to a loss of biodiversity.
- Disruptive seasonal rainfall patterns lead to droughts and floods, impacting crop production and increasing food insecurity in many parts of the developing world.
- Increased frequency and intensity of extreme weather events combined with constraints on mobility lead to loss of life, injury, population displacement, and economic devastation in the least-developed countries.

Sources: IPCC 2001, 2007; Martens 1998; Masika 2002.

KEY GENDER ISSUES

Until recently, international climate change policy makers have neglected the gender dimension of climate change (Lambrou and Piana 2006a). A focus on technical solutions has ignored social and political factors (Masika 2002). The successful implementation of climate change policies and projects requires an understanding of the gender-based roles and relationships vis-à-vis natural resources, as well as the gender-differentiated impacts of climate change and the different risks and vulnerabilities of women and men. This includes the structural constraints that curtail women's access, control, and ownership over assets (Denton 2002). Research must also identify who is responsible for CO₂ emissions and how social, political, and planning conditions might affect emission reduction (Lambrou and Piana 2006b). A discussion of some gender issues related to climate change follows.

Climate change impacts

Climate change could alter the tasks people perform and their time use, affecting men and women differently. For

example, rural women, and girls to some extent, frequently provide households with water and fuelwood for heating and cooking. The time needed for their work in gathering water and fuel will likely increase with water shortages and depletion of forests. Decreasing the time available to women for food production and preparation as well as participation in income-generating activities will likely affect household food security and nutritional well-being (see also Module 1).

Another example of climate change that directly impacts men and women differently is the effect of climate change on water quality and supply. Children and pregnant women are physically vulnerable to waterborne diseases, and their role in supplying household water and performing domestic chores makes them more vulnerable to diseases, such as diarrhea and cholera, that thrive in conditions of degraded water.⁸ Decreased water resources may also cause women's health to suffer as a result of the increased work burden and reduced nutritional status. For instance, in Peru following the 1997–98 El Niño events, malnutrition among women was a major cause of peripartum illness.

Adaptation

At the local level, farmers continuously adapt to climate variability. They change crops or varieties, choose different harvest and sowing dates, alter land management, and employ water efficiency techniques (FAO 2007). Long-term climate change poses a new set of challenges to farmers dependent on natural resources, and so at the national and international levels, governments and development agencies play a fundamental role in building the capacity of farmers to cope with and adapt to a changing environment (Sous-sain, Burton, and Hammil 2003).

The adaptive capacity of people depends on how they can draw from resources to maximize their livelihood outcomes (Masika 2002), so adaptation depends on factors such as economic status, technology, health, education, information, skills, infrastructure, access to assets, and management capabilities (IPCC 2001). Differentiated power relations between men and women and unequal access to and control over assets mean that men and women do not have the same adaptive capacity; instead, women have distinct vulnerability, exposure to risk, coping capacity, and ability to recover from climate change impacts (Masika 2002). Although women are generally more vulnerable to the impacts of climate change, they play an active role in adapting to its impacts to secure food and a livelihood for their household.⁹

Gender components determine adaptation strategies in terms of how men and women can contribute. For example, as a result of gender-differentiated roles in agrobiodiversity management, women often have greater knowledge of indigenous plant varieties with important nutritional and medicinal values (FAO 2005). As the keepers of seeds, women often possess knowledge of a variety of genetic resources to adapt to varying climatic conditions such as resistance to drought or pests. However, because men have more secure access to land or land tenure, they have more incentive to contribute to effective natural resources management, use, and contributions necessary for adaptation.¹⁰

Gender also often determines who receives inputs for adaptation strategies. Frequently new agricultural technologies bypass women farmers, despite women's knowledge. For example, extension personnel introducing new varieties intended for higher drought or heat tolerance rarely speak directly with women farmers (Kurukulasuriya and Rosenthal 2003).

Finally, a gender component exists for the adaptive strategies that are pursued and the consequences of adaptation. For example, in New South Wales, Australia, women migrate away from farms for work, which enables men to remain in agriculture. In other regions impacted by drought, men migrate, leaving women, who have fewer resources, to perform agriculture. In either case, the drought strains traditional gendered relationships (Alston 2006).

Mitigation

Mitigation has revolved around the reduction of greenhouse gases and the enhancement of carbon sinks to absorb them (Boyd 2002).¹¹ Although responsibility for carbon emissions resides primarily in industrial countries, fossil fuel use and industrial processes, rural poverty, and subsistence agriculture account for a portion of emissions of carbon dioxide that stem from deforestation and land-use change.¹² In addition, rural poor women and men generally lack access to energy-efficient services that do not degrade the ecosystem or contribute to environmental change. Rural households typically rely on biomass for cooking and heating. Because women usually prepare food, their decisions about cooking fuels and efficiency can reduce carbon emissions. Households with lower average income and level of education generate lower emissions; however, they also have a lower mitigation and adaptive capacity. Low educational levels of women and men household members limit awareness of mitigation options, such as the use of energy-efficient devices (Lambrou and Piana 2006a). Therefore, as issues of

sustainable energy development (renewable energy and energy efficiency) and sustainable transportation receive more attention, it is important to encourage and improve the active involvement of key stakeholders. Women's active involvement in agriculture, and their dependence on biomass energy, make them key stakeholders in effective environmental management related to mitigation (Denton 2002).

GOOD PRACTICES AND LESSONS LEARNED

Programs in Bolivia, Costa Rica, and India contribute to good practices and lessons learned.

Bolivia: Noel Kempff Climate Action Project

Unfortunately, many climate change projects fail to take gender into account. For example, in 1996, in the region of Santa Cruz in the Bolivian Amazon, the Noel Kempff Climate Action Project's primary objective involved purchasing logging concessions and expanding the Noel Kempff National Park to 1.5 million hectares for conservation and increased carbon credits. However, the project failed to take into account a gender perspective that recognized the different power relations and cultural practices as well as the gender bias in institutions (Boyd 2002). The project also aimed to improve local agricultural and forest management practices, stimulate employment, and obtain 400,000 hectares of communal land for three key local communities. The project provided opportunities for the participation of both women and men, who successfully participated in some aspects of the project. The participants met some basic necessities, such as trying new varieties of crops and accessing credit. With a majority of men local and technical staff, women had little chance to join decision-making processes relating to the future of the park, land title, and other project activities. Men dominated public meetings, overlooking women's needs and concerns, which ultimately were not reflected in the project activities. Boyd (2002) stresses that the project did not challenge existing gender relations and division of labor, nor did it empower women. The project's enforcement of existing social structures and wide reliance on traditional norms in decision making weakened women's ability to participate.

Costa Rica: Carbon emission mitigation through Payment for Environmental Services Programme

Since 1996 Costa Rica's government has implemented the Payment for Environmental Services Programme (Programa

de Pago por Servicios Ambientales) to promote and encourage conservation, reforestation, carbon emission mitigation, and sustainable management of Costa Rica's natural resources.¹³ The program offers economic rewards to landowners who conserve the forests on their land. However, most landowners are men, and women have little access to the economic rewards. To help resolve this problem, FON-AFIFO (National Fund for Forestry Finance), the national institution in charge of implementing the program and promoting gender equity, imposes a fee. This fee goes into a fund to support women who want to become landowners.¹⁴

India: carbon sequestration project

An innovative agroforestry project in Gudibanda Taluk, Karnataka, India (implemented by the NGO Women For Sustainable Development [WSD]), supports local women and men farmers in planting mango, tamarind, and jack-fruit tree orchards for harvest and carbon sequestration.¹⁵ The project supports women's participation in decision-making processes. One way in which the project does this is by taking into account women's time and cultural constraints when establishing public forums. The project set up a prototype carbon marketing facility to sell the certified emissions reduction of the global environmental services that the participants (poor rural women and men) provide.¹⁶ Because farmers have an average annual income of less than \$100, they cannot afford to plant fruit trees without financial assistance. Success requires expensive irrigation changes and planting tools. Farmers will live on the carbon sales from their mango plantations for the first few years, until they harvest their crop. Fruit production should start about four years after planting, and one acre of crop will at least triple their annual income. The program anticipates sustainable incomes for women and men farmers, as well as the additional benefits derived from the ecofriendly farming techniques. The project lifetime is 35 years, with an estimated CO₂ benefit of 23 tons of carbon sequestration per acre. The project target is 35,000 acres, for a total sequestration of 575,000 tons of carbon.

POLICY AND IMPLEMENTATION ISSUES

The United Nations Framework Convention on Climate Change (UNFCCC), the main international policy instrument to address climate change, aims to stabilize the concentrations of greenhouse gases in the atmosphere within a time frame sufficient to allow ecosystems to adapt naturally to climate change. The UNFCCC, supported by the 1997

Kyoto Protocol, contains legally binding targets that dictate that industrialized countries must reduce by 2008–12 combined emissions of six key greenhouse gases by at least 5 percent in relation to 1990 levels.¹⁷ The Global Environment Facility and the Clean Development Mechanism (box 10.9) of the Kyoto Protocol play a role in climate change mitigation and adaptation strategies.¹⁸

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

Awareness and understanding of the complex links between gender roles and relations, the environment, and livelihood security will aid in the design of climate change mitigation and adaptation projects. To ensure women's participation in climate change mitigation and adaptation projects, we must incorporate women's needs and concerns in the design of relevant and successful climate change policies. Pinpointing specific goals within the main climate policies and developing corresponding indicators for monitoring and evaluation will help mainstream gender issues into climate change policies. Ways of incorporating women's needs and concerns relating to mitigation include the following:

- Analyze women's and men's energy use, transport use, and other consumption patterns impacting climate.
- Introduce more formal and informal education about the environmental impacts of their current life styles to increase men's and women's mitigation capacity (Lambrou and Piana 2006b).
- Promote cleaner-burning fuel for household use to reduce harmful emissions, cut household energy costs, and reduce women's and girls' work burdens.
- Increase poor women's and men's access to payments for environmental services.

Goals and issues related to adaptation include the following:

- Many women prove to be proactive at local levels in mitigating hazards and strengthening the disaster resilience of households and communities.
- Make available to both men and women usable, science-based climate prediction information and incorporate existing local knowledge (FAO 2007).
- Strengthen the capacity of rural institutions such as extension services to use appropriate tools and strategies, including participatory identification of current vulnerabilities and risk reduction measures, implementation of prioritized community-based disaster risk reduction

Box 10.9 The Potential of the Clean Development Mechanism

In the Kyoto Protocol the Clean Development Mechanism allows for and addresses divergent objectives and priorities between the North and South. A bilateral agreement between an industrialized country and a developing country mandates reduced greenhouse gas emissions under the convention. Under the CDM industrialized countries invest in projects that increase economic productivity and may reduce local environmental problems in developing countries (Denton 2002).

Those projects that focus on technologies relating to household energy, food processing, forest management, and water pumping must target both rural women and men and take into account their different roles and responsibilities. However, extension services that convey this technology typically target men, who are perceived as the principal decision makers and users of these technologies (for a more detailed discussion, see Denton 2002; Wamukonya and Skutsch 2001).

activities, and increased capacity of communities to manage their resources (FAO 2007).

MONITORING AND EVALUATION

Examples of gender-sensitive indicators in climate change include (indicators are from Aguilar 2007; FAO 2007) the following:

- Proportion of men and women who own and use non-motorized transport and use public transport
- Number of women owning and using energy-efficient technologies, using renewable energy, and involved in sustainable forest management (climate change mitigation)
- Number of women and women-headed households receiving training and assistance related to disasters (such as the number of women who know how to swim)
- Participation of women in climate change-planning institutions, processes, and research (including disaster preparedness and management) at the professional and lay-community levels.

Gender and Bioenergy

Over one-third of the world's population, 2.4 billion people, rely on traditional biomass in the form of fuelwood, agricultural residues, and animal wastes for their primary energy needs (Sagar and Kartha 2007). Use of traditional biomass poses many problems: poor health, heavy workloads, land degradation, deforestation, biodiversity loss, and climate change. New forms of bioenergy, primarily liquid biofuels, are rapidly being developed as replacements for fossil fuels. Global interest in modern bioenergy—which includes liquid biofuels, biogas, and solid biomass—has grown rapidly in recent years.¹ (This Thematic Note focuses on modern bioenergy; for a detailed discussion on the wider issues of gender and energy, refer to Modules 9 and 15.)

