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Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA)

Chapter 7 Forestry: Reforestation, Natural Forest Management, and Agroforestry

Contents

Forests are a land-use option that in many cases, and on otherwise marginal land, can help meet basic human needs for fuel, food, fodder and building materials.

Forestry Overview

Forestry sector development activities—including reforestation, natural forest management and agroforestry—play an important role in sub-Saharan Africa for several reasons:

- They represent a viable and productive land-use alternative that in many instances, and under a variety of otherwise marginal site conditions, can help meet basic human needs for fuel, food, building materials and fodder for animals.
- Properly managed shrub and bush forestlands are an important element for stabilizing arid and semi-arid grazing lands and keeping them productive.
- On a larger scale, forest protection and management are essential to watershed management. They are also a critical component in stabilizing the water supplies needed to:
  - upgrade agriculture through irrigation;
  - allow development of hydropower; and
  - provide potable water for growing populations and expanding cities.
- Rational forest management engages local people in the stewardship and conservation of habitats, biological diversity and ecosystems.

Forestry Overview

Forestry activities can have a significant effect on environmental conditions in sub-Saharan Africa, for several reasons:

- They represent a viable and productive land use choice
- They are an important element in stabilizing arid and semi-arid lands
- They are critical to watershed management
- They help local people acquire natural resource management skills
- They are a source of commodities for the emerging green market place

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- There is emerging worldwide recognition of the need for systematic development of sustainable forest management practices, as well as a growing "green" marketplace for sustainably produced timber and non-wood forest products. (See box on the Forest Stewardship Council, which accredits certifiers of responsibly managed forests.)

Awareness of the threat to natural forest cover has grown significantly since the UN Conference on Environment and Development in Rio de Janeiro in 1992 focused the world's attention on this critical issue. The establishment of the Intergovernmental Panel on Forests (IPF) by the UN Commission on

The Forest Stewardship Council (FSC)

FSC is an independent, non-profit, non-governmental organization that supports environmentally appropriate, socially beneficial, and economically viable management of the world's forests by:

- evaluating and accrediting certifiers,
- encouraging the development of national and regional forest management standards, and
- providing public outreach about independent, third-party certification as a tool for ensuring protection of the world's forests for future generations.

Certification of forest management practices and conditions is a first step towards the "green" marketing of forest products. Consumers buying products carrying an FSC label can be assured that their purchase comes from a forest that has been responsibly managed according to FSC principles of forest stewardship:

1. **Compliance with Laws and Principles**: Forest management shall respect all applicable national laws, international treaties, and agreements to which the country is a signatory, and comply with all FSC principles and criteria.
2. **Tenure and Use Rights and Responsibilities**: Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.
3. **Indigenous Peoples' Rights**: The legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected.
4. **Community Relations and Workers' Rights**: Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.
5. **Benefits from the Forest**: Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.
6. **Environmental Impact**: Forest management shall conserve biological diversity, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and integrity of the forest.
7. **Management Plan**: A management plan appropriate to the scale and intensity of operations shall be written, implemented and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated.
8. **Monitoring and Assessment**: Monitoring shall be conducted to assess the condition of the forest, yields of forest products, chain of custody, management activities, and their social and environmental impacts.
9. **Maintenance of Natural Forests**: Primary forests, well-developed secondary forests, and sites of major environmental, social or cultural significance shall be conserved. Such areas shall not be replaced by tree plantations or other land uses.
10. **Plantations**: Plantations shall complement, not replace, natural forests. Plantations should reduce pressures on natural forests.

More information on the FSC can be found at their Web site http://www.fscoax.org/

Sustainable Development was specifically intended to counter the danger by encouraging sustainable forest management. The UN Convention to Combat Desertification, ratified by the United States in 2000, focused attention on land use in Africa, including the degradation of forest and shrub lands.

Forestry and USAID

Forestry development activities, particularly reforestation, have been an important part of USAID's sub-Saharan Africa development strategy since the late 1970s. A widely discussed fuelwood crisis emerged at that time, coinciding with a period of significant drought and concerns about desertification. Over time, forestry activities have evolved and diversified to include the management of natural forests, woodlands and savannah tree cover; agroforestry (the integration of trees and crops into a farming system); and community-based natural resources management (CBNRM).

Forestry development activities, particularly reforestation, have been an important part of USAID's sub-Saharan Africa development strategy since the 1970s. Photo: Oregon State University.

USAID forestry development activities must comply with section 118 of the Foreign Assistance Act, which clearly and specifically prohibits the use of USAID funding for the "procurement or use of logging equipment . . . unless

Regulations Affecting Forestry Activities

Section 118 of the Foreign Assistance Act calls for denying aid to several activities affecting forests unless an environmental assessment shows that the activity "will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development:

- Activities which would result in the conversion of forest lands to the rearing of livestock.
- The construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively un-degraded forest lands.
- The colonization of forest lands.
- The construction of dams or other water control structures which flood relatively un-degraded forest lands."

an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction."

While these regulations are often noted for their prohibitions (see sidebar), they also foster positive measures that advance the conservation and sustainable management of tropical forests. They call for policy discussions with USAID partner countries to address the "importance of conserving and sustainably managing forest resources for the long-term economic benefit of those countries." They also stress the need for the agency to support projects and activities that increase national capacity to formulate and implement forest policy, as well as improve forest management. Additionally, in each of their country development strategies, USAID missions must now include an analysis of the actions needed to conserve and sustainably manage tropical forests (Section 118) and to conserve biological diversity (Section 119), as well as the extent to which their proposed programs meet these needs and opportunities.

Items Which Deserve Special Attention

Several threats to natural forests and forestry projects deserve special attention. These include deforestation trends and processes; forest fires; forest resource depletion, such as overharvesting; and unsound government policies.

Deforestation. Deforestation often reflects a larger land-use issue driven by factors outside the forestry sector, including:

- **Misguided subsidies** that lead to forest conversion or degradation.
- **Policy attitudes and decisions** driven by population pressures and employment needs. These may result in resource mining, rather than management and conservation.
- **Underdeveloped capacity** for land-use planning and mapping.
- **Underfunded and understaffed forestry institutions** unable to manage the forest resource base and forest-related activities.
- **Narrowly focused development strategies** that fail to recognize the integrated nature, and the ecological and economic impacts, of land-use decisions.
- **Forest revenue systems** that allow or induce the concessionaire to adopt cost-cutting measures that disregard long-term sustainability of the resource base.
- **Rent-seeking behavior** by forestry and other authorities that sell national forests and timber resources to the highest bidder.
- **Failure to recognize local communities' rights** in forest areas in favor of outsiders, thereby undermining local initiatives for conservation of forest resources.

- **Governmental policies geared towards providing cheap energy** (typically charcoal or wood) to urban areas. Such attitudes distort the economics of forest management operations and plantation forestry.

Reforestation has often been cited by policy- and decision-makers, as well as foresters, as the solution to deforestation. Yet FAO statistics estimate global deforestation rates at about 15 million hectares per year, while reforestation barely reaches 1 million hectares annually. The enormous net loss of forest attests, among other things, to the drawbacks of reforestation, including the high cost of tree planting, reduced productivity of sites under rehabilitation, and the probable lower value of plantation-grown wood. These costs, however, pale beside the costs of lost ecosystems, biodiversity and timber.

