

Module 5: Investment in Sustainable Natural Resource Management for Agriculture

In recent years, increases in agricultural productivity have come in part at the expense of deterioration in the natural resource base on which farming systems depend. It is urgent that this trend be reversed by encouraging farmers to adopt more sustainable methods of farming that will have long-term benefits in environmental conservation and development of sustainable livelihoods. Public sector investments are critical to reversing trends in degradation of natural resources. Specific objectives for sustainable natural resource management (NRM) include improving agroecosystem productivity, conserving biodiversity, reducing land degradation, improving water management, ensuring the sustainability of forests, managing the sustainability of wildlife and fisheries, and mitigating the effects of global climate change.

NRM refers to the processes and practices relating to the allocation and use of natural resources. Sustainable NRM optimizes the use of resources to meet current livelihood needs, while maintaining and improving the stock and quality of resources so that future generations will be able to meet their needs. NRM decisions are made at various levels—household, farm, community, national, and global. This module focuses on off-farm investments and activities at the local and community level that have direct implications for sustainable agricultural systems. Farm-level practices or technologies with a benign or positive effect on the natural environment are outlined in Module 4, “Investments in Sustainable Agricultural Intensification.”

Rationale for Investment

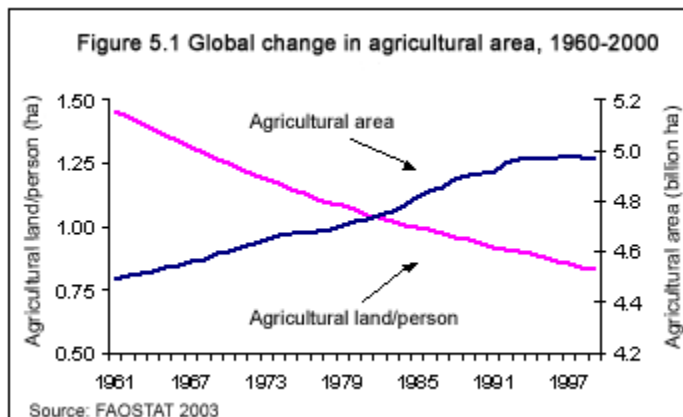
Agricultural production systems *depend on* natural resources—land (over 55 percent of nonforest land), water (about 80 percent of total fresh water), biodiversity, forests, pastures, and wildlife. Farm activities can also have major *impacts* on the quality and availability of these resources well beyond the boundaries of the production system (for example, downstream pollution and soil erosion). Although natural resources are critical to agricultural production, farm households also frequently depend on them to meet other needs, such as fuel, construction materials, and supplemental foods. Thus rural livelihoods are intricately linked to the condition of natural resources, particularly for those 1.3 billion people living on fragile lands.

Over the last 40 years as food production has doubled, agricultural production systems have expanded, with significant impacts on the natural resource base (figure 5.1):

- The amount of agricultural land going out of production each year due to soil erosion is about 20 million hectares, and approximately 40 percent of the world’s cropland is now degraded.
- Irrigated agriculture consumes about 70 percent of the total volume of fresh water used by humans, resulting in major environmental consequences: salinization,

lowering of water tables, waterlogging, and degradation of water quality, with subsequent impacts on ecological systems affecting fisheries and wetlands.

- Agriculture currently contributes about 30 percent of the global emission of greenhouse
- gases resulting from human activity. This has major implications for global climate change.
- The unplanned expansion of intensive production systems, which are typically monoculture and often developed at the expense of primary forests and savanna woodlands, can contribute to a significant loss in biodiversity.
- Deforestation rates have reached almost one percent per year in some regions.
- The major findings of the recently concluded Millennium Ecosystem Assessment warned that approximately 60 percent of the ecosystem services (box 5.1) supporting life on Earth was being degraded or used unsustainably and that the consequences of degradation could grow significantly worse in the next half-century.



Box 5.1. Ecosystem services

An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. Examples of ecosystems include natural forests, landscapes with mixed patterns of human use, and ecosystems that are intensively managed and modified by humans, such as agricultural land and urban areas. Ecosystem services are the benefits people obtain from ecosystems. These include:

- *Provisioning services* such as food, water, timber, and fiber.
- *Regulating services* that affect climate, floods, disease, wastes, and water quality.
- *Cultural services* that provide recreational, aesthetic, and spiritual benefits.
- *Supporting services*, such as soil formation, photosynthesis, and nutrient cycling.

The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services.

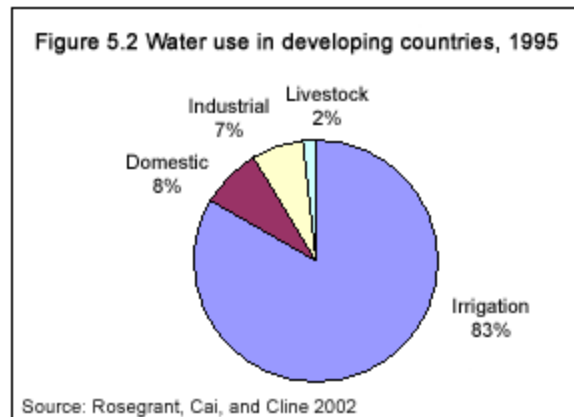
Source: Millennium Assessments 2005, www.millenniumassessments.org

Sustainable NRM is critical to reducing poverty. If productive capacity continues to erode, the potential to satisfy future food needs will be seriously compromised. The poorest will suffer the most, through increased food costs and greater vulnerability to their livelihood. Further, increased agricultural production and productivity and increased incomes provide more resources in the long run for addressing environmental problems. Improvements in natural resources facilitate farmers' transition to production systems that are better matched to the available natural and human resources, can respond to

market signals, and are more profitable, stable, and sustainable. Good NRM also expands income and employment opportunities throughout the wider community—for instance, through eco/agrotourism or through agroforestry production that attracts downstream processing industries.

Sustainable NRM is important to agricultural development as a basis for:

- *General agricultural productivity.* As mentioned, agriculture is the major user of most available land and water resources (figure 5.2). However, many farmers lack essential knowledge, resources, and skills to manage intensive farming operations on a sound basis. This leads to the use of inappropriate technologies and unsustainable practices that contribute to the exhaustion of natural resources and environmental pollution.
- *Off-farm agricultural uses.* Many agricultural systems rely on “off-farm” natural resources, such as livestock grazing on roadsides and woodlots. Forests provide building materials for farms, fences, and homes.
- *Nonfarm employment.* Natural resources provide off-farm income through employment in industries (such as fishing, timber extraction, and tourism) and through other uses, such as power generation. This income is often critically important for the purchase of production inputs to maintain the productivity of the farming system.
- *Risk and vulnerability reduction.* Sustainable NRM reduces the vulnerability of both farm and urban communities to natural resource disasters, such as droughts, landslides, and floods and to the loss of biodiversity from overgrazing and deforestation. A healthy resource base helps mitigate vulnerability to climate variability and reduces risks of failed harvests.
- *Pollution reduction.* Pollution from agricultural production and processing can have major impacts on “off-site” natural resource quality. Water pollution from agricultural chemicals and livestock manures is a potential health hazard; irrigation can cause salinity problems; and the burning of crop residues may affect air quality and human health.
- *Environmental services.* Improved NRM provides extensive downstream benefits in the form of “environmental services” such as hydrologic function, sediment control, nurseries for fisheries, and biodiversity conservation. Environmental resources contribute to the health of the global ecosystem, because wild races of the major food crops and semidomesticated crops, located in forest reserves and natural ecosystems, are important sources of genes for crop improvement programs, and semidomesticated crops represent new market opportunities. Maintaining tree cover and following appropriate hillside grazing and crop cultivation practices will preserve



soil and water resources and enhance the hydrologic functions of watershed areas. Coastal zone protection, mangrove and wetlands preservation, and border areas of parks and protected areas are important for the maintenance of environmental services.

- *Cultural integrity.* Indigenous cultures use land and other natural resources in unique ways which often help to define national identities, even in industrial countries. Indigenous technical knowledge coupled with scientific research provides significant scope for management innovations to conserve natural resources and develop new marketable products (for example, nutraceuticals).

Past Investment Activity

Prior to the 1980s, most natural resource investments by the World Bank were extractive: timber, fishing, and water for irrigation. In the late 1980s, the Bank shifted attention to conservation and sustainable management of natural resources, with a dramatic increase in NRM and forestry investment. Annual investments, including all forestry-related investment, peaked at over US\$1 billion in 1994 but have since declined to approximately US\$250 million annually (box 5.2).

Recent projects have relied on local capacity building and user groups to improve resource management. Decentralization, community-driven development mechanisms, stakeholder participation, and local ownership of natural resources have featured increasingly in Bank-assisted projects, which are also becoming increasingly multisectoral. This change has occurred partly in response to stakeholder demands to complement NRM investments with activities to produce more immediate impacts on incomes and poverty reduction. As a result, the number of integrated projects, especially watershed and microwatershed projects, is increasing, as well as the number of projects incorporating rural development funds and alternative livelihood options.

Key Issues for Investment

NRM investments are generally focused on conservation and sustainable use of resources, with institutional strategies emphasizing local management, equitable access, and provision of alternative livelihood options. Because of the environmental externalities associated with NRM decisions, investments are increasingly considered from a basin or ecoregional perspective and analyzed in terms of ecological, economic, and social systems. Key implementation issues are as follows.

Political nature of NRM. Power and politics are central to many NRM issues, as natural resources, a major source of wealth, tend to be at the center of many governance issues and conflicts among communities. Any change in access will almost certainly create "losers"—often the powerful, who have strong incentives and ability to resist change, or the poor, who are powerless and lose access to a resource. Efficient, equitable, and sustainable NRM is often difficult for this reason, and governments must balance competing demands for use of resources and conflicts among the parties. Negotiating skills for community groups are essential to broker agreements and facilitate decision

making by local users. For many NRM programs, however, the sustainability of these local institutions has been a problem, because they become inactive once a project ends.

Box 5.2 Key trends in past lending for improved natural resource management by area of intervention

- *Biodiversity.* Earlier approaches introducing “fortress” protection systems to restrict access to parks and protected areas were generally unsuccessful. These have been replaced by programs relying on local peoples’ participation in the conservation and rehabilitation of protected areas and buffer zones.
- *Forests/forestry.* Forestry lending has declined, but there is increased emphasis on forestry in watershed conservation investments and agroforestry.
- *Land resource management.* Lending continues to focus on combating land degradation and promoting sustainable land management, especially relating to arid land management and watershed management. Major past investments have been for intensification of agricultural production.
- *Natural resource management (NRM) institutions.* Institutional capacity development, focused on local institutions tasked with managing natural resources, has led to increasingly decentralized NRM and development of a range of participatory management systems.
- *Water resources.* Investments in new irrigation construction have declined because of their high costs, environmental impacts, and low returns on investments. Attention is now focused on water use efficiency, water resource planning, and watershed development.

Source: Authors

Policy and regulatory environment. Ineffective NRM policy and regulatory environments (particularly subsidies, taxes, and property rights), together with poor infrastructure (affecting access to markets) often discourage sustainable long-term investments by distorting incentive systems and increasing uncertainty. However, relationships between policy and incentive structures and product prices are complex. Agricultural producers compete for natural resources with other users such as industry and municipalities, whose needs increase with population growth and increasing affluence. In these circumstances, in a complex and uncertain decision-making environment, choices generally involve tradeoffs among sustainable resource use and other objectives. Resource preservation objectives are frequently at odds with production objectives, and while conservation and development goals can be complementary, they can also be in conflict.

Economic characteristics of natural resources. Land, water, forests, and biodiversity are generally regarded as public goods (to which access is nonrival and nonexcludable) or common pool goods (to which access is nonexcludable but rival). Investment in “developing” these natural resources may shift the status of the resources to that of a private good, negatively impacting poor people by affecting their access to these assets. In addition, as investment benefits accrue only in the medium to long term, it may be difficult to persuade resource users to undertake NRM investments. Success may depend on (1) appropriately valuing these resources with incentives for conserving and maximizing their productivity and (2) developing markets and appropriate pricing mechanisms that reflect the true value of the resource, incorporating externality values. Since resources have different values for different stakeholders, accruing over different

time periods, a variety of interventions are required to strengthen the different sources of value (table 5.1). Farmers should pay for the use of natural resources (for example, irrigation water) and for costs of mitigating agricultural pollution (agrochemical runoff, manure disposal), and they should be reimbursed for the positive externalities such as planting trees for carbon sequestration.

Table 5.1 Investment strategies to enhance value of natural resources

Source of value		Examples of value	Strategies to enhance value
Value from use	Direct	Agricultural production, timber, recreation	Investment in increasing productivity and efficiency in use of resources
	Indirect	Watershed protection, natural beauty, carbon sequestration	Development of environmental services markets
Value from preservation	Future options	Possible future uses	Investments in natural resource conservation; environmental education
	Existence	Biodiversity, religion and culture, inheritance	Conservation of protected areas

Source: Authors

Promoting adoption of NRM practices. Most farmers place a high priority on improvements in land, water, and forest resource management, because these resources are central to their livelihoods. Although generally sympathetic to improving environmental conditions, they are often unwilling or unable to invest to improve these conditions or to produce long-term benefits. NRM programs must deal with such problems by providing appropriate incentives, monetary or otherwise, to make small-scale farmers' investment possible. This effort may require public funding for development activities or economic incentives, linked to the introduction of sustainable NRM practices. An improved understanding is needed of the factors influencing farm and household decision making. In many areas, farmers have invested heavily in NRM (for example, terracing in northern Ethiopia, Eritrea, and parts of Asia; tree planting in hill areas of Kenya), irrespective of the government policy and program frameworks.