At a time when energy analysts anticipate a period of unpredictable oil markets, fossil fuel dependence poses a major risk for many developing economies. Oil imports now consume a large and unsustainable share of the meager foreign exchange earnings of many poor nations, offsetting any gains from recent foreign debt elimination agreements. Unstable and unpredictable oil prices have complicated economic planning around the world and are further damaging poor economies (UN-Energy 2007).

Available energy services currently fail to meet the needs of the world's poor. Four out of five people without electricity live in the rural areas of developing countries (UNDP 2004; UN-Energy 2007). Extending an electricity supply grid to remote households in rural areas is unlikely to occur quickly because of costs that are seven times the cost of providing electricity in an urban area (FAO 2006).

Given plausible economic and institutional assumptions, this century could see a significant switch from fossil fuels to bioenergy, with agriculture and forestry as the leading sources of biomass for biofuels (FAO 2005).² Although increased production of, and access to, bioenergy offers only one of the possible answers to climate change and energy

security challenges,³ a number of features make it an interesting but complicated option (FAO 2007). Locally produced bioenergy can supply energy for local agricultural, industrial, and household uses, in some instances at a lower cost than fossil fuels (UN-Energy 2007). Modern bioenergy, with appropriate policies, could help meet the needs of poor women and men who lack access to electricity, while generating income and creating jobs in poorer areas of the world.

Although the rapid development of modern bioenergy presents a broad range of opportunities for achieving sustainable energy, it also entails multiple trade-offs and risks. The first concern relates to the impact of bioenergy on food markets, food prices, and food security. Current biofuels depend on food crops, including corn, sugarcane, soybeans, rapeseed, and palm oil. The boom in bioenergy has already resulted in some rises in food prices.⁴

A second concern is the impact of modern bioenergy production on sustainable livelihoods for rural households. If production and processing of biofuels occur through large-scale, vertically integrated commodity chains, small farmers will be unlikely to benefit. Efforts to use biofuels to promote sustainable development must include strategies to incorporate small producers (Sagar and Kartha 2007).

The rapid development of modern bioenergy requires careful handling of key social, economic, and environmental sustainability (UN-Energy 2007). New crops, farming techniques, and second-generation technologies (for example, fuels made from lignocellulosic biomass feedstock using advanced technical processes) now under development may mitigate some of the social, environmental, and economic costs associated with large-scale production of liquid biofuels and increase their potential and environmental benefits.⁵ Where we grow crops for energy purposes, use of large-scale monocropping could lead to significant biodiversity loss, soil erosion, and nutrient leaching, with negative consequences

for local rural women's and men's ability to secure food and their livelihoods.

Most likely, new bioenergy production will involve large-scale biomass production that does not necessarily benefit the rural poor. The challenge is to develop small-scale bioenergy concepts and technologies that local people can use and sustain. A transitional solution uses improved cook stoves, which reduce indoor pollution and burn fuel much more efficiently. Bioenergy options, such as small- and medium-scale biogas or gasifiers and power generators, operate with locally available biomass resources. They may become the most economical and reliable providers of energy services for poor rural women and men (UN-Energy 2007).

KEY GENDER ISSUES

Gender-differentiated issues related to bioenergy differ substantially among traditional biomass, small-scale biofuel production, and large-scale biofuel production.

Gender and traditional bioenergy

Rural women shoulder the burden of traditional biomass (fuelwood, manure, agricultural residues) collection. Many women spend up to three to four hours a day collecting fuel for household use, sometimes traveling 5 to 10 kilometers a day (WHO 2006). Women in women-headed households report water and fuelwood collection as their most time-consuming tasks (FAO/IFAD 2003). In many African, Asian, and Latin American countries, rural women carry approximately 20 kilograms of fuelwood every day (FAO 2006). Increasing pressure on and degradation of these resources result in women walking longer distances from the safety of their communities. This increases their work burden, limiting time available for food production and preparation, household-related duties, and their participation in income-generating activities and educational opportunities.

Women's limited access to fuelwood relates to the heavily gendered nature of rights and responsibilities with respect to trees. Mearns (1995) reports that in Kenya women are expected to provide their households with daily supplies of wood, but they lack access to tree farms. Men dominate tree planting, and trees planted in woodlots typically fall under men's control. Rights to trees are tied to land ownership, which falls almost exclusively to men. Thus, although trees may be nearby, women may lack access to them and therefore walk long distances to gather wood or switch to other types of biomass for fuel, such as maize stalks or dung.

Reliance on traditional biomass further entrenches gender disparities. When women spend many hours collecting traditional fuels, they do not receive education and training for productive income-generating activities. When withdrawn from school to gather fuel and attend to other domestic chores, girls lose literacy opportunities and suffer lifelong harm. They also have less time to participate in organizations and learn to negotiate in decision-making processes. Household use of traditional bioenergy locks people in the developing world, women in particular, into a cycle of poverty and ill health (UN-Energy 2007).

The most dramatic gender-differentiated and health benefits from the use of modern bioenergy relate to household applications. Traditional bioenergy uses affect the health of women more severely than men, because women traditionally bear responsibility for household-related duties, including food preparation (UN-Energy 2007). Rural people rely heavily on biomass as their primary cooking fuel: 93 percent in sub-Saharan Africa, 87 percent in India, and 93 percent in Indonesia (Sagar and Kartha 2007). Open fires in the household produce unventilated smoke and expose women and children, who are most often indoors, to high concentrations of carbon monoxide, nitrogen oxides, and other pollutants (Lambrou and Piana 2006). Smoke inhalation from cooking indoors with traditional biomass increases the risk of major diseases and is the sixth largest health risk in developing countries. The rural poor in Southeast Asia and sub-Saharan Africa suffer the highest death toll (Schirnding and others 2000; UN-Energy 2007).

Many early efforts to reduce use of traditional biomass involved the development and introduction of improved cook stoves. These efforts had limited success. Some of the improved stoves were less efficient than claimed and were relatively expensive. Women were reluctant to give up traditional cook stoves because they preferred cooking with them, and the stoves offered additional benefits of heating and repelling insects. More recent cook stoves have achieved more success, especially in China and India, with estimates of 220 million improved cook stoves worldwide (Sagar and Kartha 2007).

Gender and modern biofuels

Shifting basic energy uses from traditional bioenergy (when used in unsustainable and health-damaging forms) to modern fuels and electricity poses difficult challenges (UN-Energy 2007). When household income increases, people typically switch to more fuel-efficient technologies. The push to modern bioenergy offers both possibilities and

challenges for enhancing gender equity. Poor rural women and men often lack the economic resources to use different bioenergy options.⁶ The rural poor, a disproportionate number of whom are women, do not have the means to purchase modern energy services. The cost and efficiency of a stove or other systems such as biogas or small gasifiers often deter women more than the actual cost of fuel (UN-Energy 2007).

Modern bioenergy may take the form of small-scale production or large-scale plantation production. Small-scale biofuel use has the potential to reduce women's health risks from wood fires and reduce their work collecting fuelwood. Biofuels have the potential to reduce women's work burden, but they may also generate additional work if women produce the biomass to make the fuel (such as for biogas) (UN-Energy 2007).

The transition to liquid biofuels may especially harm women and men farmers who do not own their land and the rural and urban poor who are net buyers of food. "At their best," according to UN-Energy (2007: 24), "liquid biofuel programs can enrich farmers by helping to add value to their products. But at their worst, biofuel programs can result in concentration of ownership that could drive the world's poorest farmers off their land and into deeper poverty." The rural poor, women in particular, typically do not have official title to their land. Driving small farmers without clear land titles from their land will destroy their livelihoods (UN-Energy 2007).

Large-scale bioenergy production

Several key gender issues that may result from the production of large-scale biofuels include the following:

- Biofuels require the intensive use of resources including land, water, chemical fertilizers, and pesticides, to which small farmers have limited access. Women, and particularly women in women-headed households, will face greater barriers acquiring these resources and participating in biofuel production (Rossi and Lambrou 2008).
- The large amount of land required for biofuel production will put pressure on marginal land and common property resources. Marginal lands are particularly important for women who raise food crops, collect fodder and fuel, and graze livestock. The conversion of these lands to biofuel crops might result in the displacement of women's agricultural activities toward lands that are even more marginal, thus decreasing household food security (Rossi and Lambrou 2008).

- The potential loss of biodiversity from large-scale monoculture plantations may affect women and men differently. The establishment of plantations on previously uncultivated land may threaten wild edible plant species. Women often rely on the collection and preparation of wild plant species for food, fodder, and medicine.
- Livestock farmers will be particularly affected by biofuel production with the conversion of grazing land to crop land and the higher price of livestock feed. Livestock is especially important for the food security of poor farmers. The potential reduction in the number of animals, especially ruminants (cattle, sheep, and goats), raised by small farmers, will reduce their livelihood strategies. In many regions men are primarily responsible for managing cattle and buffalo, and their ability to raise these animals will be affected (Rossi and Lambrou 2008).

POLICY AND IMPLEMENTATION ISSUES

The Earth Summit in Rio de Janeiro in 1992 and the Fourth World Conference on Women in Beijing in 1995 recognized the need to design environmental and energy programs with a gender focus (Salazar 1999). In 2001 the Ninth Session of the Commission on Sustainable Development urged governments to address the health and safety concerns of women and children in rural areas related to the impacts of carrying loads of fuelwood over long distances and exposure to smoke from indoor open fires. In addition, the commission recommended international cooperation to promote equal access to energy through energy policy decision-making processes (Lambrou and Piana 2006).

In 2006 FAO launched the International Bioenergy Platform as a framework for bioenergy cooperation. This program aims to enhance access to energy services from sustainable bioenergy systems, emphasizing the provision of modern, gender-sensitive bioenergy services for local communities and the most vulnerable and poor.

In many developing countries, small-scale bioenergy projects could face challenges obtaining financing from traditional financing institutions. Although these projects could provide modern energy services to rural women and men currently lacking access, they will likely require credit mechanisms at all stages of production.

GOOD PRACTICES AND LESSONS LEARNED

Some observers have suggested that the rural poor, who have a small environmental footprint, gained positive experiences with the decentralized and small-scale production

and use of fuel crops. The production and use of liquid biofuels from local feedstock improve access to sustainable and affordable energy for poor rural women and men (DESA 2007).

Zambia: Small-scale production of liquid biofuels

For the last seven years a group of Zambian women with the support from German Technical Cooperation (GTZ) have developed a soap-making enterprise using jatropha oil. Between 2000 and 2001 the National Oilseeds Development Program, under the Ministry of Agriculture and Cooperatives of Zambia, carried out demonstrations on the various uses of jatropha oil through national agricultural and commercial shows. This project used a bottom-up approach, promoting women's participation and ownership. In 2006 the Biofuels Association of Zambia mounted an awareness campaign on the potential of *Jatropha curcas* to provide practical substitutes for fossil fuels and its important implications for meeting the demand for rural energy services. In its 2007 budget the Zambian government allocated \$150,000 for research on *J. curcas* and other biofuels. Biofuels predominate in new energy policies, which often set standards for a specified minimum proportion of biofuels in blends for all consumers. In this project rural women and men are improving their livelihoods and generating income through activities related to the production of jatropha oil.