Forest fires. In the forests of Africa, farmers and herders traditionally use fire to clear land and/or promote plant renewal for grazing. Over time these practices tend to degrade forest resource quality. Campaigns to prevent forest fires have not generally been successful. The Center for International Forestry Research (CIFOR) and the World Agroforestry Centre (formerly ICRAF), particularly its Alternatives to Slash and Burn Program, are important sources of information on the biophysical and social dimensions of forest fires and their economic impacts (see www.cifor.cgiar.org/fire-project and www.asb.cgiar.org; both sites include links to other organizations active in this area).

Over-harvesting and/or forest resource depletion. One of the pivotal principles of forest management is *sustained yield*—managing forests to produce a steady flow of the desired products and services over the medium and long term. Yield can be measured both quantitatively, by the volume of existing stock and extraction rates, and qualitatively in terms of product excellence. Activities that undermine sustained yield, such as over-harvesting, *high grading* (the practice of cutting only the most valuable trees and leaving the rest), and sometimes clear-cutting, harm both forests and the various species of animals, trees and plants they harbor. Sustained yield provides the best way to maintain the value of forest ecosystems in the eyes of society, local communities and landowners. Standing forests that are valued by society usually fare better in decisions about appropriate land use and stewardship of the resource base.

Policy Environment. Local policy and institutional frameworks can seriously damage the sustainability of forestry activities. Poor policies can lead to over-exploitation, careless harvesting of products, or failure to invest in proper management. Even more problematic are government policies that undervalue forest cover and its potential products in favor of other agricultural or livestock development options. These options often turn out to be unsustainable because the sites involved are so fragile: relatively poor land that can sustain a forest may degrade rapidly under the stress of farming or grazing. Unfortunately, it is difficult to analyze the suitability of remaining forests for development. Studying them takes time and money, as well as institutional and staff capabilities that developing countries may not possess.

Important Policy Issues Facing Forestry Projects

- **Deforestation trends**, which are often driven by improper policy decisions and lack of capacity among local forestry institutions
- **Forest Fires**, used by farmers and herders to clear land for crops and grazing
- **Overharvesting and depletion of forest resources**, particularly by 'high grading' and clear cutting trees
- **Creating a policy environment** to support sustainable forestry projects

Guidance for Forestry Projects

Potential environmental impacts need to be addressed early in project planning. Sound design criteria include:

- Ensuring community participation in the design and management of forestry projects
- Using the best available tools to design the project, including modern GIS and mapping technology, satellite imagery and field studies
- Considering such things as policy design, public outreach, capacity building and the role of women when developing forestry projects

Guidance for Forestry Projects

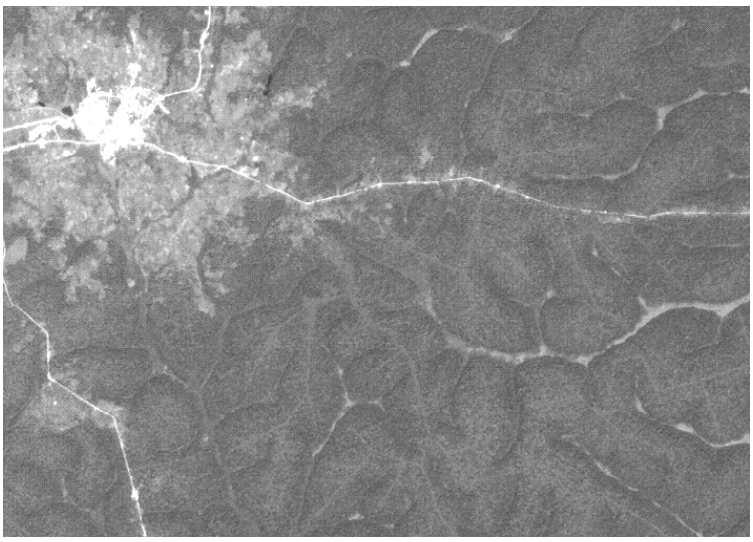
As with other program and project development activities, potential harm to the environment needs to be addressed early in the design process to avoid costly mistakes or project failures. Sound management practices and design criteria that can help prevent environmental damage and project failure are summarized below.

Community Participation: Most community forestry has traditionally focused on helping local communities obtain forest resources for basic needs through reforestation or agroforestry interventions. Many recent projects, however, have involved community management or co-management of *natural forests*—with significant and (to some) surprising results. Communities genuinely engaged in participatory management of natural forests have shown they understand that they will have both *rights* to the resource (sharing of the benefits stream of a productive and managed natural forest) and *responsibilities* for it (accountability for safeguarding the resource base).

This sharing of rights and responsibilities has led to outstanding examples of community action to protect and conserve the forest, respecting the management plan's restrictions and defending forest areas from the inroads of others. It is essential to ensure that government supports the community's right to protect the managed forest from third parties who wish to exploit its resources.

Tools for Forestry Projects. Important tools for forestry project design include:

- **Modern technologies.** Sound forest management planning for all activities begins with an assessment of the current forest resources, classifying ("stratifying") different areas according to the way they are used. In the past, this involved tedious and labor-intensive comparisons of current field conditions against existing data based on aerial photography and topographical maps. Access to new technologies, such as geographic information systems (GIS), global positioning systems (GPS) and enhanced satellite imagery, make it easier to classify different areas. Using these, project planners can quickly prepare maps of the program area showing the overall layout of the land and the inherent qualities of its various sites.



Satellite imagery—such as this photo showing logging and logging roads in Cameroon—can be a useful tool in planning forestry projects.

Maps can show where sustainable harvesting of forested areas might not be possible, such as those with steep slopes, poor soils, concentrations of endangered species, or prime habitat for conserving biodiversity.

- **Maps.** The scale and scope of many small-scale forestry activities are typically larger than those of the agriculture sector. Good maps are essential to planning, implementing and monitoring these activities. Maps can show areas where sustainable harvesting might not be possible, such as those with steep slopes, poor soils, concentrations of endangered species, or prime habitat for biodiversity conservation. Activities in these areas may be technically difficult, costly, or environmentally harmful. Maps also illustrate the areas where protection and conservation are necessary, and where more detailed surveys are required to make sound management decisions.

- **Field studies.** Sustainable forest management requires an interest in the complexities of the forest ecosystem and the skills and experience to understand cause and effect in forest management. Classifying different forest areas to distinguish between those suited for production and those needing conservation is the first step in sound management. However, data about the effects of forest management on specific types of forests are insufficient in many countries of sub-Saharan Africa. The information needed to fill in these gaps can be generated by keeping good records of stand conditions, of the activities (both planned and unplanned) that have taken place within the forest, and of the follow-up observations of field staff.

