USAID
FROM THE AMERICAN PEOPLE

SECTOR ENVIRONMENTAL GUIDELINE

FORESTRY

Full Technical Update 2015

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Cover Photo: Illegal timber observed during a Tropical Forestry and Biodiversity Assessment (FAA 118/119) outside of Pucallpa, Peru. Photographer: Charles Hernick.

About this document and the *Sector Environmental Guidelines*

This document presents one sector of the *Sector Environmental Guidelines* prepared for USAID under the Agency's Global Environmental Management Support Project (GEMS). All sectors are accessible at www.usaidgems.org/bestPractice.htm.

Purpose. The purpose of this document and the *Sector Environmental Guidelines* overall is to support environmentally sound design and management (ESDM) of common USAID sectoral development activities by providing concise, plain-language information regarding:

- the typical, potential adverse impacts of activities in these sectors, including impacts related to climate change;
- how to prevent or otherwise mitigate these impacts, both in the form of general activity design guidance and specific design, construction and operating measures;
- how to minimize vulnerability of activities to climate change; and
- more detailed resources for further exploration of these issues.

Environmental Compliance Applications. USAID's mandatory life-of-project environmental procedures require that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via the Environmental Impact Assessment (EIA) process defined by 22 CFR 216 (Reg. 216). They also require that the environmental management/mitigation measures ("conditions") identified by this process be written into award documents, implemented over life of project, and monitored for compliance and sufficiency.

The procedures are USAID's principal mechanism to assure ESDM of USAID-funded Activities—and thus to protect environmental resources, ecosystems, and the health and livelihoods of beneficiaries and other groups. They strengthen development outcomes and help safeguard the good name and reputation of USAID.

The *Sector Environmental Guidelines* directly support environmental compliance by providing: information essential to assessing the potential impacts of activities, and to the identification and detailed design of appropriate mitigation and monitoring measures.

However, the *Sector Environmental Guidelines* are **not** specific to USAID's environmental procedures. They are generally written, and are intended to support ESDM of these activities by all actors, regardless of the specific environmental requirements, regulations, or processes that apply, if any.

Region-Specific Guidelines Superseded. The *Sector Environmental Guidelines* replace the following region-specific guidance: (1) Environmental Guidelines for Small Scale Activities in Africa; (2) Environmental Guidelines for Development Activities in Latin America and the Caribbean; and (3) Asia/Middle East: Sectoral Environmental Guidelines. With the exception of some more recent Africa sector guidelines, all were developed over 1999–2004.

Development Process & Limitations. In developing this document, regional-specific content in these predecessor guidelines has been retained. Statistics have been updated, and references verified and some new references added. However, this document is not the result of a comprehensive technical update.

Further, *The Guidelines* are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of references for additional information.

Comments and corrections. Each sector of these guidelines is a work in progress. Comments, corrections, and suggested additions are welcome. Email: gems@cadmusgroup.com.

Advisory. The Guidelines are advisory only. They are not official USAID regulatory guidance or policy. Following the practices and approaches outlined in the Guidelines does not necessarily assure compliance with USAID Environmental Procedures or host country environmental requirements.

Contents

BACKGROUND AND PURPOSE OF THE GUIDELINE

Forestry is the science and practice of managing trees and forests to provide a diverse range of ecosystem goods and services. USAID's Forestry Sector Environmental Guideline provides information on the types of projects typically funded by the Agency.[1] It gives a broad overview of forestry activities with a particular focus on environmental and social impacts, mitigation measures, and environmentally sound design and management (ESDM) best practice for USAID projects. This document was prepared to help missions comply with Section 117 of the Foreign Assistance Act (FAA) and Regulation 216, which require that environmental impact assessments be conducted, and mitigations implemented, for all USAID projects. It seeks to ensure awareness of Section 118 of FAA and other relevant legislation that pertains to tropical forests. The guideline is also intended to help USAID partners and staff design forestry activities that reduce greenhouse gas emissions and minimize the vulnerability of people, ecosystems and the project itself to climate change, all of which are important aspects of Regulation 216. The references section of the document includes the cited documents and additional resources on topics discussed in the text. Additional sections in the annex address international agreements and trade policies of relevance to forestry, forest types, ecosystem services, as well as tools from other donors and international organizations.

Readers are also referred to USAID's Office of Forestry and Biodiversity for further information (USAID, 2013).

Forestry development activities, particularly reforestation, have been an important part of USAID's development strategy across the globe since the 1970s.

FORESTRY AND USAID

USAID's history in forest conservation and management can be described in three phases: the first phase, dating back to the 1970s, focused on supporting governments in developing countries to promote fuelwood plantations, multipurpose tree planting, agroforestry, and various forms of social forestry. By the mid-1980s, USAID's program evolved to include working with NGOs at the local level to promote natural forest or protected area management activities that generate benefits to communities. This approach, which dominated through the 1990s, also included building institutional capacity to support and promote sustainable forest use and management, working to ensure community use and access rights, transferring appropriate technologies, and supporting legal and policy reforms. The agency also sharpened its focus on conserving larger landscapes in priority areas, such as the forests of the Congo Basin and the Amazon, in an effort to conserve biodiversity

[1] These projects typically involve small-scale, low-impact, or community-based forestry. However, USAID works both directly with forest-dependent communities and with policymakers to address issues that encompass broader geographic areas. As such, defining "small-scale" for USAID projects is challenging to do in any comprehensive and practical manner.

and mitigate emissions from deforestation. Finally, at the turn of the millennium, USAID began implementing new business models based on public-private partnerships and leveraging resources from multiple stakeholders in order to reconcile conflict over natural resources, economic growth and livelihoods, and conservation at both the national and local levels. Globally, USAID has joined other donors in harnessing market forces in an effort to link trade with forest governance practices. In each phase, USAID has strengthened its commitment and approaches to forest conservation and management.

USAID emphasizes small-scale forestry projects within a landscape approach as integral to ensuring the concept of "sustainable livelihoods." Today, the term "small-scale" forestry project does not necessarily imply geographic size but instead refers to projects that are people-oriented and managed by individual or groups of smallholders. Traditional, small-scale forest industries are seen as being "closer to the people" and potentially more responsive to local consumption needs. The landscape approach focuses on the forest ecosystem as an integral part of an interconnected whole, where maintaining forest health, diversity, and productivity over time works to enhance the overall economic, social, and biological integrity of a much larger landscape. The concept of sustainable livelihoods encompasses the cumulative benefits that accrue to people from the natural resources, physical assets, financial assets, health, education, social relationships, and cultural assets available to them. The promotion of sustainable livelihoods is one of the central long-term goals of USAID.

USAID has used the following strategies while working with international financial institutions, national governments, and local communities to highlight the value of forests and improve the management and protection of forest lands:

- Worked with financial institutions to improve their environmental risk assessment of loans to companies engaged in commercial forestry or forest conversion (i.e., oil palm). This has led to better environmental management and practices by these companies, as they did not want to risk having their financing disappear.
- Brought national decision-makers from parliaments and relevant ministries together with local stakeholders in the field to help them understand realities of implementation, for better policy formulation.
- Promoted policies that create incentives and an enabling environment for sustainable forest management, local control of forests, and transparent decision-making and accounting systems.
- Fostered public-private partnerships based on the sustainable production of forest products (including timber and non-timber forest products), which increased product values and sales.

USAID forestry development activities must be designed and implemented with care. Section 118 of the FAA recognizes the importance of forests and tree cover to developing countries and states concern over the continuing and accelerating alteration of forests. For example, Section 118 clearly and specifically prohibits the use of USAID funding for the "procurement or use of logging equipment… unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest

FORESTRY OVERVIEW

Sustainable forest management activities and practices can have a significant effect on environmental conditions and livelihoods in developing countries for several reasons, as they:

- Support biodiversity and mitigate climate change
- Are an important element in stabilizing arid and semi-arid lands
- Are critical to watershed management
- Maintain soil fertility and promote soil conservation
- Build local people's natural resource management skills
- Are a source of commodities for the emerging green market place

destruction." Tropical forests harbor 80 percent of the world's terrestrial biodiversity. Section 119 of the FAA directs USAID to conserve biodiversity and endangered species, and for this reason, tropical forest ecosystems have typically comprised USAID's top biodiversity conservation targets.

While these laws are often noted for their prohibitions, 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 USAID 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. Due to the potential for changes in policy mandated through appropriations bills and other vehicles, those involved in forestry projects should contact the Forestry and Biodiversity Office for the latest USAID legal interpretation of mandates.

LAWS AFFECTING FORESTRY ACTIVITIES

Section 118(c)(15) of the Foreign Assistance Act calls for denying aid for the following activities 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 that 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."

FORESTRY: RECONCILING SUPPLY AND DEMAND

The global demand for wood and paper, as well as for other forest goods such as palm oil, continues to exert substantial pressure on the world's remaining natural tropical forests. Voluntary certification schemes emerged in the 1990s and continue to expand, but while numerous success stories exist of improved forest management practices, a relatively small proportion of tropical forests have achieved or maintained certified status. Reasons for this include the persistence of illegal logging and associated trade, which continue to economically undermine legitimate operations in countries with limited enforcement. Since 2008, the United States and other countries have passed new laws to address this issue.

THE LACEY ACT AND SIMILAR TRADE POLICIES

The United States' Lacey Act, European Union's Timber Regulation, and Australia's Illegal Logging Prohibition Act are developed country efforts to stem the illegal trade in forest products by decreasing demand, which remains substantial, and results in billions of dollars in lost in tax revenue, lost businesses and livelihoods, and environmental degradation. The table below summarizes the similarities and differences between these laws. Additional information is available in Annex I.

<table>
<tr><th>LAW</th><th>SIMILARITIES</th><th>DIFFERENCES</th></tr>
<tr><td>U.S. Lacey Act</td><td rowspan="3">• Intent is to deny illegally harvested timber access to the market
• Definition of illegal timber is based on law of country of harvest
• Punishes individuals and companies who deal in illegally harvested products even if they did not know that the products were illegal. Responsibility of individual to perform due diligence.
• Liability is on the buyer
• Require substantially similar information demonstrated in different ways</td><td>• Covers entire supply chain; illegal activity at any point means timber cannot be legally traded in United States
• All parties equally liable under the law, not just first placer on U.S. market
• Informal due diligence process. Up to each individual U.S. buyer to conduct due care.</td></tr>
<tr><td>EU Timber Regulation

(see also Forest Law Enforcement, Governance and Trade or FLEGT)</td><td>• Specifically prohibits first placing of illegally harvested timber/timber products on the EU market
• Operators placing timber/timber products on EU for first time liable
• Formal due diligence process includes requirement to undertake a risk assessment and risk management exercise</td></tr>
<tr><td>Australian Illegal Logging Prohibition Act</td><td>• Covers importation and processing of illegally harvested timber
• Importers and processors liable
• Formal due diligence process includes risk assessment</td></tr>
</table>

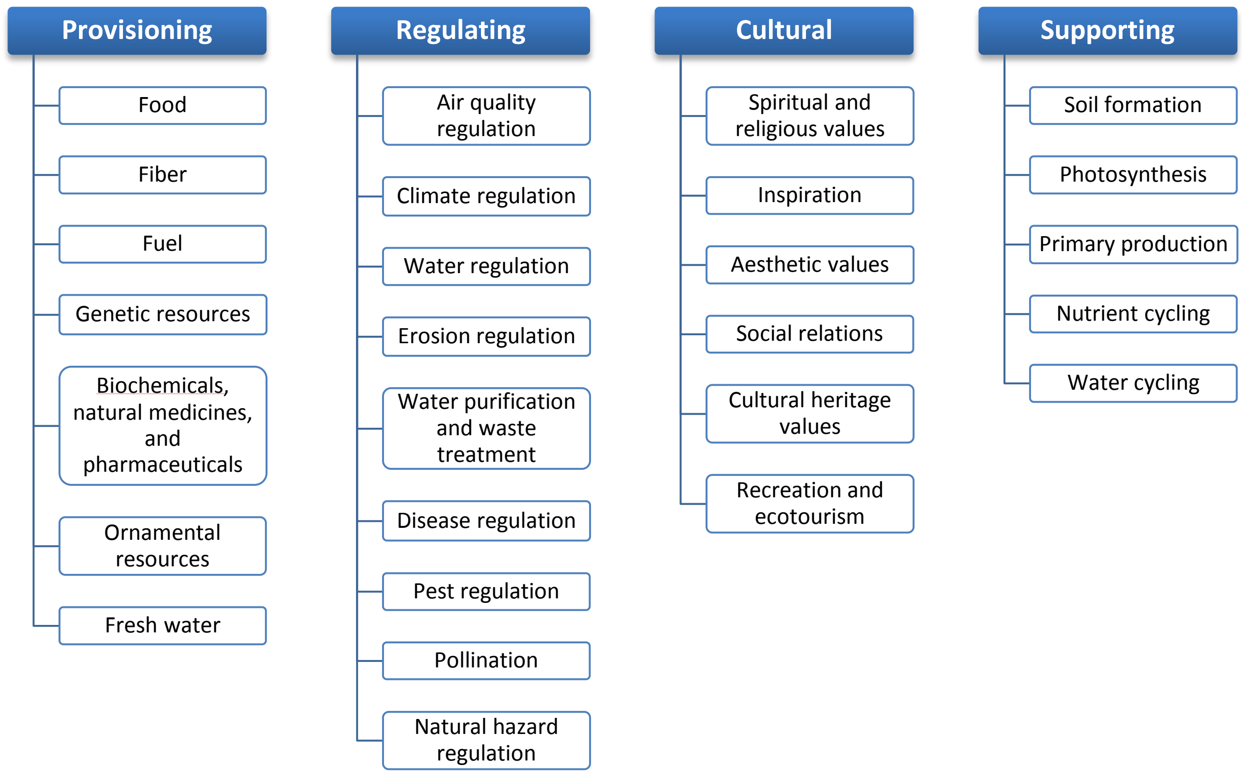
EFI, 2012, and Australian Government, Department of Agriculture, 2014. For more information, see the Forest Legality Alliance website. http://www.forestlegality.org/.