Environmental services markets and government transfer payments should reward farmers for sound resource management, encourage conservation, and provide an additional source of income to farmers. Payments ideally should come from downstream beneficiaries, such as industry, urban areas, or downstream farmers using water resources. However, for many resources, identifying and collecting data on resource use is difficult (for example, aesthetic values of maintaining a "clean" environment, or the conservation of biodiversity), and government transfer payments might be necessary. This strategy may introduce the problem of moral hazard, with beneficiaries accepting program incentives and then reneging on their commitments. More experience is needed to identify effective ways of enforcing these arrangements.

Delivering NRM services. NRM investments should be based on sound technical analyses provided within a framework and mechanism that effectively delivers NRM services at the community level. Turkey's East Anatolia Watershed Rehabilitation Project, with its participatory watershed management planning, provided a framework for ensuring that performance would be measured against specific indicators. Local government institutions decided how they could most effectively deliver NRM-related services based on the stated needs of the community. Decentralized approaches for planning and local organization of service delivery are important, because most NRM problems and recommended practices are site-specific, requiring a high level of managerial input and adaptation to local ecological, economic, and social circumstances.

Box 5.3 Marginal areas: a special focus

Agricultural systems in marginal areas that are less favorable for agricultural production often provide farmers with only a precarious existence. As a general rule, natural resource conservation is a priority for these less-favored production areas. Sound NRM may require public policy initiatives to establish markets, strengthen or establish property rights, and ensure realistic pricing of natural resources. In some systems, traditional usage rights (for example, for grazing or use of forest resources) can be effectively and sustainably maintained through internal social discipline. Mechanisms that provide better drought preparedness are particularly important for food security and environmental management. In areas with sufficient agricultural potential, public investment is needed to support technology development, roads, and irrigation.

Source: World Bank 1999

Providing alternative livelihood options. Appropriate incentives are key to NRM program success. Direct income benefits accrue to the farmers, men and women, who adopt new management practices, and government incentive systems can benefit others. Even so, this strategy may still leave many others who do not benefit from NRM programs and who consequently may be tempted or forced to overexploit natural resources. To reduce such pressures on natural resources, investments are often needed to provide alternative income opportunities within agriculture, by intensifying production systems and expanding processing and marketing opportunities, or through education, business development services, and microfinance programs, which may or may not be linked to natural resource use.

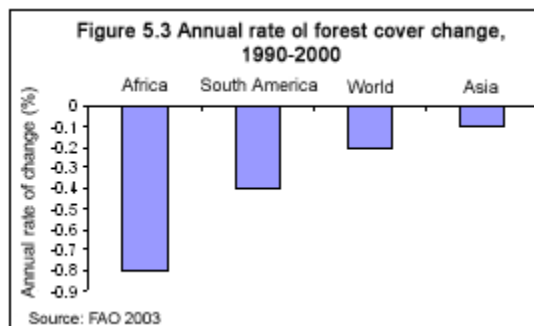
Poverty focus. Past NRM projects have not been very satisfactory in their poverty focus or socioeconomic impact analysis. Although impacts may be indirect and long term, NRM investments must emphasize rural poverty reduction, especially in marginal areas, where pressure on the natural resource base makes improved NRM a priority (box 5.3). Providing for the critical needs of clean water, fuel, and income of poor people is a prerequisite for effective incentive systems and market mechanisms to improve NRM.

Box 5.4 Biodiversity: careful management can help diversify rural livelihoods

Biodiversity is a unique asset to rural communities. Many herbs are used for medicinal purposes; plant extracts can be used as biopesticides; roots and tuber crops contain novel carbohydrates for use as functional food ingredients; and many woody species produce polymers of interest to industry. Indigenous ethnic groups and rural women have extensive knowledge and management skills relating to plant and animal biodiversity. One means of adding value to these resources is to combine the indigenous knowledge of local communities with the knowledge of the science and business community. The resource management challenge is to ensure the environmental sustainability of the resource, including sustainable harvest or domestication of the species of interest. A social and economic challenge is to design contracts for use of the resource with sound mechanisms for fair sharing of benefits among different stakeholders.

Source: Nickel and Sennhauser

Maintaining protected areas. Protected area management plans now recognize the need to educate farmers and other rural people about the value of biodiversity and its potential benefits, especially buffer zone arrangements to conserve protected areas and critical ecosystems, and the preservation of biological corridors for movement of wildlife (box 5.4). Continued rapid deforestation in many areas underscores the threat to protected areas (figure 5.3). The development of income opportunities for local people is important to provide direct incentives for conservation, as biodiversity conservation is often a difficult “sell” to farmers, because benefits are long term and not always obvious.



Global and regional considerations. The many natural resource issues with regional and international impacts require concerted regional and international action, as provided for in part by the GEF (box 5.5). Mechanisms and institutions are needed to facilitate global financing and support for global public goods, such as biodiversity conservation and carbon sequestration. Regional public goods are an even more common phenomenon, with many shared resources and ecosystems, dictating coordinated and integrated action by neighboring countries to sustainably manage resources such as shared pasture lands, water bodies, and ecoregions.

Box 5.5 Global Environment Facility

The Global Environment Facility (GEF) program is an important resource for expanding investment in sustainable natural resource management. GEF financing provides grants for projects and studies, strategy development, and project preparation for activities that address six critical threats to the global environment—climate change, biodiversity loss, degradation of international waters, ozone depletion, land degradation, or persistent organic pollutants. GEF cofinancing can support conservation of protected areas and biodiversity, sustainable land management, and water resource planning and management.

Source: World Bank 2000

Future Directions for Lending

Future investments must promote policy and interventions that respond to major government and market failures underlying current trends in natural resource degradation. When there are positive externalities and net societal benefits, individuals and organizations underinvest. They may overinvest where environmental costs are borne by the wider community.

Improved natural resource management requires the integration of sound policy, innovative technical solutions, and effective and sustainable institutions.

Establishing a sound policy and regulatory environment. Policies and programs must put in place appropriate incentives for sustainable NRM and the removal of subsidies that discourage sustainable NRM. Where short-term subsidies are provided, recipients' actions need to be monitored.

Establishing secure property rights. Secure property rights to natural resources for individuals or organized community groups are essential in both conserving these resources and, in cases where this is appropriate, valuing and developing markets for them. Clearly defined and legally recognized property rights are critical to long-term investments in land improvement. In practice, rights to resources are often unclear and conflicts develop. Because of the difficulties in registering formal title to resources, seeking secure usufruct rights is often more appropriate than attempting to establish full ownership rights to the resource. Traditional use rights, especially communal rights of indigenous groups, are important in many areas, and investments should be sensitive to these and ensure that they are safeguarded.

Decentralizing NRM. Government willingness to devolve legal, fiscal, and administrative decision-making power to the appropriate level is critical to strengthening tenurial rights and key to effective and sustainable NRM. Decentralization, coupled with community-based natural resource management, facilitates farmer participation in NRM through:

- Community-driven development with devolution of natural resource use rights and decision making to community groups.¹
- Rural investment funds that provide demand-driven grants for natural resource management subprojects, such as tree planting or the development of resource management plans.
- Participatory management plans or joint management systems under which government retains control over natural resources, but communities are consulted on key issues (for example, user rights) and may be given roles in monitoring and evaluation.
- Communal management of a common resource such as pasture or tribal lands.

Strengthening NRM institutions. Investments to build institutional capacity to equip local communities and governments with the skills to manage resources in a sustainable and productive manner are key to ensuring that decentralization works. Management systems must preferably be democratic in action, ensure transparency and accountability, have well-defined mechanisms for conflict resolution and for establishing secure property rights, and empower vulnerable populations, such as women, indigenous people, and very poor people.

New technologies—knowledge and information services. New technologies and approaches have been developed to improve NRM. For example, private rainwater harvesting technologies are useful in mountainous areas where more conventional irrigation options are not available. Integrated watershed management combines water harvesting, groundwater recharge, and vegetative cover with the development of viable agricultural systems to increase agricultural carrying capacity. Land management systems use integrated management packages including conservation tillage practices, soil treatment, weed control, vegetative cover, and agroforestry. Mass media communication approaches will help deliver to the widest audience possible extension and information services about new technologies and approaches to improve NRM, and thereby increase the potential for sustainable use.

Developing market-based strategies. Establishing a base for commercial profitability for sound NRM depends on a favorable policy environment with an appropriate incentive structure. Models for private sector investment are being used successfully in management of forest areas and plantations. Recent NRM projects have supported private insurance companies providing index-based livestock insurance for pastoral systems,² development funds for accredited microfinance institutions, and business centers facilitating development of small- and medium-scale enterprises in fragile areas.

Improving environmental monitoring and information systems. Establishing the science and knowledge base for monitoring and evaluating interventions is important to planning

¹ See the AIN, “Community-Based Natural Resources Management.”

² See the IAP, “Mongolia: Sustaining Livelihoods in Areas with High Natural Disaster Risk,” Module 11.

and monitoring natural resources. New technologies, such as satellite imagery, geographic information systems, and the Internet, will facilitate more efficient and reliable collection of data on land cover, water usage and quality, biodiversity, and other measures of resource inventory and quality needed for sound management.

Providing a range of livelihood options. Project investments will generally need to integrate activities contributing to natural resource conservation, sustainable productivity, and improved rural livelihoods. The linkages between NRM interventions and poverty reduction are critical to project design, and special emphasis should be given to involving women and vulnerable populations in decision-making processes. Many local development and production-oriented activities can be financed through matching grants. Cost sharing and parallel development of rural financial services to support productive projects are helpful in broadening impacts and enhancing financial sustainability of NRM program investments.

Reducing agricultural system pollution. The impacts of agricultural production, processing, and marketing systems on downstream environmental resources result in “brown environmental impacts.” These are growing concerns that require greater attention in environmental impact assessments for agricultural investments. “Green environmental impacts,” arising from the impact of production systems on forest cover, biodiversity, and ecosystem stability, require substantial investment in research, extension, and training relating to NRM practices.

Developing environmental services markets. Markets for environmental services are a developing issue. For example, downstream beneficiaries such as cities, power plants, and farmers can pay for sound natural resource management and conservation of watershed areas. Ecotourism is another example. Payment for carbon sequestration is another potential source of income for developing countries, providing incentives for conservation of pasture and forest resources. Innovative approaches to market such services require extensive feasibility studies and extensive testing through pilot activity before they can be scaled up.³ One risk of market arrangements for environmental services is that local elites capture the benefits, with poor people suffering from a loss of access to resources.

Scaling Up Investments

Strengthening national data collection, monitoring, and evaluation systems should be an element of most NRM projects, providing a basis for improved monitoring and evaluation of the projects themselves. Key impact indicators for NRM investments will be rural incomes, quality and stock of natural resources, and rates of change in natural resource indicators. Outcome indicators should relate to the numbers of adopters and adapters of new management systems, area coverage of adoption, impact per unit of

³ See the IAP, “Latin America and Caribbean: Payments for Environmental Services in Silvopastoral Systems.”

adoption of new practices, changes in agricultural and resource productivity, and development of social capital relevant to sound NRM.

Scaling up is a challenge for NRM investments. Many locally successful NRM pilot activities and models for development have not succeeded at the national level. Frequently, the problem relates to the level of technical and managerial support required for programs, the site-specific nature of most NRM interventions, and the need to negotiate implementation arrangements suited to local power structures and institutions. However, community management systems and decentralization are increasingly being scaled up and incorporated into wider government programs and policies. Ensuring site-specific adaptations of NRM investments is challenging in larger projects, and it will be even more critical in any attempts to incorporate NRM into program investments. Safeguard policies are often critical to NRM investments (box 5.6).

The complex nature of NRM issues requires that integrated program approaches be promoted to achieve sustainable outcomes. Investments must be multidisciplinary, cover multiple activities, and be financed over relatively long periods, making the Adaptable Program Lending (APL) approach potentially valuable. Efforts to achieve a better balance between conservation and poverty reduction objectives can be expected to lead to greater cross-sector coordination in development and implementation of ecotourism, watershed, agroforestry, and silvipastoral approaches.

Box 5.6 Key safeguard policy issues for natural resource management investments

- *Environmental Assessment (Operational Policy [OP]/Bank Procedure [BP] 4.01)*. An environmental assessment is required if a natural resource management (NRM) project has potential for adverse environmental risks or impacts.
- *Natural Habitats (OP 4.04)*. Protection of natural habitats (land and water areas where most of the original plant and animal species are still present) is required for any NRM investment that may cause degradation of the habitat.
- *Projects in International Waterways (OP 7.50)*. The borrower must notify other riparian countries of any proposed NRM investment involving a body of water that flows through or forms part of the boundary of two or more countries.
- *Involuntary Resettlement (OP/BP 4.12)*. A Resettlement Action Plan is required if an NRM investment results in physical relocation, loss of land or access to land or other assets, or impacts on livelihoods arising from restrictions on access to parks or protected areas.
- *Indigenous Peoples (Operational Directive 4.20)*. An Indigenous Peoples Action Plan is required if an NRM investment affects indigenous people.
- *Forestry (OP 4.36)*. Government commitment to undertake sustainable management and conservation-oriented forestry is required for any investment with potential to impact significantly on forested areas. (Investment with an exclusive focus on environmental protection or supportive of small-scale farmers may be appraised on its own merits.)

Source: World Bank, Operational Manual

Future work is needed to develop good practice recommendations and to synthesize experience with investments in: indicators for sustainable NRM investments; technologies and metrics for NRM program monitoring and evaluation; investing in

wetland conservation; investment in marginal lands; conserving agro-biodiversity; and minimizing agricultural pollution.

Selected Readings

Asterisk (*) at the end of a reference indicates that it is available on the Web. See Appendix 1 for a full list of Websites.