Forestry Policy. Important considerations for forestry policy include:

- **Policy design and public outreach/participation.** A constant issue with small-scale, experimental or pilot forestry projects is that their promising findings and results are often not widely disseminated and cannot be used by others to promote large-scale change. These activities generate important lessons that can illuminate the policy, administrative, economic and institutional barriers to promoting sound field activities on a far broader scale. Program implementers (NGOs, governmental forest services and donors) should make a concerted effort to apply

important lessons learned to larger policy and program contexts.

Encouraging forest recreation, ecotourism and public awareness among the emerging middle class can create a home-grown constituency for sustainable forest management.

Forestry program implementers should also engage the government in policy dialogue. While it is true that this dialogue takes time as well as staff or contractor resources, it is essential to building awareness and capacity at the national level and overcoming policy errors that lead to deforestation or undermine sustainable forestry production and conservation programs.

In many developing countries of sub-Saharan Africa, the forestry sector is also confronted by a public relations challenge. Public awareness and environmental education campaigns ensure that lessons learned in the field receive wider attention. Encouraging forest recreation, ecotourism and public awareness among the emerging middle class can create a home-grown constituency for sustainable forest management. Similarly, an advisory council representing all stakeholders should use key lessons learned to advise the government forestry service and sector decision-makers on issues beyond forest management or reforestation technologies.

- **Capacity building.** Certain obviously harmful activities—such as clear-cutting, constructing poorly built logging roads, harvesting on steep slopes, and making inroads into protected areas and ecosystems known to be sensitive—can be readily addressed. However, much of the eventual success of forest management endeavors will lie in building institutional and human resource capabilities for forest stewardship in partner countries. This must include both governmental and non-governmental capabilities—the former to ensure that the conditions for sustainable forestry management are present in a given country, and the latter to create a constituency to monitor those conditions' development and implementation.
- **Appropriate roles for the government forest service.** Many small-scale forestry development activities are carried out under the aegis of local or international NGOs working in collaboration with communities living in or near forest areas. These programs cannot, and should not, operate in isolation from government forestry services.

The program and exit strategy for any NGO forestry project should ensure that the technical and professional services needed for participatory forest management are institutionalized.

The program and exit strategy for any NGO should include ensuring that the technical and professional services necessary for participatory forest management are institutionalized. Although local communities may be the *de facto* implementers of forest management plans, they will continue to need technical advice and assistance in forest resource assessment, management planning, silviculture and harvesting practices, among other skills. The government's forestry service or department can provide this service, which requires government commitment to a trained staff, adequate budget, and proper equipment and materials.

Situations leading to conflicts of interest or lack of transparency should be anticipated and prevented. For example, experience has shown that the unit in charge of preparing forest management plans should not be the body to approve them as well.

- **Balancing reforestation with natural forest management**. As noted earlier, many people still have the mistaken impression that reforestation is the solution to deforestation. In fact, continued efforts by governments and their donor partners to counter deforestation through reforestation projects is one reason that natural forest management capacities and systems remain underdeveloped in sub-Saharan Africa. Even more disturbing are well-intentioned reforestation campaigns and programs that lead to the final clearing of secondary natural forests in order to establish tree plantations.

  In most countries, as discussed earlier, deforestation is driven by policies and programs outside the forestry sector, and it easily outpaces the reforestation rate. It makes little sense to pour scarce resources into reforestation and agroforestry if the forces leading to degradation (e.g., high-grading and illegal logging) and deforestation (e.g., land clearing because of exhausted soils and population growth) remain unchecked.

- **Balancing short-term pressures with long-term sustainability.** National policies must also balance short-term pressures on forests with long-term sustainability. The long gestation period for forestry projects requires a supportive, stable policy environment and the capability to produce planned benefits. Since many of the pressures on forests arise from local people's efforts to meet urgent, basic needs, forestry development programs must supply tangible benefits for communities on a shorter time scale. These short-term returns should, however, be coupled with longer-term sustainable payoffs.

In most countries, deforestation is driven by forces outside the forestry sector, and it easily outpaces the reforestation rate. It makes little sense to pour scarce resources into reforestation and agroforestry if the forces leading to degradation and deforestation remain unchecked.

Many sub-Saharan African communities already depend on resources harvested from shrinking or degraded forests. Forestry programs cannot expect local communities to absorb all of the tradeoffs (such as loss of production) required to implement sustainable forest management, even if the measures are the direct results of their own unsustainable use of the resource base. Governments and their donor partners must, therefore, create appropriate incentives that allow local communities the luxury of planning for the future. Again, enabling local communities to profit from better management of the forest resource base has proven to be the most effective method for guaranteeing conservation and wise use of forests and woodlands.

- **The role of women in the forestry sector.** In sub-Saharan Africa as in many other parts of the world, women—particularly as gatherers of fuelwood—play a predominant role in the traditional use of forest resources. Women's knowledge, views, needs and involvement should be built into all forestry activities. Forming a women's forestry committee, or similar local organizations, is often fundamental to ensuring the representation and participation of the entire community.

- **Expanding from small-scale/pilot projects to national programs**. In many sub-Saharan African countries, there is a growing awareness of the potential of sustainable forest management as a viable and productive land-use option. Pilot projects for community-based management of natural forests now complement decades of investment in reforestation and agroforestry programs. But, despite growing

experience, few African countries can claim that they have a self-sustaining development program in place for the forestry sector. As discussed earlier, short-sighted national policies continue to inhibit the spread of sustainable development approaches.

Small-scale forestry development activities may overcome these constraints locally because they have the resources or the latitude to operate under special, project-specific conditions. However, if the nation as a whole is to develop a system favorable to sustainable forest management, small-scale activities need to influence overall rural sector policy and programming. Lessons learned in the field must inform national discussions of issues such as governmental capabilities; staffing and budgets for forestry; strategies for participatory development; the marketplace for timber and non-wood forest products; and the vital role of forest cover in watershed stability, biodiversity conservation and wise land use.

Beyond Forestry

Forestry, Watershed Management and Other Environmental Services. USAID natural resource management programs in Africa are beginning to take water resource issues more seriously. This trend needs to be actively encouraged. Considerable attention is currently being focused on the full range of environmental services provided by forests in order to incorporate their value into program planning. Maintaining forest cover preserves forests' critical watershed function, which is of growing importance in Africa as demand for hydropower, potable water and irrigation increases. Such benefits constitute a powerful new rationale for investment in forestry projects (e.g., Landell-Mills and Porras 2002; Nasi, Wunder and Campos, 2002; Smith and Scherr 2002 and World Bank 2002).

Forestry and Integrated Land Use Management: Improving the Land-Use Mosaic. Most small-scale reforestation or tree planting is used to rehabilitate degraded areas and/or meet basic community needs for fuel, food, wood and fodder. If done correctly, tree planting can also support environmental stability by containing erosion and by contributing to a mosaic of sustainable land use.

Nevertheless, in the case of degraded areas, the primary causes of the damage must be addressed first; simply reforesting the degraded area will not resolve the problems. In sub-Saharan Africa, for example, reforestation solutions are often applied to land that has been overgrazed and eroded. Reforestation will not address the reasons for the excessive grazing, which may simply shift to other areas where the cycle of degradation will begin again.