Despite these laws, producer countries remain strapped by ineffective institutions, corruption, poor data management systems, conflicting and unclear laws, social conflict, and development needs. Therefore, stakeholders and donors are focusing on innovations and technologies to ease the verification and tracing of forest products.

OVERVIEW OF THE FORESTRY SECTOR

FOREST ECOSYSTEM SERVICES

Consistent with the Millennium Ecosystem Assessment (2005) framework, the USAID Biodiversity Policy (2014) defines ecosystem services as the short- and long-term benefits people obtain from ecosystems. These economic, ecological, and social benefits, may exist at the local level (e.g., timber, wildlife habitat) and global level (e.g., carbon sequestration). They include 1) provisioning goods or services, or the production of basic goods such as food, water, fish, fuels, timber, and fiber; 2) regulating services, such as flood protection, purification of air and water, waste absorption, disease control, and climate regulation; 3) cultural services that provide spiritual, aesthetic, and recreational benefits; and 4) supporting services necessary for the production of all other ecosystem services, such as soil formation, production of oxygen, crop pollination, carbon sequestration, photosynthesis, and nutrient cycling (for more detail on ecosystem services provided by forests see Annex III). Forestry sector development activities impact most, if not all, of these ecosystem services, and, therefore, forestry can be viewed as the management of forest ecosystem to maximize one or more of these ecosystem services (for a list and description of forest types see Annex II).



Ecosystem services include tangible economic values that are easily measurable, such as food and timber, along with services that are not as easy to quantify, such as flood protection, nutrient cycling, and recreational uses. Understanding the ecosystem services provided by forests can help communities assign value to forests and to realize the trade-offs associated with using and managing forested lands in different ways. This understanding helps justify the need for investments in forest management and protect forests from overexploitation.

A major impediment to protecting forests and the environmental services they provide is the failure of the market to capture non-commercial (non-marketed) values of forests and the opportunity costs of competing land uses. Where ecosystem services are undervalued, or not valued at all, and competing land uses (e.g., agricultural or pasture expansion) are subsidized, land holders and settlers are likely to opt for the highest short-term return, which often results in forest conversion to other uses. The Millennium Ecosystem Assessment (2005) found that "most resource management decisions are most strongly influenced by ecosystem services entering markets; as a result, the non-marketed benefits are often lost or degraded. These non-marketed benefits are often high and sometimes more valuable than the marketed ones…account[ing] for between 25 percent and 96 percent of the total economic value of the forests" (MEA, 2005).

GLOBAL ISSUES OF CONCERN

DEFORESTATION AND DEGRADATION

Deforestation is a decrease in the land area covered by forest, through the clearing and conversion of forest areas to non-forest land uses. These non-forest uses can include agriculture, urban development, logged area, or wasteland, and such conversion has been occurring over the past few decades at alarming rates. Forest degradation does not involve a reduction of the forest area per se, but a decrease in the quality of one or more forest ecosystem components, such as vegetation layer, soil, or fauna; the interactions between these components; and, more generally, overall ecosystem function.

Ecosystem services depend on the function and structure (capital stock) of the ecosystem. The attributes of an ecosystem—extent and distribution, diversity and biological balance, ecological function, physical and chemical attributes—are interconnected, and a change in any attribute changes the condition of an ecosystem, affecting the flow of ecosystem services (NRC, 2005; U.S. EPA, 2008). Deforestation directly impacts the extent, connectivity, and distribution of a forest, which can indirectly impact other forest attributes and have cumulative global effects (e.g., climate change). Degradation can directly impact one or more forest attributes and lead to additional indirect impacts to others. Both deforestation and degradation decrease the ecosystem's capital stock, yielding fewer ecosystem services and reducing forest resiliency. About fifteen percent of global greenhouse emissions come from the forest sector—predominately through deforestation. In many developing countries, in particular, land use and land use change driven by deforestation is a major share of total greenhouse gas emissions.

The Food and Agriculture Organization (FAO) estimates the global deforestation rate in the period from 2000 to 2010 to be close to 13 million hectares per year, lower than the 16 million hectares per year experienced in 1990 to 2000, but still of concern (FAO, 2010). The rate is decreasing at the global level but remains alarming in some countries with large forested areas. In many areas, policies and programs outside the forestry sector drive deforestation, which easily outpaces the reforestation rate. Depending on the scale of forested areas, dedicating scarce resources to reforestation and agroforestry may not be the best course of action if upstream causes of degradation (e.g., high-grading[2] and illegal logging) and deforestation (e.g., land clearing because of exhausted soils and population growth) remain unchecked. In other words, identifying and addressing the drivers of deforestation and degradation (discussed later) can sometimes be a more effective use of limited resources.

CLIMATE CHANGE

As part of the natural carbon cycle, trees and other vegetation remove carbon dioxide from the air through photosynthesis and store the carbon in woody biomass (in trunks, leaves, roots and, eventually, soils). Thus, planting or restoring forests can help mitigate climate change by removing carbon dioxide from the air through the process called terrestrial carbon sequestration. But, forests can also be a source of greenhouse gases, contributing to climate change by releasing the carbon dioxide stored in their trunks, leaves, roots and soils into the atmosphere when they are deforested or degraded. About fifteen percent of global greenhouse gas emissions are related to the clearing, overuse, or degradation of forests.

At the same time, forest ecosystems are vulnerable to changes in temperature, precipitation, seasons, and the frequency and severity of extreme events. Many forest ecosystems have been altered by changes in climate over the past few decades and these trends are expected to continue and potentially intensify in the future. Forestry projects are typically multi-decade activities. Therefore, successful projects need to plan for exposure to an altered climate.

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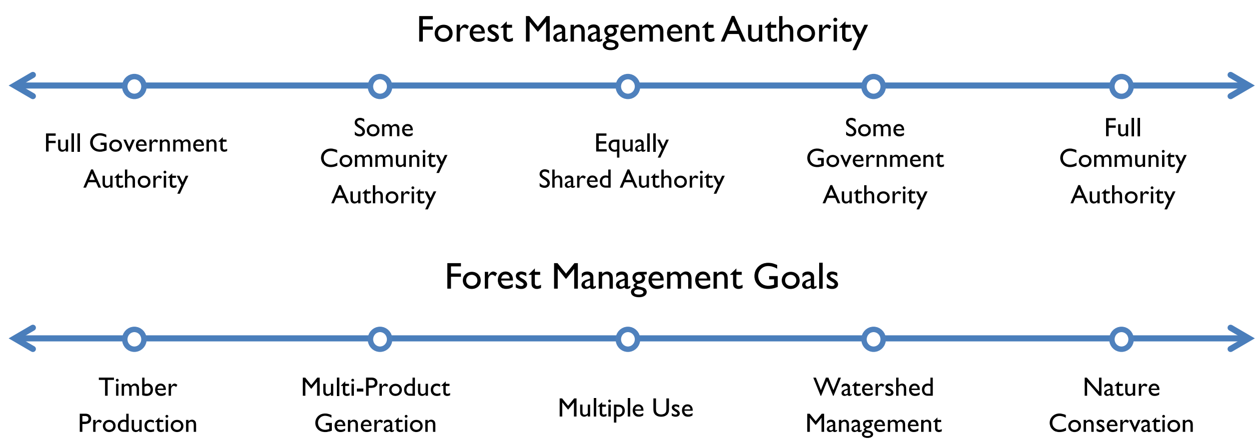
[2] High-grading is the practice of selectively logging the highest quality trees while leaving the lower-quality trees, which impacts the genetic stock of a forest.

Project managers should consider how greenhouse gas emissions in the forest sector can be reduced, how their projects can enhance sequestration and how they can contribute to climate change adaptation of both the forest ecosystems themselves and the of the people who depend on them.

FOREST USES, MANAGEMENT, AND MANAGEMENT GOALS

Two factors that significantly influence forest management are the management authority in place and the authority's (or authorities') goals (see figure below). The authority can range from full government authority over a forest to full community authority (including indigenous peoples). Government authority may involve the governance of a forest by a department or agency that controls many or all the country's forests and manages them according to strategic country-wide objectives, such as economic growth, conservation, or a mixture of both. A community-based approach involves the local community playing a significant role in forest management and land use decision-making for communal benefit, not just for the benefit of individual smallholders (i.e., family farmers managing 10 hectares of land or less). A community authority may consist of an aggregate of smallholders managing public land to produce multiple private and community benefits. Indigenous communities have lived within the rainforests of Latin America, Central Africa, and Southeast Asia for hundreds of years and typically engage in a mix of subsistence and employment activities. In some countries, such as Colombia, they have legal ownership over vast areas of land.



Forest management goals can range from product generation to watershed management to conservation (e.g., conservation of a specific species or the ecosystem at large).

Forestry activities fall along a spectrum ranging from supporting all ecosystem services to removing the vast majority of forest components and ecosystem services in favor of monoculture timber (i.e., plantation forestry) or conversion. These goals reflect different levels of human activity in the forest. A low human footprint is generally required for the conservation of forest ecosystems, whereas a high human footprint is required for creating timber plantations. In some developing countries, national governments often refer to the "forest estate" to include a country's forest resources, which may be managed under national, local, or community jurisdiction.

The objective of commercial forestry is to produce timber and other forest products from natural or planted forests for sale. Commercial forestry from standing, intact natural forests should involve a management and harvesting plan designed to meet defined sustainability criteria codified by country laws or by voluntary standards and guidelines. Farm forestry includes small woodlots/areas (0.5 to 3 acres, typically) planted with fast-growing trees such as eucalyptus, poplar, or acacia, with rotations of less than five years. These woodlots produce fuelwood, pulpwood, forage, and other forest products that are generally managed by the farmer and sold directly by the harvester to the final user. Timber, however, enters multiple stages of processing and transport to yield a variety of products.

Multiple-use forest management allows for two or more objectives, such as harvesting of timber and/or non-timber products, wildlife management, carbon sequestration, recreation and tourism, and/or protection against floods and erosion. Multiple uses enable the pursuit of commercial, community, and individual smallholder interests on the same forestland. According to the FAO, multiple- use management is the management of land resources with the objective of achieving an optimum yield of products and services from a given area without impairing the productive capacity of the site (Mcardle, 1960).

The Millennium Ecosystem Assessment found that the benefit of managing an ecosystem more sustainably—where total economic value includes values of both marketed and non-marketed ecosystem services—often exceeds that of converting the ecosystem by many times. However, the private benefits—the actual monetary benefits captured from the services entering the market—typically favor conversion or unsustainable management (MEA, 2005).

SUSTAINABLE FOREST MANAGEMENT

The International Tropical Timber Organization (ITTO) defines sustainable forest management as "the process of managing [a] forest to achieve … a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment." Multiple ecosystem services can be maximized by working with forests as managed ecosystems to benefit commodity production, ensure biodiversity conservation, and provide a continuous stream of other ecosystem services.

By managing for multiple services, wood and non-wood forest products may be 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. Potentially unsustainable practices—including felling and skidding, conversion of forest land to agriculture, road building, and illegal logging—are avoided in favor of good management practices, including thinning, culling, and selective harvest.

AGROFORESTRY

Agroforestry is the practice of deliberately incorporating trees and other woody perennials into cropping or livestock production systems (Nair, 1992). This may be accomplished by planting trees and shrubs on agricultural lands or by converting part of the forest to mixed forest and agricultural land. Agroforestry involves a tradeoff between ecosystem services (e.g., food versus habitat). However, agroforestry enhances the overall sustainability and productivity of agriculture and is a better use of agricultural land than traditional open-furrow agriculture. For instance, biodiversity is generally greater in agroforestry systems than in traditional agricultural systems.

Incorporating trees and perennials into agricultural systems can be particularly important where smallholders have expanded onto fragile, sloping, or hilly areas. It can also ease growing demographic pressures on land use in the near to medium term by enabling land users to intensify sedentary agricultural production in one area rather than moving to another area for production. Almost half the world's agricultural land has at least 10 percent tree cover, making agroforestry critical to the livelihoods of millions.

Agroforestry systems are classified, based on their components, as agrisilviculture, silvopastoral, and agrosilvopastoral (Society of American Forestry, 2008), and according to spatial and temporal features as simultaneous or sequential. Agrisilviculture refers to crops and woody perennials only. Silvopastoral systems combine livestock and woody perennials useful for timber, fodder, and/or shading livestock. Agrosilvopastoral agroforestry includes livestock, woody perennial, and crop components.