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This overview was prepared by Jaime Webbe, Sam Kane, Gary Alex, and Idah Pswarayi-Riddihough, with input from the Natural Resources Management Thematic Team of the Bank. Peer review comments were provided by Gunars Platais, Agnes Kiss, Nadim Khouri, John Pender (IFPRI), and Mary Hill Rojas (WIDTECH).

Community-Based Natural Resources Management

Community-based natural resources management (CBNRM) is an approach under which communities become responsible for managing natural resources (forests, land, water, biodiversity) within a designated area. The community—often assisted and monitored by outside technical specialists—utilizes and protects natural resources within established guidelines or according to a detailed, mutually agreed plan. The active participation of stakeholders in natural resource decision making and use increases economic and environmental benefits. Critical investment areas include the introduction of viable management systems, securing legal control over resources and resource utilization, improving environmental governance, and information management.

Population growth and economic development are increasing pressure on land, water, forest, and biodiversity resources. Government attempts to conserve natural resources through top-down regulatory systems have often failed. Limited government capacity to enforce laws and regulations compounds management problems, particularly when regulations are inappropriate to the social, cultural, and ecological context. In seeking an alternative, natural resource managers have found that increasing the role of local people in managing their natural resources is often the most appropriate solution.

CBNRM gives communities full or partial control over decisions regarding natural resources, such as water, forests, pastures, communal lands, protected areas, and fisheries. The extent of CBNRM control can range from community consultations to joint management or to full responsibility for decision making and benefit collection, using tools such as joint management plans, community management plans, stakeholder consultations and workshops, and communal land tenure rights.

Community-based institutions are key to any CBNRM project, and selecting and building the capacity of local institutions is critical. The selection process must ensure transparency and accountability and minimize conflict. Together with decentralization reforms, CBNRM ensures stakeholder participation, increases sustainability, and provides a forum for conflict resolution. Such a community-based approach often leads to more equitable and more sustainable natural resource management for the following reasons (Brown et al. 2002; Brown 1999):

- *Proximity to resources.* Those in closest contact with, and whose livelihoods are impacted by, natural resources are best placed to ensure effective stewardship.
- *Equity.* Natural resources should be managed to ensure equitable benefits for the diverse interest groups within a population.
- *Capacity.* Communities often have better knowledge and expertise in the management of the natural resources than government agencies/private industry.
- *Biodiversity.* Multiple-purpose management of natural resources by communities generally provides more varied land use, with greater species diversity than private/industrial management systems.
- *Cost-effectiveness.* Local management may help reduce government costs.

- *Development philosophy.* Local participation, decentralization, and subsidiarity may, in themselves, be considered important development objectives.

Benefits

Sound CBNRM optimizes the use of the natural resource base to enhance agricultural productivity goals, ensure long-term sustainability, and protect the livelihoods of farm families. Improved natural resource management has increased soil fertility and water retention, reversed soil erosion, improved water management, maintained and/or improved biodiversity, reduced habitat destruction, and reduced deforestation. Economic opportunities from sustainable use of natural resources can act as a catalyst in reducing poverty and improving food security (box 5.7). Early economic benefits from NRM, equitably distributed to stakeholders, are important to develop the commitment to continue sustainable management systems. In addition, the transfer of control over development funds to community institutions enables them to contribute to decision-making processes; it also increases rural peoples' ability to demand and obtain rights and services. The Access Initiative, a new Bank tool, is an effort to assess people's access to information, participation, and justice in decisions that affect the environment (The Access Initiative, <http://www.accessinitiative.org>).

Box 5.7 Armenia: Natural Resources Management and Poverty Reduction Project

In Armenia, the Natural Resources Management and Poverty Reduction Project contributes to sound resource management and poverty reduction through:

- A small grants scheme for biodiversity investments that supports alternative livelihoods to increase rural incomes while reducing pressure on natural resources.
- A community infrastructure and income generation fund that supports the rehabilitation of access roads and the stabilization of land at risk from landslides and erosion.
- A forest management component that supports the generation of employment opportunities targeted at surplus household labor.

Source: World Bank internal documents

Policy and Implementation Issues

Conflict resolution. Control over natural resources is often highly political, since natural resources can be the basis of production and wealth (box 5.8). Powerful interest groups, hesitant to give up control over natural resources, often come into conflict with local stakeholders over scarce resources. Devolving control to community groups can lead to conflicts between local authorities and communities as roles and responsibilities change. Without adequate traditional or formal mechanisms for conflict prevention, management, and resolution, conflicts among different interest groups often result in inequitable sharing of economic benefits and unsustainable practices of natural resource use.

Box 5.8 Zimbabwe: uneven benefits from CBNRM

The Communal Areas Management Program for Indigenous Resources is a rural development and conservation initiative in Zimbabwe that seeks to provide rural people the authority to manage and benefit from their natural resources. The program decentralized decision making and devolved resource management responsibilities, thereby passing financial incentives for conservation management down to local communities. In some areas, this devolution of power successfully changed attitudes from dependency on central institutions to self-reliance and self-sufficiency. However, in areas where natural resource control and economic benefits were retained at the district council level or higher, local communities were left frustrated and powerless, ultimately leading to misunderstandings and hostility towards the program and continued illegal poaching and encroachment into wildlife areas.

Source: Grimble and Laidlaw 2002

Interests of poor people. Natural resources are the basis for most rural economic activities and therefore are especially important for poor people. Improving access can increase livelihood opportunities, while restricting access can disrupt traditional economies. Since changes to NRM practices can have disproportionate impacts on poor people and marginalized groups such as indigenous populations, their interests must be considered in any intervention (box 5.9).

Governance and rights to resources. Resource use rights are central to CBNRM programs, and governance reforms have profound implications for management of natural resources. Good governance can promote economic growth, but mismanagement of natural resources can exacerbate conflict and corruption. Many NRM systems may serve one community's interests over those of another. For example, wetlands can be important to both fisheries and agriculture; pasture lands for pastoralists or settled agriculturalists; and forests for downstream hydrology or for shifting cultivation. This situation requires development of institutions that protect the rights of different stakeholders, resolve differences, and balance investments that might develop one use over another.

Box 5.9 Argentina: Indigenous Community Development Project

Since indigenous populations in Argentina have high poverty levels, the National Institute for Indigenous Affairs was created to engage indigenous populations in development activities. The Indigenous Community Development Project empowers vulnerable groups by:

- Strengthening the capacity of pre-existing indigenous organizations.
- Ensuring legal recognition of customary indigenous land and resource use rights.
- Introducing gender concerns into social programs through gender workshops.
- Building social and cultural assets in indigenous communities.
- Involving nonindigenous stakeholders in consultations to minimize conflict.
- Establishing a transparent system for the allocation of project development resources.

Source: World Bank internal documents

Scaling up. CBNRM is by definition a local intervention, and is by nature a relatively slow process of participatory decision making. However, scaling up successful activities is important to expand the scope of benefits. Since CBNRM relies upon a number of location-specific criteria, such as available natural resources and the strength of community groups, scaling up CBNRM can be slow and costly. It is made easier by flexible project designs, demonstration of benefits to policy makers, and a focus on scaling up community processes rather than on a particular project.

Sustainable financing. Long-term viability of NRM requires sustainable funding for operating and maintaining local institutions. Innovative mechanisms are needed for cost sharing, cost recovery for program operations, and the establishment of income generation schemes to provide incentives to participate in the program.

Lessons Learned

Effective community participation comes from empowerment, which depends largely on government commitment to the time and resources needed to build consensus among stakeholders, establish new institutional arrangements with appropriate rules and incentives for local involvement and capacity building, and decentralized finance and administration (box 5.10).

Information systems. Reliable and timely information is critical to sound NRM and to good economic and governance decisions. Types of information relevant to CBNRM include: stream flow surveys, species composition indices, vegetative cover mapping, and changes in land use over time.

Information from farmers, including traditional knowledge, needs to be at the forefront of any CBNRM program. Science-based knowledge and information tools, including geographic information systems, can complement local knowledge and be integrated into CBNRM programs, especially in building management capacity of government institutions.

Combining production and conservation. Sound NRM strategies must encourage subsistence farmers to use better manage production systems. Since this often depends on their ability to finance investments in resource management, income generation activities are an important component of CBNRM initiatives, as are extension and information services that build farmers' skills and confidence to invest in NRM.

Stakeholder participation. Critical to long-term sustainability of CBNRM is the ability to institutionalize stakeholder participation. "Operationalizing" participatory development rests on a willingness to share power and be receptive to new ideas, to listen to people

Box 5.10 Criteria for well-functioning community organizations

- Groups/communities address a felt need and have a common interest.
- Benefits to individuals outweigh the costs of their participation in the project.
- There is clear understanding of the benefits to be derived from the project.
- Groups/communities have the capacity, leadership, knowledge, and skills to manage the tasks for implementing the project.
- Groups/communities are capable of making and enforcing their own rules and regulations.
- An inclusive decision-making process exists throughout the project's life.

Source: World Bank 1996

instead of lecturing them, and to take risks by opening up management processes rather than trying to control them. Tools for facilitating stakeholder participation include Participatory Rural Appraisal (also termed Participation–Reflection–Action) (Institute of Development Studies) and community-driven development (World Bank, Community-Driven Development). While community empowerment and participation are ultimate objectives, external agencies are often helpful in awareness raising, catalyzing group formation, and facilitating identification of community projects.

Recommendations for Practitioners

Three general implementation themes important to CBNRM initiatives—institutions, policies, and technologies—provide a framework for CBNRM investments (box 5.11).

Institutions. Investments in CBNRM must build local capacity to assume responsibility for NRM. This requires:

- Accepting that CBNRM is a time-consuming and labor-intensive process. Program supporters must be patient and willing to work collaboratively with local groups.
- Ensuring that stakeholders and partners have a thorough understanding of natural resources and their complexities and potential changes that occur over time.
- Fostering accountability and responsibility, by establishing mechanisms, such as public posting of information on resource allocations, broad representation in local institutions, and requiring external audits of community organizations.
- Avoiding overly complex management and administration systems, or capital and technical inputs that can overwhelm the capacity of local institutions

Box 5.11 Potential investments

- Government policy formulation.
- Capacity building for community organizations and local government.
- Development of community management plans.
- Rural investment funds for community projects.
- Detailed environmental communication strategies and research and extension support.
- Baseline studies and comprehensive monitoring and evaluation systems.
- Training for local stakeholders.
- Assistance to local organizations in obtaining legal status and legal recognition of traditional resource use rights.
- Enforcement systems to reduce illegal resource use.

Source: Authors

Policy. A sound legal framework for local institutions is necessary to enable them to enter into contractual agreements, collect fees, levy sanctions, access loans for investments, and own and manage property. Investments must strengthen resource use, access, and ownership rights, including, as appropriate, intellectual property rights. Effective enforcement of rights to resources relies on sound arrangements for checks and balances, pluralistic approaches, and conflict management.

Technical. CBNRM programs should avoid dogmatic approaches and “technology packages,” and rather seek alternatives adapted to diverse agroecological and cultural contexts. Demand-driven research/extension services and programs that foster innovation and adaptive NRM and social learning, are needed to develop location-appropriate

technologies. On-farm research and socioeconomic research support CBNRM, while farmer-to-farmer extension and farmer group approaches contribute to efficient and effective extension service delivery. These approaches often need to be complemented by general environmental education.

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<p>This investment note was prepared by Timothy Donnay (USAID) and Jaime Webbe, with input from the Natural Resources Management Thematic Team of the World Bank.</p>

Watershed Management for Agricultural Development

Watershed management harmonizes the use of soil, water, and vegetation in the watershed area to increase agricultural productivity and conserve natural resources. Conservation measures include revegetating barren land to assist in the control of runoff; introducing sustainable agricultural practices for hilly areas to improve soil and water management; and constructing water reservoirs for irrigation. Watershed management often requires collective action among diverse stakeholders, among whom costs and benefits may be distributed unevenly. Accordingly, watershed investments must rely on people with the experience, incentives, and skills to organize stakeholders. Complementary investments may be needed to improve access to agricultural inputs and services (seedlings, veterinary services, land titling, and so forth) and output markets (processing facilities, roads).

Rainfed agriculture in much of the world is characterized by low yields, low and declining soil fertility, severe soil erosion, and low investment in land improvement. Soil and water conservation efforts have treated these problems in a piecemeal manner and have failed to capture synergies among various components of a watershed system. As a result, development efforts are often threatened by deteriorating environmental conditions in the watershed area, due in part to inappropriate resource use and increasing population pressures.

Key Investments in Watershed Management

Watershed management seeks to make the best use of soil, water, and vegetation within the constraints of a watershed's agroclimatic and topographic conditions to strengthen the natural resource base (soil, vegetation cover) and to increase agriculture productivity, thereby improving peoples' livelihoods. Watershed management strategies vary. For example, in dry areas, increasing water availability raises potential returns, making the land more attractive to investment; in areas with short, intense rainy seasons, watershed management harvests water in surface reservoirs; and in areas with excess moisture, facilitating safe runoff through contour plowing or drainage systems reduces waterlogging and erosion. New modeling tools coupled with more precise spatial and temporal impacts of land cover and land-use changes on water flows are providing new information to guide managers and policy makers (box 5.12). Investments in technology, social institutions, and markets are frequently needed to maximize the impact of improved watershed management.

Technical investments. Soil conservation, water harvesting, increasing vegetative cover, and safe disposal of excess water are basic watershed management technologies. In dry areas the focus is on water harvesting (capturing rainfall otherwise lost to runoff), whereas in wet areas it is disposal of excess water. In many upland watersheds in seasonally water-scarce areas, upper catchments are often degraded lands used for grazing, gathering firewood, or cultivation (often on unproductive plots). Lower watershed areas typically contain better agricultural land. Harvesting water from the upper catchment areas makes it available for irrigation and other uses downstream.