The next three sections take an in-depth look at three forestry strategies—reforestation, natural forest management and agroforestry. These sections describe possible impacts, propose mitigation solutions and offer design guidance for each strategy.

Reforestation

Brief Description of Sector

Small-scale community reforestation programs aimed at providing farmers and smallholders with appropriate ways to use their marginal land are often a sustainable development option. Typically, such programs introduce fast-growing tree species—often exotics such as neem, pine or eucalyptus—to meet the community's basic need for fuelwood, building materials and fodder. These programs generally involve establishing temporary local or farmstead nurseries and providing minimal technical advice for interested farmers.

Reforestation programs introduce fast-growing tree species—often exotics such as neem or eucalyptus—to meet the community's basic need for fuelwood, building materials and fodder. Photo: IFAD.

Reforestation projects can often take advantage of the lower opportunity costs of off-season labor and marginal lands. The most serious challenges for small-scale reforestation programs are (1) finding appropriate site/species matches, (2) ensuring that farmers perform required maintenance, and (3) protecting the saplings from grazing animals and fire.

There are also plantation forestry solutions for larger projects that are sometimes attempted simultaneously in multiple small-scale settings, including seed banks, tree seed orchards, centrally operated nurseries and reforestation incentives. One popular technique involves restocking cut-over or secondary forests with enrichment plantings. Strips or gaps in existing growth are cut and replanted with nursery-raised seedlings, normally of high-value native species. However, if the seedlings belong to a slow-growing tree species, their potential value can be overwhelmed by the years of labor and production inputs necessary to keep them free of pests and otherwise ensure their survival. Experience has shown that this type of plantation is economically difficult to justify.

To succeed, reforestation programs must have a clear understanding of the market demand and long-term potential for forest products. Programs that offer incentives for reforestation need especially careful planning and management to avoid economic distortions and misuse.

Fundamentally, all successful reforestation programs require a clear understanding of market demand for forest products, as well as their long-term economic potential. Reforestation incentive programs, in particular, need careful planning and management to avoid economic distortions and misuse (see Scherr, White and Kaimowitz 2002).

Reforestation Issues

Small-scale reforestation programs are often a viable development option. They can, however, have adverse environmental effects, including:

- Loss of local biodiversity, including useful niche species
- Introduction of exotic or non-native tree species
- Use of agrochemicals on tree plantations
- Conversion of natural forest to tree plantations
- Disruption of local communities' current land uses

Potential Environmental Impacts

Biodiversity conservation. Plantation programs that establish an extensive area of monoculture (planting with a single species) may offer certain benefits, such as restoring protective forest cover and producing valuable timber and non-wood forest products. Typically, however, such plantations are spread across an area without regard for its basic topography. Native plants suited to special locations—such as stream bottoms, ravines, or niche habitats for wildlife conservation—can be disturbed or destroyed. Plantations also use exotic tree species (e.g., *Eucalyptus spp*.) in lieu of disappearing local species with lower short-term economic value. For example, Eucalyptus are often planted on degraded lands, as well as on slopes and ridges that lack topsoil, in the hope that they will restore soil quality, prevent erosion and generate quick economic returns for impoverished families. Unfortunately, these species neither prevent erosion nor restore soil quality.

The Dilemma of Exotic Species. No discussion of the effects of these activities would be complete without addressing the controversy over the use of exotic species. Typically, concerns are voiced about their replacement of local species that may be disappearing.

An outright ban on the use of exotic species for plantations makes little sense and sets a disturbing precedent—after all, many agricultural crops are, in effect, "exotic species." Nevertheless, project planners should examine whether a local species might be used with the same success to produce the desired commodities, quickly and at a reasonable cost, and thereby meet the needs of the local people.

Plantations and agrochemicals. Like their counterparts in agriculture, single-species forest plantations often require extraordinary measures to protect them from pests and diseases. These measures often have substantial materials and labor costs, require farmer training, and pose serious toxic risks. On degraded sites, efforts to increase productivity may also require the use of fertilizer, which could lead to *non–point source pollution* (pollution from diffuse sources, often carried via runoff).

Conversion of natural forests. Reforestation programs can replace wood and other forest resources unsustainably harvested from threatened natural forests. The idea is to plant new forests on deforested or otherwise sparsely wooded terrain. Unfortunately, strong promotion and extension efforts, or attractive reforestation incentives, may encourage these programs to also convert secondary natural forests (which have already been harvested or high-graded) into tree plantations. This should be avoided, since managing an existing natural forest often costs less than starting and maintaining a new plantation and provides a wider range of environmental benefits.

Community displacement. Reforestation schemes that displace people or communities without compensation can be devastating. Fortunately, such

schemes are rare. Reforestation programs can, however, make life harder for local people by disrupting their existing land-use strategies. For example, taking farmland out of fallow for reforestation can lead to lower food production. Even degraded lands or wastelands may still be places where local people find part of their subsistence needs. For example, women who now collect fuelwood on highly degraded brush lands will no longer be able to do so if the land is converted to a tree plantation. Degraded areas may also serve as grazing land that cannot be taken out of production without harming herders' and stock-raisers' livelihoods.

Sector Program Design—Some Specific Guidance

Using reforestation and plantation technology can be exceedingly complex and costly. It involves many steps, from seed collection and nursery production to plantation protection and maintenance. To make a project as sustainable as possible, planners need to consider these critical elements: (1) site/species match; (2) genetic selection of seed source; (3) site preparation; (4) timely planting; (5) weeding; and (6) protection from fire and grazing animals.

Projects can help avoid environmental damage by following these guidelines:

- Plantations should not replace natural forests, not even secondary forests that have already been harvested or high-graded.
- Reforestation plans should consider the effects they may have on the land-use mosaic of the area around the plantation, including impacts on natural forests, biodiversity conservation and alternative land uses.
- Native species should be preferred to exotic species. Any exotic species should be fully tested in an introductory trial under conditions similar to those at the site, to ensure its adaptability and avoid introducing noxious weeds.
- Every effort should be made to avoid large-scale, contiguous blocks of monoculture plantations. Site planning should take into account natural topography—such as ridges, valleys and the margins of watercourses—and, where possible, leave natural corridors of native vegetation suited to such areas.
- To enhance the plantation's robustness, include areas of different ages to spread out the eventual impact of harvesting.
- The plantation's layout should make it easy to transport harvested timber without causing soil erosion or siltation in adjacent watercourses.
- In areas that are prone to wildfires, the forest layout should include firebreaks and provide access for fire equipment.
- To forestall soil degradation and hydrological problems from clearing land for planting, the design should include:

Guidelines for Reforestation Projects

- Don't replace natural forests (even secondary forest).
- Consider the effect of reforestation on all existing uses of the land.
- Prefer native to exotic species.
- Avoid large blocks of monoculture; leave natural vegetation in special areas
- Stagger ages of different planted areas
- Make it easy to transport timber without eroding soil
- Include firebreaks and access to fire equipment as needed
- Use soil conservation measures when clearing land for planting
- Close off degraded marginal slopes
- Use integrated pest management; follow USAID guidelines if applying agrochemicals