In simultaneous agroforestry systems, the tree and crop components grow at the same time and may compete for light, water, or nutrients. Examples include:

- Alley cropping, in which crops are planted between rows of shrubs or trees;
- Certain silvopastoral systems that combine shade-tolerant grasses with trees useful for timber, fodder, and/or shading livestock; and
- Multistrata systems that involve planting annual crops with several species of trees that vary in size, shape, and use (e.g., fruit, timber) and grow to form two or more strata of different heights (home gardens are the most common type of multistrata systems).

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. 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 shifting cultivation, trees and bushes grow wild on fallow fields; in the improved (or enriched) fallows system, farmers plant useful, nitrogen-fixing trees and bushes on a harvested field before leaving it fallow.

Additional examples of simultaneous and sequential agroforestry systems are summarized in the table below.

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

SIMULTANEOUS	SEQUENTIAL
Boundary plantings	Shifting cultivation
Living fences or hedges	Improved bush fallows
Hedges planted on the contour	Relay intercropping
Alley cropping	Taungya plantation system
Parkland or tree canopy systems	
Silvopastoral systems	
Home gardens	
Shaded perennial crops	
Windbreaks	
Multistrata systems	

REFORESTATION

Reforestation refers to the re-establishment of forest through planting and/or deliberate seeding on land classified as forest, for instance, after a fire or storm or following clear felling. It is a high human footprint activity aimed at restoring a forest and its ecosystem services once they have been lost or diminished. Decision-makers, as well as foresters, have often cited it as the solution to deforestation. However, it is important to note that reforestation is expensive, the character of the forest lost will never be fully recovered, and a healthy forest and the ecosystem services that it yields will take a long time to reappear. Thus, the possibility of reforestation does not reduce the need for preventing deforestation before reforestation is necessary.

As stated earlier, FAO (2010) statistics estimate that while global deforestation rates are slowing reforestation efforts are barely covering the loss, with reports suggesting 2.5 million to 5.2 million hectares being reforested each year compared to 13 million hectares of deforestation per year. The low rate is due to many factors, including the high cost of tree planting, reduced productivity of sites under rehabilitation, and the probable lower value of plantation-grown wood.

Alternatives to large-scale reforestation projects include small-scale community reforestation programs aimed at providing farmers and smallholders with appropriate ways to use their marginal or uncultivated land. For example, community-based adaptation projects that address key climate change stressors might include activities such as repopulation of deforested or degraded areas with tree saplings or improved local agricultural techniques. Such programs sometimes 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 (however, see later discussion on the threat of invasive species). These programs generally involve establishing temporary local or farmstead nurseries and providing significant technical advice for interested farmers, landowners, or land stewards. 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.

SILVICULTURE

Silviculture refers to management at the stand-level to meet overall forest management goals (as opposed to managing the whole forest as a single unit). For example, thinning out a crowded stand of trees allows targeted species to increase in volume. Silviculture is an essential part of forest management that aims to enhance production goals as well as to maintain the long-term continuity of essential ecosystem services and the health and productivity of forested ecosystems (BC Ministry of Forests, 2014a).

Regeneration is the act of renewing tree cover by allowing for the emergence of sprouting young trees, generally after the previous stand or forest has been removed. Regeneration can either be natural or artificial. The essential tenets are that seed sources of all tree species comprising the ecosystem should be retained; soil disturbance over the entire production forest should be minimized; the canopy opening should be minimized; and corridors of undisturbed forest should be protected, including streamside buffer zones.

Overexploitation 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, which is valued as an aphrodisiac.

Stand tending is a treatment designed to enhance growth, quality, vigor, and composition of the stand after establishment or regeneration and prior to final harvest. Pruning removes the lower branches of younger trees. It can supply good healthy wood for the next crop, maintain the correct balance between leaf area and crop, prevent overbearing and dieback,[3] reduce biennial bearing,[4] and maintain good tree shape.

Common harvesting methods include:

- Single-tree selection is most suitable when shade-tolerant species regeneration is desired. It is typical for older and diseased trees to be removed to allow younger, healthy trees to grow. This method disturbs the canopy layer the least compared to other methods.
- Group selection is used when mid-shade-tolerant species regeneration is desired.
- Clearcutting involves the complete removal of the forest stand at one time. Subsequently, it can employ either natural or artificial regeneration.
- Seed tree retains widely spaced residual trees in order to provide uniform seed dispersal over a harvested area.
- Shelterwood cutting is a progression of cuttings that removes trees in a series of three harvests to allow for controlled growth of preferred species: 1) a preparatory cut whereby undesired species are removed; 2) an establishment cut, done in a year when the seed crop is good, that provides for enough light for seedlings to start to grow, but not grow freely; and 3) a removal cut, which gives more light to the established seedlings, allowing them to grow freely.
- Coppicing depends on the sprouting of cut trees, mostly from stumps. This method generally produces fuelwood, pulpwood, and other products dependent on small trees.
- Variable retention retains forest structural elements (stumps, logs, snags, trees, understory species, and undisturbed layers of the forest floor) for at least one rotation.

A common criticism of silviculture (i.e., stand-level management) is that it manages towards uniformity within forests, which decreases the resilience of forests to future challenges (e.g., climate changes, pests and invasive species, development activities). The FAO provides guidance on incorporating silviculture into project design (FAO, 2000).

PLANTATION FORESTRY

Plantation forestry includes commercial activities such as seed banks, tree seed orchards, and centrally operated nurseries, as well as community or individual-oriented activities such as woodlots (typically small-scale private areas that grow trees for building material or fuel). These are high human footprint activities that are often monocultures, rather than fully functioning ecosystems, and therefore do not provide the full flow of ecosystem services provided by a forest. One popular plantation 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 at small scales, and sometimes at larger scales as well, or for individuals with limited capital to invest.

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[3] In overbearing, old trees with spreading crowns shut out light to younger trees.

[4] In which trees have an irregular crop load from year to year, alternating between too large amounts of small fruit in one year and too little fruit the following year.

THREATS TO FORESTRY AND THEIR ROOT CAUSES

A powerful combination of human-induced drivers and threats is causing forest loss globally. As defined in the USAID Biodiversity Policy (2014), a threat is a proximate human activity or process that explicitly causes degradation or loss of biodiversity, whereas a driver (also known as a root cause) is the ultimate social, economic, political, institutional, or cultural factor that enables or exacerbates one or more threats. Examples of drivers and threats that lead to deforestation and degradation are discussed in this section.

USAID uses Results Frameworks in its program design process. The Forestry and Biodiversity Office further advocates using a Concept or Situation Model to think through the causal relationships leading to a final Theory of Change. In support of this section on threats and root causes, Annex IV shows a draft generalized example of a forest situation model. This illustrative examples shows how projects can and should consider the complex relationships and causal pathways between the drivers and threats described in the following sub-sections.

DRIVERS (ROOT CAUSES)

The social, economic, political, institutional, and cultural context can significantly influence the sustainability of forestry activities. Projects that do not address these contextual factors risk becoming a merely temporary fix to a recurring issue. Projects should consider design and implementation strategies that take the local context and potential drivers of environmental degradation into account (see below table for examples of economic, political, and institutional drivers).

CATEGORY	DRIVER
Economic	Subsidies that promote a type of economic development that leads to forest conversion or degradation.
	Faulty forest revenue systems that allow or induce the concessionaire to adopt cost-cutting measures that disregard the 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.
Political	Policy attitudes and decisions driven by population pressures and employment needs. These may result in resource mining, rather than management and conservation.
	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.
Institutional	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.

WEAK LEGAL FRAMEWORKS AND ENFORCEMENT

Some of the greatest challenges to designing and implementing sustainable forest management are weak legal frameworks and/or weak enforcement (partly due to poor funding), which can undermine efforts to protect natural resources. Even when national governments sign laws and international agreements committing to sustainable forest management, collusion and corruption between timber buyers, business people, and government officials can thrive where strong legal enforcement mechanisms have not been put into place (Forest Trends, 2013). One weakness often found is that ministries and institutions often have compartmentalized duties and different mandates and lack the cooperative and coordinated efforts needed for strong enforcement mechanisms.

Decentralizing forest management from national governments to local communities, coupled with democratic reforms, has been shown to improve forest governance when capacity exists and funding is appropriate. In addition, some studied communities given the authority to manage their own forest resources have shown a decreased likelihood of conflict (Clausen and Hube, 2003). Project design should take into account possible conflicts between customary forest tenure (tenancy and other arrangements for the use of forests) and formal rights to land. Since small-scale forestry initiatives are part of the commercial trade network, strengthening the supply chain for forest goods and services is an important key to sustainable forest management and should be a part of project design. See Annex IV overview of Social and Environmental Safeguards for further discussion on land tenure and involving indigenous voices, especially those of women.

BALANCING SHORT-TERM PRESSURES WITH LONG-TERM SUSTAINABILITY

National policies must 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.

For instance, reforestation has often been viewed as an easy fix for deforestation, but this solution greatly underestimates the complexity of recreating intact forest ecosystems. Efforts by governments and their donor partners to counter deforestation through reforestation projects have the potential to distract from creating management capacities and systems that focus on conserving ecosystem services.

In addition, many communities worldwide 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) incurred as a result of implementing sustainable forest management, even if the actions required are the direct results of the unsustainable use of the resource base by those local communities. Sustainable forestry projects would therefore benefit from providing some kind of livelihood enhancement or incorporating alternative livelihood activities to compensate for reduced forest usage.

THREATS

More information on these threats can be found in the 2010 FAO Global Forest Resources Assessment document (FAO, 2010).

CONVERTING FORESTLAND FOR AGRICULTURAL USE

The most significant threat to forests is conversion of forestland for commercial agriculture and other non-forest use. A 2014 Forest Trends report found that "agriculture accounts for over 70 percent of all deforestation across tropical and sub-tropical countries". This widespread problem is due to increased demand for consumer products and prioritization of economic development and food security. Forests are being converted into plantations for oil, rubber, tea, and coffee and forests felled for fuel and fiber. Vast areas of tropical swamp/peat forests in Southeast Asia, the Amazon Basin, and the Congo River Basin are being converted to agricultural use for palm oil and other crops, causing a significant negative impact on livelihoods, human health, and greenhouse gas emissions (FAO, 2011).

ILLEGAL LOGGING

Illegal logging is the "harvest, transport, purchase, or sale of wood products in violation of national and international laws" and can include harvesting protected species, logging in an unauthorized area, and logging without permission (U.S. Forest Service, 2009). Illegal logging methods can include falsification of logging permits; bribes to obtain logging permits; logging beyond concessions; hacking government websites to obtain transport permits for higher volumes or transport; laundering illegal timber through a web of roads, ranches, and palm oil forest plantations; and co-mingling with legal timber during transport or in mills (Nellemann, 2012).

Addressing illegal logging is a separate issue from addressing the sustainability of logging. It is important to note that legal logging is not necessarily sustainable, and while environmental considerations are a factor in combating illegal logging, other considerations such as loss of tax revenue are also major drivers. Illegal logging has wide and negative impacts on international trade, causes habitat and watershed degradation, destabilizes land tenure and property rights, increases rural poverty from lost employment, and weakens governance systems. Combating illegal logging is difficult given the complex supply chain and trade flow for international timber markets. Tracking timber through countries, such as China, Vietnam, and Malaysia, that serve as intermediary processors can add to the complexity. Traders face difficulties working with governments that do not have laws against illegal logging or poorly enforce existing ones.

Importers of significant amounts of wood and wood products, particularly the United States, the European Union, and Australia, have a stake in stopping illegal trade. The World Bank estimates that $15 billion in government revenue is lost every year from trade in illegal wood that floods markets and drives prices down for legally harvested wood. As a result, the United States, European Union, and Australia, as significant timber importers, have passed several laws designed to curtail international trade of illegally logged timber and forest products (see discussion on The Lacey Act and Similar Trade Policies in Background section). However, these laws are typically based on a definition of illegal logging set forth by the country of origin, so it is important to ensure strong national and local policies and laws in exporting countries. Some tropical timber-supplying countries have agreed to implement forest governance laws and regulations to demonstrate legality of timber products. For example, Peru has agreed to enforce, track, and audit timber producers and exporters for products exported to the United States as part of a larger bilateral trade agreement (U.S. Trade Representative, 2010).

FUEL PRODUCTION

Fuel production is defined as the forest biomass removed for energy production purposes, whether for industrial, commercial, or domestic use. In rural areas, biomass is an important resource for cooking and heating. Wood is one of the largest biomass energy resources; others include food crops, plants, and residues from agricultural and forestry activities. Forests are also cleared for agricultural land to grow feedstocks for biofuels such as corn, sugarcane, and palm oil. Recent research has found that projected forest biomass removal and use for bioenergy will release more carbon dioxide than current forest management practices over the next 20 years (Hudiburg, et al., 2011).

SHORTENED FALLOW PERIODS

Shifting cultivation, otherwise known as slash-and-burn agriculture, is a centuries-old system for land use based on alternating cropping periods with periods of regrowth of vegetation (fallow). The forest is cut, burned, and used to raise agricultural crops for one or more years before farmers move onto another plot and allow the used land to lie fallow. However, increased population pressure is increasing agricultural demand, shortening the fallow periods dramatically and causing the system to be unsustainable. Further conversion of these agricultural areas to grazing can damage the soil and can permanently exclude the possibility of reconversion to forests. Impacts of the overuse and misapplication (shorter or no fallow periods) of this technique can have devastating impacts in terms of climate change, soil erosion, watershed degradation, and loss of biodiversity. 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 identifying technological and policy alternatives to slash-and-burn.