Tanzania and Mali: Small-scale biofuel production

In Tanzania a project has sought to introduce and expand production of jatropha as a cash crop for raw material for plant-oil industries. They demonstrated its potential in reforestation, erosion control, and reclamation of degraded land. Working with local women's groups, the grantee (KAKUTE Ltd.) trained over 1,500 women and men in jatropha management techniques and planted more than 400 hectares of jatropha on marginal lands donated by the communities. The project successfully demonstrated the livelihood benefits of the crop, helping launch jatropha farming as a cash crop, while assisting others to begin soap-making businesses. Seventeen different village-based women's groups coordinated the project. Women produced the seedlings and cuttings for planting. In the first four years of the pilot project, they sold 52,000 kilograms of seeds to oil processors for approximately \$7,800, producing 5,125 liters of oil, worth about \$10,250 on the local market, and 3.5 tons of soap, worth \$20,533. Although the amount of oil and soap produced does not

approximate the capacity of the land to produce jatropha seeds, it goes a long way toward demonstrating the potential profitability of the crop. The project aimed to improve rural women's and men's livelihoods and income-generating activities using bottom-up approaches and promoting women's participation and ownership.

The Mali Folke Center in Mali works with local rural women and men in developing plantations of jatropha.⁷ Working with the GTZ, they use a UNDP-led technology, a multifunctional apparatus called the Mali platform, which can run on crude jatropha oil. The platform generates electricity for the whole community and powers water pumps, crushes the oil seeds, and provides energy for a welding and carpentry shop. The Mali Folke Center converted its Toyota pickup truck to run on jatropha oil. Women, the main beneficiaries of the project, have cited the ability to use jatropha oil for soap making as more of an economic benefit than the energy.

Nepal: Biogas program

The World Bank's biogas project in Nepal aims to develop biogas use as a commercially viable, market-oriented industry by bringing fuel for cooking and lighting to rural households. Subsidies provide a key element in making these biogas plants accessible to poor households. Between 2004 and 2009 the project will install 162,000 quality-controlled, small-size biogas plants in the Terai, hill, and mountain regions of Nepal. Revenue from the Community Development Carbon Fund will reduce the dependency on large government and external donor subsidies and will help expand the biogas installation to more remote and poorer areas. These biogas plants displace traditional fuel sources for cooking—fuelwood, kerosene, and agricultural waste. Each biogas plant can reduce 4.6 tons of carbon dioxide equivalent annually. The project will generate approximately 6.5 million tons of carbon dioxide equivalent during the 10-year crediting period. The Community Development Carbon Fund expects to purchase a minimum of 1 million tons of carbon dioxide equivalent with the potential of additional purchase. The project engages household members to understand their needs, the possibilities of the technology, and where to locate it. The project estimates that women will save three hours daily per household using biogas for cooking versus cooking with collected fuelwood. Women use this time for child care, literacy training, and participation in community organizations. Biogas-fueled stoves also dramatically reduce indoor air pollution.

Costa Rica: Solar-powered cookers

The focus of a project implemented by the Fundación Sol de Vida (Foundation of Sun and Life) in the Santa Cruz and Nicoya counties of the Guanacaste region of Costa Rica is to promote the use of solar power for cooking and to build women's capacity for other activities through constructing and using solar cookers. Over 130 households have switched from wood, electricity, or gas to solar cooking, thereby reducing greenhouse gas emissions. The project has reduced the health risks associated with wood burning and reduced women's workload because they no longer collect fuelwood. The project, led almost completely by women, has supported and built women's ability to take action, particularly regarding the environment and livelihood issues. Its work illustrates how women's solar energy can open up new opportunities for women and improve their standing in the community. Because women build the stoves themselves, the project covers only the costs of materials, in addition to small amounts for transportation and instructors for the workshops. After women learn how to build these cookers, they teach others to do the same. Sol de Vida has exported this model to Guatemala, Honduras, and Nicaragua.

India: Large-scale biofuel production

India's National Mission on Biofuels plans to bring 400,000 hectares of marginal land under cultivation of jatropha for biodiesel production (Rajagopal 2007). The biofuels plan considers these marginal lands to be of little ecological or economic benefit. However, these lands, which are common property resources, provide essential food, fuel, fodder, and building materials for the rural poor, especially the most vulnerable (Rajagopal 2007). In India common property resources contribute between 12 and 25 percent of a poor household's income. The poorest households, often headed by women, rely most heavily on these common property resources. Thus, without specific interventions to benefit and include poor men- and women-headed households in the benefits of jatropha production, the livelihoods of the rural poor are likely to decline (Rossi and Lambrou 2008).

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

Understanding and addressing the linkages among gender, environment, and energy undergird the success of

bioenergy project development and implementation (UNDP 2007).

- Rural women and men possess different needs and priorities vis-à-vis energy services. Multiple strategies for providing energy to the rural poor are needed, including promoting more efficient and sustainable use of traditional biomass and enabling poor women and men to switch to modern fuels and technologies. The appropriate strategy will depend on local circumstances.
- We must reduce harmful emissions where dependency on traditional fuels will likely continue—for example, in the next two to three decades in Africa (UN-Energy 2007).
- Additional measures may be necessary for small-scale women and men farmers to be included in medium- or large-scale biofuel crop production, such as policies supporting decentralized production, local use of the energy produced, and organization of cooperatives or other forms of participation.
- Subsistence farmers, women in particular, remain less likely to shift their production to bioenergy, particularly if they live in marginal areas and have fewer options to counteract risks and higher discount rates. Organizing small-scale women and men producers' groups can enhance local benefits. Cooperatives can play a useful role in linking large firms to independent growers (as in Brazil and Mauritius). However, projects require rural women's participation in these cooperatives to ensure attention to their needs and concerns.

MONITORING AND EVALUATION

Examples of gender-sensitive indicators in bioenergy include the following (FAO 2007; see also the Monitoring and Evaluation section in the Overview):

- Percentage of women-headed and men-headed rural households with access to electricity, water, markets, and adequate storage facilities
- Percentage of men and women owning and using energy-efficient technologies and low-carbon practices
- Percentage of men and women who participate in decisions about biomass use for energy
- Number of hours spent by men and women in obtaining biomass for household consumption and small-scale enterprises
- Number of men and women producing bioenergy crops.

Gender and Natural Disasters

The incidence of natural disasters and related environmental disasters has escalated since the 1990s (UN 2001; UNDP 2004).¹ In the first half of 2006 alone, 174 disaster events occurred in 68 countries, affecting 28 million people and damaging property and assets valued at more than \$6 billion (UNDP 2007). The effects of earthquakes, landslides, drought, floods, storms, and tropical cyclones severely threaten human survival and sustainable livelihoods and pose a challenge to achieving the UN Millennium Development Goals (FAO/WFP 2005). Disasters cause major loss of human lives and livelihoods and destroy economic and social infrastructure (UN 2002). Climate change, environmental mismanagement, and degradation (including unsustainable exploitation of natural resources) as well as unplanned urbanization and uneven distribution of assets cause increased risk and vulnerability to natural disasters (UN 2002). (The focus of this Thematic Note is on natural disasters; for a wider discussion on crises relating to conflicts and wars, see Module 11. For more on climate change, see Thematic Note 2.)

Natural disasters, often exacerbated by environmental degradation and mismanagement, adversely impact the environment. With sound management, the reverse proves true, thus establishing a direct link between disaster mitigation and environmental management (King 2002). Natural resource degradation leads to an increased frequency of small- or medium-impact disasters, such as recurrent floods or minor landslides, as well as slow-onset disasters, such as land degradation and drought. Human activity has altered ecosystems. The ability to recover from natural disturbance has diminished considerably. For instance, deforestation impairs watersheds; raises the risk of fires, landslides, and floods; exacerbates droughts; and contributes to climate change. Destruction of coastal wetlands, dunes, and mangroves diminishes the environmental buffer system for coastal storms. All these contribute to making at-risk areas

such as low-lying islands more vulnerable to extreme weather events (Abromovitz 2001). Although often excluded from databases evaluating disaster impacts, small-scale disasters often account for more aggregate suffering than major ones (UN 2001). Scientists project that these will continue to increase as a result of climate change (Abromovitz 2001).

A growing body of evidence links environmental degradation and competition for natural resources to many of the internal and international conflicts that contribute to many complex emergencies (McNeely 2000). For example, desertification exacerbated the conflict in Darfur because it forced people to migrate from their homes into areas where they competed with others for scarce land and water (Harvey 2007). Severe environmental stress—when accompanied by underlying social or ethnic conflict, poverty, and weak governance—contributes to violent conflict and complex emergencies (UN 2001, 2002).

Although natural disasters strike in the industrialized and developing worlds, developing countries remain the most vulnerable to these risks and sustain greater losses. Countries that face similar patterns of natural hazards—from floods to droughts—often experience widely differing impacts when disasters occur. The impact depends in large part on previous investment in appropriate infrastructure, urban planning, and disaster risk management and reduction policies (UNDP 2004).² Within developing countries, the poor and socially disadvantaged remain the most vulnerable. Often the rural poor occupy the most marginal lands, relying on areas prone to drought, flooding, and other hazards for precarious livelihoods. They also face greater exposure to hazards resulting from poor-quality construction material and lack of access to information (Kumar-Range 2001). Rural poverty frequently determines risk for disasters such as flooding or drought (UNDP 2004).

Gender-based inequalities in access to livelihood assets, division of labor, and participation in decision-making processes result in women's and girls' increased vulnerability to the risks of natural disasters.³ Disaster risk reduction and management interventions must take gender into account to reduce vulnerability effectively. The impacts of natural disasters can be mitigated by using a gender perspective to address their root causes, including social, political, economic, and cultural vulnerabilities (UN 2002).

KEY GENDER ISSUES

Key gender issues include risk and vulnerability to disasters, postdisaster vulnerability, and disaster mitigation, response, and recovery.

Risk and vulnerability to disasters

Natural disasters affect rural women and men differently. Women and girls have limited access to and control over critical assets that provide livelihood security, protection, and recovery, and thus they remain most vulnerable to the impacts of natural disasters. Understanding their different roles and responsibilities—in agriculture, fisheries, and forestry, both within the household and at the community level—can reveal women's and men's different vulnerabilities (Cannon 2002).

Disaster statistics, for which sex-disaggregated data exist, show that women are more likely to die or be injured when disaster unfolds.⁴ Women and children are 14 times more likely than men to die as a result of disasters (Aguilar 2008). Women's disaster exposure results from their overrepresentation in highly vulnerable social groups, including the poor and elderly, that are less able to prepare for, survive, and cope with disaster (UN 2004). Additionally for, women do not receive timely warnings or other information about hazards and risks (Fothergill 1998; UN 2001). Mobility restrictions, dress codes, and culturally ascribed roles and behaviors disadvantage women. A disproportionate number of women died in the 1991 cyclone in Bangladesh because of cultural norms restricting their mobility outside the household. Less likely than men to know how to swim, women had few chances of escaping from the affected areas. More women than men died in the tsunami in Sri Lanka because they did not know how to swim or climb trees (Sachs 2007). Recent evidence also suggests that many women who drowned in the tsunami were looking for their children. Existing gender-based inequalities in the allocation of food within the household put women at risk (see also Module 1). For

instance, in Bangladesh women's lower nutritional status in predisaster situations worsened during crises (Cannon 2002; Masika 2002). Because they lack mobility and resources, elderly women, those with disabilities, pregnant and nursing women, and those with small children remain most at risk in cases of emergency.

Postdisaster vulnerability

In postdisaster situations women remain more vulnerable than men. Women's responsibilities in caring for household members increase after a disaster, as access to resources for recovery decreases. The daily work involved in providing food, water, and fuel for households after a disaster requires intensive labor. In the aftermath of Hurricane Mitch in Honduras and Nicaragua, women's household and care responsibilities increased, making it difficult for them to return to work (Nelson and others 2002).

In many parts of the developing world, discriminatory customary and social practices curtail women's rights to land. This situation deteriorates after natural disasters. Natural disasters such as hurricanes, tsunamis, and earthquakes damage and destroy land vital to women's and men's livelihoods. Disasters disrupt land ownership and use patterns by killing land titleholders, destroying land records, and erasing boundaries. Other efforts delay and impede the equitable redistribution of land, including the location of refugee camps, the relocation of affected communities, and measures to increase future resilience such as no-construction zones (Brown and Crawford 2006). Poor and marginalized women and men often have little alternative but to remain in or return to disaster-prone areas (Masika 2002).