Irrigation can transform agricultural systems from single-season, rainfed cropping with livestock subsisting on degraded grazing land, to multiple cropping of irrigated land, cash crops, and intensive livestock production (such as stall-fed dairy cattle). Watershed management technologies must be appropriate to local resource conditions, population densities, crop types, and institutional capacities, and they must ensure that poor people benefit (box 5.13).

Social institutions. At the community and national levels, watershed management improvements rely on the development of social institutions for the resource user groups for water, forests, and land, as these groups are key to most watershed programs. The groups also represent social capital formation that can have wide applicability in empowering rural people, enabling them to undertake additional development activities. Such groups must often deal with problems of unequal distribution of benefits in which downstream land users benefit at the expense of upstream land users.

Box 5.12. Are forests and reforestation beneficial for hydrology and groundwater recharge?

- *Do forests increase runoff?* Catchment studies show that because of increased interception, transpiration, and deeper rooting depth in forests compared with cropland or grassland, annual runoff is generally decreased under forests.
- *Do forests regulate flows?* Increased dry season transpiration but increased infiltration and, for cloud forests, cloud water deposition, may augment dry season flows. More and more evidence from catchments worldwide shows that most forests reduce dry season flows. Infiltration properties are critical in partitioning runoff. Effects are site-specific, so more research is needed.
- *Do forests reduce erosion?* Natural forest is associated with high infiltration rates and low soil erosion, but plantations may not show these benefits because of roads, ditches, and splash erosion. Forest canopies may not protect soil from raindrop impacts. More research is needed on species and drop size.
- *Do forests reduce floods?* Canopy interception of rainfall and increased evapotranspiration may reduce floods. However, forest management activities (roads, drains, soil compaction) may increase floods. Studies show flood prevention benefits for small events only in small catchments and little or negative benefit for large rainfall events. Studies in large catchments show no measurable effects on the frequency or magnitude of flooding.
- *Do forests improve water quality?* In general, forest water is of better quality than catchments under grazing or agriculture. Forest management rather than the presence of forests is critical for water quality. In environments where pollution is high, forest catchments and forest water may become acidified.

Source: Calder 1998

Box 5.13 India: positive and negative effects on poor people

If watershed management succeeds in expanding irrigated area substantially, demand for labor may rise sufficiently to raise incomes, thus benefiting the poorest people in a watershed community. The NGO Social Centre in Ahmednagar, India, offers several examples of such success. In Adgaon village watershed, annual employment rose from 75 to 200 days, and laborers' incomes rose above those of small-scale farmers. After four years of watershed management, laborers in Mendhwan could find employment eight months of the year, compared with three months of work previously. In Sherikoldara, landowners began to lease land to laborers rather than pay the high wage costs.

Watershed management also can make people worse off if it limits their access to uncultivated common lands on which they depend. A survey in 10 villages covered by watershed projects found that respondents' perception of benefits from the projects rose with landholding size. Landless people were much more likely to indicate that projects had harmed their interests, with the unanimous complaint relating to lost access to common of lands.

Source: WOTR 1999

Investment in markets. Sustainable watershed development relies on well-developed markets to give farmers incentives to invest in sustainable production systems, facilitate access to inputs, and increase agricultural productivity. Increasing productivity and decreasing marketing costs lead to increased profitability, which reduces the need for farmers to expand into marginal areas, such as steep slopes. Where market access is poor, watershed projects may need to invest in infrastructure and communications systems to improve access to input and output markets.

Policy and Implementation Issues

Unit of implementation. A watershed is defined by topographic boundaries. It may be much easier to implement watershed management projects, however, if the area is aligned to boundaries defined by human settlement patterns or political units. This alternative makes it easier for stakeholders, including women, to work collectively to establish and abide by new land-use patterns and to establish benefit-sharing mechanisms. Such action, which is difficult even within a village, is much harder when working across village boundaries. When small watersheds combine to form larger ones, good management of a large-scale watershed

will require harmonizing the use of water resources between small watersheds, not just within them. Projects in Northeastern Brazil have had considerable success with

Box 5.14 Brazil: microwatershed management

Microwatershed management is often chosen as an alternative to projects that include entire watersheds. Brazil's State of Santa Catarina Natural Resource Management and Poverty Reduction Project identified a number of reasons for this, including:

- Greater ease in measuring results.
- Stronger social cohesion within microwatersheds.
- More manageable size, compared to large watersheds.
- Greater ease in scaling microwatershed management projects to other areas such as downstream communities.

Source: World Bank internal documents

watershed management implemented at the community level (box 5.14). This decentralized approach facilitates the design of projects that reflect the needs and interests of local groups. Such community-based approaches are not always appropriate when watersheds extend over large areas with large populations.

Lag time for receipt of benefits. Watershed management investments are complicated by the fact that benefits are generated only slowly. Natural vegetation can take years to establish, and since watershed management aims to arrest all forms of degradation, some benefits may not even be visible. Under such circumstances, maintaining support requires active local involvement, avoiding high costs, and providing complementary funding (grant or loan) for income-generating activities, especially in the early stages of work. Projects must consider tradeoffs between cost and participation, because initial participation may be improved if costs are allowed to rise, but the initiative may prove to be financially unsustainable in the longer term.

Sharing of benefits. Watershed development can either help or harm poor people (box 5.15). Improved watershed hydrology that generates benefits largely for downstream water users may be successful only if upstream land users limit grazing and other activities, and this result requires the cooperation of everyone involved. One option to minimize this problem is to establish environmental service markets or other such mechanisms, so that benefits can be transferred from one group to another. For example, downstream water users would lease land from upstream landholders to take it out of production or limit the types of use. Under such circumstances, downstream users profit from increased water supplies and improved water quality, while upstream users receive compensation payments for nonuse. Such benefit transfers help ensure that everyone participates.

Box 5.15 India and Ethiopia: sharing benefits

Well-publicized watershed projects in India and Ethiopia provide good examples of how the benefits of watershed development can be shared with those who bear the costs.

- *In Sukhomajri village, India*, a project aimed at providing irrigation water from a small runoff pond. Landless families used the pond's catchment area for grazing, but the resulting lack of vegetative cover caused erosion that threatened the pond with siltation. To resolve this problem, villagers proposed that landless families receive rights to irrigation water in exchange for eliminating grazing in the catchment area. Irrigators paid for the water they used, with proceeds distributed equally among households regardless of landholding status.
- *The village of Echmare, Ethiopia*, on its own initiative, assigned degraded land to community members for the purpose of private tree planting. Everyone in the community was assigned a small plot under the condition that their rights would be revoked if they did not manage the land well. Results were quite positive. Participants managed their plots very well, tree survival rates were high, and household wealth increased. This experience demonstrates how harnessing private incentives can result in the achievement of broader social benefits.

Source: World Bank internal documents

Accessing social development skills. The design of social institutions to ensure that all land users support watershed investments is context-specific. Many government agencies responsible for watershed management employ only technically trained people, who are not well equipped to address social problems of watershed development. As many NGOs have strong social organization skills, it may make sense for government agencies to use these NGOs to implement projects.

Program coordination. Watershed development cuts across traditional administrative boundaries relating to soil conservation, forestry, irrigation, and agriculture, requiring coordination and involvement of these departments from the outset of a project. National or state governments must also harmonize planning with participatory planning and implementation at the local level. This approach helps to avoid duplication of effort and prevent conflict among localities about activities and objectives. Coordination among government agencies is often more difficult to achieve at the national or state/provincial level than at the district or local level, however.

Monitoring. Social and biophysical impacts of watershed management can be monitored to assess the usefulness of watershed management investments and identify the best approaches to management. Monitoring can range from using sophisticated instruments to collecting simple indicators involving various interest groups. Watershed management initiatives must build capacity and systems for routinely monitoring watershed conditions.

Lessons Learned

Conditions for success. Watershed development is most likely to succeed where agroecological conditions are conducive to major improvements in water management, where local people have the capacity to work collectively for the common good, and where markets are accessible. Watershed development involves long-term investments, requires a long-term vision within user groups, and requires that user costs remain low, particularly during the early stages of a project, to avoid discouraging local participation. Experience suggests that good management practices and social institutions must be undertaken at the small watershed level before taking steps to improve watershed management of a larger area.

Priority innovations. Water harvesting in dry climates and drainage in areas with good soils, but excess moisture, are likely to yield the greatest water management benefits. Projects that reduce soil erosion and incrementally raise the moisture content of soils in rainfed areas may find it more difficult to demonstrate the quick benefits needed to persuade producers to participate in programs.

Institutions. Some drawbacks may be associated with relying on NGOs to establish institutions at the local level. For example, such outsourcing may lead government agencies to fail to make staff investments in these skills and to take the outsourced work less seriously than the technical work, even though it is essential to project success. Contracted services may be restricted to a short period at the start-up of a program, even though the need may be ongoing.

Sustainability. Evidence suggests that farmers are more likely to maintain soil and water conservation investments when they contribute at least part of the cost, providing it is relatively low, and when conservation measures provide direct benefits. Ensuring that benefits from improved watershed management are equitably shared is key to ensuring that all stakeholders are willing to participate in project activities.

Recommendations for Practitioners

- Watershed management investments must be planned to fit local conditions and needs (box 5.16). Where upper catchments are denuded by overgrazing, firewood extraction, or cultivation, heavy soil erosion can cause siltation of water harvesting and storage structures, making the watershed investment unsustainable in these areas. Revegetating uplands is a high priority in such areas. In gentle sloping areas, investments may need to focus on increasing soil moisture. In high rainfall areas, better soil and water management can result in higher land productivity. On steep slopes, contour hedgerows reduce erosion and retain fertilizers and other inputs, thus raising yields. On flatter lands, use of furrows and drains reduces waterlogging and raises productivity.
- Projects may offer landless people employment, such as planting vegetation or constructing soil and water conservation structures, to compensate for their lost access to uplands. Such employment may not give them an intrinsic interest in watershed management, which is essential to long-term sustainability, if they lack incentives to maintain vegetative cover on upper watershed lands. Institutional mechanisms to share watershed benefits among all concerned users are preferable to only providing landless people with access to project-sponsored employment.
- If desired economic benefits are to be realized, watershed development programs must ensure the incentives and inputs needed to stimulate agricultural productivity.
- Developing cooperation between departments of soil conservation and agriculture and with other government agencies, although frequently difficult, is essential to planning and implementing effective watershed management programs.

Box 5.16 Potential investments

- Revegetation of pastures and forest areas based on a conservation plan agreed to by all stakeholders.
- Development of social institutions to support revegetation and eliminate future denuding of pastures and forests, particularly by ensuring that everyone benefits from revegetation.
- Soil conservation and water harvesting infrastructure.
- Environmental monitoring systems to determine changes in water availability, moisture levels, soil erosion, and vegetative cover, coupled with livelihood monitoring systems to identify those benefiting and those hurt from watershed management efforts.
- Extension services to introduce profitable new cropping systems and conservation measures and environmental education to ensure that local people understand the potential economic benefits of watershed management.
- Infrastructure improvements such as roads, bus service, communication.
- Improved access to credit and input and output markets for crops and livestock.

Source: Authors

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Agroforestry Systems

Agroforestry has long been recognized for its potential as a stable and sustainable production system and for its potential contribution to broader agricultural systems. Agroforestry can extend the amount of time that a given area can be productive, improve livelihoods, and contribute to forest and biodiversity conservation. Constraints to agroforestry systems include high interest rates, unclear institutional responsibilities, limiting policy frameworks, poorly developed markets, and inadequate research and extension. Support to agroforestry needs to address this broad range of issues, within flexible program designs.

Agroforestry investments present opportunities to address NRM and agricultural needs through on-farm and off-farm tree production (box 5.17). Agroforestry investments have been accepted as an appropriate investment area for many years, and they frequently are combined with other rural development activities. Generally, agroforestry investments aim either at ensuring environmental sustainability through the conservation of soil or forests or at reducing poverty by generating new income opportunities.

Agroforestry Investments

Agroforestry investments can take one of two forms: simultaneous agroforestry, in which trees are intercropped with crops or livestock, and sequential agroforestry, in which trees and crops are rotated. There is a broad range of specific investment choices representing different agroforestry technologies, including:

- *Boundary planting.* Trees are planted as living fences along field borders to provide fodder and limit soil erosion and water runoff.
- *Hedgerow intercropping.* Leguminous, nitrogen-fixing trees are planted in rows, interspersed with rows of crops in areas where fallow periods are not possible.
- *Parkland system.* Trees and crops are grown together, with trees acting as a permanent upper canopy providing shade or protection from wind.
- *Silvopastoral system.* Trees are planted on pastureland to provide shade and forage for grazing livestock.
- *Home gardens.* Trees are planted for productive purposes within small plots with other crops, including vegetables, fodder, grains, herbs, and medicinal plants.
- *Multistrata system.* Trees and crops are interplanted with multiple tree species maturing at different rates and occupying different canopy positions.
- *Improved fallow.* Tree species are planted either just before or just after crops have been harvested in areas entering a fallow cycle.
- *Taungya system.* Trees are intercropped with other crops until the trees become mature, at which point cultivation of the other crops is abandoned.

Box 5.17 Agroforestry defined

The World Agroforestry Centre defines agroforestry as “a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels.”

Source: World Agroforestry Centre

- *Relay cropping.* Trees and crops are planted together with planting dates staggered such that crops mature before trees become very large at the end of the rainy season.