FIRE

Natural fire is a vital process that helps maintain the health of some forests. Its pattern, frequency, temperature, and seasonality all dictate what type of animals and vegetation will be found in that area. By controlling how and where fires burn in some forested landscapes, forest managers can help to ensure the health of a forest. However, forest fires worldwide are increasing in frequency and size due to grazing, fire suppression, the spread of non-native and fire-adaptive plants, and climate change. These wildfires become a problem when they burn at the wrong frequency or temperature, or in the wrong area, altering the structure and composition of forests, opening up areas to encroachment by invasive species, and threatening biological diversity.

OVERHARVESTING AND RESOURCE DEPLETION

Though often difficult to implement in practice, one of the pivotal principles of forest management is sustained yield—managing forests to produce a steady flow in quantity and quality of the desired products and services over the medium and long term. Activities that undermine sustained yield, such as farming, grazing, overharvesting[5], high-grading (the practice of cutting only the most valuable trees and leaving the remaining), and clearcutting, both harm forests and reduce forest productivity and long-term economic potential. Sustained overexploitation can lead to the destruction or degradation of forest resources to the extent that it threatens global biodiversity.

DISTURBANCE OF PLANT AND ANIMAL COMMUNITIES AND 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.

CONVERSION OF NATURAL FORESTS

Reforestation programs replace forest resources that were unsustainably harvested or degraded by planting new forests as a plantation or woodlot. 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.

Though plantation and woodlot programs may offer certain benefits for biodiversity, such as restoring protective forest cover, a planted forest rarely maintains the same biodiversity as a natural forest. Plantations also often use exotic tree species (e.g., Eucalyptus spp.) in lieu of disappearing local species of lower short-term economic value. Certain animals and wildlife that could live in standing natural forests may not be able to survive in plantations of reforested areas, leading to a collapse of biodiversity and

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
- Conversion of natural forest to tree plantations
- Disruption of local communities' current land uses

[5] Overharvesting can refer to harvesting forest resources at a rate that decreases capacity for reproduction of the stand but does not necessarily always lead to mortality or destroyed capacity for reproduction.

subsequently a loss of environmental benefits and services.

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 soil 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.

INVASIVE SPECIES

Native species have evolved to the local climate, hydrology, and geology conditions over a long period of time. These plants, animals, fungi, and insects define the basic structure and function of a local ecosystem. Non-native species, on the other hand, are introduced on purpose or by accident and can disrupt ecosystems. Non-native or exotic species may not have natural predators at the sites where they are introduced, so they are prone to proliferate and outcompete healthy, native species, which can threaten the entire forest ecosystem. The FAO defines invasive species as any species that are non-native to a particular ecosystem and whose introduction and spread cause, or are likely to cause, sociocultural, economic, or environmental harm, or harm to human health (FAO, 2009). Not all non-native species can adapt to local conditions and proliferate as invasive species. Therefore, an outright ban on the use of non-native species for plantations or woodlots may not be appropriate, but the use of non-native species deserves careful consideration.

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. Reduced-impact logging, described in detail in the section on Forest Management Planning Overview and Tools, can minimize impact to the soil.

ROAD BUILDING

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

The poor road conditions found in many regions in the developing world make rational forest management—and, for that matter, many other production systems—quite difficult. High transport costs resulting from bad roads erode the potential for forest management investments. Logging often contributes to the deterioration of poorly constructed roads. Water and mud from skid trails or interior forest roads are 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, impacting the efficiency and profitability of operations, loggers look for every way possible to cut costs—such as high-grading the forests and paying minimal wages to the local individuals who extract timber. The high-grading results in degraded forest; the low pay limits the development of the local economy. If roads are built ineffectively with inadequate drainage structures, especially in high rainfall areas, they cannot be considered development; instead they can be an economic, social, and environmental liability.

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, plant, and animal communities. These practices leave the residual forest open to pest invasion and weaken its health or regeneration capabilities. Failure to properly site, drain and reseed skid roads can lead to significant erosion that decimates fragile soils and pollutes downstream biodiversity habitats. Similarly, leaving logging residues (slash, "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 atypical changes in the structure and composition of tree stands.

LARGE-SCALE LAND ACQUISITIONS

Large-scale land acquisitions occur in various forms and are a pressing environmental and social justice issue in developing countries. The most contentious large-scale land acquisitions, as defined by the International Land Coalition, are "acquisitions or concessions that are one or more of the following: (i) in violation of human rights, particularly the equal rights of women; (ii) not based on free, prior, and informed consent of the affected land-users; (iii) not based on a thorough assessment, or are in disregard of social, economic and environmental impacts, including the way they are gendered; (iv) not based on transparent contracts that specify clear and binding commitments about activities, employment, and benefits sharing, and; (v) not based on effective democratic planning, independent oversight, and meaningful participation." Most large-scale land acquisitions are by foreign corporations, often aided by governments anxious for investment (Kachingwe, 2012). Africa is home to half of the world's unused and uncultivated land, and only 10 percent of rural land is registered (Byamugisha, 2013).

Large-scale land acquisitions have increased due to increased demand for resources such as food, freshwater, and biofuels. Weak governance has also contributed to an increase in large-scale land acquisitions. Governments lacking the capacity to enforce existing land rights, or those without clear land rights policies to begin with, do not have the ability (and sometimes legal authority) to govern large-scale land acquisitions and subsequent land use. Customary lands that are not recognized by governments are also susceptible to being acquired. Corruption also plays a role in land acquisitions whereby personal interest and financial gain of government officials can supersede the public good (Boudreaux, 2012).

Forests and communities face pressure from large-scale land acquisitions. Buyers looking for high-yield investment opportunities may convert forests and undeveloped land to crops like sugar, rice, maize, cassava, palm oil, and soybean (Kiishweko, 2012).

COMMUNITY DISPLACEMENT

Reforestation schemes or proposed forestry projects that displace people or communities without compensation can be devastating. Fortunately, such schemes are rare. Even degraded lands or wastelands may still be places where local people go to meet 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.

FORESTS AND CLIMATE CHANGE

As part of the natural carbon cycle, trees and other vegetation remove carbon dioxide from the air through photosynthesis and store the carbon in woody biomass (in trunks, leaves, roots and soils). Thus, forests can act as a sink that helps mitigate climate change by removing carbon dioxide from the air through the process called carbon sequestration, particularly when new forests are planted or restored. But, forests can also be a source of greenhouse gases, contributing to climate change by releasing carbon dioxide into the atmosphere when they are deforested or degraded. About fifteen percent of global greenhouse gas emissions are related to the clearing, overuse, or degradation of forests.

Strategies for climate change mitigation in forests include sustainable forest management, avoided deforestation (including REDD+), and forest restoration.

PLANNING FOR A CHANGING CLIMATE

Forest ecosystems are vulnerable to changes in temperature, precipitation, seasons, and the frequency and severity of extreme events. Many forest ecosystems have been altered by changes in climate over the past few decades and these trends are expected to continue and potentially intensify in the future. Forestry projects are typically multi-decade activities. Therefore, successful projects need to plan for **exposure** to an altered climate.

In order to plan for expected climate change impacts, project managers should focus on incorporating information on climate from historical records, recent trends, and future projections. How far into the future those projections go should reflect the type of investment you are making (agroforestry projects may have a slightly shorter timeframe, but a protected area should plan for multiple decades, if not longer). Future projections should also take into consideration environmental thresholds that, if surpassed, could cause rapid ecosystem change. Note that near-term projections are more reliable and less uncertain than long-term emissions and climate predictions. In many cases managing for greater uncertainty rather than specific trends may be most appropriate.

Planning for climate change requires an understanding of the unique characteristics of specific forest ecosystems and tree species with an eye towards differential sensitivities to climate shifts. An altered local climate can drive changes to forest ecosystems and the goods and services they provide to communities (e.g., water purification and regulation). Climate change impacts may be worsened if other non-climate stressors (e.g., land clearing for agriculture, fire suppression practices, or infrastructure development) make forests more sensitive.

Although forest ecosystems are inherently dynamic, there are signs that the speed of climate change may already be exceeding their natural adaptive capacity to moderate potential damages or cope with the consequences of such changes. As a result, many historic forest species ranges or distributions are shifting, and individual species are being affected by pest infestations or invasive species.

In the context of EIA, mitigation is the implementation of measures designed to eliminate, reduce or offset the undesirable effects of a proposed action on the environment.

In the context of climate change, mitigation is an intervention to reduce the sources or enhance the sinks of greenhouse gases in order to limit the magnitude and/or rate of climate change.

ADAPTING TO CLIMATE CHANGE BY MINIMIZING VULNERABILITY THROUGH PROJECT DESIGN

A forest's vulnerability to climate change is the degree to which it may be unable to cope with a changing climate. Vulnerability is a function of exposure, sensitivity, and adaptive capacity. As such, project managers working with communities who are heavily dependent on forests for food, medicine, fuel and income, need to provide guidance on measures that reduce **sensitivity** and increase the **adaptive capacity** of forests and of the people who depend on them.

For instance, projects can be designed to focus on sustainable forest management practices that ensure resiliency and regenerative capacity of the forest itself—and link to communities. Government agencies, forestry companies and forest communities all have an important role to play. For example, sustainable forest management can be integrated into projects that create employment opportunities, like wood production, wood-based manufacturing, eco-tourism, and licensed hunting. Promoting payment for ecosystem services schemes that compensate local communities for ecosystems services such as clean water provisioning can be a way to protect ecosystems services that may provide an important climate change adaptation benefit in cases where expected climate stresses make clean water provisioning more important.

Also, adaptive capacity of forests may be enhanced through active restoration and conservation activities. Well-managed forests provide a natural buffer against landslides, floods, and soil erosion. These services will be even more important as the incidence and severity of extreme events like storms and droughts increases with climate change. From a **risk management perspective**, it is less costly to take account for the potential direct and indirect impacts of climate change on forests and people in project design rather than to continue practicing "business as usual" and risk paying the full cost of damages or lost income in the future. Planning ahead reduces vulnerability, increases resilience, and facilitates adaptation to climate change by ecosystems and communities alike.

POTENTIAL CLIMATE CHANGE IMPACTS THAT COULD AFFECT FORESTRY PROJECTS

CLIMATE STRESSES	DIRECT IMPACTS	INDIRECT IMPACTS	POSSIBLE ADAPTATION RESPONSES
NOTE THAT IMPACTS WILL VARY BY REGION	ILLUSTRATIVE EXAMPLES	ILLUSTRATIVE EXAMPLES	ILLUSTRATIVE EXAMPLES; ADAPTATION RESPONSES SHOULD BE TAILORED TO LOCAL CIRCUMSTANCES
• Increased temperatures • Change in seasons • Increased/ decreased/ more variable precipitation • More frequent extreme events • Sea level rise	• Shifting habitat suitability • Specialist species loss/migration	• Increased soil erosion • Agricultural expansion encroachment • Pressure from human migration • Land use/human/animal conflicts • Water pollution due to flood/drought	• Soil conservation and fertility restoration through rainfall capture, agro-forestry, and rangeland restoration • Rural livelihood diversification through devolution of rights to trees, water, wildlife, tourism, carbon • Integrated watershed management to improve groundwater availability • Maintaining habitat connectivity along expected change gradients • Reducing other threats to biodiversity and forest ecosystems (e.g., hunting, pollution, habitat fragmentation)

REDUCING GREENHOUSE GAS EMISSIONS AND MAXIMIZING SEQUESTRATION

About fifteen percent of global greenhouse gas emissions are related to the clearing, overuse, or degradation of forests. Forest projects that may directly or indirectly result in release of carbon should include information on the potential emissions from the project.

Furthermore, work in the forestry sector provides an opportunity to contribute to climate change mitigation by reducing emissions that might otherwise have occurred or by increasing carbon sequestration. The important role that forests play in regard to climate change has been recognized in the global effort to Reduce Emissions from Deforestation and Forest Degradation (REDD+).[6] Many countries have established

[6] The United Nations defines REDD as is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon

national strategies for emission reductions such as national REDD+ strategies or low emission development strategies (LEDS). Therefore, forestry projects should be aligned with those strategies. The provision of relevant climate change mitigation information and coordination with national monitoring and measuring, reporting and verification (MRV) systems will be an important aspect of coordination with national efforts.

Technical assistance to countries and stakeholders can decrease the potential adverse impacts that forestry activities can have on climate change. This includes improved management of forest fires and charcoal production and use, reduced land clearing for agriculture, anti-desertification initiatives, and the establishment of forest resource monitoring and assessment systems.

Forests can also mitigate climate change by absorbing and storing carbon dioxide in forest biomass and soil. Practices to maximize carbon storage and sequestration include forest protection, managing forests to store carbon, agroforestry and establishing mixed plantation forests dedicated to carbon sequestration.

GENERAL BEST DESIGN PRACTICES AND GUIDING PRINCIPLES

FOREST MANAGEMENT PLANNING OVERVIEW AND TOOLS

Forest management planning is essential to managing natural resources, reducing environmental impacts of small-scale activities, and sustaining livelihoods. Planning should be a continuous process rather than just a one-time event at the beginning of a project especially considering prospective changes in climate. Continuous planning helps ensure that planners make forest management decisions that align with changes in resources, governance, and livelihoods. Planners must take into consideration several cross-cutting issues, such as community involvement, participatory planning, and recognition of land tenure and resource rights. These overarching components are not specifically addressed in this document but nevertheless are important factors to consider when managing forests.