Natural disasters frequently result in the degradation of water sources. Children and pregnant women are particularly susceptible to diseases such as diarrhea and cholera that thrive in such conditions. Because of their roles in managing household water supply and domestic chores, women take greater risks.⁵ Women's health may also suffer as a result of reduced nutritional status when their workload increases. For instance, in Peru following the 1997–98 El Niño events, malnutrition among women caused peripartum illness. Flooding or rise in temperature in highland areas can extend the range of vector-borne diseases, such as malaria. Also, HIV and AIDS and other diseases can exacerbate the disaster risks brought on by climate change, urbanization, marginalization, and conflict (UNDP 2004). Health problems during disasters have psychological components as well as physical ones. Rural women and men victims of disasters may suffer from a variety of psychological problems

related to loss of family members, trauma, unemployment, and identity (Graham 2001).

To cope with small- and medium-scale, and slow-onset disasters, women (and girls to some extent) often take on additional roles and responsibilities. With water shortages and depletion of forests (as a result of wildfires, droughts, desertification, land degradation, and other occurrences), women and girls walk longer distances to collect water and fuelwood, sometimes far from the safety of their households. This decreases the time available for food production and preparation, with consequences for household food security and nutritional well-being. Girls sometimes leave school to help with the increased work burden. Food distribution in refugee camps has resulted in a significant drop in girls' schooling rates.

As a result of slow-onset disasters such as land degradation and drought, men's out-migration has increased in some parts of the developing world. In Brazil, for example, people call women household heads "widows of the drought" (Branco 1995). Women left behind take on men's traditional roles and responsibilities, increasing their work burdens, but without having equal access to financial, technological, and social resources (Lambrou and Laub 2004). In some regions women's out-migration accompanies drought, such as in Australia, where women migrate to urban areas to seek additional income while their husbands remain on the farm (Alston 2006).

According to some estimates, 25 million environmental refugees have lost their homes because of environmental degradation or localized conflicts related to competition for resources (Tickell 2001). Uprooted populations generally encounter problems of protection and safety, with women in particular suffering sexual and physical abuse. Areas outside camps where women gather fuelwood and water can present dangers. Families frequently select girls to collect fuelwood used for the preparation of food inside refugee camps, and girls receive food in return. Women experience more violence while displaced than in normal circumstances, and violence against women increases in postconflict situations (FAO/WFP 2005). When displaced, women in particular frequently find themselves stateless and dependent on external assistance (Graham 2001). Gender and age determine entitlements to relief supplies, and access to food based on household registration procedures favors men in some settings.

Disaster mitigation, response, and recovery

People regularly cope with all kinds of "daily" disasters and have developed local strategies for reducing risk and

responding to natural disasters (UN 2001).⁶ Although women and children remain most vulnerable, many women at local levels mitigate hazards and strengthen the disaster resilience of households and communities. In Central America, the Caribbean, and other regions where the proportion of women-headed households is high and women actively engage in economic activities, women assume leadership roles in situations such as food distribution that require organizational and administrative capacities, impartial judgment, and social commitment (Toscani 1998).

Responses by men and women before, during, and after disasters relate to their status, roles, and position in society (Kumar-Range 2001). Most studies show that women's and men's responses to a disaster follow traditional gender lines (Fothergill 1998). Women take responsibility for child care, household, and supportive tasks, whereas men take leadership positions. Men usually participate in the public sphere in formal emergency and planning operations, and they discourage women from participation in critical planning and preparedness decisions.

Household organization also affects resilience. In responding to and recovering from disasters, social and kin networks determine available strategies (Kumar-Range 2001). Women-headed households remain the most economically and politically disadvantaged in gaining access to these networks (Graham 2001). In addition, rural poor women and men often lack savings or assets to ensure them against external shocks (Masika 2002).

Emergency decision-making processes after disasters often exclude women. Women's limited participation restricts their engagement in political decisions that impact their specific needs and vulnerabilities. Relief workers view women as victims rather than potential agents of change, which leads to the reconstruction of gender inequalities. For example, failure to recognize women's informal sector work may reduce their access to economic recovery assistance and undermine perceptions of women as full contributors to the recovery process. To take an active part in shaping projects that meet their needs, women must participate. Men are also at risk. Failure to recognize men's socioeconomic and emotional needs may delay men's long-term recovery (UN 2001, 2002).

POLICY AND IMPLEMENTATION ISSUES

Natural disasters and environmental management appeared on the international agenda throughout the International Decade for Natural Disaster Reduction (1990–2000). The Yokohama Conference in 1994 strongly emphasized the

links between disaster reduction and sustainable development. It also recognized the need to stimulate community involvement and the empowerment of women at all stages of disaster management programs. Additionally, the Beijing Platform for Action (1995) and the twenty-third special session of the United Nations General Assembly (2000) viewed a gender perspective as integral to natural disaster mitigation (Enarson and Meyreles 2004). In 1999 the United Nations Inter-Agency Standing Committee issued a policy statement that requires all member organizations to mainstream gender when providing humanitarian assistance in emergencies. In 2005 the World Conference on Disaster Reduction emphasized integrating a gender perspective into all disaster risk management policies, plans, and decision-making processes.

A recognition of the social dimensions of disasters has resulted in increased attention to community involvement and ownership. However, gender perspectives in policies and strategies to prevent and respond to natural disasters (CSW 2002) have not yet received adequate attention.

Postdisaster reconstruction presents the opportunity to challenge existing gender relations and empower women to better respond to this challenge. Immediately following a disaster, the political climate lends itself to much-needed legal, economic, and social change in such areas as governance, land reform, skills development, employment, housing, and social solidarity (UN 2002). However, an excessive focus on relief assistance may obscure or compromise efforts to challenge these roles. Emergency relief used inappropriately may discourage independence and undermine local coping strategies. These strategies result in the reconstruction of vulnerability rather than the promotion of more equitable and sustainable conditions during the postdisaster window of opportunity for social change (UN 2001).

Major research gaps exist on the linkages among gender, environmental management, and disaster risk reduction at all levels—from climate change to local, small emergencies. Further work must examine gender-based differences in vulnerability, livelihood impacts, and specific needs during disasters (UN 2001).

GOOD PRACTICES AND LESSONS LEARNED

Interventions and life-saving strategies may succeed when gender differences have been properly understood and addressed (FAO/WFP 2005). The following examples of good practices and lessons learned from relevant projects take gender issues into account.

Safe access to fuelwood and alternative energy in humanitarian settings

An interagency program aims to promote safe access to fuelwood and alternative energy in humanitarian camps.⁷ When women leave camps to collect wood, they often experience gender-based violence. In Chad all humanitarian efforts include efforts to reduce gender-based violence. In Rwanda and Tanzania programs support safety improvements. In Sudan some women have successfully transitioned to the use of mud-based fuel-efficient stoves in the camps. In Indonesia policies promote access to sustainable timber and minimize illegal logging caused by demand for shelter. Large concentrations of displaced populations in camps place excessive pressure on already degraded natural resources. This endangers the food security and livelihood of nearby local communities and fosters resentment and controversial relations with the host population. People compete for charcoal and wood for fuel and timber for shelter construction. Alternative sources of energy have had a positive impact on the livelihoods of women and men. These alternative sources have reduced women's and girls' time and workload for fuelwood collection and have reduced the risk of gender-based violence.

Nepal: Community-based disaster management project

The UNDP currently implements a community-based disaster management project in Nepal aimed at disaster risk reduction. It represents a clear shift from postdisaster rescue and relief to predisaster mitigation and preparedness and mainstreaming disaster risk reduction. The main goals of the community-based disaster management project are to enhance the safety of women and men vulnerable to natural disasters and to protect common property and community resources in select disaster-prone districts. The project uses participatory approaches and capacity-building measures and aims to enhance the capacities of stakeholders at the community, district, and national levels in different aspects of disaster management. Additionally, the project focuses on supporting specific disaster mitigation measures to reduce the vulnerability of women-headed, displaced, and poor households. Activities include 50 percent women's participation in training and education on HIV and AIDS, violence against women, and trafficking related to vulnerability during natural disasters.

Pakistan: Building capacity to cope with disasters

Pattan, a local NGO in Pakistan, increases community capacity to cope with disasters through supporting social

organizations and developing local institutions. Previously Pattan worked in flood-prone areas that have unrepresentative community organizations dominated by local power elites, usually men. The NGO worked with the community to organize representative, democratic forums called Pattan Dehi Tanzeems (PDTs) that made collective decisions. Barred by local tradition from joining the PDTs, women formed separate PDTs and overcame resistance to their participation. Pattan used the disruptive nature of floods to develop institutions enabling women to make key decisions. The 1992 floods completely destroyed many villages, and so the NGO initiated a project to rehabilitate houses in which women participated in the PDTs. In Pakistan women maintain traditional (*kacha*) housing. The project involved women in the design and construction of improved (*pakka*) housing. Households received loans, and women took responsibility for collecting money to repay loan installments. Initially, men objected to giving women this responsibility, but the NGO developed an easy-to-use monitoring system. The NGO introduced the concept of joint ownership of the new *pakka* housing. It took time for the concept to take hold, but men eventually saw the value in joint ownership. The experience of the housing project has given women confidence to take collective action in many other projects (Bari 1998).

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

Understanding the gender dimension in disaster-related development processes requires addressing root causes and ensuring equitable and efficient risk reduction measures (UN 2002). A gendered approach considers (1) the specific roles and responsibilities of men and women in food security and agriculture, (2) their main constraints and needs, and (3) their ability to carry out activities under emergency situations and early rehabilitation (FAO/WFP 2005). The following are important principles of disaster management (see box 10.10 for additional guidelines):

- Understand gender-based differences in vulnerability and in livelihood impacts in natural disasters, including small- and medium-scale and slow-onset disasters.
- Consider gender divisions of labor, time-use patterns, additional workload, and gender-based asymmetries in accessing and controlling livelihood assets (FAO/WFP 2005).
- Recognize that community-based preparedness and response must consider women's and men's different physical and socioeconomic vulnerabilities to reduce their exposure to the adverse effects of climate change

Box 10.10 General Guidelines for Disaster Management

- Create and implement, with the involvement of community groups and women's groups, comprehensive rural and urban development strategies and land-use plans that provide opportunities to mitigate damages caused by hazards.
- Include gender-based hazard mapping and social and environmental risk assessment at the appraisal stage of all development projects, involving women and men equally at all levels of the assessment.
- Systematically include hazard proneness and gender-based vulnerabilities in environmental impact assessments and formulate disaster reduction measures where appropriate, with particular regard to the protection of lifeline infrastructure and critical facilities.
- Promote agricultural technologies and give specific regard to addressing, from a gender perspective, environmental degradation hazards that threaten food security.
- Recognize the expertise and local knowledge of women and men disaster survivors and empower them in the management of social and environmental hazards and prevention of disasters.
- Target disadvantaged groups and households, and raise their awareness of women's human rights and the critical role women play in coping with natural disasters.
- Increase women's access to risk management information through gender-sensitive early warning systems and target specific social groups for warning information to address gender-specific needs and circumstances.
- Collaborate in the creation of networks that promote community access to gender-sensitive information and communication technologies that support information exchange on environmental management and disaster risk reduction.
- Establish appropriate channels and mechanisms for information flow and dialogue that women and men in disaster-affected areas may access.

Source: UN 2001.

(Lambrou and Piana 2006). The participation and involvement of local women and men are essential.

- Create early warning systems and monitoring based on detailed information to minimize exposure to vulnerabilities and ensure preparedness. One strategy to increase preparedness is the creation of risk maps, including gender-based hazard maps (UN 2002).
- Factor the effects of food aid, subsidies, and rehabilitation programs on women as the principal providers of food for the household. In documentation and registration procedures, women should have the right to register in their own names. Devote attention to ensuring that women household heads receive benefits (FAO/WFP 2005).