Agroforestry technology investment choices balance forestry and agricultural production and conservation and production goals. Agroforestry is not appropriate in all areas, however, because trees take up space on a more-or-less permanent basis and may compete with crops for water, sunlight, and nutrients, thereby limiting crop production.

Benefits

Poverty reduction. Agroforestry projects can reduce poverty directly by providing lumber, fuelwood, fruit and nuts, and livestock fodder, all of which can be sold to generate income or fulfill basic family needs (box 5.18). The sale of timber is particularly important to poverty reduction, as returns are long term. Indirectly, agroforestry can increase crop production and incomes through conservation of soil and soil moisture.

Reducing vulnerability. Agroforestry has long been a traditional coping mechanism to reduce production-related risks, particularly during times of drought or crop failure. Trees store biomass during good production seasons and, when annual crops fail, can be harvested to provide income to purchase food and other needs.

Environmental sustainability. Agroforestry is associated with positive environmental outcomes because of the role trees play in larger ecosystem functions. Trees can improve soil quality in various ways: root systems prevent soil erosion, leguminous species fix nitrogen and improve nutrient recycling, and detritus from trees increases the organic content of soil. Well-developed agroforestry systems provide habitat for wild animals and contribute to biodiversity. Agroforestry affects climate change by storing carbon and offsets deforestation by providing an alternative source of wood products. Finally, agroforestry can act as a buffer between protected forests and surrounding agricultural land and minimize edge effects in natural forests.

Box 5.18 Benefits of agroforestry

- Agroforestry plantings in Indonesia currently harbor 50 percent of the plants, 60 percent of the birds, and 100 percent of the large animals that normally would be found in a natural forest.
- Cocoa agroforestry in Cameroon conserves 62 percent of the carbon found in a natural forest and contains a plant biomass of 304 tons per hectare (compared to 85 tons per hectare in crop fields).
- In Southern Africa, improved fallow agroforestry systems (including species such as *Sesbania*) add soil nutrients equivalent to approximately US\$240 worth of chemical fertilizers per hectare.
- In Burkina Faso, the planting of live fences (including *Acacia nilotica*, *A. senegal*, and *Ziziphus mauritiana*) has increased farm incomes by US\$40 per year.

Source: World Bank 2002; Adesina et al. 2001; Sanchez, Izac, and Scott 1999

Policy and Implementation Issues

Land tenure. Because agroforestry requires a long-term investment, with benefits delayed by three years or more, farmers must be willing and able to invest in medium- to long-term land improvements. Where land tenure is not legally established, landholders will seldom commit to long-term land improvements. Land tenure issues are complex, but they must be addressed if agroforestry is to be promoted as an investment.

Market access. Agroforestry's contribution to poverty reduction is dependent on people's access to forest product markets. Market access can be improved through construction of roads, development of farmer organizations to increase the bargaining power of producers, or negotiation of contracts between farmers and larger forestry companies. Market analysis is essential to assess suitability of tree species as cash crops (box 5.19).

Box 5.19 China: Sustainable Forestry Development Project

The China Sustainable Forestry Development Project strengthens monitoring of markets for both forest species and fruit trees. Product market and price information is stored in a database used to project trends in market prices and aid in selecting species for future plantings. Market monitoring will help to avoid flooding the market with products of one tree species, while ensuring that producer groups are able to make harvesting and marketing decisions to obtain the best return on their agroforestry investments.

Source: World Bank internal documents

Gender. In the many situations where it is women's responsibility to gather fuelwood and tend household gardens, agroforestry can give women more control over a productive resource. In other cases, where men exert traditional ownership rights over trees, they may not have control over the use of agroforestry products or proceeds from their sale. Gender issues, and the site-specific factors that affect them, should be addressed by gender assessments to ensure equitable access to agroforestry benefits.

Monoculture plantations and pests. Monoculture plantings are often a pragmatic choice in agroforestry, simplifying the provision of planting materials and technical recommendations and responding to demands for higher-value species. However, single-species plantings are vulnerable to pest attacks. Prudent planning requires a technically sound assessment of pest risks for any agroforestry program.

Lessons Learned

Participation of poor people. Care needs to be taken when designing an agroforestry activity to ensure that vulnerable groups are not excluded, especially the landless poor and people with poorly defined land rights. Inclusive implementation mechanisms need to be incorporated into the activity to enable the sharing of benefits and the encouragement of democratic approaches to decision making in the community.

Species selection. Appropriate species selection is important and varies by location, depending on agroclimatic conditions, markets, and farmer experience. Species selection should also be coordinated across areas to ensure that the market is not flooded following overproduction of a single species. Agroforestry can have other negative effects on surrounding ecosystems if non-native tree species spread beyond the farm boundaries. Where such risks are substantial, agroforestry programs should consider the use of native species instead of exotic trees.⁴

Policy framework. The policy and regulatory framework must ensure that agroforestry products are marketable. Many governments have enacted limitations on the sale of timber to curb illegal logging. These limitations can result in small-scale farmers either being prohibited from selling timber and fuelwood or being harassed and forced to pay informal “fees” to do so. Policies can support agroforestry production by establishing certification systems or easing restrictions on sales of certain, noncritical species.

Institutional base for agroforestry. Government agencies (forestry and agricultural ministries) need to clarify roles and responsibilities, since agroforestry incorporates aspects of both agriculture and forestry. Local NGOs can be effective in disseminating agroforestry technologies and in market development (box 5.20). Building capacity in producer organizations can strengthen the marketing abilities of small-scale producers and provide a base for long-term sustainability of both small-scale producers and their organizations.

Box 5.20 Brazil: The Agroecological Laboratory of the Transamazon Highway

The Agroecological Laboratory of the Transamazon Highway is a Brazilian nongovernmental organization (NGO) that seeks to fill a gap in extension services by addressing both agricultural and natural resource management issues (such as agroforestry). The NGO brings together different actors, including researchers, other NGOs, small-scale farmers, and farmer organizations to facilitate the exchange of agroforestry information, and it has also helped to establish a commercialization center for negotiating contracts between agribusiness and small-scale agroforesters.

Source: Authors

Technical support. Agroforestry technologies tend to be highly location-specific, requiring demand-driven adaptive research and extension services that can draw on local knowledge, address different user group problems, and provide incentives for work on the real problems of farmers. Demonstration plots have proven to be effective in promoting agroforestry technologies, and farmer-to-farmer extension has worked well in incorporating local knowledge into programs. Formal training programs and workshops are needed to train extension staff and community leaders, and an effective information dissemination strategy for agroforestry projects is necessary. At another level, better integration of agriculture and forestry programs in universities can be beneficial.

⁴ See the IAP, “China: Commercial Plantations to Help Conserve Forests.”

Private sector roles. In general, private sector entities such as nurseries and forest product manufacturers are more efficient than the public sector in supplying services such as marketing contracts and inputs. With their emphasis on profit, however, private manufacturers are likely to contract with large agroforestry producers whose economies of scale enable them to be more efficient producers. This situation presents problems for small-scale farmers who lack bargaining power and who may be less efficient producers.

Community-based agroforestry. With agroforestry activities on communal lands, the community's collective management can provide advantages of economies of scale, minimize individual investment costs, and provide equitable distribution of benefits. One drawback of community management is that often the advantages of individual management are lost, such as more timely and responsive decision making and lower transaction costs. To be successful, community-based agroforestry must be supported by a strong institutional base and conflict resolution processes. Decentralizing control over resources and establishing institutions for farmer participation can help to facilitate community management. Community action can be a means of introducing a new resource management system, such as forest certification, which increases the value of timber products. This strategy is widespread in Mexico, where 70 percent of forests are owned by communities.

Monitoring and evaluation. Monitoring and evaluation are important to support flexible program management. Mapping technologies such as geographical information systems (GIS) provide information on program impacts, including land-use changes and environmental conditions, and feedback from farmers on knowledge, attitudes, practices, and income relating to agroforestry activities, markets, and benefits is critical to refining the technologies used and the management of the program.

Recommendations for Practitioners

Agroforestry investments require flexible design and must focus on markets, adequate technical support, and attention to financial sustainability (box 5.21). Reviews repeatedly emphasize the importance of agroforestry investments being flexible and responsive to the demands of local producers. Projects should generally:

- Build capacity in NGOs, line ministries, producer organizations, and the private sector to develop or strengthen local networks for transferring information.
- Assign adequate resources for research and extension.

Box 5.21 Potential investments

- Community nurseries to provide seedlings.
- Demonstration plots, in-country study tours and workshops, and development of farmer-to-farmer extension networks.
- Adaptive research on agroforestry technology, markets, and social issues.
- Capacity building in farmer organizations, NGOs, government, and the private sector.
- Marketing studies/strategies.
- Assistance with improving access to credit.
- Establishment of production databases and land-use mapping.
- Facilities for postharvest processing.

Source: Authors

- Facilitate access to credit that takes into account the unique characteristics of agroforestry, especially the time required to realize returns on investment.
- Supply reliable and high-quality seed stock through local nurseries or cooperation with the private sector.
- Facilitate market access through road building and/or maintenance programs.
- Promote security of land tenure rights and the ability of farmers to benefit from their agroforestry investments.

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This investment note was prepared by Jaime Webbe, with input from the Natural Resources Management Thematic Team of the World Bank.

Pastoralism on Arid and Semiarid Lands

On arid rangelands used by pastoralists, NRM is important to environmental and social sustainability, especially in Africa and the Middle East. Poverty is often acute in these areas, where population pressure can lead to overgrazing and conflicts over land use, further accentuating problems of natural resource degradation and economic vulnerability. Early donor support for range livestock development failed because it did not take into account local social, economic, and environmental conditions. More recent interventions have taken more of an NRM approach, working with herder organizations and using participatory approaches. Public investment is essential to improve public services and policy frameworks, strengthen local institutions, and improve management of rangeland resources.

Sustainable use of rangeland resources remains a key issue in many developing countries. At least 10 million square kilometers of the earth's land surface is categorized as arid or semiarid rangeland. These areas directly support about 180 million people living in close association with about 960 million ruminant livestock. Social deprivation is acute in these areas, which are among the most degraded in the world.

Sustainable Pastoralism

Pastoral systems use free-ranging or grass-fed animals as the principal means of utilizing natural range and grasslands. Grasses and woody plants (browse) provide feed for animals, but overgrazing reduces productivity and can make land susceptible to erosion or weed infestation. Incomes from pastoral activity also decline. The sustainability of pastoral systems is also threatened when rangeland is converted to cropland, because much rangeland is marginal land, susceptible to accelerated resource degradation. Improving the sustainability of pastoral livelihoods depends on ensuring access to the land suited to pastoral systems and requires that pastoralists have the knowledge and resources to manage land sustainably. Pastoral systems differ in certain key features:

- *Mobility* is a common feature, though it varies in range, seasonality, and links between movements of people and livestock. Nomads, for example, move as whole families with their livestock; transhumance pastoralists move livestock according to set seasonal and geographic routes; and other pastoralists are sedentary or semisedentary.
- *Livestock species* associated with pastoral systems are determined by the environment, local culture and traditions, and required functions (meat, milk, transport).
- *Economic orientation* of land use for subsistence or market activity will significantly influence management practices.
- *Social-territorial organization* describes pastoralists' relations with markets, settled agriculture, and nonpastoral communities, all of which are shaped by customary ethics, environmental factors, and accumulated management experience.

Benefits

Poverty is often endemic in arid zones. Poverty can be reduced by producing marketable products such as meat and wool and adding value to them through meatpacking and yarn production. Inequality can also be reduced if poor people can participate effectively in such activities. If climatic conditions permit and some diversification of economic activities can be introduced, it will reduce pastoralists' dependence on only one economic activity and their vulnerability to economic loss, especially if drought occurs.

Environmental benefits from sustainable management of pastoral systems result from the reduction of overgrazing, which causes the loss of browse and desirable grasses, spreads weed species, erodes soil, and leads to the deterioration of key resources, such as water sites, salt licks, and bottom lands. Sustainable pasture management prevents loss of plant and animal biodiversity and negative livestock-wildlife interactions. The role of grasslands as a storehouse of carbon makes them potentially important in efforts to mitigate global climate change, and carbon sequestration may provide a future income opportunity through transfer payments.

Policy and Implementation Issues

Population pressure. A growing population will add pressure to the resource base and can greatly affect development of a sustainable pastoral system. For this reason, agroecological assessments must embrace the entire system and projected changes over time. Assessments should cover population, especially numbers of people and animals; household indicators of wealth and well-being, such as herd or flock size; and social support mechanisms, such as extended family or tribal obligations. Environmental indicators should include the condition and health of the resource base, particularly for key resource areas such as flood plains, bottom lands, and drought refuges, which are important in more arid zones.

Enabling policies. Policy issues that have affected or currently affect sustainable pastoral development include:

- *Exchange rate policies.* The 1994 devaluation in the CFA countries of francophone West Africa affected livestock prices.
- *Trade policies.* Open trade regimes are generally desirable but can result in imports of food, such as meat, with negatively effects on local production.
- *Crop input prices.* If governments support agriculture with price policies that favor crop production to the disadvantage of pastoral systems (as has been the case), then crop production can encroach considerably into marginal range areas.
- *Feed subsidies.* If governments provide subsidies in general or to cover losses from drought, they may have detrimental environmental effects on range areas and raise equity issues.

Land tenure and laws. Pastoralists often graze animals on land that is owned by the state but whose use is actually governed by a complex interaction between customary institutions and their rules, and national law. Land tenure laws become important to

protect pastoralists' rights when pastoral land is sought by outsiders for pasture or other uses. In arid regions, land and water rights must be dealt with together, as pastoralists may have to compete with cultivators or urban dwellers. Laws are important in providing pastoralists with a legal basis for access to and control over their lands, but laws and tenurial systems are often quite complex and may differ between adjacent countries through which pastoralists move. Familiarity with both customary and formal land law, especially their relative effectiveness, is necessary in preparing for investments in pastoral systems. Key questions involve the types of local organizations recognized under law and the possibility of recognizing the authority of traditional leadership.