FOREST MANAGEMENT PLANS AND THE CAPACITY TO IMPLEMENT THEM

Before engaging in forest management, planners should develop a forest management plan that includes a clear long-term objective for the forest along with an integrated management strategy. The management objectives can differ substantially between public and private land ownership regimes and also be subject to different laws and regulations. For long-term sustainability, a forest management strategy should build capacity of local forest managers and planners so that good forest management may continue in the absence of donor coordination. Forest management plans clarify the roles and responsibilities of stakeholders and ensure compliance with international, national, regional, local, smallholder, and indigenous customary or collective rights. Some forest certification systems, discussed in more detail in Annex IV, require forest management plans to achieve certification (Forest Stewardship Council, 2010).

Forest management plans should contain environmental, governance, and socioeconomic components to ensure that forests are properly managed. Plans often encompass forest areas with multiple uses. Therefore, management plans often include forest use zones and maps that divide the forest into areas, each with their own set of management activities for purposes such as production, protection, local use, and restoration. Plans identifying forest species and appropriate rates of harvest help sustain forest resources over the long-term. Landowner policies and socioeconomic conditions of indigenous communities should also be documented to help avoid encroachment on resource rights and livelihoods. Procedures for dispute

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paths to sustainable development, in contrast REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

resolution should also be included. Using a public, participatory approach to management planning can build consensus among community members, particularly the local indigenous community.

Forest management plans are dynamic and should be revised based on changing circumstances and conditions. They are useful for monitoring and documenting forest activities and changes over time, and they help determine environmental safeguards that may need to be put into place to mitigate negative impacts of forest activities before or after a project has begun (Forest Stewardship Council, 2010).

GROUND-BASED FORESTRY INVENTORY TOOLS

Sound forest management planning for all activities begins with an assessment or inventory, which involves classifying different forest areas according to their potential use, estimating their value, and planning for reforestation and/or regeneration. In the past, this involved labor-intensive field data collection, such as tree species identification and other measurements in representative sample plots. Advances in technology such as satellite imagery, aerial photography and video, and LIDAR (radar) have enabled some of this work to be done remotely; however, conducting forest inventories remains one of the most expensive components of the management process due to the need for periodic ground-truthing and monitoring.

COMMUNITY-BASED MAPPING AND GEOSPATIAL TECHNOLOGY

Because many small-scale forestry projects are larger than agricultural parcels, good maps are essential tools for 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. Maps can also illustrate the areas where protection and conservation are necessary and where more detailed surveys are required to make sound management decisions. Public participation in the map-making process should be encouraged. Community-based mapping combines modern map-making techniques with the expert knowledge of local residents. Revised or new maps should be made readily available to the community, and any comments received should be incorporated.

Access to new technologies, such as geographic information systems (GIS), global positioning systems (GPS), and enhanced satellite imagery, discussed below, can make it easier to classify different areas. In situations where it is practical and justified to use more sophisticated technologies, project planners can quickly prepare maps of a program area showing the overall layout of the land and the inherent qualities of its sites. Geographical data are important for establishing geo-referenced points at the beginning of projects to enable proper monitoring over the life of the project. Geospatial data can also help establish property boundaries, help to reduce conflicts, and increase the speed of land registration (Byamugisha, 2013).

FOREST CENSUS

A forest census is a traditional, ground-based inventory of tree structures, sizes, species, functions, and value measured at sample plots. A census-taker records information about a tree's characteristics, such as its bark, leaves, flowers, and fruit, to identify the species. The diameter, height, basal area, and number of trees of given species are also recorded. GPS may be used during a census to help mark and map sample plots. A census at a small scale is often used to verify remotely sensed data gathered at larger scales (Ecobasis Ecology Consultancy, 2013).

HIGH CONSERVATION VALUE FOREST ASSESSMENT AND RISK ASSESSMENT

Considering competing uses for land and the expansion of industrial and agricultural activities, a careful process of land-use planning that identifies sensitive areas can reduce or prevent threats to biodiversity and forests. The High Conservation Value (HCV) approach identifies types of high conservation values and provides guidelines for how they should be evaluated. The HCV approach is referred to by the major certification schemes (e.g., Forest Stewardship Council) and leading development bank safeguards (e.g. IFC

Performance Standard 6). The Africa Biodiversity Collaborative Group (ABCG)[7] has a number of resources and case studies on HCV available online.

REMOTE SENSING-BASED INVENTORY TOOLS

Remote sensing is a technology using satellite and other imagery to produce spatial images. Such images can indicate burned forest areas, roads, changes in tree density, and other forest and land use changes useful for making comparisons over time or between different areas. Coupled with GIS, remote sensing helps define areas that need protection during activities such as road building, road-driven colonization, and logging. Remote sensing has become a useful tool to help control illegal logging and increase compliance with forest regulations (Astrium, 2011).

USAID has formed a partnership with the U.S. Geological Survey's (USGS) Earth Resources Observation and Science (EROS) Center to analyze satellite images around the world. This partnership allows USAID to monitor and evaluate landscape changes in its project areas, determine the success of conservation measures, and share the results with communities. USGS has been collecting satellite data for over 40 years and in 2008 made its Landsat satellite images available to the public for free (Fakan, 2011). USAID also provides funding to Global Forest Watch, an online forest monitoring and alert system that uses satellite technology, open data, and crowdsourcing to provide up-to-date and reliable information about forests.

DNA MARKING

DNA marking is another modern tool for forest management and is traditionally used in the later stages of planning. It allows forest management practitioners to identify the geographic origin and genetic make-up of a species of tree. DNA marking is a more secure way to identify a tree species and its origin than external markings since DNA cannot be tampered with. It allows timber importers, traders, and customs officials to positively identify incorrectly marked (and possibly illegally harvested) trees, and reduces the likelihood of alterations to chain-of-custody documents.

Stakeholders are increasing efforts to develop and use DNA marking technology. USAID has partnered with the U.S. Forest Service to pilot DNA mapping in the Amazon Basin, Russia, and Central America (U.S. Forest Service, 2013). In addition, stakeholders formed the Global Timber Tracking Network, developing a database containing geo-referenced data on tree species and genetic make-up, with the aim of reducing illegal logging.

ENVIRONMENTAL ASSESSMENT TOOLS

Land owners, communities, and planners use environmental assessment tools to identify impacts of forest management activities and to develop mitigation plans that address negative impacts on the environment and on livelihoods.

As noted earlier, the Foreign Assistance Act mandates that USAID take into account the environment, tropical forestry, and biodiversity when designing and implementing activities. To help staff and partners do this, USAID has developed several environmental assessment tools that should be used when identifying forest management techniques and associated impacts.

- Best Practices for Biodiversity and Tropical Forest Assessments provides an overview of Section 118 and 119 of the Foreign Assistance Act for country development strategies (Global Environmental Management Support, 2005).
- Environmental Procedures Training Manual (EPTM) assists USAID mission staff and USAID partners with design for projects that mitigate negative environmental impacts. The manual also helps staff and partners

[7] The ABCG is made up of seven international conservation NGOs (African Wildlife Foundation, Conservation International, the Jane Goodall Institute, The Nature Conservancy, Wildlife Conservation Society, World Resources Institute, and World Wildlife Fund) and is funded in part by USAID. It seeks to work collaboratively and efficiently and effectively to further a sustainable future for the African continent.

comply with the USAID environmental procedures found in Title 22 of the Code of Federal Regulations (22 CFR 216), commonly referred to as Reg. 216 (USAID, 2002).

- Environmental Compliance Procedures ensure that USAID staff integrate environmental factors into decision-making and hold staff responsible for assessing environmental impacts of USAID activities (USAID, 2013a).
- Environmental Compliance Management System, Standard Operating Procedure Manual describes the processes for developing an initial environmental examination and a request for categorical exclusion (USAID E&E Bureau, 2012).

CRITERIA AND INDICATORS TOOL

Criteria and indicators (C&I) are tools developed by ITTO for the sustainable management of natural tropical forests. C&I are used to define, assess, and monitor progress towards sustainable forest management. The tools identify criteria, the main factors that influence the health and productivity of a forest, and suggest indicators for forest managers to measure over time in order to assess the sustainability of management practices for forests and forest-dependent communities. Based on the findings of these measurements, management plans can be adapted to sustain the necessary yield of ecosystem goods and services.

ITTO trains forest concessionaires, industry workers, and government officials in tropical member countries on how to apply the C&I nationally and at the forest management unit level. The original C&I tools were developed for natural tropical forests, but since then similar processes have been initiated for other ecological zones and regions in hopes of ensuring consistency of forest management policies.

REDUCED-IMPACT LOGGING

Sustainable harvesting activities rely on the principle of sustained yield—the amount harvested annually should not exceed the annual growth during the rotation period. However, understanding and maintaining the growth patterns of mixed tropical forests takes time and information. Reduced-impact logging is recommended when not enough information is available to understand the forest growth patterns or if the available information suggests the need for a conservative approach. Reduced-impact logging can help a project avoid or reverse unsustainable exploitation patterns and 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 can actually lower costs and increase profit margins while mitigating the environmental impacts of harvesting (e.g., minimizing ecosystem impacts, reducing carbon emissions) (Sasaki, 2011). Much of the investment in reduced-impact logging involves retraining forest workers. Training both provides improved operating capabilities and efficiency of crews and increased awareness of the economic and ecological benefits of managed forests.

SOCIAL SAFEGUARDS

Forests sustain the livelihoods of a large portion of the world's rural population. On the whole, sharing the rights (the benefits stream of a productive and managed natural forest) and responsibilities (accountability for safeguarding the resource base) of forest management with communities leads to improved forest management and livelihoods. It is essential to ensure that government supports the community's right, through land tenure and other means, to protect the managed forest from third parties who wish to exploit its resources.

Customary rights of indigenous groups or collective rights of smallholder communities are recognized to different degrees by national governments (Bruce et al., 2010). When traditional or legal tenure has not been recognized, or where enforcement is weak, there is little to no community incentive to manage resources for the long term. Weak tenure also creates conflict and instability, which threaten livelihoods. On the other hand, secure land tenure leads to economic growth, job creation, higher agricultural productivity, better food security, an incentive to invest in and protect the land, and decreased land degradation. Communities can become stewards of land when, through strengthened tenure, they have confidence that their investments will provide returns (USAID, 2014).

Examples of recent projects that have involved community management or co-management of natural forests include the following:

> A study done on twelve community-based forest enterprises (CFEs) managing 107,000 hectares of forest in and around the protected Rio Platano Biosphere Reserve in Honduras found that the presence of CFEs added a layer of protection to the reserve and contributed to lower forest loss. A 2010 study in the Gualaco and Guata municipalities found that in the six years following CFE presence on 40,000 hectares of forest land, illegal logging decreased, forest fires affected less than 2 percent of the land, and silvicultural practices controlled a pine bark beetle infestation (Gatto, 2013).
>
> USAID's Guinea Natural Resource Management project provided capacity building for a regional watershed management group, allowing the group to participate in forest management planning. The project trained the group in tree nursery development, credit management, and beehive and stove construction and found markets for new community enterprises and products such as honey, wax, soap, and dyes. These activities strengthened the connection between improved livelihoods and forest resource management, creating a vested interest in protecting and sustaining the natural forest (Clausen and Hube, 2013).

It is important to note that participatory management does not necessarily lead to better forest management. Local knowledge, beliefs, and attitudes greatly influence the way forests are managed by local landowners. In some cases, local dynamics and economic incentives can trump environmental considerations. If there is no market-based economic value to be derived from intact forest, then other more damaging land uses may prevail. On the other hand, forests with local spiritual or recreational value may lead communities to conserve forests even where no market-based economic value exists. To shift attitudes that may hamper forest conservation, sustainable forest management projects should analyze the socioeconomic issues of landowners, encourage the development of community groups where appropriate, and increase forest-based entrepreneurial efforts (Pool et al., 2002).

USAID and the Millennium Challenge Corporation together have invested $800 million in programs in 32 countries that improve land tenure and resource rights (USAID, 2014). Land tenure is also critical to REDD+ programs, where governments or communities receive payments for carbon emissions avoided by not cutting down or degrading forests. Defined and recognized property rights lead to more efficient and equitable distribution of payments for these carbon offsets, and REDD+ project certifications require proof of land tenure security (Naughton-Treves and Day, 2012).

Both formal and customary land policies seldom account for impacts on women and commonly exclude them from equal rights to land, even though family livelihoods most often depend on women. In developing countries, rural women control less than 2 percent of the land despite providing households with 80 percent of their food and playing a predominant role in fuelwood gathering, globally. Participation by women in forest management planning and forestry projects is therefore critical to the success of forest management and livelihood objectives (Agarwal, 2002). Women's knowledge, views, needs and involvement should be built into all forestry activities. Forming a women's forestry committee, or similar local organizations, may be beneficial for all projects and is a necessary course of action in cultures where mixed gender committees are not allowed.

The international community, including USAID, recognizes the importance of including gender in policies and standards for natural resource management. In 2013 the Women Organizing for Change in Agriculture and Natural Resource Management (WOCAN) introduced the W+ Standard to measure women's participation and empowerment in forest carbon offset projects through REDD+. The W+ Standard lists a set of six requirements for evaluating the impact of REDD+ projects on women's income and assets, time, education and knowledge, leadership, food security, and health (WOCAN, 2013).