MONITORING AND EVALUATION

Monitoring and evaluation processes enable staff to analyze the performance of emergency operations. Indicators include the following (FAO/WFP 2005):

- Percentage of aid targeted to the different needs of affected men and women
- Percentage of women elected and appointed to village committees
- Roles of women members in distribution committees (for example, weighing, rebagging, and monitoring that people actually got their entitlements) and whether this made the distribution fairer
- Percentage and number of women and men who benefited from the relief project
- Percentage of women and men who migrate and the impact of migration on the recovery pace within the village
- Impact on women's income and livelihood options (for example, income-generating activities and new employment opportunities)
- Ratio of the number of women to men who received emergency project relief and distributed food rations to their families.

Gender Dimensions of Land and Water Degradation and Desertification

Land degradation affects more than 900 million people worldwide and as much as two-thirds of the world's agricultural land (UNDP 2007a). Unsustainable land use and climate change drive land degradation, including soil erosion, nutrient depletion, water scarcity, and desertification.¹ Land degradation leads to the loss of plant and livestock genetic and species diversity, important sources of food, medicine, and commercial products (UNDP 2007a). Increased irrigation and expansion of agricultural land into former dry-season grazing areas exacerbate land degradation (FAO 2002). In Africa, 36 countries face dryland degradation or desertification (GEF 2003).

If present trends continue, 1.8 billion people will live in countries or regions with absolute water scarcity by 2025, and two-thirds of the people in the world could be subject to water stress.² The decline in quantity and quality of water leads to overexploitation of surface and groundwater resources and magnifies problems related to desertification. Water crises raise political tensions in many parts of the world, particularly where people share rivers and lakes across borders. Africans have the least access to clean water; the largest numbers of people with no access to basic sanitation live in Asia (UNDP 2005). Competition for increasingly precious water resources has intensified dramatically over the past decades. Water shortages, water quality degradation, and aquatic ecosystem destruction seriously affect economic and social development, political stability, and ecosystem integrity (UNDP 2005).

Desertification has emerged as one of the most pressing global environmental challenges facing the world today.³ Drylands occupy 41 percent of the Earth's land area and are home to more than 2 billion people, 90 percent of whom live in developing countries.⁴ Dry and subhumid lands present unique landscapes containing a wide variety of biodiversity well adapted to the often harsh conditions that characterize these areas (CBD 2007). Some 10 to 20 percent

of drylands have already degraded, with a much larger number under threat from further desertification (MEA 2005). Desertification, which leads to loss of production capacity, reduces the land's resilience to natural climate variability and may temporarily affect climate change (UNCCD 2005). It results in persistent reductions in the capacity of ecosystems to provide services such as water, fuel, nutrients, soil fertility, and other necessities. Observers have seen a major decline in the well-being of women and men living in drylands (MEA 2005). Desertification contributes significantly to food insecurity and famine, the internal displacement of people, and international migration, and it creates environmental refugees who add stress to areas that may not yet have degraded.⁵

Pastoralists and farmers in drylands try to maximize herd size and crop production during good periods and to minimize losses and obtain some yield during periods of drought. Pastoralists may follow seasonal variations in vegetation by moving their livestock, sometimes over long distances. Resilience against fluctuations may mean bridging drought periods by drawing on local reserves, such as using different types of seeds or other adaptable genetic resources. Knowledge of local biodiversity minimizes risks in the face of land and water degradation. Rural women and men's reliance on a variety of genetic resources, including plant varieties and livestock breeds, allows them to adapt their agricultural systems to changing environmental, economic, and social conditions. For instance, livestock helps provide a safety net when other sources of income are no longer available.

Desertification causes rural poverty, just as rural poverty contributes to desertification. Poverty induces women and men to increase pressure on deteriorating drylands and to exploit the natural resource base in unsustainable ways. This accelerates land degradation, leading to a reduction in productivity and incomes while decreasing the livelihood

options for poor rural women and men. The result is food scarcity, malnutrition, and economic and social instability, which increase poverty and further exacerbate pressure on the natural resource base.

Policies, programs, and projects implemented at the local, international, and national levels often fail to account for land and water degradation and desertification when addressing poverty and sustainable development.⁶ Land degradation and desertification cannot be addressed in isolation from other efforts to protect biodiversity, water resources, food security, and energy security and to combat climate change.

KEY GENDER ISSUES

Combating desertification and reversing land and water degradation will help secure the livelihoods and overall well-being of women and men farmers and pastoralists. Land and water degradation impacts poor rural women and men most severely, because they directly depend on these resources for securing food and livelihoods (Lambrou and Laub 2004). When drylands become degraded, rural women and men become vulnerable to food insecurity, malnutrition, disease, and loss of livelihoods (FAO 2003). Gender-based inequalities make rural women and girls more vulnerable than men. Caste, ethnicity, and other socioeconomic considerations interact with gender to make certain groups of women and men particularly vulnerable.

Rural women and men have different roles, responsibilities, and knowledge in managing natural resources. Consequently, the impact of land and water degradation on rural household members will vary according to gender. This division of labor results in women's and men's different priorities for water use and management. Men typically use water for agricultural production, principally for irrigating cash crops. Women play an important role in water management as collectors, users, and managers of water (FAO 2007a), and they use water for both agricultural and household purposes. As previously discussed, the task of providing domestic water almost always falls to women and girls. Women also water some subsistence crops and vegetable gardens and spend considerable time collecting water for household use (for example, food preparation, drinking, and sanitation). Water collection makes up a large part of rural women's work in Asia and Africa. In Senegal women spend 17.5 hours each week collecting water, whereas in Mozambique they spend 15.3 hours in the dry season. In Nepal girls play an important role collecting water, averaging five hours per week (Crow and Sultana 2002). In rural

Africa and India, 30 percent of women's daily energy intake is spent in carrying water (Ray 2007).

Depletion of land and water resources may place additional burdens on women's labor and health as they struggle to seek their livelihoods in a changing environment. Land degradation, water degradation and scarcity, desertification, and deforestation often cause women and girls to walk longer distances to collect fuelwood and water, with consequences for their health and sometimes exposing them to violence. In some cases, such as in Bangladesh, extraction of groundwater for irrigation has made drinking water pumps dry up (Crow and Sultana 2002).

Through their different tasks and responsibilities, rural women and men have accumulated knowledge and skills concerning the management and use of biodiversity in dryland ecosystems. This includes knowledge of local crop varieties, animal breeds, tree species, agricultural systems, and the medicinal and nutritional values of plants. Adept at managing their own scarce resources, rural women and men living in drylands have developed coping strategies to deal with periods of scarcity. Local knowledge provides a wide range of accumulated experience on how to manage natural resources in farming and grazing (UNCCD 2005). Rural women's and men's local knowledge proves crucial to the conservation, use, and management of drylands, including its biodiversity.

In southern and eastern Africa, some HIV- and AIDS-affected households have turned to livestock production as an alternative to crop production. People adopted this strategy when soils became infertile and crop management practices too demanding for the available labor. Other households sell cattle to pay for medical bills and funeral expenses. In pastoral societies, in which milk provides a major component of nutrition, selling cattle can contribute to malnutrition. Some households raise small livestock, such as poultry, which is a less labor-intensive practice and is often the responsibility of women (White and Robinson 2000).

Insecure land tenure reduces rural women's and men's incentives to make long-term investments in soil rehabilitation and conservation, which are crucial to drylands management. A reduction of agricultural productivity and more competition for relatively productive land leave women with the more marginal, fragile lands. The impact of environmental degradation on common property resources in drylands threatens household food security and livelihoods. Poor rural women who lack secure land tenure depend on these common resources for fuelwood, fodder, and food—and, therefore, the well-being of their households.

The projected increase in freshwater scarcity will cause greater stresses in drylands. Water shortages not only undermine agricultural production but also threaten the health of affected households. Local norms and customary practices can limit women's rights to water resources (Gender and Water Alliance 2003). Access to water depends on land rights, control over resources, and social networks, all of which more severely restrict women than men (IFAD 2006).

Excluding women's roles and perspectives in water and land management interventions will have adverse effects. For instance, an inappropriate design or location of tap stands or wells may increase the time women spend collecting water (FAO 2007a). Many projects emphasize participation of men and women in water management associations. A study in India found that (1) even when women are on water management boards, they choose not to attend meetings and send men relatives instead, and (2) women in different castes often have different needs for water, with elite women's preferences determining the placing of hand pumps and thus decreasing poor women's access to water (Singh 2006).

In southern and East Africa, HIV and AIDS have led to increased tenure insecurity for women and children. As women become widows and children lose their parents to AIDS, the incidence of "property grabbing" increases. The perpetrators are not always women; in some regions of Namibia and Zambia, sisters-in-laws are the main perpetrators (Izumi 2007). Most often, a husband's relatives take land and other productive assets from the deceased's widow or children.

POLICY AND IMPLEMENTATION ISSUES

The international community has long recognized that desertification presents a major economic, social, and environmental concern to many countries in all regions of the world. In 1977 the United Nations Conference on Desertification adopted its "Plan of Action to Combat Desertification." The United Nations Environment Programme concluded in 1991 that the problem of land degradation in arid, semiarid, and dry subhumid areas had intensified (UNCCD 2005). To tackle the problem of desertification with renewed efforts, the international community adopted the United Nations Convention to Combat Desertification (UNCCD) in 1994. The convention stresses the importance of a bottom-up participatory approach in identifying, implementing, monitoring, and evaluating projects that combat desertification and mitigate the effects of drought. The UNCCD recognizes the role of women in rural livelihoods,

explicitly encouraging the equal participation of women and men (Lambrou and Laub 2004).

The Convention on Biological Diversity (CBD) also acknowledges the importance and uniqueness of the biodiversity of dry and subhumid lands.⁷ In 2000 the CBD Conference of the Parties emphasized the importance of increasing the knowledge base and supporting best management practices on dry and subhumid lands; the CBD also recognized the need for the full participation of women at all levels of policy making and implementation.⁸ The World Summit on Sustainable Development reaffirmed land degradation as one of the major global environment and sustainable development challenges of the twenty-first century, calling for action to address causes of desertification and land degradation and to restore land and address poverty resulting from land degradation (GEF 2003).

Linkages among biodiversity, poverty alleviation, and gender issues remain intertwined with land and water degradation and desertification. Because they consider it "nonscientific" or inferior, practitioners overlook or ignore rural women's and men's local knowledge on the conservation and sustainable use of natural resources.

GOOD PRACTICES AND LESSONS LEARNED

Involving women in participatory land and water management promotes more sustainable land and water use, reversal of desertification, and improved socioeconomic conditions (Aswani and Weiant 2004; Nyssen and others 2004). Projects that adopt a bottom-up participatory approach create an "enabling environment," designed to support local women and men in achieving livelihood security.

Asia: Farmer-Centered Agricultural Resource Management

Supported by the UNDP and implemented by FAO, the Farmer-Centered Agricultural Resource Management (FARM) program was implemented in China, India, Indonesia, Nepal, the Philippines, Sri Lanka, Thailand, and Vietnam.⁹ Between 1993 and 1998, the program aimed to promote sustainable use and management of natural resources in agriculture and household food security in ecologically fragile, rain-fed areas. Recognizing that women farmers contribute significantly to agriculture, the program promoted women's participation in decision-making processes and other activities at all levels. FARM adopted a participatory assessment planning (PAP) approach that incorporated a gender analysis tool—a practical tool for

examining activities, problems, knowledge, and access to natural resources of both women and men. The output of the PAP approach resulted in greater accountability and equitable sharing of benefits and ownership of assets. FARM also carried out training of trainers under FAO's Socio-economic and Gender Analysis Program (SEAGA). The emphasis on gender has created awareness and improved understanding of social-equity issues among community members. Women have begun to play important roles in decision making and leadership management.

China: Wulin mountains minority-areas development project

This joint IFAD–World Food Programme project aimed to increase food and cash crop production through a range of land-improvement activities. These included the conversion of dryland to paddies, improvement of livestock and fish production, and literacy and numeracy training for women. Improved drinking water supply systems and the introduction of labor- and time-saving technologies reduced women's workloads. Small livestock husbandry provided additional income for food, school fees, and clothing, and drinking water systems and training improved hygiene and health. Women gained self-esteem and social position with their entrepreneurial success.