Project strategies may differ: in some cases, it may be possible to define exclusive areas for grazing by pastoralist communities; in other situations, it may be better to maintain the traditional flexibility that allows groups to renegotiate grazing territories according to the year's rainfall. The subdivision of pasture among individuals or families has not worked well in most pastoralist situations.

Social services. Pastoral areas are usually among the worst-served parts of any country in terms of basic social services. Mobile services tend to be preferred over fixed facilities. Health services usually separate human and animal health, even where there is little reason to do this. While literacy programs are increasingly important, because more responsibility passes to literate community members, investment is also needed in general and technical education. Deficiencies in communications and transportation infrastructure remain major constraints to the development of input and output markets for pastoralists' products.

Institutional arrangements. Technical services (such as extension, research, animal health, and water supplies) and financial services (such as marketing, banking, and credit) are key to improving pastoralists' livelihoods. Institutional options for delivering these services include either allocating responsibilities to local government or developing the capacity of communities to deliver these services. The balance between public and private responsibilities is defined by the type of good or service to be provided (table 5.2). The present trend is toward devolution of service delivery to the private sector, with central government focusing on formulating policy and providing infrastructure.

Lessons Learned

Analysis of the pastoral system. The design of effective interventions depends on an understanding of the integrity of the pastoral system as a whole and of the pastoralist's rationale for mobility or reduced mobility in the pastoral system. Analysis of the overall system should consider the roles of livestock, access to resources and decision-making processes, likelihood of drought, population changes, trading systems, and equity issues.

Information needs. An adequate information base (including databases characterizing the project area, field appraisals, and special studies) is essential to design sound investments in pastoral systems. Investments in pastoral systems require information on the entire area used by a pastoral population, including all seasonal grazing areas and drought reserves.

Table 5.2 Activities and responsibilities in support of pastoral development

Support area	Activity	Implementing responsibility
Policy framework	Strategy for resource use, policy statements, legislation, advocacy for national pastoral organizations	Central government with the possibility of contracting out some technical assistance
Environmental conservation	Tree planting, wildlife management, alternative fuels/stoves, fire control	Private sector with local government and community involvement
Drought management	Early warning systems, contingency measures, recovery measures, insurance	Central/local government, with essential contributions from pastoral communities and possibly from traders and banks
Basic infrastructure	Physical infrastructure, institutional framework	Central/local government
Social services	Health services, primary education, adult literacy	Central/local government support for private services; public inputs for vaccination and other public goods
Technical services	Extension, credit, animal health services, water supply systems, marketing support, agronomic inputs	Private provision of credit and technical services subcontracted by the public sector as required; local government and producers can manage extension
Institution building	Counseling/training	Local government and national and regional herders' federations

Source: de Haan, Pratt, and Le Gall 1997

Herder organizations. Herder organizations can manage communal resources and coordinate members' management of their own household resources, facilitate grazing and water management, secure territorial rights, resolve conflicts, and provide services such as animal health, borehole operation, and marketing. Development of herder organization requires a three-step approach: (1) understanding existing social-territorial organizations; (2) formulating development objectives; and (3) identifying or establishing associations that build on customary institutions.

Market development. Herders frequently lack access to formal markets and the capacity (relating to production, marketing and inputs) to supply these markets. Improving market access requires public and private investments in market infrastructure (communication and transport systems, cold-chain facilities), systems for certification of grades and standards, policies and regulations that facilitate trade, and technical services to improve product quality.

Drought management. Drought is a natural feature of arid and semiarid areas, and projects need to be designed with drought management consideration permeating all

components, or with a separate drought management component (box 5.22). Investments should provide for drought preparedness, customary drought strategies, drought management capabilities, and drought recovery assistance.

Box 5.22 Kenya: drought management for pastoralists

The arid lands of northern Kenya are home to around one million pastoralists, most living below the poverty line. Herders practice opportunistic grazing management to take advantage of the unpredictably variable ecology. Growing pressures on rangeland resources and the lack of legal recognition of pastoral land rights are undermining customary arrangements for regulating resource access, control, and management. The Kenya Arid Lands Resource Management Project institutionalizes drought mitigation and management tools, including a drought early warning system, marketing outlets for livestock and livestock products, infrastructure, and community development subprojects to promote alternative livelihood strategies. The project develops institutional mechanisms for managing all phases of the drought “cycle,” including preparedness, mitigation, and recovery.

Source: Bruce and Mearns 2002

Technical inputs. Technological interventions require an understanding of how inputs interact within a holistic system that considers market and economic interactions, social impacts, and the institutional base. New inputs (such as fencing), new breeding stock, pest control, and pasture improvement all require management systems that use them effectively, such as supplementary feeding, breeding management, marketing, and grazing practices. Investments in processing innovations can improve market access and generate new employment opportunities.

Process monitoring. Pastoral system development projects often need to emphasize a “process” approach that enables managers to make adjustments as the project proceeds. A sound management information system must have data collection procedures and performance indicators for ecological, socioeconomic, and institutional changes and must ensure that objectives and perspectives of all project stakeholders are reflected.

Recommendations for Practitioners

Participation, flexibility, and sustainability must be incorporated into project design to support the development of economically, socially, and environmentally sustainable systems. Thus pastoral development investments (box 5.23) must:

- Consider the pastoral system as a whole, assessing its potential to provide a basis for sustainable livelihoods but recognizing inherent limitations.
- Improve baseline knowledge of pastoral systems and their environments, developing a comprehensive understanding of resources, resource users, and the geopolitical system in which they operate.
- Develop mechanisms to ensure feedback from project implementation experience to design of future program activities.

- Strengthen existing pastoral institutions to minimize dependence on external inputs and enable them to undertake activities on a sustainable basis.
- Promote market development to use available resources most efficiently.
- Ensure adequate provision of technical inputs and knowledge relating to pasture and livestock management, grazing practices, and drought management.

Selected Readings

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Box 5.23 Potential investments

- Policy studies and policy formulation.
- Land tenure laws and dispute resolution.
- Information systems, databases, and mapping of pasture conditions and soil erosion, using remote sensing, field surveys, and other methods.
- Herder association strengthening and training.
- Animal health service provision systems based on paravets and private veterinarians.
- Livestock markets, marketing systems, and market information services.
- Drought monitoring and preparedness.
- Diagnostic studies of social systems and traditional management systems.
- Research on pasture and herd management and use of alternative feedstuffs.

Source: Authors

This investment note was prepared by Gary Alex and Francois Le Gall, based on the World Bank Agricultural Technology Note, "Investing in Pastoralism," and input from the Natural Resources Management Thematic Team of the World Bank.

Integrated Livestock-Wildlife Management

Differing objectives of biodiversity conservation and rural livelihood improvement have at times led to competing land-use options. Agricultural cultivation or intensive livestock grazing up to park boundaries has led to conflict when wild animals damage crops and property and transmit diseases to livestock. The integration of wildlife with extensive livestock management can bridge potentially conflicting interests. Integrated livestock and wildlife management (ILWM) offers potential benefits by mainstreaming sustainable biodiversity conservation in rangeland management. ILWM can create alternative sources of income from livestock ranching and reduce land degradation. Game or mixed game and livestock ranching can provide higher and less volatile returns than livestock ranching in arid and semiarid landscapes.

Conventional livestock farmers in arid and semiarid areas often have problems due to dry and unpredictable climates, infertile soils, tick-borne diseases, and limited support services. Wild game species are better adapted to harsh environments than livestock, as they are adapted to heat stress, water shortages, and endemic diseases and can feed on local vegetation. Game, which includes browsers and mixed feeders as well as grazers, is less affected by bush encroachment in rangeland, a phenomenon resulting from overgrazing, droughts, and land degradation. Extensive livestock husbandry in an integrated wildlife-livestock environment maintains habitat for wildlife and can improve overall rangeland productivity.

There is growing recognition of potential complementarities between wildlife protection and extensive livestock production systems, if these systems are well managed. Wildlife and livestock are generally more compatible than wildlife and crop agriculture, and both can thrive in arid and semiarid rangelands. In areas with variable rainfall, livestock and wildlife resources have a competitive advantage over crops.

A driving force for ILWM is the profitability of game and mixed game/livestock ranches, particularly in arid and semiarid landscapes in Africa, as livestock ranchers move into game ranching to reduce their exposure to a volatile market and extreme climatic conditions. South Africa now has 5000 game ranches and more than 4000 mixed farms (box 5.24) (ABSA 2003).

Another driving force behind ILWM is the recognition that there are opportunities for conservation and sustainable use of biodiversity within the productive landscape. In countries with large wildlife populations outside protected areas (for example Namibia, South Africa, and Botswana), ILWM approaches offer the opportunity both to conserve wildlife and confer socioeconomic benefits—especially as wildlife areas and extensive rangelands all over Africa are under pressure from human population growth, deforestation, and agricultural expansion. Wildlife and livestock are being pushed onto marginal lands, arid rangelands, and buffer zones around protected areas. Competition for access to water and grazing areas, especially in the arid rangelands, increases with seasonal influx of migratory species as the dry season progresses and as the diversity and quantity of grasses decline.

Box 5.24 South Africa: profitability of game ranch management

Profits from game ranch management depend on sufficient critical mass, a large diversity in wildlife, stocking with rarer animals, an emphasis on ecotourism, and a natural equilibrium between carnivores and prey animals. Game ranching is sensitive to economies of scale. In South Africa, very small game ranches (below 150 large stock units—LSU) struggle to be economic, while medium-sized hunting ranches (around 600 LSU) on average obtain an annual return of 9.1 percent on the capital invested. Although up-front capital investments (land and fencing, game/cattle, buildings and infrastructure, vehicles, and operating costs) are lower for cattle farming than for game ranching, cattle farming is rarely economic below a production size of 400 LSU. Even large farms (1,000 LSU) usually do not exceed annual returns of 4.5 percent on capital invested (compared with 10.3 percent for a game ranch of comparable size). Hunting or professional game-capturing for sale of game at auctions increases the profitability of game ranches. Game ranching can further increase profits and create job opportunities for skilled and semiskilled labor, if combined with ecotourism.

Source: ABSA 2003

Benefits

Efficient management of domestic and wild stock can increase incomes and reduce livelihood vulnerability. Traditional practices of maximizing the number of cattle have changed where revenue from wildlife has become an important alternative to livestock. Wildlife can provide a steady income during times of drought or floods (Boyd et al. 1999) and provide varied economic benefits:

- *Harvest and export of wildlife meat* can provide substantial income, as long as sanitation and hygiene requirements are met. Wildlife meat is important for personal consumption and for sale. Close monitoring of wildlife harvest areas is necessary to avoid overharvesting with its effect on wildlife numbers.
- *Trophy hunting* provides income from fees that professional hunters and their clients pay to hunt and camp. About 6,000 trophy hunters visit South Africa annually, spending on average US\$6,000 on fees, not including the price for trophies hunted (ABSA 2003). Overhunting and diversion of funds may occur with trophy hunting, so adequate safeguards must be in place to avoid these problems.
- *Fees for capture permits for wild animal trappers* who sell game to zoological gardens, game parks, and wildlife management areas provide another income possibility.
- *Wildlife tourism* is becoming more popular (box 5.25). Although the average hunter spends more than four times as much as the ordinary tourist, far more tourists can be accommodated than hunters. The main income for larger-sized game ranches is from tourism (ABSA 2003). In Kenya, wildlife tourism generates more than 100 times more revenue than all other wildlife businesses together (Ashley and Elliott 2003).

Box 5.25 Tanzania: wildlife policy

The Wildlife Policy in Tanzania aims to empower local communities to establish Wildlife Management Areas (WMAs), which are managed to obtain benefits from wildlife conservation outside protected areas in addition to livestock. The WMAs are defined as “areas declared by the Minister to be so and set aside by village governments for the purpose of biological natural resource conservation.” Communities may lease trophy hunting or game viewing concessions to tourist outfitters or may engage in hunting. As part of the process of establishing a WMA, village assemblies must pass a resolution and develop a village land-use plan based on a sound resource survey and approved by the District Council, the regional authorities, and the line ministry.

Source: Shauri 1999

A critical mass of conservation areas can have a synergistic marketing effect as an area becomes known for wildlife tourism and the total number of visitors grows. It can also have a positive impact on stocks of rare species, as competition among enterprises for tourists, based on the diversity of wildlife, has encouraged the breeding of rare species such as rhinoceros, giraffe, and oryx and fuelled a market for translocation this game.

Policy and Implementation Issues

Removing barriers to ILWM. The most critical problems of mixing wildlife and livestock are disease transmission, competition for forage and water, and predators. Profitable ILWM generally requires establishment of animal health service centers, extension services, and early warning systems based on disease and pest monitoring. Private ranchers are likely to use animal health extension service systems, while pastoralists, such as nomads and transhumance herders, are more likely to benefit from community-based, low-input veterinary support service units. Some problems can be reduced if locally adapted breeds are the main livestock rather than high-producing but exotic breeds, because disease and parasite transmission are likely to be reduced. Damage by predators and other “problem animals” can be minimized by fencing off homesteads and gardens, killing problem animals, and locating community areas away from known game trails and watering points.

Encouraging acceptance of ILWM. As wildlife contributes to the economies of many countries through hunting or ecotourism, it is important that this contribution is recognized by all, but especially farmers and rangeland managers. Local governments, communities, and private landowners need an understanding of the trade-offs involved for people and for wildlife conservation under different land-use scenarios. Individual farms or communal group land often may not be sufficiently large for profitable game or mixed game and livestock management, but, as in southern Africa, adjoining private farms and communal groups can organize and operate under comanagement agreements for ILWM to conserve biodiversity and realize sustainable profits (box 5.26).