    - contour planting or *bunding* (making earth embankments that follow the contours of the land; intended to hold soil and moisture on medium slopes)
    - buffer strips of native vegetation, and/or
    - gully plugging (constructing a series of barriers in a gully to prevent erosion).
- On steep and marginal slopes in need of rehabilitation, close the area to protect it from fire, grazing animals and illicit tree cutting. It is more cost-effective, per unit area treated, to let the vegetative cover grow back naturally rather than reforest the area. If vegetative cover does not regenerate, other lower-cost options include direct seeding, use of cuttings, and bare-root planting stock.
- All use of agrochemicals should conform to USAID regulations and every effort should be made to foster integrated pest management approaches. (See the chapter on "Integrated Pest Management" [IPM] in these *Guidelines*)

Environmental Mitigation and Monitoring Issues

Table 1: Mitigation and Monitoring of Reforestation and Plantation Forestry Activities

Adverse Impacts	Indicators	Causes	Mitigation Measures	
			Specific	General
Loss of forest ecosystem quality	• Natural forests and ecosystems replaced by artificial plantations • Over-dependence on exotic plantation species • Decreases in the supply of essential products and services of the forested areas	• Misunderstanding of the potential returns from natural forest management • Lack of community inclusiveness that leaves out certain segments of society, e.g., women, herders • Misguided incentive programs or subsidies • Market failures that undervalue native species and timber	• Improved integrated program planning, resource assessments and site stratification • Clear criteria for selection of suitable sites • Promotion of values and methods of natural forest management • Testing and development of native species as integral part of reforestation programs	• Developing a reforestation master plan or program strategy • Promoting research and development on native species for reforestation programs • Understanding the micro- and macro-economics of sustainable forest management • Enhancing national government's capacity for land-use planning
Unsafe or unauthorized agrochemical use in seedling nurseries	• Program records and physical evidence • Poisoning or pollution accidents	• Failure to carry out environmental assessment of pesticide use • Poorly trained staff or participants • Improper storage or disposal of chemicals or byproducts	• Greater reliance on IPM solutions for pest problems • Improving training packages and pesticide handling guidelines • Training and fielding para-technicians from within farmer community to advise peers	• Development of national agro-chemical use guidelines that include forest nurseries

Adverse Impacts	Indicators	Causes	Mitigation Measures	
			Specific	General
Unintended changes in land use or shifting of use pressures to other areas	• Current users of degraded lands dis-placed by reforestation programs	• Treating the symptoms rather than the causes of degradation • Misguided incentive or subsidy programs	• Improve integrated program planning, resource assessments, and site stratification	• Enhance national government's capabilities for land-use planning

Natural Forest Management

Brief Description of Sector

Sustainable natural forest management is an effort to develop existing natural forests as managed ecosystems that maintain the rights of their owners (states, communities, individuals) to the benefits of commodity production, while ensuring biodiversity conservation and environmental benefits. Wood and non-wood forest products are extracted in ways that foster a sustained yield, assuring natural regeneration of trees affected by harvesting and avoiding depletion of the natural productive capital of the forest. Good management also upgrades the forest resources—in both quantitative and qualitative terms—through thinning, culling and selective harvest.

Over-exploitation of forest resources for their products may threaten their survival, at least locally. The yohimbe trees in this photo have been felled and stripped for their bark, valued as an aphrodisiac.

Natural forest management addresses several rural development needs and opportunities:

- It represents *a viable and productive land-use alternative* that in many instances—using a variety of otherwise marginal sites—can contribute directly to basic human needs, as well as providing a source of raw materials for wood and non-wood forest-based industries that create employment, income and export earnings.
- It *offers significant economic advantages.* By using such practices as low-impact logging to avoid the environmental and social damage associated with land degradation, it eliminates the high costs of rehabilitating degraded forest areas, and is likely to provide opportunities for an earlier and steadier benefits stream.
- Large-scale forest protection and management will be *essential to enhancing the critical watershed function of forests* needed to upgrade farming systems through irrigation, develop hydropower, and provide potable water supplies for growing urban populations.
- Rational, participatory forest protection, management and use offers *the best chance to engage local people in the stewardship and conservation* of large areas of habitat that sustain the unique, globally important biological diversity of Africa.

The forest resource base as a key to wise stewardship. Natural forest management provides an important way to help people assign value to the resource base. Where local people or companies realize that they will benefit from the investment in forest management, protection and production, they quickly realize that it is also in their best interest to protect the forests from over-exploitation.

Natural forest management—a proactive measure for biodiversity conservation. At one point, supporters of natural forest management, particularly those involved in logging, seemed to be in direct conflict with the proponents of biodiversity conservation. In recent years, however, growing field experience has shown that natural forest management can support biodiversity conservation goals. While forest management does not provide pure biodiversity conservation or absolute protection, it is much

better than the typical next choice for using tropical forestlands—conversion, often irrational and destructive, to agricultural and grazing land.

In many tropical countries, biodiversity conservation needs—beyond some issues like endangered species—are not well known. Even less is known about managing for biodiversity conservation or the more delicate matter of reconstituting biodiversity assets. For this reason, proactive natural forest management aims to maintain forest cover and natural habitats that can have wide-ranging, positive impacts on biodiversity conservation. There is growing acceptance of certified forest management plans that are environmentally responsible, socially beneficial and economically viable. As mentioned earlier, a global network of standards for certified natural forest management is spreading; see box on the Forest Stewardship Council (FSC) on pg. 2 above and the discussion on forest certification in the next section. For details on the progress of certification efforts in Africa see the FSC international Web site http://www.fscoax.org.

Natural Forest Management

Sustainable natural forest management seeks to use forest products, including timber, while respecting local rights and safeguarding the environment. Plan carefully to avoid these common environmental problems:

- Harm to fragile ecosystems and endangered species
- Soil erosion and compaction, potentially leading to runoff, fertility loss, siltation of water bodies and downstream flooding
- Unintended in-migration and resource mining using logging roads
- Damage to residual tree stands after logging
- Social problems and loss of access to traditional resources for local communities

Potential Environmental Impacts of Unsound Forest Use

Disturbance of fragile plant and animal communities and the biological processes that sustain them. Harvesting timber and non-wood forest products may adversely affect biodiversity by harming fragile or endangered species of plants and animals and their habitats. Direct and indirect over-exploitation can fragment forests, disrupting animal behavior and migration patterns. It may also damage aquatic habitats and wetlands when, for example, watercourses are used to transport logs.

Soil and site degradation. Unsound logging or harvesting practices can cause erosion, soil compaction, runoff problems, and contamination and/or siltation of water bodies. The extent of the damage depends on slope, soil depth, and soil type and on how close the activities are to watercourses. When this damage becomes acute or covers large areas, its cumulative effects can destabilize the watershed, leading to significant sedimentation of watercourses and downstream flooding.

Damage from land clearing. Clearing land for tree planting may result in erosion, uncontrolled runoff from the site, changes in the hydrological cycle, soil compaction or fertility loss. If kept in check through careful planning, these problems should disappear once the trees are established. However, they can be catastrophic if appropriate preventive measures are not part of plantation design.