Egypt: Matruh Resources Management Project

The Matruh Resources Management Project, funded by the World Bank, seeks to break the cycle of natural resource degradation and poverty in the fragile ecosystem of Matruh, Egypt, in which Bedouin women play a critical role in rural production and environmental management. The project works closely with community groups to define the needs of women and men and ensure participation in preparing and implementing local resource management plans. To fulfill these objectives and enable the community groups to address gender issues effectively, project staff received early gender training. In addition, women extension agents based in each subproject area work directly with women.

The Gambia: Partial participation by women in irrigation program

Efforts undertaken through development initiatives have rarely succeeded in providing women farmers with secure access to irrigated assets.¹⁰ Sometimes women obtain access indirectly or acquire irregular or seasonal access, but even

when they do obtain use of irrigated land, they may end up losing this access. When IFAD-funded drylands projects attempted to ensure better access for women to irrigated land (for example, by designating the land only for women's crops), men sometimes took over the crops, as in a rice irrigation project in The Gambia. However, "partial participation" by women in irrigation projects may still benefit women. Women's consumption of water improved, even though their control of assets and status did not increase. Women may also use water for their livestock or their domestic needs, even though they cannot use it for their crops. Indirect or limited access to irrigation water may somewhat improve their livelihoods in the short term.

Mauritius and Rodrigues: Capacity-building for sustainable land management

The UNDP implemented this three-year, \$1.38-million project (including a Global Environmental Facility grant of \$600,000) to design sustainable land management capacities in appropriate government and civil society institutions and user groups.¹¹ The project's long-term goal was to ensure that agricultural, pasture, forest, and other land management efforts in Mauritius and Rodrigues consist of sustainable, productive systems that maintain ecosystem productivity and ecological functions while contributing directly to economic and social well-being. Women participated actively in stakeholder consultations during the project's formulation. Women represented 31 percent of overall participation at the inception workshop, where they voiced their needs and contributed their perspectives. Since that time, the project has ensured a good balance of women and men in training courses and other activities. A gender specialist conducts capacity-building exercises to ensure that the project takes gender issues into consideration in all UNDP-supported projects, including sustainable land management.

Niger: The Keita Project

The Keita Project, financed by the Italian Government and implemented by FAO with support from the World Food Programme, aimed at combating desertification in the Keita region of Niger. The project adopted a gender-sensitive participatory approach that led to better understanding of local land-use systems and husbandry. Its aim was to facilitate women's access to income-generating activities (garden and fruit production, sheep production) and promote their participation in local and national-level organizations and

activities. Time-saving technologies introduced by the project alleviated women's work burden.

GUIDELINES AND RECOMMENDATIONS FOR PRACTITIONERS

An assessment of gender-specific relationships to natural resources and of gender-differentiated impacts of land and water degradation and desertification will facilitate the development of effective projects related to land and water degradation and desertification. The following guidelines are of particular importance:

- Understanding the gender-based inequalities in accessing livelihood assets, in the division of labor, and in participation in resource planning and management provides a sound basis for the sustainable management of land and water.
- To understand the gender-differentiated vulnerabilities and coping strategies in relation to land and water degradation and desertification, we must identify changes in land use, land scarcity, and the economy that affect the ability of women and men to meet their livelihood needs.
- The success of sustainable land and water management requires women's and men's full and equal participation, through incorporating local women's and men's perspectives, needs, and priorities. In some cases, women can benefit from partial participation. Efforts to encourage women's participation in decision-making processes and organizations should take into account women's time and mobility restrictions. Serious efforts should ensure that women's participation goes beyond tokenism. In addition, these efforts must acknowledge that women from different castes and classes may have different interests and power in making natural resource management decisions such as where to locate pumps.

- Strengthening the capacity of women and men users and managers of drylands resources remains one of the most important factors in reversing land and water degradation. Participatory processes and innovations in community-based planning and decision making work best to build capacity. Women must gain leadership positions, participate in organizations, and gain access to technology. Strengthening women's group-based lending has sometimes enabled women to overcome requirements for collateral. Credit activities served as entry points for organizing women for broader activities (IFAD 2006).

MONITORING AND EVALUATION

Examples of gender-sensitive indicators include the following (FAO 2007b):¹²

Land:

- Average number of hectares of land owned by women-headed and men-headed households
- Percentage of women and men with de facto and de jure land rights
- Number of women and men with decision-making authority in cooperatives and marketing associations
- Ratio of number of men and women with access to credit based on land rights.

Water:

- Ratio of women and men who are members of water users associations
- Ratio of number of irrigated farms managed by women and men
- Change in the number of hours of labor required by men and women with the introduction of irrigation projects.

Gender, Biodiversity, and Local Indigenous Knowledge Systems (LinKS) for Food Security

PROJECT OBJECTIVES AND DESCRIPTION

The goal of the LinKS project was to improve rural women's and men's food security and promote the sustainable management of agrobiodiversity.¹ To achieve this goal, the organizers raised awareness of how rural men and women use and manage agrobiodiversity and promoted the importance of local knowledge for food security and sustainable agrobiodiversity at local, institutional, and policy levels. They worked with a range of stakeholders—development agents, researchers, and extension services—to strengthen their ability to recognize and value women and men farmers' knowledge and use gender-sensitive and participatory approaches in their policies, programs, and interventions.

Launched in 1997, the project, funded by the government of Norway and administered by FAO, operated in Mozambique, Tanzania, and Zimbabwe. Activities in Swaziland began in 2000 and continued until the end of September 2005.

The main strategy of the project was to support, build on, and strengthen the efforts of other groups already working on food security, indigenous knowledge, and agrobiodiversity issues in the four countries. These other groups included NGOs, research, training, and academic

institutions; government agencies; and policy institutions. The project teams and management used participatory approaches in project design, formulation, and implementation activities.

The project operated through three central areas of activities:

- *Capacity building and training* to raise awareness and develop tools and methods to enhance capacity, change development practitioners' attitudes about rural women and men's local knowledge, and stress the importance of this knowledge for sustainable management of biodiversity and food security
- *Research on gender-based differences* in farmers' knowledge and management of biodiversity, highlighting the role of agrobiodiversity management for food security, and the different roles and responsibilities of rural women and men in the use and management of agrobiodiversity
- *Communication and advocacy* to enhance the exchange of information about the value of local knowledge in agriculture between communities, as well as with institutions that work with farmers and policy makers.

INNOVATIVE FEATURES

The LinKS project was conceived in response to the emerging international debates on the sustainable management of natural resources and participatory approaches during the early 1990s culminating in the 1996 International Technical Conference on Plant Genetic Resources for Food and Agriculture. In the period leading up to 1996, the understanding of gender and local knowledge systems and the rich source of information embodied in the knowledge, skills, and practices of women and men as managers and users of biodiversity were not very clear. Agricultural and rural development programs and policies, in particular those related to natural resources management, often failed to take into account

What's innovative? The LinKS project played an important role in shedding light on how food security will have to build much more on local knowledge and agrobiodiversity with a clear understanding of gender implications, keeping in mind the continuously changing global socioeconomic and political conditions. The participatory management style, together with a holistic approach, represented a new and innovative approach for FAO in project implementation.

rural women's and men's local knowledge systems in farming activities (Rocheleau 1996; Shiva 1996). Furthermore, research, science, and national policies tend to undermine the value of local knowledge, capacities, skills, and innovations of local farming communities to sustain and manage agrobiodiversity and secure food. The misconception that local knowledge proves inferior to scientific and technical approaches leads to a marginalization and loss of local practices and knowledge.

The LinKS project evolved with the aim to bridge this gap between local and scientific knowledge (box 10.11).

BENEFITS AND IMPACTS

The project enhanced the capacity of participants in understanding the linkages between local knowledge, gender, and agrobiodiversity and incorporating these issues in their work through the use of gender-sensitive participatory approaches. Workshops organized to document traditional practices emphasized, first, the potential benefits and risks of sharing such knowledge, and, second, the responsibilities of researchers and development agents to record and document local knowledge. Several specific training workshops were organized to strengthen knowledge and skills in implementing gender-sensitive participatory agricultural and livestock research and training. Other capacity-building activities included the following:

- About 1,125 people participated in the training workshops on gender, local knowledge, and biodiversity and the application of gender analysis and participatory methods.

- A training manual, *Building on Local Knowledge, Gender and Biodiversity*, highlighted the specific concepts and links between these issues from the perspective of sustainable livelihoods.
- A local pool of experienced trainers was built up to facilitate with the training workshops on LinKS issues and gender-sensitive participatory approaches.
- Integration of local knowledge, gender, and agrobiodiversity issues in the educational curriculum of local training colleges, universities, and other institutions of higher learning (such as the Sokoine University of Agriculture).
- Visits provided farmers, researchers, NGO representatives, and development workers an opportunity to exchange ideas and experiences, and to take part in mutual learning experiences. In Tanzania, as part of a research project focusing on the management of animal genetic resources by the Maasai, pastoralists from various study areas exchanged visits to share experiences and views.

The project also supported 28 research activities that documented and increased understanding of the linkages between local knowledge, gender, and agrobiodiversity; reinforced collaboration between researchers and rural communities; demonstrated the complementarities between the local and scientific systems of knowledge; and enhanced the potential of developing approaches to increase food security and agrobiodiversity. The stakeholders identified three broad topics as particularly important: (1) traditional seed systems (box 10.12), (2) animal production and genetic diversity (box 10.13), and (3) the relation between HIV and AIDS and local knowledge systems (box 10.14).

Box 10.11 Linkages between Local Knowledge, Biodiversity, Food Security, and Gender Issues

Biodiversity serves as one of the most important natural assets for poor rural women and men. They rely on a diverse range of natural resources—crops, trees, livestock, fish—for subsistence production and sale. Yet, because of environmental stresses, introduction of new improved varieties and marginalization of local knowledge, biodiversity is lost at a rapid rate, posing a grave threat to long-term food security.

The different tasks and responsibilities of rural women and men result in accumulation of different types of local knowledge and skills. This local knowledge

Source: FAO 2005.

shapes and influences plant and animal diversity at both the gene and species levels. It also provides an important coping strategy for poor rural women and men vulnerable to the risk of environmental degradation and natural disasters. For instance, poor rural women and men farmers often spread risk by growing a wide variety of locally adapted crops, some of which will be resistant to drought or pests.

Thus, local knowledge, gender, and agrobiodiversity are closely interrelated.

Box 10.12 Tanzania: Traditional Seed Systems

Research activity on gender and biodiversity was set up in the southern highlands of Tanzania, a region heavily exposed to improved seed varieties. The goal was to improve the availability and accessibility of high-quality seeds of crop varieties preferred by farmers to enhance household food security. The main findings at the end of the project were the following: (1) some crop species had disappeared because of changes in weather, migration, government policies and interventions, or farmers' preferences; (2) many varieties had been introduced; (3) in general, agrobiodiversity increased over the years; (4) levels of food consumption and their composition varied within the different socioeconomic groups; (5) food-secure households relied more on staple food and less on natural and collected crops; and (6) the informal system provided a better source of seeds and information for many farmers than the formal seed system.

Source: Author.

Box 10.13 Tanzania: Animal Production and Genetic Diversity

In the Mbarali district, a study was conducted to gauge local knowledge on breeding and selection of livestock in the Maasai community. The study examined the types of animals (cattle, sheep, goats) preferred and the criteria used to achieve the desired traits. These preferences were analyzed in relation to gender and age, roles and responsibilities, decision making, and goals of food security and herd survival. The objective was to let the Maasai pastoralists identify the gaps and make corrections. The threats or constraints to the pastoralists' local knowledge for the sustainable management of indigenous livestock were identified, and possible solutions offered. The decreasing grazing land and water for livestock in the Mbarali district and livestock diseases were major constraints. (See also Module 14.)

Box 10.14 The Relation between HIV and AIDS and Local Knowledge Systems

A study on the impact of HIV and AIDS on local seed systems in both Mozambique and Tanzania showed the gender specificity of local knowledge. Men and women are responsible for different crops; for example, a widower would not necessarily know or be able to produce, after his wife's demise, the local crops she had planted. Her specific knowledge about local seed varieties would be lost. HIV and AIDS constitute a severe threat to agrobiodiversity. At the request of four communities in Tanzania, several local seed fairs enabled farmers to share and exchange their local knowledge and local seed varieties.