Capturing benefits for rural poor people.

In extensive rangelands that are larger than national parks and reserve networks, wildlife and livestock can coexist. Wildlife do exert a “cost” on livestock production, competing for food and water and becoming predators and possible pest and disease transmitters. These costs to rural communities need to be offset by benefits from wildlife, most of which currently flow to government and the largely foreign-owned private sector. In some countries, transfer of wildlife management rights to communities has established a basis for them to benefit. For example, safari hunting, ecotourism, and commercial ranching for meat, hides, and live sale provide opportunities for improving rural livelihoods and meeting conservation and development objectives.

Box 5.26 Key criteria for profitability of game ranching

The following criteria and costs need to be taken into account in estimating potential returns prior to establishing a game ranch:

- Minimum ranch size required for specific game.
- Purchase and selling price of game.
- Additional expense of fencing to ensure that large and dangerous animals remain inside/outside a dedicated area.
- Operating costs, including disease management and food supplements during droughts on smaller farms.
- Infrastructure such as water provision, roads, lodges, and/or hunting camps.
- Abattoir facilities, vehicles, and housing.

Source: ABSA 2003

Payments for environmental services. ILWM might not always be the preferred land-use option, because rural communities or private landowners may consider that other forms of land use will provide better short-term returns, even though they may be unsustainable. If an area is important for biodiversity conservation, interested parties such as local conservation NGOs, government, and international donors may pay the community or landowner to maintain wildlife-compatible land-use practices. Such a compensation scheme provides income to the rural people who bear the costs of global biodiversity conservation but receive minimal direct benefits from wildlife (box 5.27).

Box 5.27 Namibia: “conservancy” policy

In Namibia about 75 percent of wildlife exists outside protected areas. An industry has developed based on consumptive and nonconsumptive use of wildlife. Wildlife management units called “conservancies” can be established on commercial and communal land. Conservancies gain rights to the use and benefits from wildlife and tourism concessions. They must be legally constituted and have clearly defined boundaries, defined membership, a committee representative of the membership, and a basis for equitable distribution of benefits to members. By 2003, 14 conservancies were registered, covering 38,500 square kilometers of land, and a further 30 conservancies were being formed. All have the objective of conserving and utilizing wildlife while integrating traditional livestock-raising activities. Despite the progressive nature of existing policies, a lack of secure group tenure still undermines conservancies’ ability to enforce zoning of areas for different land-use purposes.

Source: Namibia Ministry of Environment and Tourism

Lessons Learned

Benefits for pastoralists versus agropastoralists. Potential benefits from ILWM differ significantly for pastoralists, whose livelihood is primarily from livestock, and agropastoralists, whose livelihood is from integrated livestock and agriculture. The pastoralists' way of life is likely to facilitate ILWM, whereas conflict with wildlife is much higher for agropastoralists, as crops can be damaged and predators harm livestock. These circumstances may make it more difficult to introduce ILWM among agropastoralists, but they may also see its financial advantages because of their more secure land tenure and way of life, which facilitate the development of tourism.

New monitoring and data management tools. Ecological information models capable of tracking the full range of land-use options are important for long-term land-use planning and policy formulation at the local, regional, and national levels. Technology such as SAVANNA (Coughenour et al. 2000) also facilitates land-use planning, allowing the prediction of future range conditions, wildlife migratory corridors, livestock distribution, and populations and also. For wildlife conservation planning, it is very important to have the capacity to examine ecosystems that are under pressure for conversion into farmland and other uses that hamper wildlife conservation.

Recommendations for Practitioners

Establishing ILWM systems to conserve natural resources and improve livelihood options for rural people requires investment strategies to (box 5.28):

- Encourage wildlife-compatible land use by providing services necessary to improve pastoralists' incomes and by removing policy barriers to income generation from ILWM.
- Support participatory land-use planning by village councils or land-use planning forums representing all key stakeholders. Invest in strengthening institutional capacity at the community and local levels and providing technical support for resource assessments, planning, and monitoring of ILWM systems.
- Emphasize habitat management rather than species management.
- Develop markets for ecosystem services by establishing innovative payment schemes for maintaining ecosystem goods and services, such as habitat maintenance.

Box 5.28 Potential investments

- Development of policy and regulatory frameworks for ILWM.
- ILWM feasibility and baseline studies on ecosystem status and biodiversity.
- Development of models to support informed decision making at all levels.
- Support to participatory land-use planning.
- Institutional strengthening of community and local government levels.
- Sustainable consumptive and nonconsumptive wildlife use enterprises (ecotourism enterprise development, sport hunting, game cropping).
- Establishment of animal health centers and animal health extension services.
- Establishment of early warning systems for diseases and pests.
- Training in livestock marketing and upgrading of livestock marketing infrastructure.

Source: Authors

- Provide for holistic evaluation of ILWM systems with comprehensive impact studies measuring both environmental and socioeconomic impacts.

Selected Readings

Asterisk (*) at the end of a reference indicates that it is available on the Web. See Appendix 1 for a full list of Websites.

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This investment note was prepared by Nina Doetinchem and Cristophe Crepin, with input from the Natural Resources Management Thematic Team of the World Bank.

Brazil: Participatory Microcatchment Strategy for Increased Productivity and Natural Resource Conservation

Prior to the 1980s in Brazil, agricultural production increases were primarily the result of expansion in areas under cultivation. After 1986, the agricultural sector rebounded with intensified production so that by 1996, agriculture accounted for about 10 percent of GDP. This period left a legacy of deforestation and increased soil erosion, and questions about sustainability, specifically of soil productivity and water quality. In the state of São Paulo, 62 percent of total land areas is considered cultivable, although most soils are of moderate or marginal quality and declining productivity.

What's innovative?

Developing production and improve watershed health.

Project Objectives and Description

In 1986 the Government of São Paulo commissioned a study on the risks of erosion in the Peixe-Paranapanema River watershed. The findings emphasized the seriousness of sheet and gully erosion. The purposes of the Land Management Project were to increase agricultural production and farm incomes while ensuring the conservation of natural resources. Major components included:

- Technology and institutional development to increase awareness of natural resource management issues and facilitate participatory management of land resources.
- Adaptive agricultural research to provide technical solutions for soil conservation, integrated pest management, disposal of residual inputs, and crop diversification.
- An incentive program for sustainable NRM and conservation through community awareness building, the provision of grants for demonstration plots, and greater enforcement of land legislation.
- Training of extension agents and beneficiaries.

All of these interventions at the microwatershed level take advantage of geographical units of a more manageable size, linked by hydrological processes; stronger social cohesion within microwatersheds; ease of monitoring and measuring results; and ease of scaling microwatershed management projects to other areas, such as downstream communities.

The Technology and Institutional Development component finances rural extension, rural organization, and agroecological mapping at the microcatchment level. To change the crop-focused orientation of the extension system and farmers toward a microcatchment orientation, the project provides operational and technical guidelines and intensive training to all extension staff, including municipal and private extension workers.

Incentive grants are provided to farmers adopting sustainable technologies and practices that have a demonstration value. Groups of farmers may receive grants for collective purchases of specific farm implements for tillage and improved land management. They may also receive grants to construct water supply systems for agrochemical mixing points, which prevent the pollution of streams and water sources. Individual farmers may obtain grants for land management practices (such as contour farming and strip cropping, vegetative contours, bunding, and terracing), protective fencing along water courses, and seed of green manure crops.

Based on the results of a participatory socioeconomic and agroecological survey and on the agroecological maps produced under the project, project extension workers, together with the microcatchment beneficiaries, prepared a mutually-agreed Microcatchment Development Plan. The plan identified the principal agronomic and environmental problems and proposed solutions in the form of collective land and water management activities. The plan, which sets technical targets for all community works and farm-level interventions, is supported by individual farmland-use plans and by plans for collective activities. These are reviewed and approved by the Regional Microcatchment Commission and by the Project Coordination Unit.

Benefits and Impacts

So far, the project has produced important behavioral changes among technical staff, local governments, and project beneficiaries; supported synergies between project activities and other state and local initiatives; approved and implemented 310 microwatershed management plans; established 71 demonstration plots for new technologies (including 51 for no-till pasture rehabilitation and 20 for small-scale dairy production); approved 4,270 management plans for individual properties; disbursed incentive grants to 710 beneficiaries; replanted or restored 626 hectares of riparian vegetation; and engaged 24,810 beneficiaries in project activities.

Lessons Learned and Issues for Wider Applicability

- The management and implementation structure must set out clear responsibilities at the state, regional, and local levels, with emphasis on strong local participation (government, beneficiaries, and private sector).
- NRM strategies should be based on technological changes adapted to local needs and conditions to produce immediate benefits.
- Creative, motivated, and well-trained extension workers, provided with intensive training in group dynamics and participatory methods, are essential.
- Participatory methods should be used for selecting microwatersheds and activities to be undertaken, based on technical, environmental, and social criteria.
- Financial incentives are needed for adopting technology/behavioral changes.
- Robust monitoring and evaluation systems must be in place, with strong management units able to adjust implementation plans.

- A legal framework, including sanctions against activities detrimental to the environment and community efforts, is essential.
- Inputs need to be supplied in a timely manner to prevent implementation delays.

Country	Brazil
Project Name	São Paulo Land Management Project
Project ID	P006474
Project Costs	US\$123.0 million
Dates	FY 2000 – FY2006
Contact Point	Graciela Lituma The World Bank, 1818 H Street, NW, Washington D.C. 20433 Telephone: (202) 473-1892; email: Glituma@Worldbank.org

China: Commercial Plantations to Help Conserve Forests

In China, the forest sector is critical to rural livelihoods, supplying 40 percent of rural household energy as well as raw material for construction projects and the pulp and paper industry. Wood supply is limited, with forest cover of only 0.13 hectare per capita (in comparison to a global average of 0.6 hectare per capita). Recently China has been losing 500,000 hectares of natural forest per year, largely because of poor governance of the logging industry. To address these issues, the government announced a ban on logging in natural forests, introduced new land laws, initiated reforestation programs with investments in plantations, and promoted environmentally sustainable logging practices.

What's innovative?

Promoting commercial plantations to ensure forest conservation, with public assistance focused on facilitating initial market development and ensuring public good benefits.

Project Objectives and Description

The China Sustainable Forestry Development Project aims to develop a participatory framework for the sustainable management and conservation of forests and associated biodiversity, while minimizing the social and economic costs of the new government policy. The project includes a protected area management component, a national forest management component, and a plantation component. The plantation component—accounting for 81 percent of the total project costs and 99 percent of the World Bank loan—involves individual farmers and local organizations in commercial tree plantations established to narrow the gap between domestic wood supply and demand and to generate employment and income opportunities for rural households. These objectives are addressed through four plantation subcomponents, including:

- Establishment of timber plantations (to control soil erosion, contribute to watershed management, and support forestry research).
- Establishment of economic tree crops.
- Precommercial thinning of existing plantations.
- Provision of technical support to develop planting stock and improve nursery management.

Plantation establishment is accompanied by the appropriate market and technical research, much of it drawn from other Bank projects and Chinese research institutions. This research coordination effort allowed the task team to gather information (for example, to identify ecotypes and develop lists of plantation species) in a cost-efficient manner.

Provided that they are managed and monitored appropriately, commercial plantations can reduce pressure on natural forests by providing fuelwood and lumber that might otherwise be cut illegally from natural forests. A clear system for monitoring and

evaluation provides for monitoring on three levels: implementation progress, growth and quality of plantations, and environmental and social parameters.

The appropriate selection of trees species, taking soil, water, and slope conditions into account, is important for growth and market potential. To avoid flooding the market with a single species, the project monitors market prices and forecasts trends for lumber and fruit trees. This information is made available to plantation owners to improve outreach to the private sector and influence investment decisions.

Benefits and Impacts

Under this project, which started to be implemented only recently, some 115,090 hectares of commercial tree plantations for fiber and pulp, plywood, and construction timber will be established in nine provinces to overcome projected national and local shortages of wood. The main beneficiaries are individual households, shareholding cooperative forest farms, village/township collective forest farms, and state forest farms.

The project will also establish some 57,940 hectares of economic forest crops, including fruit, nut, and medicinal trees, in 11 provinces. The tree crops include chestnut, walnut, ginkgo, eucommia, apricot, jujube, apple, pear, prickly ash, pomegranate, and Chinese yew. Those participating in this subcomponent include individual households, shareholding cooperative forest farms, village/township forest farms, and state forest farms.

Lessons Learned and Issues for Wider Applicability

Experience during planning and project development helped identify key factors associated with plantation management:

- Forests and biodiversity can be conserved by establishing protected areas, improving management of community forests, and developing alternative sources of forest products. By establishing plantations on nonforested land, local and regional demand for wood products can be met more easily, without threatening natural forests. As government legislation prohibits the acquisition of wood products from natural forests, private plantations are the favored investment choice.
- The establishment of large-scale commercial plantations requires the cooperation of government agencies and the private sector, and this requirement should be considered early in the project development cycle.
- Finally, establishing plantations requires credible empowerment mechanisms so that owners are able to invest in land improvements with the assurance that they will receive the benefits from their investment.