More information is available from USAID's Land Tenure division, which provides land tenure and property rights tools that can be used in planning social safeguards for small-scale forestry projects, and USAID's gender office and USAID missions' gender specialist(s) can provide guidance and tools for gender inclusion. Additional safeguards in use are described in Annex IV.

SUSTAINABLE FOREST MANAGEMENT

The following table lists a few sample best practices for several main objectives of sustainable forest management. These practices should be incorporated into all forestry projects (FAO, 1998).

OBJECTIVE	SAMPLE BEST PRACTICES
Maintenance of Ecological Processes	Forest use should not cause deterioration of the hydrological functions of forested catchments
	Forest cover should be maintained to protect soils against the erosive effects of rainfall.
	Soil erosion should be minimized.
	The forest structure should, as far as possible, be maintained to ensure that the biological regeneration capacity is preserved.
	Removal of inorganic nutrients should be minimized by leaving branches and foliage, and debarking logs, in the forest.
	Ecologically sensitive areas, especially buffer zones along watercourses, should be protected.
	Forest management operations should not cause avoidable ponding or waterlogging.
	There should be no chemical contamination of soils and food chains.
Maintenance of Biological Diversity	Sites important for rare or localized species should not be disturbed.
	Endangered plant and animal species should be protected.
	Natural processes should be mimicked to allow for varying spatial density needs of species.
	Small areas of undisturbed forest can preserve wildlife species, which can recolonize a forest which regenerates after logging.
Maintenance of Harvesting of All Forest Products	Sustainability should not be based upon a single product; management should aim at the production diverse forest products.

Forest managers or government entities should consider the need for and impacts of road development for sustainable forest management practices before such management and operations commence. Road development should be done within the framework of sustainable forest management plans. 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.

AGROFORESTRY

Agroforestry activities are generally aimed at developing sustainable farming systems. As such, they aim to cause minimal environmental harm or address existing harm. 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. There are several considerations that need to be taken into account to safeguard the environment. The World Agroforestry Centre has created a toolkit to assist with incorporating agroforestry practice into project design (Taylor and Beniest, 2003). The following general design principles should be applied.

INFORMATION-BASED STRATEGY DEVELOPMENT

The choice of tree species and technological approach is a complex challenge due to the many possible combinations of production goals and ecological conditions. For instance, trees may compete with, rather than support, agricultural crops if 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, and/or host pests and diseases.

Efforts to introduce agroforestry can 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. It is important to carefully assess soil, topography, and climate, as well as markets, for possible products. When developing sound management approaches, planners should consult farmers and engage them in participatory design and testing of agroforestry practices and strategies. 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, and productivity loss.

When applying agroforestry techniques in hilly areas with mixed topography, micro-site adjustments, such as contour hedgerows and other permanent vegetation strips, may need to be made—combined with soil and water conservation technologies—to prevent erosion.

Another consideration for management is the role that agroforestry plays in landscape-scale carbon sequestration and forest preservation programs. The growth in carbon markets has led to opportunities for agroforestry practices that help mitigate climate change and reduce land degradation. Planners may choose to conserve a landscape and plant woody perennials to increase carbon sequestration levels and receive PES payments. New plantings like fruit trees and other species can increase soil fertility and yields, provide income opportunities to communities, and increase nutrition (Foster, 2012).

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
- Demarcating a field boundary
- Sequestering carbon to slow the rate of global climate change
- Extending biodiverse habitats
- Stabilizing watersheds

ENSURING FARMER SATISFACTION

The ultimate test of the sustainability of agroforestry technologies is farmer satisfaction over the long term, as agroforestry systems take several years to yield benefits. Projects should provide for farmer consultation and participation in land use planning. 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.

REFORESTATION AND PLANTATION FORESTRY

Using reforestation and plantation methods can be complex. It involves a great deal of planning 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 general guidelines:

- Plantations should not replace natural forests, not even secondary forests that have already been harvested or high-graded.
- Reforestation plans should take into account the effects of reforestation on the land-use mosaic of the area around the plantation, including impacts on natural forests, biodiversity conservation, and alternative land uses.
- Native species are preferable to non-native species. The use of exotic species deserves careful consideration. 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 while reducing environmental risk. Any exotic species should be fully tested in an introductory trial under conditions similar to those at the site, to ensure its adaptability and to avoid introducing invasive species.
- 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 variability within a plantation, include areas of different ages to spread out the eventual impact of harvesting over time.
- The plantation's layout and associated access roads 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.
- The practice of clearing land for planting should generally be avoided and be used only when absolutely necessary (e.g., to remove pest-infested trees). If it is done, the project design should include the following to forestall soil degradation and hydrological problems:
  - 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 be minimized, conform to USAID regulations, and be consistent with integrated pest management approaches. (See the Integrated Pest Management [IPM] Guideline).

The following are two examples of best practice reforestation approaches that help improve degraded forests:

- Facilitated natural generation, or assisted natural regeneration, uses naturally occurring trees to stimulate new natural generation. It is a flexible approach to reforestation that emphasizes enrichment planting, replanting with the native stock (from a nearby forest, if necessary), managing fires to encourage natural regeneration, and restoring a diverse native forest.
- Forest landscape restoration is a participatory restoration practice involving all local stakeholders in the landscape to turn deforested or degraded land into healthy, fertile, working landscapes where local communities and ecosystems can cohabit sustainably. Stakeholders decide how to integrate site-level forest restoration actions with landscape-level objectives so that ecosystem and human needs are met. The concept is supported by groups such as the International Union for Conservation of Nature, World Wildlife Fund, and the ITTO.

ECONOMIC VALUES OF FOREST GOODS AND SERVICES

INCOME GENERATION AND SMALL-SCALE FORESTRY ACTIVITIES

Economics is a fundamental driver of small-scale forestry activities. Forest communities sustain their livelihoods and earn income from forest products and services, including selling wood for fuel, construction, and for high-value products and selling and consuming non-timber products such as fruit, honey, rubber, fiber, and medicine. Forest services, such as tourism, can also generate income, boost livelihoods for local communities, and increase conservation initiatives.

Establishing and maintaining income-generating small-scale forestry projects can be an effective tool for development activities. It is critical to consider both up-front costs and operational maintenance costs. These can be extrapolated from pilot projects, but can vary widely depending on project specifics. Projects that do not build in enough operational maintenance costs run the risk of unintentionally derailing forest management projects and causing negative environmental impacts. Ideally, these maintenance costs should be covered by revenue from forest products and services, which builds in economic sustainability and helps increase the likelihood that communities will continue to see economic benefits and benefits from forest conservation long after a donor-funded program has ended.

One example of an income-generation and conservation strategy is FAO's participatory training process called Market Analysis and Development (MA&D). MA&D provides a framework to help communities conserve natural resources and generate income through enterprise development. Community entrepreneurs follow the MA&D approach with help from a facilitator to make sure they include the necessary elements for starting their business. The process emphasizes entrepreneur participation and social, environmental, and long-term business sustainability (FAO, 2014).

PAYMENTS FOR ECOSYSTEM SERVICES

Natural resources such as timber, fossil fuels, and minerals have clear economic value in economies and gross domestic product (GDP). However, other components of ecosystems and their services do not have a quantifiable measurement of value that can be easily factored into economic growth. For example, carbon sequestration, watershed protection, water purification, and biodiversity conservation provide high value on the local and global scale but are not captured in the traditional economic valuation of ecosystems. Payment or reward to land owners for ecosystem or environmental services solves this problem by creating a direct economic market for conservation and gives resource users market signals for the value of natural services.

Payments for ecosystem or environmental services (PES) are defined as "voluntary transaction[s] in which an environmental service buyer, who does not control the environmental factors of production, pays an environmental service provider, who controls the environmental factors of production, for a well-defined environmental service using a cash or in-kind payment that varies conditional on the quantity and quality of the environmental service provided" (Ferraro, 2007). Payments can be in cash or in the form of land tenure rights, employment opportunities, economic development, and government services.

Two key considerations when developing PES arrangements are time of payment and receipt of ecosystem or environmental services. Some activities and payments are appropriate for a short time frame (e.g., payments to land users who do not cut down trees), but other activities take much longer to complete (e.g., restoring a degraded forest). Stakeholders need to be knowledgeable about the timeline so that conservation initiatives are not abandoned due to misguided expectations (Jindal and Kerr, 2007).

Latin America and Asia have the highest number of PES schemes. Tools that can be used to quantify the value of ecosystem goods and services for PES schemes are discussed in Annex IV.

COST BENEFIT CONSIDERATIONS

USAID requires analysis of gender, environmental, and sustainability issues as part of project design, but it does not explicitly mandate cost-benefit analysis (CBA), because it would be inappropriate for some projects. Consideration of costs and benefits for USAID projects typically entails financial analysis, stakeholder analysis (who wins, who loses), and economic analysis.

The basic objective of financial analysis, the starting point of CBA, is to determine whether a financial investment in a project can be recovered, given prevailing and expected prices of inputs, outputs, and other variables. The financial analysis is carried out from the points of view of the various economic agents participating in the project, principally farmers or foresters but also others in the value chain such as lenders, traders, and millers.

The objective of economic analysis is to determine the desirability or viability of a project (for society as a whole, assuming the winners compensate the losers). Economic analysis requires adjustments to financial analysis to correct for a variety of price distortions, such as those introduced by subsidies, taxes, tariffs, and exchange rates, and externalities, such as the costs of sediment from timber harvesting reducing the life of a dam, or costs associated with underpriced (or non-monetized) natural resources such as water. The purpose of these adjustments is to express benefits and costs at their true economic values to society. Hence, it is the economic analysis that allows for the inclusion of possible compensation or mitigation opportunities.

The ecosystem services framework used throughout these guidelines provides an ideal starting point for consideration of the CBA tool for forestry projects (see Annex III: Forest Ecosystem Services). Through this framework, project planners can consider the ecosystem services' contribution to total economic value (TEV), as detailed in The Economics of Ecosystems and Biodiversity (TEEB) reports (Pascual et. al. 2010). The components of TEV include use values (e.g., direct use, indirect use) and non-use values (e.g., bequest value, existence value, option value). There are several potential valuation methodologies, such as direct/market methods (e.g., market price, replacement costs), revealed preferences (e.g., hedonic pricing, travel cost), stated preferences (e.g., contingent valuation), or benefits transfer (e.g., applying ecosystem services values calculated from similar earlier projects researched by others). Annex IV contains an introduction to some of the tools available that quantify ecosystem services.

An issue being addressed within USAID is how to limit the large number of possible ecosystem services associated with forestry projects to a reasonable number with credible values for inclusion in the CBA. One promising methodology is the United Nations Development Programme (UNDP)'s Targeted Scenario Analysis, which narrows down the ecosystem services needing quantification to those directly contributing to "production" (in whatever forms that takes for the relevant sector). The framework also encourages inclusion of ecosystem values not easily quantified. In other words, it looks to offer a higher degree of credibility of the CBA inputs, while also focusing on ecosystem services directly relevant to business decisions (UNDP, 2013).

MITIGATION AND MONITORING

The mitigation and monitoring measures that would apply to different types of forest management (sustainable forest management, agroforestry, and reforestation and plantation forestry) are listed in the following table. Many of the problems listed in the table below may be affected by climate change, or conversely, they may impact climate. The associated mitigation measures may be particularly helpful for increasing adaptive capacity or for decreasing sensitivity or exposure to potential climate changes. However, in all cases, the application of mitigation measures should be based on site specific information.