Forest roads and access (skidding) trails. Improperly constructed forest roads, particularly those that fail to take watercourses and drainage into account, quickly lead to erosion and runoff problems. Badly built roads can generate as much as 10 times more erosion than properly engineered ones. Furthermore, unless properly controlled, penetration and service roads intended only for management and harvesting purposes may expose the forest to unintended uses, such as in-migration; conversion to agriculture, livestock, hunting, and mining; illegal fuelwood extraction and/or charcoal production; and colonization by invasive plant species.

Damage to the residual stand after logging. Improper logging practices, including poor felling of trees, excessive skidding of logs through tree stands, and careless transport of logging equipment, can damage the forest's

remaining trees and plant communities. These practices leave the residual forest open to pest invasion and weaken its health or regeneration capabilities. Similarly, leaving logging residues ("lops and tops") in the forest can impede natural regeneration and increase the danger of forest fire. Taking too many trees of any one species may eliminate seed sources necessary for natural regeneration and lead to changes in the composition of tree stands.

Human environmental impacts. Activities in previously unmanaged forest areas can have damaging impacts on local communities. These areas are often used for traditional hunting and gathering, and the activities can reduce community access to forest resources. The influx of "outsiders" involved in forest management and harvesting can lead to conflicts between local inhabitants and forest workers, to the spread of sexually transmitted diseases such as HIV/AIDS, and to hardship and social disintegration within the local communities dependent on adjacent forests.

Sector Program Design—Some Specific Guidance

Paying more attention to economics. Attention should be given to the economics of natural forest management to ensure that:

- communities and concessionaires are optimizing their investment returns (microeconomics).
- country-level planning considers unit cost per area (e.g., the investment needed for a forest to sustainably produce a ton of lumber per hectare) in choosing among different sector and land-use options (macroeconomics).

In many cases, the steps needed to make a forest sustainably productive must be made (and paid for) well before production rises rises enough to pay for them. In the developed world, the key to pre-commercial activities to improve timber stands has been a sound understanding of the costs involved. Because it is so difficult to project timber prices at the end of the next rotation 30–60 years down the road, many European countries, Canadian provinces, and American states offer modest subsidies and incentive programs to convince forest owners to make such investments, which could be applied to African owners as well.

If innovative natural forest management programs are to be effective in Africa, stakeholders will need to pay attention to the microeconomics of their use. Can present activities finance such investments, or will government and/or donors need to chip in? Do local people in government-promoted, community-oriented natural forest management projects understand the costs and benefits in real terms? Calculation of both economic costs and financial returns should be a routine part of these programs.

Certification—a golden opportunity. The emerging worldwide acceptance of certification for the "green marketing" of sustainably produced forest products is a golden opportunity to bridge the gap between conservation and forest production. Although this comparative advantage has yet to be fully realized in the form of premium prices for certified timber products,

Externalities that limit adoption of reduced-impact logging

Potential reasons that firms don't adopt reduced-impact logging include:

- A perception that reduced-impact logging systems are more expensive than conventional practices;
- The failure of conventional accounting systems to factor in the direct and indirect costs of wasted wood;
- The lack of trained people to implement new practices;
- Low net profit margins that lead loggers to maximize throughput (i.e., aim for the highest possible volumes of wood) rather than overall profit**;**
- Transition costs (to replace machines and train workers);
- Undervaluation of standing timber; and
- Failure to enforce existing environmental regulations.

Source: Holmes et al., 1999.

Reducing the Paperwork Burden

A project can raise the payoff for constructing a sustainable forest management plan by using the plan:

- For "green marketing" certification
- To comply with USAID Regulation 216
- To demonstrate the project's sustainability to donors
- As a template for monitoring and evaluating the project

Consolidating paperwork this way saves time for donors and projects, making sustainable planning more feasible.

certification has given several countries a much-needed edge in the marketplace.

Certification, however, costs money—to finance the enhanced forest management measures to meet sustainability criteria, and to pay for certification assessments and regular monitoring. Until a premium price structure on the world market becomes routine, the payoff for such investments will be longer term—in greater operating efficiency from a satisfied work force and in the growing value of a well-managed forest. USAID missions and partners need to see whether sustainable forest management plans can be used for multiple purposes—for certification, for compliance with USAID Regulation 216, for analysis of their sustainability as development activities, and as a template for monitoring results associated with program performance. (For an important discussion on forest certification and communities, see Molnar 2003.)

If donors are able to coordinate so as to consolidate requirements in this way, repetitive examinations of these plans by different donors should not be necessary. This should substantially lessen the cost burden on aid recipients in this sector.

Reduced-impact logging. Sustainable forest management and harvesting activities rely on the principle of sustained yield—the amount harvested should equal the annual growth increments. In many instances, however, understanding and maintaining the growth patterns of mixed tropical forests takes time. Accordingly, a conservative approach to harvesting, using reduced-impact logging, is recommended in order to avoid or reverse unsustainable exploitation patterns. Reduced-impact logging includes the following best practices:

- Design forest roads and skid trails to minimize the distance logs must be hauled, reducing damage to the forest floor.
- Use directional felling to ensure that harvested trees fall towards the skid trails and avoid harming the residual stand.
- Set minimum diameter limits and maximum harvest densities.
- Ensure good spacing among harvest trees to leave forest cover intact.
- Leave seed trees.
- Avoid cutting trees or stands that serve as critical habitat for animals and birds.

Worldwide experience suggests that reduced-impact logging—when well planned and executed—can actually lower costs and increase profits for timber extraction, while mitigating its impacts on the environment.

Worldwide experience suggests that reduced-impact logging—when well planned and executed—can actually lower costs and increase profit margins from timber extraction, while mitigating the environmental impacts of harvesting. Its achievements include:

- Upgrading the operating capabilities and efficiency of timber harvesting crews, which improves their employer's competitiveness.
- Leaving behind a residual stand with less damage—and a higher future value—giving stakeholders a strong reason to protect the forest from subsequent incursions or conversion to other uses (agriculture or livestock husbandry).

- Minimizing impacts on the ecology of the forest ecosystem, thus helping to conserve its biodiversity.

Much of the investment in reduced-impact logging involves retraining forest workers. Training both provides the immediate economic benefits discussed above and at the same time teaches foresters to value the future economic and ecological benefits of managed forests—an important and very practical lesson for forest conservation.

Rules, Roads, and Realism

The relationship between roads and forests is a complex one. Despite considerable hype and media coverage, the building of new roads does not necessarily lead to forest destruction. The lack of political will and capacity to guide and control what happens *after* a road penetrates an area is far more destructive. Too often, incentives and controls for sustainable forest management are not in place or are distorted by the political process. Much time and energy may be spent fighting against new roads which could be better spent planning for and building roads that will contribute to sustainable local development.

Building new roads does not necessarily lead to the destruction of the forest. Far more destructive is the lack of political will and capacity to control what happens after a road penetrates an area.