Country	China
Project Name	Sustainable Forestry Development Project (Plantation Component)
Project ID	P064729

Project Component Cost	US\$174.96 million
Dates	FY 2003 – FY2010
Contact Point	Mohamed Benali The World Bank, 1818 H Street, NW, Washington D.C. 20433 Telephone: (202) 473-7357; Email: Mbenali@Worldbank.org

Egypt: Matruh Resource Management to Ensure Sustainable Livelihoods for Remote Bedouin People

Egypt's poverty rate remains approximately 20 to 25 percent, and poverty is a disproportionately rural phenomenon. Given Egypt's limited potential for expanding irrigation, NRM issues are critical to sustainable economic development, especially in the more marginalized Bedouin areas along the northwestern Mediterranean coast.

What's innovative? Engaging an isolated group in a broad natural resource management project through the incorporation of existing tribal structures.

The Bedouin people who make up 85 percent of the population in the area rely on rainfed agriculture and herding. Given that population in this area was expected to increase by more than 20 percent from 1992 to 2002, the sustainability of these livelihood systems is in question. The Government of Egypt has sought to maximize the agricultural potential in dryland areas while managing natural resources in a sustainable manner, but problems have arisen, as the tribes have tended to remain isolated and the government has had little experience addressing Bedouin concerns.

Project Objectives and Description

The Matruh Resource Management Project I was aimed at (1) conserving water, land, and vegetation resources in the project areas and (2) alleviating poverty and improving the quality of life among the local Bedouin population. The following project components were designed to achieve these objectives:

- Water harvesting and watershed management, which would introduce several environmentally sound water-harvesting interventions.
- Rangeland and grazing management, which would focus on improvement and effective utilization of rangeland and vegetative cover.
- Adaptive research implemented on a demand-driven basis.
- Extension and training, which would provide funding for establishing an effective agricultural extension service.
- Rural finance, which would give special attention to promoting on-farm income-generating activities targeted to small-scale farmers, the landless, and rural women.

All activities are implemented within the framework of traditional tribal organizations, resulting in a demand-driven development process. This tribal framework ensures that government personnel become sensitized to Bedouin needs and concerns, and it mobilizes local populations to manage natural resources in a sustainable manner. To incorporate tribal systems into their management framework, community groups (which determined their composition and structure) were established.

Benefits and Impacts

The first Matruh project (1994-2002) has been recognized for its innovative participatory approach. To conserve the natural resource base, 1.2 million cubic meters of water storage facilities were constructed, exceeding the estimated target by about five times and representing an increase in water availability of 45 percent. The project also established 250 rangeland management units, and it established fodder trees and shrubs on approximately 5,000 hectares. The project helped to improve livelihoods in several ways and thereby, reduce poverty. Construction of facilities for safe storage of drinking water yielded health and agricultural benefits for the Bedouin population. Increased fodder availability and genetic improvement raised income from livestock production, and the adoption of high-yielding varieties increased the productivity of barley, olives, figs, and vegetables (increases ranged from 27 to 70 percent). Overall, socioeconomic conditions were improved for 10,440 households. In addition, the project built a good foundation for local capacity in resource management through technical assistance, training, and support for project staff, farmers, and community representatives.

The second Matruh project (2003-2009) is continuing to improve local capacity by supporting local representatives, providing training in Community Action Plan development and implementation, providing access to information and communication facilities, and developing literacy classes and women's groups. All community development activities take place within the framework of traditional tribal systems.

Based on experience with the first project, the second project added a component specifically directed at conserving biodiversity, increased the focus on generating off-farm income, and provided for the rehabilitation and construction of feeder roads.

Lessons Learned and Issues for Wider Applicability

- A multisectoral/multidisciplinary approach in NRM and poverty reduction projects is more likely to achieve objectives than single-sector projects.
- Participatory project implementation requires flexible budgeting that is not constrained to predetermined outputs, but relies on a demand-driven identification of activities.
- Adequate initial training and capacity building are prerequisites to the start-up of activities requiring beneficiary participation.
- Rural credit programs, particularly in remote areas, require innovative mechanisms that adapt to constraints on the financial institutions and on the beneficiaries.
- Targeting the poorest sections of a society where communities have strong traditional structures can be a challenging process.

Project Name	Matruh Resource Management Project I and II (MRMP I and II)
Project ID	MRMP I: P005153, and MRMP II: P074075
Project Cost	MRMP I: US\$29.5 million, and MRMP II: US\$39.8 million
Dates	MRMP I: FY 1994 – FY 2003, and MRMP II: FY 2003 – FY 2009
Contact Point	Marie-Hélène Collion The World Bank, 1818 H Street, NW, Washington D.C. 20433 Telephone: (202) 473-4994; Email: mcollion@worldbank.org

Latin America and Caribbean: Payments for Environmental Services in Silvopastoral Systems

In Central America, approximately 38 percent of the total land area is classified as permanent pasture. Permanent pasture area has increased substantially over the last decade, partly owing to the conversion of tropical rainforest to pasture. In Colombia, Costa Rica, and Nicaragua, the rate of deforestation in natural forests over the past decade has been between 6 and 25 percent. Much past deforestation in tropical areas could be accounted for by distorted incentives, such as subsidized interest rates or export subsidies used to promote large ranching operations. More recent deforestation has largely been a function of poverty, unemployment, and inequitable land distribution, and landless poor people have cleared tropical forests for subsistence farming. While current practices of preserving forests within protected areas are necessary, they are not sufficient to ensure forest protection.

What's innovative? Providing financial incentives to farmers, in the form of payments for eco-services—converting degraded pasture land into more diverse vegetation resulting in increased carbon sequestration and associated biodiversity.

Project Objectives and Description

Established to protect forests lying outside protected areas, the Regional Integrated Silvopastoral Approaches to Ecosystem Management Project encompasses sites in Colombia, Costa Rica, and Nicaragua. The project will institute a system of incentive payments to farmers who adopt silvopastoral techniques on degraded pasture lands. Techniques include replanting degraded lands with trees, legumes, and fast-growing shrubs that are environmentally sound and financially productive so that the resulting system broadly mimics a forest ecosystem. The silvopastoral project consists of five components:

- Ecosystem enhancements through institutional capacity building and the development of community training programs.
- Environmental monitoring to measure changes in land use, carbon sequestration, biodiversity, and water quality.
- An eco-services fund to pay for environmental services provided by the silvopastoral systems.
- Policy formulation and dissemination focusing on sector and environmental policies associated with the sustainable intensification of livestock production.
- Project management through international NGOs.

Payments for environmental services are distributed through individual contracts with farmers based on land-use changes compared with the baseline. These land-use changes are measured using satellite and global positioning system technology, which help control monitoring costs. While development programs typically make payments ex ante (that is,

for costs of inputs), participating farmers are paid ex post (that is, when they have made the change).

The relation between land-use changes, carbon sequestration, and biodiversity is closely monitored to provide precise estimates of the contribution of different land uses to these “global public goods.” The effects of payments on the adoption of silvopastoral systems, and farmers’ views, especially related to risk, are the main socioeconomic variables monitored. The goal is to test whether payments for environmental services are needed to tip the balance in favor of the adoption of silvopastoral systems.

Payments will total about US\$1.2 million. To sustain payments in the long term, the project is exploring various funding sources. The Government of Costa Rica has already earmarked general tax funds for the incentives. Possible revenues—a cost recovery approach—may come from those benefiting directly from biodiversity conservation, such as municipalities benefiting from improved water quality.

Benefits and Impacts

Socioeconomic surveys, technical/information workshops, and preliminary studies have begun. Three hundred farms will participate in the payment program. Initial feedback indicates that:

- Farmers’ response to the incentive scheme has been positive. Farmers say that although the payment offered is small compared to the costs of establishing the more intensive silvopastoral systems, the payment is very important, as is the technical assistance.
- The most likely land-use changes are more trees in pasture, improved pasture, live fences and windbreaks, and “protein” banks (shrubs and other vegetation for livestock).
- Policy makers see this project as an opportunity to improve the environment and productivity. The Minister of Environment of Costa Rica has already indicated that silvopastoral activities will be eligible for government environmental payment schemes.

Lessons Learned and Issues for Wider Applicability

A virtual platform⁵ has been established by FAO-LEAD (Livestock, Environment, and Development Initiative, cofinancier and partner in the project) for the dissemination of information, dialogues, and e-mail conferences on issues related to the project. The platform allows the project to be known worldwide and to benefit from interaction with global experts.

⁵ See the LEAD Website: <http://lead.virtualcentre.org>.

Experiences in similar projects have shown that economic incentives, such as those developed in the Latin America and Caribbean project, are especially important for ensuring buy-in from individual participants, because payments are linked directly to participation level. Payments had previously been used with hesitation, as land rights were poorly established, but this project circumvented the risks associated with weak land rights by not requiring land titles to make payments.

Initial experience has shown the need for well-established institutional mechanisms to manage and monitor the process and to value the opportunity cost of alternate land uses when calculating appropriate payments.

Country	Colombia, Costa Rica, and Nicaragua
Project Name	Integrated Silvopastoral Approaches to Ecosystem Management
Project ID	P072979
Project Cost	US\$8.4 million
Dates	FY 2003 – FY 2008
Contact Point	Paola Agostini and Cees De Haan The World Bank, 1818 H Street, NW, Washington D.C. 20433 Email: Pagostini@Worldbank.org and cdehaan@worldbank.org

China: Watershed Management Approach to Optimizing Incomes and Ecology in Poor Highlands

Although the productivity of China's irrigated areas is now among the highest in the world, progress in dryland agriculture has lagged, particularly in rainfed regions in Northwest and Southwest China. High population pressure and unsustainable agricultural practices characterize these areas. The Loess Plateau in Northwest China is one of the poorest areas. Early efforts to address environmental issues (soil erosion) of the Loess Plateau included campaigns to terrace slopes, plant trees and shrubs, and build dams in gullies to intercept sediment runoff. These interventions were not integrated with efforts to raise agricultural productivity and farm incomes. Planners and farmers now realize that land conservation is compatible with sustainable and productive agriculture and that these goals are mutually reinforcing. This strategic approach has been implemented with considerable success on more than 700,000 hectares of land in the first Loess Plateau Watershed Rehabilitation Project (Loess I).

What's innovative? Using an integrated small watershed management approach in highlands, drawing on local knowledge resources and integrating land tenure, grazing management, farming, and conservation priorities to optimize productivity and ecological balance.

Project Objectives and Description

The Loess Plateau Watershed Rehabilitation Project II aims to implement the interventions tested by Loess I in other provinces, promote sustainable development by increasing agricultural production and incomes, and improve ecological conditions in tributary watersheds of the Yellow River. Specific objectives are to introduce more efficient and sustainable uses of land and water resources and to reduce erosion and sediment flow into the Yellow River.

The project targets several of the poorest counties in Shanxi, Shaanxi, and Gansu Provinces and the autonomous region of Inner Mongolia. It follows an approach of integrated planning and treatment of small watersheds and:

- Creates productive farmland for sustainable production of field crops and orchards, replacing crop area on erodible slopelands.
- Plants slopelands with trees, shrubs, and grasses to produce fuelwood, timber, and fodder, increasing the per hectare productivity on improved farmland.

The project follows a participatory approach and encourages the involvement of key local public institutions to ensure an integrated approach to interventions. Small watershed development involves the integration of forestry, soil and water conservation, agriculture, and livestock. The various interventions include terracing, sediment control structures, and irrigation for cropland improvement. Slope lands are protected by through better

livestock management, afforestation, vegetative cover, and horticulture. The projects have involved specialists in these areas. Following a two-year participatory planning process, during which staff collected information about local soil erosion control practices, the project proceeded to assist participating farmers to complete over 80,000 hectares of terracing and replant 160,000 hectares with forest trees and income-generating shrubs and trees, such as apple, pear, walnut, and apricot.

While the private sector has been reluctant to finance the types of investments involved, farmers share project costs by providing labor (up to 25 days per year) and by paying for part of the investment costs, with the share paid depending on the extent of private and public benefit of the investment. Overall, farmers contribute about one-third of the total investment. Local and provincial governments pay most of the remaining investment costs.

The lead implementing agency is the Ministry of Water Resources. Four provincial water resources bureaus and twenty county water conservancy bureaus have led project implementation.

Benefits and Impacts

Within two years, participating farmers were able to double and in some cases triple crop yields and replant previously barren hillsides, enabling over 500,000 farmers to improve their standard of living. Over 3,000 villages are now actively involved and working with over 1,200 microcatchments. By the end of Loess II, more than 3 million people will have benefited directly from the projects.

Lessons Learned and Potential for Wider Applicability

Much of the projects' success has come from keeping project activities focused and simple and allowing each watershed group to develop its own terracing and reforestation plans. Overly complex designs for extension and agricultural programs can complicate implementation, take authority out of the hands of farmers, and limit potential for success. Major lessons learned were that similar projects are well advised to:

- Insist that, from the very start, farmers plan for grazing and livestock management.
- Allow local procurement for construction, terracing, and land reclamation, but use a strict quality control system for work at all levels, including random spot-checking.
- Import improved tree seedlings that can improve farmers' ability to protect hillsides.
- Provide farmer-to-farmer exchange trips to pilot/project areas.
- Use a comprehensive media campaign to publicize project objectives and activities for a sustained period of time to ensure that they are widely known.
- Keep projects as simple as possible, given local circumstances and the objectives set.

Country	China
Project Name	Loess Plateau Watershed Rehabilitation Project (I & II)
Project ID	Loess Plateau I: P003540 and Loess Plateau II: P056216

Project Cost	Loess Plateau I: US\$150 million and Loess Plateau II: US\$150 million
Dates	Loess Plateau I FY 1995 – FY 2003 and Loess Plateau II: FY 2000 – FY 2004
Contact Point	Jurgen Voegelé The World Bank, 9th Floor, Building A, Fuhua Mansion; No. 8, Chaoyangmen Beidajie; Dongcheng District; Beijing 100027, China Email: JVoegele@worldbank.org