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
Sustainable Forest Management				
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 • Reduced community access to forest resources • Conflicts between local inhabitants and forest workers • Hardship and social disintegration within the local communities dependent on adjacent forests	• Land tenure uncertainties • Market failures • Lack of community inclusiveness, leaving stakeholder groups (e.g., women, herders) out of decision-making • CFEs, cooperatives, and other community groups are disengaged from participatory management of natural resources as they don't recognize their rights or responsibilities in forest protection and management • 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 • Gaps in understanding of silvicultural practices of individual species and groups of species; overall lack of	• 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 paratechnicians 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 • Avoid silvicultural practices that result in increased fragmentation of forest habitat	• 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 • Consider and plan for climate impacts • Conduct more careful research and understanding of local/traditional knowledge • Develop and adhere to a sound sustainable management plan

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
		understanding of general silvicultural practices • Influx of "outsiders" involved in forest management and harvesting		
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 • Failure to take into account habitat range shifts or increased vulnerability of species in the context of climate change • 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 • Heightened monitoring of endangered species and increased conservation measures as needed	• 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 • Consider and plan for climate impacts
Increased GHG emissions	• Depleted stored carbon • Increased soil erosion • Increased natural disasters • Increased forest diseases • Decreased availability of resources needed by the local community	• Agricultural land clearing • Logging • Forest fires (planned and accidental), which may be increasing in frequency and severity due to climate change	• Improved fire management • Higher-efficiency cook stoves or lower-emissions alternatives to household firewood use • Alignment of programs with national REDD+ strategies and national emission reductions goals.	• Information and technical assistance to support sustainable forest management • Restoration of degraded forests • Mixed plantation forests for carbon sequestration • Land use planning and enforcement resulting in protection of forests and other carbon-rich ecosystems

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
				• Inclusion of climate models for broader forest management planning and improved measures of environmental variables in forest management activities.
AGROFORESTRY				
Competition with crops for water, shade, and soil nutrients	• Limited growth of crops • Poor yields • Nutrient depletion in the soil	• Spacing between crops and trees • Improper training • Semi-arid conditions increase competition	• Ensure proper spacing between trees and crops • Plant trees with reduced water needs and limited shade	• Choose species that can adapt and grow in the specific environment
Exotic species can become invasive	• Native species decrease in abundance or disappear altogether	Exotic species crowd out native species • Over-reliance on certain exotic species such as Eucalyptus spp., Leucaena spp., Prosopis spp., and Acacia spp.	Balance species selection • Select native, multipurpose species	Review the basic forest management plan and ensure that proper prescriptions are in place to control exotics • Increase training on species selection
Interference with farming operations such as plowing and tilling the crops	• Farmers unable to cultivate crops efficiently • Possible loss of harvest	• Improper placement of crops and woody perennials • Root growth	• Land use planning • Plant deep-rooted trees and shallow-rooted crops • Proper spacing or configuration of trees and crops	• Restoration of degraded forests
Pests and diseases (Sileshi, et al., 2008)	• Plant stress • Degraded farming system	• Increased soil nutrients can lead to susceptibility to other pests • Trees serve as alternate hosts to crop pests	• Diversify species in agroforestry system	• Use ecological principles and decision-making tools • Understand interactive effects of plants, trees, soil, crop, and environment on pests

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
		• Increased leaf litter may cover ground for most of the year and cause disease build-up • Single-species fallows (monoculture) • Shifting pest and disease range due to climate change		• Considering and planning for climate impacts
REFORESTATION AND PLANTATION FORESTRY				
Loss of forest ecosystem ability to deliver associated ecosystem goods and services.	• Loss of tree diversity (e.g., plantations) • Use of non-native plantation species • Decreases in the supply of essential products and the services provided by the naturally forested areas • Changes in wildlife, including bird populations and compositions	• Underestimation of the potential returns from sustainable forest management • Can be exacerbated by climate change when new conditions lead to lower productivity or increased natural disturbance • Poorly designed incentive programs or subsidies • Market failures that undervalue native species and timber • Undervaluing of forest carbon and other ecosystem services	• Improved integrated program planning, resource assessments and site stratification • Clear criteria for selection of suitable sites • Valuation of additional marketable forest products or ecosystem services. • Testing and development of native species as integral part of reforestation programs • Incorporating climate information in land use planning and project planning, including selection of target species	• Developing a reforestation master plan or program strategy • Understanding the micro- and macro-economics of sustainable forest management • Enhancing national government's capacity for land-use planning • Considering and planning for climate impacts • Educating stakeholders and making climate information available so that their forestry activities and land use planning take climate change into account • Increased awareness of cost issues, timing, periodicity

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
Point- or non-point pollution as a result of misuse or unauthorized use of agrochemicals 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 • Change in precipitation patterns due to climate change, leading to runoff	• Greater reliance on IPM solutions for pest problems • Improving training packages and pesticide handling guidelines • Training and fielding paratechnicians from within farmer community to advise peers • Educating stakeholders and making climate information available so that agrochemicals are used optimally	• Development of national agrochemical use guidelines that include forest nurseries
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 • Climate change causes lands to become more marginal or crops to become suitable in new areas	• Improve integrated program planning, resource assessments, and site stratification • Including climate information in land use planning and project planning • Coordinating with government-led REDD+ strategy and low emissions development strategy (LEDS) work	• Enhance national government's capabilities for land-use planning • Considering and planning for climate impacts
Increased GHG emissions	• Depleted stored carbon • Increased soil erosion • Increase in natural disasters	• Agricultural land clearing • Logging • Forest fires (planned and accidental), which may be	• Land use planning and enforcement resulting in protection of forests and other carbon-rich ecosystems	• Information and technical assistance to support sustainable forest management

ADVERSE IMPACTS	INDICATORS	CAUSES	MITIGATION MEASURES	
			SPECIFIC	GENERAL
	• Increase in forest diseases and pests • Decreased resources necessary for livelihood of communities	increasing in frequency and severity due to climate change	• Improved fire management • Higher-efficiency cook stoves or lower-emissions alternatives to household firewood use • Inclusion of climate models and improved measures of environmental variables in forest management activities. • Alignment of programs with national REDD+ strategies and national emission reduction goals.	• Restoration of degraded forests • Mixed plantation forests for carbon sequestration • Realism of behavioral shifts over time and considerable costs

KEY RESOURCES

European Union's (EU) site on forests: http://ec.europa.eu/environment/forests/home_en.htm.

Food and Agriculture Organization's (FAO) Committee on Forestry (COFO): http://www.fao.org/forestry/57758/en/.

Forest Legality Alliance: http://www.forestlegality.org/.

Forest Trends: http://www.forest-trends.org/.

International Institute for Sustainable Development's (IISD) brief on global forest policy: http://www.iisd.ca/process/forest_desertification_land-forestintro.htm.

International Tropical Timber Organization: http://www.itto.int/policypapers_guidelines/.

International Union for Conservation of Nature (IUCN) Forest Conservation: http://www.iucn.org/about/work/programmes/forest/.

Organisation for Economic Co-operation and Development's (OECD) site on issues pertaining to environment: http://www.oecd.org/environment/cc/.

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ADDITIONAL RESOURCES

OVERVIEW OF THE FORESTRY SECTOR

- For more information on the Alternatives to Slash and Burn program, see CIFOR's Fire Research: http://www.cifor.org/fire/ and ASB's Partnership for the Tropical Forest Margins: http://www.asb.cgiar.org/

- World Agroforestry Centre [formerly ICRAF]: http://www.worldagroforestry.org/

ISSUES IN FOREST GOVERNANCE

- For more information on conflict analysis tools, see: http://www.conflictsensitivity.org/node/81

INTERNATIONAL ENVIRONMENTAL CONVENTIONS RELATED TO FORESTRY

-Convention on Biological Diversity (CBD), adopted in 1992, aims to conserve and sustain biodiversity: http://www.cbd.int/

-United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD), adopted in 1994, collaborates with the UNFCCC and CBD to address natural resource management and use: http://www.unccd.int/en/Pages/default.aspx

- The Ramsar Convention on Wetlands - The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources: http://www.ramsar.org/

-United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992, sets a goal to stabilize greenhouse gas emissions to prevent human interference with the climate system: https://unfccc.int

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival: http://www.cites.org/

RESOURCES AND TOOLS FROM OTHER DONORS AND AGENCIES

- Evans, K. et al. (2006). Guide to Participatory Tools for Forest Communities. Bogor, Indonesia: Center for International Forestry Research (CIFOR): http://info.worldbank.org/etools/docs/library/238390/BKristen0601.pdf

- The CBD Secretariat, with generous funding from the governments of Belgium and Norway and in consultation with Collaborative Partnership on Forests (CPF) members, launched a new web-based tool to support the conservation and sustainable use of the world's forest biodiversity, based on the TEMATEA platform: http://www.tematea.org

- International Tropical Timber Agreement took effect in 2011, replacing the 1994 International Tropical Timber Agreement, and promotes trade expansion of tropical timber from sustainably managed forests: http://www.itto.int/itta/

- Food and Agriculture Organization's (FAO) 2010 Global Forest Resources Assessment: http://www.fao.org/docrep/013/i1757e/i1757e.pdf; Global Conventions Related to Forests: http://www.fao.org/docrep/003/y1237e/y1237e00.htm; and Collaborative Conflict Management for Enhanced National Forest Programmes (NFPS) Training Manual: http://www.fao.org/docrep/017/i3101e/i3101e00.pdf.

- U.S. Forest Service (USFS), Legally Binding Agreements: http://www.fs.fed.us/global/aboutus/policy/multi/bind.htm

- U.S. Forest Service, Climate Change Emphasis Area: http://www.fs.fed.us/climatechange/; and Climate Change Resource Center: http://www.fs.fed.us/ccrc/

ANNEX I: TRADE POLICIES

U.S. LACEY ACT

The U.S. Lacey Act, originally passed in 1900 to prohibit the trafficking of protected plants and animals across state borders, was amended in 2008 to prohibit the importation of illegally harvested plants, including trees and their derivatives (e.g., furniture, paper) into the United States. The law also requires some plants and plant products, with few exceptions, to be identified and declared by species name, value, quantity, and country of harvest upon entry. The Lacey Act punishes individuals and companies who deal in illegally harvested products; even if they did not know that the products are illegal. Penalties can include fines, product forfeiture, imprisonment, and charges of smuggling and money laundering.

Since many products imported into the United States contain wood derivatives, the law has succeeded in capturing industry attention. Companies are now exerting greater due care to determine the source of their imported products and seeking to eliminate illegal wood from supply chains. However, tracing wood products back to their origin is complex and costly. A lack of reliable tracking systems both in producing countries and within global value chains is a primary focus of trade discussions.

EU TIMBER REGULATION

The European Union (EU) has also approached the issue of illegal logging and associated trade through a prohibition, the EU Timber Regulation of 2013, and a long-term action plan known as the Forest Law Enforcement, Governance and Trade (FLEGT) plan. The EU Timber Regulation prohibits the import of illegally harvested wood products into the EU, and requires that due diligence be conducted regularly by those who first place timber on the EU market. Under the FLEGT initiative the EU has established voluntary partnership agreements (VPAs), bilateral agreements with supplier countries to strengthen the capacity to monitor forest product trade from the stump to the port.

AUSTRALIA'S ILLEGAL LOGGING PROHIBITION ACT

Australia's Illegal Logging Prohibition Act, passed in 2012, made it "a criminal offence to import illegally logged timber and timber products into Australia or to process domestically grown raw logs that have been illegally logged" (Australian Government, Department of Agriculture, 2014). As in the U.S. Lacey Act and EU Timber Regulation, the definition of illegal timber is based on the law of the country of harvest. In Australia, those who import the timber or process domestically grown logs are responsible for carrying out due diligence to ensure that the timber was not illegally harvested. Significant criminal penalties, including fines and imprisonment, may apply if importers or processors "knowingly, intentionally or recklessly import or process illegally logged timber" (Australian Government, Department of Agriculture, 2014).

ANNEX II: FOREST TYPES

Forests are typically classified by location and climate. The FAO (2010) defines forests as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ." This definition does not include land that is predominantly under agricultural or non-forest land use. However, the various uses of forest at different scales prompted the creation of over 800 diverse definitions (UNEP, 2009) by United Nations Environment Programme (UNEP) that reflect the diversity of forest and forest ecosystems throughout the world.

Forests can be divided broadly into primary forests, naturally regenerated forests, and planted forests. Specific forest types include:

- Primary or natural forests: These are native tree species including tropical rainforests that have been minimally disturbed by human activities. Among the countries with the largest primary forest area are Russia, Brazil, Canada, Peru, and the United States.
- Secondary forests: These forests regenerate largely through natural processes after significant removal or disturbance of the original forest vegetation by human or natural causes at a single point in time or over an extended period, and they display a major difference in forest structure and/or canopy species composition with respect to pristine primary forests.
- Tropical: Year-round high temperatures and abundant rainfall make this a dense, lush forest. Tropical forests are found near the equator, including the Congo and Amazon River Basins.
- Temperate: There are four distinct seasons in these forests as precipitation falls throughout the year as either rain or snow. These forests receive 30-60 inches of rain per year and are found in eastern North America, western and eastern Europe, and northeast Asia.
- Mediterranean: These forests are found to the south of temperate regions around the coasts of the Mediterranean, California, Chile, and Western Australia. The growing season is short, and almost all trees are evergreen but include a mix of hardwoods and softwoods.
- Savannah: A lowland, tropical or subtropical grassland with irregularly scattered trees and shrubs widely spaced without a closed canopy. They have been defined as having tree coverage as low as 5-10 percent and as much as 25-80 percent of an area. Savannah can represent a transitional region between a forest and grassland, and is found in many parts of Africa.
- Montane or cloud forests: These receive most of their precipitation from the mist or fog that comes up from the lowlands. Some of these montane woodlands and grasslands are found in high-elevation tropical, subtropical, and temperate zones.
- Coniferous: These forests, although predominantly conifer species, may include some cold-tolerant hardwood species, and they occur in zones between the 45th parallels and the poles.
- Plantations: Plantations are typically artificially established forests where trees are grown for commercial purposes. There are about 140 million hectares of "plantation forests" in the world accounting for around 5 percent of global forest cover. Plantations produce around 40 percent of the world's industrial wood.