Source: FAO 2005.

The project's communication strategy increased the visibility of women's and men's knowledge among communities, development workers, and policy makers. Communication activities conducted through participatory processes included the following:

- A total of 787 researchers, policy makers, and development workers participated in workshops and seminars organized to raise awareness and facilitate discussion of the issues.
- Small workshops explored farmers' rights and intellectual property rights. Through these workshops, the project fostered discussion of local knowledge and its link to biodiversity conservation and food security in each of the project countries.
- Twenty short case-studies, 33 research reports, and two videos were disseminated to project partners through training workshops, seminars, and the LinKS project mailing list.
- Agricultural fairs, contributions to national television and radio programs, national newspapers, and specialist magazines were given support.
- A Web site (www.fao.org/sd/links/gebio.htm) provides useful resources and links to information sources.

LESSONS LEARNED AND ISSUES FOR WIDER APPLICABILITY

The project's thematic focus and the scope of its activities, as well as the number of countries involved, made it a com-

plex project to implement. Addressing and linking the main themes of gender, local knowledge, and agrobiodiversity brought conceptual and analytical challenges as well. *Gender-sensitive participatory approaches* proved to be the most valid approach to achieve the project objectives.

The project adopted a *holistic, interdisciplinary approach* for understanding the linkages between gender, local knowledge systems, and agrobiodiversity management for food security. Research activities were designed in a process-oriented way to include the active involvement of all disciplines in planning, implementation, analysis, and interpretation. Because ministries, universities, and most NGOs traditionally work within a sectoral approach, such a multidisciplinary approach proved extremely challenging,

Project partners experienced difficulties grasping the conceptual themes and applying them to their work. Despite intensive training, the application of concepts to field work and data analysis remained unclear to researchers. Consequently, researchers participated in pre-field training to ensure that they were able to document local knowledge in such a way that local communities benefited. Training workshops focused on the application of gender-sensitive participatory tools. It became clear that workshops were not sufficient to increase understanding of the concepts and their linkages; thus, a training manual was developed to address this gap.

The participatory management style of the project presented limitations due to existing institutional frameworks and bureaucracy. To mitigate these limitations, LinKS set up a special project structure that entailed national coordination teams with managerial responsibility for project activities in each project country. National team offices within the

hosting institutions facilitated a closer collaboration with partner institutions.

A major lesson learned was that training prior to undertaking research, although important, was not sufficient. Participants often stressed the need for postworkshop follow-up, monitoring, and mentoring. LinKS tried to address this through intensive technical support throughout the research process, from research design, data collection, and analysis to interpretation and presentation. Furthermore, many researchers found analyzing socioeconomic data challenging and consequently failed to report research results in a coherent and eloquent manner, thus, pointing to the need for capacity building and developing appropriate training materials.

Research activities were closely linked to capacity building and advocacy. Government officers, researchers, and NGO staff who participated in the training and awareness workshops often developed research proposals for increasing recognition of the knowledge of men and women, documenting experiences, community-to-community exchanges, or follow-up action. All research activities explored the hypothesis that women are important custodians of knowledge in the management of biodiversity. Communication at the rural community level, conducted through participatory research processes, encouraged dialogue, feedback to communities, and follow-up action that further enhanced learning and empowerment. Research reports were shared with the local communities and stakeholders for feedback. Such feedback sessions were also important to identify follow-up action with the local communities and stakeholders to ensure that they benefited from the studies.

India: Karnataka Watershed Development Project

PROJECT OBJECTIVES AND DESCRIPTION

The aim of the Karnataka Watershed Development Project (KWDP) is to improve the productive potential of selected watersheds; the steps involved include the following actions:

- Enhance production and livelihood systems.
- Strengthen community and institutional arrangements for natural resource management.
- Promote participatory involvement of primary stakeholders/beneficiaries.
- Offer assistance to women, the landless, and other vulnerable groups by supporting investments in income generation activities.

The project also aims to strengthen the capacity of communities to participate in planning, implementation, social and environmental management, and maintenance of assets. They will operate in a more socially inclusive manner within the framework of a watershed development plan implemented through community groups.

The KWDP, initiated in 2001 and scheduled to end in 2009, is being implemented in seven districts of Karnataka by the Watershed Development Department of the government of Karnataka and funded by the World Bank. The

What's innovative? Program design promotes greater local participation and encompasses traditional soil and water conservation as well as rural livelihood development. The gender dimension of KWDP aims at creating opportunities for vulnerable groups, including women's economic activity, access to basic resources, and participation in decision-making processes.

target districts are drought prone and dominated by rain-fed agriculture. High soil erosion leads to declining productivity. Groundwater from existing tubewells is only for three to four months after monsoon rains. Deterioration of common lands results from poor management.

The project addresses (1) social mobilization and institution building to help plan and implement participatory watershed treatments, (2) farming system intensification and participatory research, (3) income generation activities to benefit socially vulnerable and landless groups, and (4) capacity building, monitoring, and evaluation. The project is being implemented in a phased manner: phase 1 consists of 10 subwatersheds, phase 2 covers 20 subwatersheds, and phase 3 covers the final 47 subwatersheds. The project is now working mainly on the phase 3 subwatershed.

The project uses a complex institutional structure to develop critical partnerships between government technical specialists, NGOs, communities, local authorities, and research organizations, for instance, through the formation of community-based organizations such as self-help groups (largely women and landless), area groups (mainly landowning farmers), and a community-level executive committee. Self-help groups, the basic units of planning for income generation activities, are consolidated at the micro-watershed level.

BENEFITS AND IMPACTS

On over 270,000 hectares, soil and water conservation improved average crop yields to between 525 and 1,136 kilograms per hectare. Crop diversity, especially cash crops, increased to four to nine crops. Groundwater availability following monsoon rains improved to four to six months.

The project established 4,300 farmer groups and 6,600 new self-help groups to sustain participatory watershed management across 7,000 communities in 742 microwatersheds.

The KWDP significantly impacts the lives of women. Visible impacts include increased self-esteem, confidence, and decision-making ability; improved livelihoods; and economic empowerment.

Annual household income increased to approximately \$373. Self-help groups flourished with project support. Taking into account member savings, project revolving funds, and leveraged commercial loans, the total potential capital base in these community groups is almost \$13 million, which is being used to help establish small businesses, particularly among women and the landless. The majority of members are women. More than 60 percent of the self-help groups are linked to commercial financial institutions. Moneylenders are no longer a major force in these communities.

The success of self-help groups in creating savings resulted in women's economic empowerment. Women in self-help groups better articulate their needs and plan their livelihood strategies. The majority of women feel that the project has offered several new opportunities, such as a teleconference, a satellite-based training program, and demonstrations.

Approximately 70 percent of the women and landless participating in the income-generating activity component preferred to enhance their incomes through livestock and poultry production. The project partners agreed to introduce village-based private veterinary service providers, "Gopal Mitras," to promote effective and low-cost service to people. Field visits and monitoring and evaluation data confirm the important role that the Gopal Mitras now play in many communities. All Gopal Mitras use mobile phones to make it easier for people in more distant villages to call via a community call box. Earnings by the Gopal Mitras range from \$75 to \$375 per month, with an average of \$125.

Women's role in decision making has improved considerably at both the family and the community/institution levels. More than 70 percent of women reported that their life has changed for the better with respect to education, financial matters, marriages, and other social issues. At the institutional level, about 70 percent of women feel that their status has improved, their views are respected, and their social acceptance level has increased.

LESSONS LEARNED

The discussion below surveys some of the lessons learned from past experiences.

- Specific emphasis on women's participation in capacity building includes training programs and exposure visits. Group formation, leadership, conducting meetings, and

skill development modules stress women's participation. This project strives to improve the status of women, increase their participation, and empower them to be more self-reliant and self-confident. The project facilitated women and vulnerable groups to participate and express their views freely. Thus, the project addresses community empowerment, social justice, and gender equality.

- The training provided by the project created a high level of awareness and confidence among the executive committee and self-help groups, but relatively less among the area groups. The training knowledge is utilized primarily for microcredit management and income-generating activity rather than for watershed activity. Women view access to credit as vital to their ability to earn income and to control their status and autonomy.
- Marginal and landless people are the major beneficiaries of demonstrations in the project (81 percent). However, the spread of knowledge about watersheds remains limited. People conceive of the project as more of an income-earning enterprise rather than spreading knowledge about watershed management.
- The increased financial stability through savings and employment generation (at the self-help group level) has substantially reduced people's dependency on moneylenders. The extra earnings and employment opportunities have decreased out-migration, especially in the Haveri district and, to a lesser extent, in Chitradurga, Kolar, and Tumkur. Families now experience the opportunity to live together with family members. However, long-term employment generation is yet to be realized.
- The Haveri and Kolar districts report slightly improved access to fodder and fuel, and a few districts report improved drinking water facilities. However, these issues largely depend on natural resource development and increased biomass, which require a longer period to show results.
- Reasons for the limited participation of women include the nonsupportive social environment, cultural taboos, the presence of dominant caste and politically influential members, illiteracy, and a lack of clarity of benefits.

CHALLENGES FOR WIDER APPLICABILITY

- Self-help groups should develop a sense of identity, cohesiveness, and competence in areas such as managing their finances, taking up group income-generating activities (IGAs), and involvement in community affairs. IGA products produced under the project can be branded as "KWDP" as a unified marketing label.

- Women are usually unable to participate in community activities without the consent and support of men in their families and in the community. Men, therefore, need to be more aware of the importance of the contribution of women to the project and to the development of the village.
- Women field guides can work effectively with women, and it is easier for women staff to interact with them in the community. More women field guides are needed, and they need to be trained in facilitating women's participation and technical aspects of the project.
- The involvement of women in project planning should be ensured, especially with respect to how they are treated, participation in productive work, and benefits of production. Open-house meetings at regular intervals ensure better transparency and participation.
- Women committee members must be given specific responsibilities and made signatories to the bank accounts to emphasize the importance of their role.
- Equal opportunities in employment and equal wages for men and women commensurate with the nature of work must be ensured.
- Women should be given rights over village common property land to access the resources for their livelihood, and benefit-sharing mechanisms should be developed for wider participation.
- Common property resources must meet daily household needs for fuel and fodder and provide livelihood options for women. Social fencing creates hardships for vulnerable groups. To circumvent the long gestation period for realizing the benefits, a buffer zone approach should be used to develop common property land.

NOTES

Overview

This Overview was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. "Global Environment Outlook 4," www.unep.org.
2. Commonwealth/International Labour Organization, WTO TRIPS Agreement, Globalisation and Gender Briefs, Series 2, July, www.ilo.org/dyn/empent/docs/F1599852333/No%20%20-%20TRIPS.pdf.

3. For a full discussion on monitoring and evaluation, refer to Module 16.

Thematic Note I

This Thematic Note was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. "Global Environment Outlook 4," www.unep.org. The Convention on Biological Diversity defines *biodiversity* as the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes they are part of; this includes diversity within species, between species, and of ecosystems. The convention defines *sustainable use* as the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

2. Over the last few decades, agricultural development has been characterized by agricultural intensification and expansion, achieved mainly through technological advancements and the replacement of local plant or livestock varieties with improved, high-yielding, uniform varieties, as well as large-scale conversion of forests or other natural habitats to monocultural farming systems (FAO 2005).

3. *Local knowledge* is a collection of facts and relates to the entire system of concepts, beliefs, and perceptions that people hold about the world around them. This includes the way people observe and measure their surroundings, how they solve problems, and how they validate new information (FAO 2004; Warburton and Martin 1999).

4. Note that there is some contention between TRIPS and the CBD. TRIPS allows for the privatization of biological resources, but the CBD acknowledges that local communities have rights over these resources and the indigenous knowledge involved in their usage (Sahai 2003).