The condition of many roads throughout the tropical region make rational forest management—and, for that matter, many other production systems—quite difficult. The reason is that the high transport costs resulting from bad roads erode the potential for forest management investments. Logging often contributes to the deterioration of poorly made roads. Water and mud from skid trails or interior forest roads is channeled onto the poorly designed surface of the main road. Heavily laden logging trucks then abuse the road base, making conditions worse. Since these difficult road conditions delay and damage trucks extracting timber, loggers look for every way possible to cut costs—high-grading the forests and paying minimal amounts to local people who extract timber. The high-grading degrades the forest; the low pay limits the development of the local economy. If roads are built badly, with inadequate drainage structures despite typically high rainfall, they cannot be considered development; they are an economic, social, and environmental liability.

Road development can proceed more smoothly:

- if the full social and ecological costs are factored in from the beginning (including the costs of managing the process of colonization that often follows the building of the road); and
- if there is a requirement to plan and implement forest management in the areas through which the road will pass, with appropriate controls and incentives.

Environmental Mitigation and Monitoring Issues

Table 2: Mitigation and Monitoring Issues for Natural Forest Management

Adverse Impacts	Indicators	Causes	Mitigation Measures	
			Specific	General
Forest degradation from unsustainable harvesting practices	• Harvesting records or physical condition of the residual stand • Changes in the availability of forest-supplied basic needs such as fuelwood or medicinal plants • Damage to remaining trees • Erosion along skid trails and logging roads • Trees cut but not removed from forest • Poor regeneration of key species for wood or non-wood products • Continued occurrence of forest fires	• Land tenure uncertainties—high costs, low benefits • Market failures • Lack of community inclusiveness leaving local stakeholding groups, such as women and herders, out of decision-making • Errors in resource assessment • Failure to respect annual cutting plan or plan for selecting trees to be harvested • Poorly trained logging and harvest crews, forest owners, concessionaires or other participants • Poorly laid-out road or skid trail system • Unauthorized use by third parties not addressed in the plan or management agreement • Lack of understanding of silvicultural practices	• Ensure that results of monitoring are factored into revisions of the management and annual operational plans • Enhance training in reduced-impact logging for forest management staff • Train and field additional para-technicians from farmer community to advise peers • Enhance record-keeping on the causes and effects of the stand's response to interventions • Develop forest fire prevention/management program	• Examine micro- and macro-economics of sustainable forest management to ensure proper incentives for investments • Routinely revise forest management plans and review monitoring records • Conduct research and development on growth, yield, and impact (economic, social, environmental) of sustainable forest management on natural forests

Adverse Impacts	Indicators	Causes	Mitigation Measures	
			Specific	General
Increased threats to endangered species or biodiversity assets	• Logging or forest disturbance in protected areas or on sections set aside to preserve biodiversity values in productive forests • Changes observed in composition of flora and fauna	• Failure to take biodiversity values into account during forest management planning or execution • Uncontrolled hunting • Forest fires • Roads that allow improved access to sites by poachers, gatherers, farmers and miners	• Conduct additional participant training and field-based inspections by supervisory staff • Control forest access • Develop forest fire monitoring, prevention, and control systems	• Review the basic forest management plan and ensure that proper prescriptions are in place • Increase training in the local community about conservation rights and responsibilities

Agroforestry

Agroforestry Products and Services

Beyond timber, trees in agroforestry systems can yield many valuable *products*, such as:

- Food
- Fodder
- Fuelwood
- Poles and rustic building materials
- Fiber
- Mulch
- Medicines and cosmetics
- Oils and resins

In addition to their role in improving degraded sites, agroforestry trees may serve important *functions* in the farming system, including:

- Improving crop field microclimate
- Conserving soil, enhancing soil fertility and suppressing weeds
- Anchoring a living fence or demarcating a field boundary
- Sequestering carbon to slow the rate of global climate change
- Protecting biodiversity
- Stabilizing watersheds

Brief Description of Sector

Agroforestry is a better use of marginal or infertile land than traditional farming, and can be particularly important where smallholders have expanded onto fragile, sloping or hilly areas.

Agroforestry is the practice of adding a tree component to common farming systems. Better reflecting the diversity of natural systems, the combination enhances the overall sustainability and productivity of agriculture. In a farming system, trees can provide an array of environmental and economic benefits. Agroforestry is a better use of marginal or infertile land than traditional open-furrow agriculture, and can be particularly important where smallholders have expanded onto fragile, sloping or hilly areas. Agroforestry can also ease growing demographic pressures on land use in the near to medium term. This is especially true where restricting access to degraded land in order to restore it would involve undue hardship and, in effect, turn local people into environmental refugees.

Trees can help crops in a number of ways. Some trees send their roots deep into the subsoil, absorbing moisture and nutrients, and returning them to the soil as leaf litter or prunings. Chopped into mulch, pruned branches can help suppress weeds and maintain soil moisture. Many trees can enrich the soil by fixing nitrogen. Trees with a light, thin canopy can help certain crops by sheltering them enough to reduce the rate of evapotranspiration while allowing them enough sunlight to grow. When planted as windbreaks, contour hedges or living fences, trees protect crops and the soil from heavy winds and rain. Trees may also, of course, have direct economic value themselves by producing fruit, nuts, bark, fodder, timber and fuelwood.

There are two basic types of agroforestry systems: **simultaneous and sequential**.

In **simultaneous agroforestry,** the tree and crop components grow at the same time, though they may compete for light, water or nutrients. Examples include *home gardens* that incorporate useful trees; *alley cropping*, in which crops are planted between rows of shrubs or trees; and several types of *silvopastoral* systems, which combine shade-tolerant grasses with trees useful for timber, fodder and/or shading livestock.

In **sequential agroforestry,** the maximum growth of the crop and the tree components occurs at different times, even though they may have been planted at the same time and quite close together. This minimizes competition for light, water and nutrients. Examples include:

- *Taungya* farming, which is much like alley cropping in that trees and crops grow side by side for a couple of seasons. When the tree canopy closes and blocks out sunlight, the farmer moves the planting of crops to fields with younger trees, leaving the older trees to form a tree plantation.
- In the *shifting cultivation* typical in many parts of Africa, trees and bushes grow wild on fallow fields; in the *improved (*or *enriched) fallows* system, farmers sow or plant useful trees and bushes on a harvested field before leaving it in fallow.
- *Multistrata* systems involve planting annual crops with several species of trees. The tree species vary in size, shape and use (fruit, timber, etc.) and grow to form two or more canopies (strata) of different heights. Leguminous ground cover is often planted to control weeds and provide fodder.

For both types of agroforestry, trees are chosen to suit different ecosystems. In a simultaneous system, trees are selected for fast growth during the agricultural off-season and diffuse crowns to minimize shade on field crops. In a sequential system, desirable tree characteristics are fast growth, the ability to recycle nutrients from deep soil layers, nitrogen fixing, and a heavy canopy to minimize weed growth.

It is important to carefully assess soil, topography and climate, as well as markets for possible products, before choosing a particular agroforestry system. Studies have shown that alley cropping, for example, succeeds only under certain very specific conditions. (See, for example, Kiang 1996 and the Web site for the World Agroforestry Centre [formerly ICRAF].)

Examples of the two types of agroforestry systems are summarized in the table below.