5. High-yielding exotic crops are often less nutritious than indigenous varieties. FAO's 1996 *State of the World's Plant Genetic Resources for Food and Agriculture* report states that the main cause of genetic erosion, reported by almost all countries, is the replacement of local varieties by improved or exotic varieties and species (FAO 2005).

6. "Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation," www.oecd.org/dataoecd/60/27/2502872.pdf.

7. Gerry Toomey, “Farmers as Researchers: The Rise of Participatory Plant Breeding,” International Development Research Centre (IDRC), Ottawa, Project No. 950019, www.idrc.ca/en/ev-5559-201-1-DO_TOPIC.html.

8. In addition to the ones listed here, the legal instruments relating to biodiversity include the International Undertaking on Plant Genetic Resources adopted by FAO in the early 1980s to protect plant genetic resources; the International Treaty on Plant Genetic Resources for Food and Agriculture, which promotes conservation and sustainable use of plant genetic resources for food and agriculture; and the Global Strategy for the Management of Farm Animal Genetic Resources, which provides a technical and operational framework for assisting countries. Further information on these aspects is highlighted in Bragdon and others (2003).

9. Because of space limitations, the relevant policy instruments will not be discussed in detail here. For a discussion on these instruments from a gender-sensitive perspective, see Bragdon and others (2003); FAO (2005); Lambrou and Laub (2004).

10. For a full discussion on the intellectual property rights of indigenous and local communities, see FAO (2005); Lambrou and Laub (2006).

11. For a full discussion on these issues, see FAO (2005).

12. Cathy Rozel Farnworth and Janice Jiggins, “Gender and Participatory Plant Breeding,” CGIAR, Program on Participatory Research and Gender Analysis, www.prgaprogram.org/modules/DownloadsPlus/uploads/PRGA_Publications/General/Reports/PPBMonograph4.pdf. Conventional breeding programs are recognized to have brought little benefit to some marginalized groups of farmers. However, encouraging examples can be found of projects in which women and men farmers are involved in crop improvement and breeding programs.

Thematic Note 2

This Thematic Note was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. The IPCC is a body of the world’s leading scientists convened by the United Nations. It has been established to assess scientific, technical, and socioeconomic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC won the Nobel Peace Prize in 2007.

2. Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the twenty-first century that would very likely be larger than those observed during the twentieth century.

3. The main human-produced greenhouse gases are carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons. Because of space limitations, this Thematic Note will not explore the scientific basis of climate change. For information, see the IPCC’s assessment reports at www.ipcc.ch.

4. This is an advance since the IPCC Third Assessment Report (2001), which concluded that “most of the observed warming over the last 50 years is *likely* to have been due to the increase in greenhouse gas concentrations.”

5. See also “Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation,” www.oecd.org/dataoecd/60/27/2502872.pdf.

6. In this context, climate change was brought before the UN Security Council for the first time in April 2007, as the issue was identified as one of the key factors behind the conflict in Darfur, because desertification had forced people from their homes and into areas where they competed with others for scarce resources such as water (Harvey 2007).

7. See the Overview for this Module and the Key Gender Issues section in this Note.

8. See “Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation,” www.oecd.org/dataoecd/60/27/2502872.pdf.

9. FAO, IFAD, and the World Bank have provided evidence through a number of their studies and lessons learned. See also Thematic Notes 1 and 4 and Module 11.

10. Human activity has altered ecosystems so extensively that their ability to bounce back from natural disturbance has diminished considerably. For instance, deforestation impairs watersheds; raises the risk of fires, landslides, and floods; exacerbates droughts; and contributes to climate change. Destruction of coastal wetlands, dunes, and mangroves diminishes the environmental buffer system for coastal storms. All these contribute to making at-risk areas (such as low-lying islands) more vulnerable to extreme weather events (Abramovitz 2001); see also Thematic Note 4.

11. For a detailed discussion on mitigation policies aimed at reducing or avoiding greenhouse gas emissions in the areas of renewable energy and energy efficiency, see Thematic Note 3 and Module 15. The causes of global warming can be reduced either by reducing the emissions of greenhouse gases or by subtracting carbon dioxide from the atmosphere (www.fao.org/clim).

12. www.fao.org/clim/mitigation_en.htm.

13. Payments for environmental services are a market-based conservation tool in which land users are paid for the

environmental services they generate. The central principles of this approach are that those who provide environmental services should be compensated for doing so and that those who receive these services should pay for their provision (see the Overview for more details).

14. www.fonafifo.com/index.htm.

15. For examples of best practices and lessons learned relating to sustainable energy development (energy efficiency and renewable energy), see Thematic Note 3 and Module 15. For natural disaster projects, see Thematic Note 4 and Module 11.

16. For more information on this mechanism, see <ftp://ftp.fao.org/agl/agll/docs/misc37> or www.climateindia.com.

17. "United Nations Framework Convention on Climate Change," <http://unfccc.int/resource/docs/convkp/conveng.pdf>.

18. For a full discussion on the Clean Development Mechanism and gender issues, see Denton (2002); Lambrou and Piana (2006a).

Thematic Note 3

This Thematic Note was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. This Thematic Note uses the following definitions: *Bioenergy*: energy produced from organic matter or biomass. Bioenergy includes all wood energy and all agroenergy resources (FAO 2006; UN-Energy 2007). *Biomass*: material of biological origin (excluding material embedded in geological formations and transformed to fossils), such as energy crops, agricultural and forestry wastes, and by-products, manure, or microbial biomass. *Biofuel*: fuel produced directly or indirectly from biomass, such as fuelwood, charcoal, bioethanol, biodiesel, biogas (methane), or biohydrogen. *Modern bioenergy*: biomass that may be burned directly, further processed into densified and dried solid fuel, or converted into liquid or gaseous fuels using so-called first- or second-generation technologies, depending on their level of development.

2. For a discussion on the plausible institutional and economic assumptions necessary for bioenergy development, see UN-Energy (2007). Projections to 2050 suggest that bioenergy sources could supply 10 to 25 percent of total energy demand (FAO 2005, 2007).

3. As a low-carbon or carbon-neutral source of energy, biofuel systems with low-energy inputs into the production

process are already significantly contributing to climate change mitigation by replacing fossil fuels and through carbon sequestration in plants and soil biomass in perennial energy plantations (FAO 2006).

4. The demand for corn for ethanol in the United States doubled or tripled the price of corn in Mexico between 2006 and 2007, which led to a tortilla crisis. Poor Mexicans receive more than 40 percent of their protein from tortillas. In the United States, chicken feed costs increased 40 percent between 2006 and 2007 because of rising corn prices (Sagar and Kartha 2007).

5. The full cycle of greenhouse gas emissions of bioenergy varies widely based on land-use changes, choice of feedstock, agricultural practices, refining or conversion processes, and end-use practice. If, for example, forest is converted into sugarcane, treated with chemical fertilizers and pesticides, and refined with coal and natural gas, the resulting biofuel could have a greater impact on climate over its life cycle than fossil fuels (UN-Energy 2007). A recent study estimates that when the amount of land cleared to grow corn, sugarcane, and soybeans for fuel crops is taken into account, biofuels will have higher greenhouse gas emissions than fossil fuels (Fargione and others 2008).

6. Modern forms of energy such as electricity and petroleum-based fuels account for only a fraction of the energy use of poor rural communities. The expansion of the electricity grid is costly and often not affordable for poor communities, particularly those in sub-Saharan Africa. Electricity from renewable energy sources such as small hydro, solar, and wind energy systems also has high capital costs. See United Nations Department of Economic and Social Affairs (DESA), "Small-Scale Production and Use of Liquid Biofuels in Sub-Saharan Africa: Perspectives for Sustainable Development," Background Paper No. 2 for Commission on Sustainable Development, Fifteenth Session, www.un.org/esa/sustdev/csd/csd15/documents/csd15_bp2.pdf.

7. www.malifolkecenter.org.

Thematic Note 4

This Thematic Note was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. Annual economic losses associated with such disasters averaged \$75.5 billion in the 1960s, \$138.4 billion in the 1970s, \$213.9 billion in the 1980s, and \$659.9 billion in the 1990s (UNDP 2004; a billion is 1,000 million).

2. The level of risk in relation to natural disasters in a society is determined by the levels of vulnerability combined with the level of probability of the occurrence of a natural hazard (flood, drought, landslide, earthquake, volcanic eruptions, storm, cyclone) as well as the level and intensity of such a hazard. See United Nations Division for the Advancement of Women (DAW), “Environmental Management and the Mitigation of Natural Disasters: A Gender Perspective,” Report of the Expert Group Meeting, Ankara, Turkey, November 6–9, www.un.org/womenwatch/daw/csw/env_manage/documents/EGM-Turkey-final-report.pdf.

3. Social vulnerability to disasters is a function of human action and behavior. It describes the degree to which a socioeconomic system or physical assets are either susceptible or resilient to the impact of natural hazards and environmental changes (ibid.).

4. Whether it is a drought in Malawi (Vaughan 1987), a cyclone in Bangladesh (Ikeda 1995), or an earthquake in Mexico (Dufka 1988).

5. “Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation,” www.oecd.org/dataoecd/60/27/2502872.pdf.

6. For a full discussion on disaster mitigation, response, and recovery, see Module 11.

7. The agencies taking part are the DPKO, FAO, IFRC, IOM, OCHA, OHCHR, UNDP, UNFPA, UNHCR, UNICEF, UNIDO, WFP, and WHO.

Thematic Note 5

This Thematic Note was prepared by Carolyn Sachs (Pennsylvania State University) and Marina Laudazi (Consultant), with inputs from David Boerma, Dominique Lantieri, Regina Laub, Sibyl Nelson, Andrea Rossi, and Reuben Sessa (FAO), and reviewed by Mary Hill Rojas (Consultant); Yianna Lambrou (FAO); Ilaria Firmian, Maria Hartl, and Sheila Mwanundu (IFAD); and Erick Fernandes, Robin Mearns, and Daniel Sellen (World Bank).

1. “Global Environment Outlook 4,” www.unep.org/geo/geo4/media.

2. Ibid.

3. United Nations University, “Experts Advise World Policies to Cope with Causes, Rising Consequences of Creeping Desertification,” www.inweh.unu.edu/inweh/drylands/Algiers_news_release-Final.pdf.

4. Ibid. According to the Millennium Ecosystem Assessment (2005), *drylands* include all terrestrial regions where the production of crops, forage, wood, and other ecosystem services is limited by water. Formally, the definition encompasses all lands where the climate is classified as dry

subhumid, semiarid, arid, or hyperarid. This classification is based on Aridity Index values.

5. See note 56 above.

6. Ibid.

7. See Thematic Note 1 for details on the CBD.

8. “What Is Dry and Sub-humid Lands Biodiversity?” www.cbd.int/drylands/what.shtml.

9. FARM Programme, <http://dbtindia.nic.in/FARM/page1.htm>.

10. IFAD (2006).

11. UNDP (2007b).

12. For more on monitoring and evaluation of natural resources management projects, see the Overview. For a full discussion on monitoring and evaluation in general, see Module 16.

Innovative Activity Profile 1

This Innovative Activity Profile was written by Marina Laudazi (FAO), based largely on Lambrou and Laub (2006), and reviewed by Catherine Ragasa and Mary Hill Rojas (Consultants) and Maria Hartl (IFAD).

1. Agrobiodiversity comprises the variety and variability of animals, plants, and microorganisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry, and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fiber, fuel, and pharmaceuticals. It also includes the diversity of nonharvested species that support production (soil microorganisms, predators, pollinators) and those in the wider environment that support agroecosystems (agricultural, pastoral, forest, and aquatic) as well as the diversity of the agroecosystems. Local knowledge and culture can therefore be considered as integral parts of agrobiodiversity, because it is the human activity of agriculture that shapes and conserves this biodiversity.

Innovative Activity Profile 2

This Innovative Activity Profile was written by Marina Laudazi (FAO), based largely on project documents, and reviewed by Catherine Ragasa and Mary Hill Rojas (Consultants) and Maria Hartl (IFAD).

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