Table 1: Types of Agroforestry Systems

Simultaneous	Sequential
• Boundary plantings • Living fences or hedges • Hedges planted on the contour • Alley cropping • Parkland or tree canopy systems • Silvopastoral systems • Home gardens • Shaded perennial crops • Windbreaks	• Shifting cultivation • Improved bush fallows • Fodder banks (concentrated stands of legumes sown on natural grass or in fallows for supplementary dry-season grazing) • Relay intercropping • Taungya plantation system • Multistrata systems

If agroforestry interventions only slow an ongoing process of natural resource degradation, consider other options. Otherwise, the gradual deterioration of the resource base will lead to a downward spiral in which productivity plunges, rural poverty worsens, and environmental and social rehabilitation becomes ever more difficult.

Potential Environmental Impacts

Agroforestry activities are generally aimed at developing sustainable farming systems. As such, the chances of their causing environmental harm are minimal. There are, however, several considerations that need to be taken into account:

Choosing strategies wisely. The choice of tree species and technological approach is a complex challenge for new programs, due to the many possible combinations of production goals and ecological conditions. Efforts to introduce agroforestry flounder when too much emphasis is placed on the search for "miracle trees." Experience demonstrates that a sound understanding of farming systems—especially their constraints and opportunities—is the key to finding out which combination of approach and species will be most productive and sustainable.

Competition between trees and crops. Despite agroforestry's many advantages, improperly designed agroforestry projects can actually undermine productivity and the farmer's well-being. Trees may compete with, rather than support, agricultural crops because they:

- cast too much shade
- use too many scarce nutrients or too much water
- reduce growing space
- interfere with farming operations such as plowing and tilling the crops
- host pests and diseases
- deplete soil fertility over the long term from overuse.

Labor intensity and cost/benefit awareness. Like the soil and water conservation technologies with which it is often combined, agroforestry

increases farm labor requirements. Farmers may consider the extra labor overly burdensome, and feel that returns from these efforts are not quick or tangible enough. Without suitable incentives, farmers may stop applying agroforestry solutions appropriately and return to less sustainable land-use patterns.

Recognizing the limitations. Some projects and programs use agroforestry systems to mitigate smallholders' impact on fragile land. Under certain conditions, this may be an appropriate solution. However, the danger exists of institutionalizing subsistence agriculture, or maintaining an unacceptable status quo, when more radical solutions are needed. If agroforestry interventions only slow an ongoing process of natural resource degradation, other alternatives should be considered. Otherwise, the gradual deterioration of the resource base will lead to a downward spiral in which productivity plunges, rural poverty worsens, and environmental and social rehabilitation becomes ever more difficult.

Sector Program Design—Some Specific Guidance

An agroforestry intervention is generally planned for a specific site, reflecting the need to restore a degraded area or raise productivity. In many situations a variety of agroforestry techniques can be used, and the choices can become quite complex. The following general design principles should be applied:

- Carefully assess the agro-ecological conditions, needs and opportunities of the local farming system, to choose the best agroforestry technology and plant species for the site.
- Ensure that the combination of trees and crops will yield a net benefit for both the farmers and the local ecosystem.
- Agroforestry may compete directly with productive forestry and agriculture for suitable land. The potential economic tradeoffs should be carefully examined by all those concerned with the project, especially the members of communities where the approach is being promoted.
- When applying agroforestry techniques in hilly areas with broken topography, micro-site adjustments may need to be made—combined with soil and water conservation technologies—to prevent erosion.

To repeat, agroforestry should not be viewed as a panacea for all forms of smallholder damage to marginal or fragile lands. While it is possible to use agroforestry to improve land-use capabilities, these practices are typically labor-intensive and costly, and thus may be limited in their applicability.

Because it is typically labor-intensive and costly, agroforestry should not be viewed as a panacea for smallholder damage to marginal or fragile lands. When projects are considering an agroforestry activity, they must thoroughly document the needs and opportunities of the farming system and local agro-ecology, using good baseline data.

Environmental Mitigation and Monitoring Issues

Agroforestry technologies are, in and of themselves, mitigation measures for the adverse environmental effects of traditional or conventional agricultural practices on marginal land. Properly designed, they can increase the productivity and sustainability of the farming system over time at acceptable costs.

The following points should be kept in mind when monitoring agroforestry systems:

- Assessments of the needs and opportunities of the farming system and agro-ecological conditions require thorough documentation with good historical baseline data. This requires a significant commitment on the part of the project, as the fragmented nature of farm plots and the sequential approach to harvest can make data collection difficult for mixed smallholder farming systems. It is also important to monitor ecological factors that would indicate resource degradation—soil erosion, fertility loss, climatic extremes that affect productivity, etc.

- The ultimate test of the sustainability of agroforestry technologies is farmer satisfaction. Lead farmers should be identified, closely monitored, and used as para-technicians to disseminate technology among their peers. Annual post-harvest evaluations involving all participating farmers can be especially valuable in gauging their perceptions of the success (or otherwise) of the technology. These events can be scheduled as part of the extension program and also serve as training and promotional activities.

References and resources

Internet Sites:

- Both the Forest Stewardship Council (International) http://www.fsc.org/en/ and the Forest Stewardship Council (United States) http://www.fscus.org/ have extensive information on forest certification.

- U.S. Forest Service/Office of International Programs has a long-term working relationship with USAID to provide technical support to forestry programs. http://www.fs.fed.us/global

- The Center for International Forestry Research (CIFOR) is located in Bogor, Indonesia. It is part of the Consultative Group on International Agricultural Research (CGIAR) system, and is a useful source of up-to-date information on sustainable forest management. http://www.cifor.cgiar.org

- The World Agroforestry Centre (formerly the International Center for Research in Agroforestry, or ICRAF) is located in Nairobi, Kenya, and provides information on including a tree component in farming systems. Like CIFOR, this center is a member of the CGIAR system. Its offerings include an "agroforestree" database, useful for screening specific tree species' suitability for application in different countries. http://www.worldagroforestry.org/

- The World Wildlife Fund-World Bank Forest Alliance is a partnership to promote forest conservation and best practices in forest management.
  http://www.worldwildlife.org/what/globalmarkets/forests/worldbankalliance.html

- The UN Food and Agriculture Organization (FAO) Forestry Department in Rome has long been a center of excellent information for forestry sector development in the developing world. Their INFOSYLVA database offers a summary of forestry sector statistics and information on a country-by-country basis. See the database at http://www.fao.org/forestry/infosylva/en/ or contact the Forestry Department, Community Forestry-Oriented Forests, Trees and People Programme at http://www.fao.org/forestry/index.jsp
  The FAO also has a listserve on Reduced Impact Logging that is conducted in French. Subscribe at:
  http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=1100&sitetreeId=1980&langId=1&geoId=0

- The International Tropical Timber Organization (ITTO), located in Yokohama, Japan, is an excellent source of information on tropical timber use and its relationship to sustainable forest management. Established as a framework organization for consultations between producer and consumer member countries on all aspects of the world timber economy, ITTO maintains a Web site that includes access to up-to-date market information on tropical timbers and on criteria for sustainable management.
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