ANNEX III: FOREST ECOSYSTEM SERVICES

FOREST ECOSYSTEM SERVICES	DESCRIPTION
Provisioning: the products obtained from ecosystems	
Food	Food products derived from plants, animals, and microbes.
Fiber	Materials including wood, jute, cotton, hemp, silk, and wool.
Fuel	Wood, dung, and other biological materials used as energy sources.
Biodiversity and genetic resources	Forests are home to 80 percent of the world's terrestrial biodiversity and include many resources used in animal and plant breeding, biotechnology, personal care products, biochemicals, and pharmaceuticals.
Ornamental resources	Animal and plant products, such as skins and flowers, are used as ornaments, and whole plants are used for landscaping.
Fresh water	About 4.6 billion people depend for some or all of their water on supplies from forest systems.
Regulating: benefits obtained from the regulation of ecosystem processes	
Air quality regulation	Forests contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality
Climate regulation	Forests influence climate both locally and globally. At a local scale, for example, changes in land cover can affect both temperature and precipitation. At the global scale, forests play an important role in climate by sequestering carbon dioxide.
Water regulation	Forests regulate the water cycle by moderating temperature and rainfall through transpiration, absorption of runoff, and recharge of the water table. Forest systems are associated with the regulation of 57 percent of total water runoff.
Erosion regulation	Vegetative cover plays an important role in soil retention and the prevention of landslides.
Water purification and waste treatment	Forests assimilate and detoxify compounds in water through soil and subsoil processes.
Disease and pest regulation	Forests with preserved structure and characteristics generally resist the introduction of invasive pests and invasive human and animal pathogens brought by human migration and settlement. Forest changes affect the abundance of crop and livestock pests and human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes and ticks.
Pollination	Forest changes affect the distribution, abundance, and effectiveness of pollinators.
Natural hazard regulation	The presence of forests, including mangroves and other tidal forests, can reduce the damage caused by floods, landslides, tsunamis, and hurricanes.
Cultural: the non-material benefits people obtain from forests through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences	
Spiritual and religious values	Many religions attach spiritual and religious values to forests or their components, including "sacred groves" found in many societies.
Inspiration	Forests provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.
Aesthetic values	Many people find beauty or aesthetic value in various aspects of forests, as reflected in the support for parks and scenic drives.
Cultural heritage values	Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species.
Recreation and tourism	Forests provide for many recreational activities, including hiking, camping, recreational hunting. Tourism is now the primary economic development strategy for a number of developing countries, and nature-based tourism has increased more rapidly than the general tourism market.

FOREST ECOSYSTEM SERVICES	DESCRIPTION
Supporting: services that are necessary for the production of all other ecosystem services	
Soil formation	Many provisioning services depend on soil fertility, thus the rate of soil formation influences human wellbeing in many ways.
Photosynthesis	Produces oxygen necessary for most living organisms.
Primary production	Assimilation or accumulation of energy and nutrients by organisms.
Nutrient cycling	Forests cycle and maintain nutrients essential for life, including nitrogen and phosphorus.
Water cycling	Water cycles through forests and is essential for living organisms.

Source: Adapted from MEA, 2005.

ANNEX IV. TOOLS

CALCULATING EMISSION REDUCTIONS

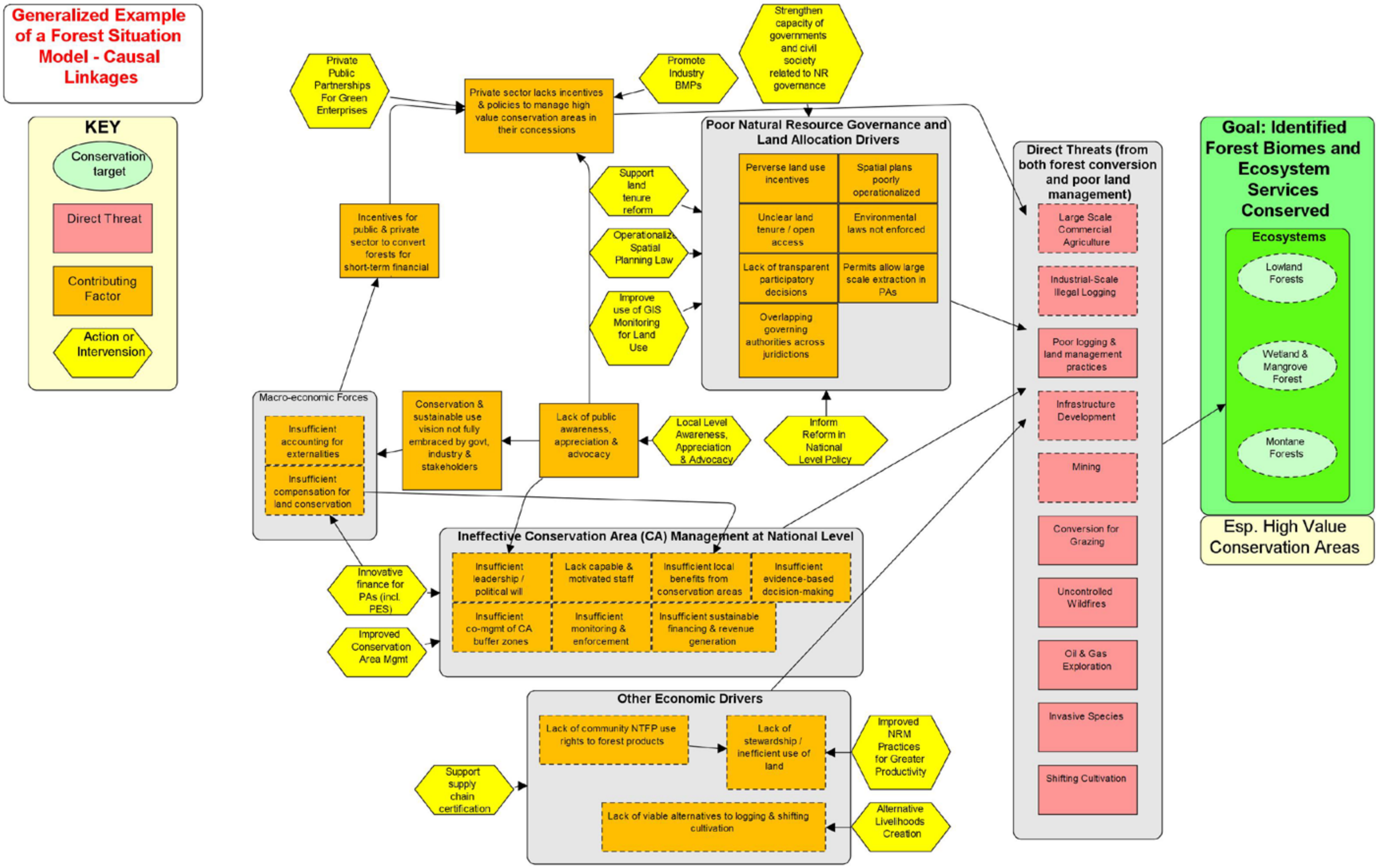
Sustainable landscapes programs help mitigate climate change worldwide by reducing emissions and promoting removals of greenhouse gases (GHG) from the atmosphere. A variety of tools and methodologies are available to calculate the impact projects have on GHGs, with varying assumptions and required inputs.

USAID AFOLU TOOL

In cooperation with the USAID Global Climate Change team, Winrock International has developed a set of simple, user-friendly, web-based calculation tools titled the 'Agriculture, Forestry and Other Land Uses (AFOLU) Carbon Calculator'. This calculator is designed to give USAID Missions and implementing partners an easy way to comply with USAID's policy of mainstreaming carbon dioxide (CO_2) as an Agency-wide indicator. The Calculator is not designed to provide the level of accuracy needed for carbon financing, but may provide an early indication of areas which have potential for such financing. The Calculator uses sound and transparent science to produce yearly estimates of avoided and/or sequestered greenhouse gas emissions, reported in tons of CO_2 equivalent (tCO_2e). It also projects these benefits forward through time to assist in setting targets.

The tool is available online at: http://www.afolucarbon.org/

GENERALIZED FOREST MODEL (DRAFT)



SOCIAL AND ENVIRONMENTAL SAFEGUARDS

Beyond Regulation 216—USAID's primary environmental safeguard—several key players in international development—including World Bank, International Finance Corporation, and Inter-American Development Bank—have social and environmental safeguards in place.

WORLD BANK

The World Bank has developed a set of safeguard policies to prevent and mitigate undue harm to people and their environment; these policies may be used as guidelines for the identification, preparation, and implementation of programs and projects. The World Bank has found that these policies increase program effectiveness and provide opportunities for involving stakeholders and local populations in projects. There are 10 sets of environmental and social safeguards; those directly applicable to forestry projects include safeguards on environmental assessment, natural habitats, forestry, pest management, physical cultural resources, involuntary resettlement, and indigenous populations. The forest policy aims to "reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development" through a three-fold strategy of "harnessing the potential of forests to reduce poverty, integrating forests in sustainable economic development, and protecting vital local and global environmental services and forest values" (World Bank, 2012).

INTERNATIONAL FINANCE CORPORATION (IFC)

International Finance Corporation (IFC) has performance standards that provide guidance on how to identify, avoid, mitigate, and manage risks and impacts, as well as on how to complete projects in a sustainable way. These eight standards are as follows:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

INTER-AMERICAN DEVELOPMENT BANK (IDB)

The Inter-American Development Bank (IDB)'s environmental and social safeguard policies "promote sustainability through a two-pronged approach:

- Enhance outcomes via mainstreaming of environmental and social concerns, an approach that promotes environmental and social aspects as central considerations for all project activities; and
- Minimize negative impacts by applying safeguards, including identification, monitoring, and mitigation of issues that arise throughout a project lifecycle." (IDB, 2014).

The safeguard policies mandate that all IDB-financed operations go through a screening and classification process—classification is based on the scale of the project, location, sensitivity, and potential for impact—in order to enable early identification of risks and necessary actions and create opportunities for stakeholder input. The safeguard policies used by IDB include:

- Operational Policy on Indigenous Peoples
- Involuntary Resettlement Policy
- Operational Policy on Gender Equality in Development
- Environment and Safeguards Compliance Policy
- Disaster Risk Management Policy
- Greenhouse Gas Emissions (GHG) Guidelines

INNOVATIVE ECONOMIC TOOLS

INVEST TOOL FROM NATURAL CAPITAL PROJECT

The Natural Capital Project, a partnership between university research institutes and conservation non-profits, developed the open-source Integrated Valuation of Environmental Services and Tradeoffs (InVEST) software. The tool is a set of models that allow users to create spatial scenarios (maps) of the impacts of environmentally related activities, such as clearing land for development on a local, regional, or global scale. The produced maps show scenarios in biophysical (e.g., amount of carbon offset and use of marine habitat and/or land) or economic terms (e.g., value of carbon offset, marine habitats, and land). InVest can be used by governments, non-profits, and corporations to map the value of and goods associated with 16 terrestrial and aquatic environmental services, including carbon storage, biodiversity, and legal timber harvest. It allows users to make decisions that balance environmental and economic concerns and is particularly useful to inform PES programs, spatial planning, permitting, and climate change adaptation (Natural Capital Project, n.d.).

MIMES FROM THE ECOSYSTEM-BASED MANAGEMENT TOOLS NETWORK

The Ecosystem-Based Management (EBM) Tools Network, a member network of coastal and marine conservation and management practitioners, developed the Multi-scale Integrated Models of Ecosystem Services (MIMES) software. The MIMES is a set of models that "quantify the effects of land and sea use change on ecosystem services and can be run at global, regional, and local levels…These simulations can help stakeholders evaluate how development, management, and land/sea use decisions will affect natural, human, and built capital" (EBM Tools Network, 2011). The tool "provides economic arguments for land use managers to approach conservation of ecosystems as a form of economic development…[by facilitating] quantitative measures of ecosystem service effects on human well-being" (AFORDable Futures LLC, n.d.).

ARIES FROM THE ARIES CONSORTIUM

ARtificial Intelligence for Ecosystem Services (ARIES) was developed with funding from the National Science Foundation at the University of Vermont's Gund Institute for Ecological Economics. ARIES is an open-source software developed to assist rapid ecosystem service assessment and valuation. "ARIES encodes relevant ecological and socioeconomic knowledge to map ecosystem services provision, use, and benefit flows…according to [the] latest understanding of ecosystem services. This is done through an automated data integration process utilizing an extensive database featuring global through local scale GIS data and ecosystem service models" (ARIES, 2014). ARIES is used to quantify tradeoffs between extractive resource use and ecosystem service provision on public lands, prioritize the conservation of ecosystem services flows to local communities and locate critical flow areas to protect and enhance, and predict climate change impacts to ecosystem services based on various scenarios (ARIES, 2014).

ECOMETRIX FROM PARAMETRIX

Parametrix, a consulting firm, developed EcoMetrix, a site-level ecosystem services evaluation methodology that supports environmental decision-making and impact analyses. The tool provides quantified values related to the potential impacts and/or benefits of project planning and site design processes. The methodology includes measuring existing quality of ecosystem services and functions, measuring and evaluating functional performance through key indicators, developing baseline and proposed future condition scenarios, analyzing change from baseline to future, and relating the results to landscape-level analyses and goals (Parametrix, 2014).

USING ECONOMIC TOOLS AT THE PROJECT LEVEL

The following tools may benefit project planning and help inform approaches to sustainable forest management and agroforestry (FAO, 2006).

The Harvesting Cost Model was developed in 1998 for an FAO project. The model calculates the delivered roundwood production cost for harvesting in the natural forest, using standard cost formulas. The model is suitable for any country with small-scale forest harvesting operations.

The ITFMP (Indonesia-UK Tropical Forest Management Programme) Forest Concession and Forestry Industry Models were developed for the Indonesian Ministry of Forestry. The models are suitable for any country with large-scale forest concessions and forest processing facilities.

Various economic tools exist for managing agroforestry projects. The following two tools may benefit project planning and help inform approaches to agroforestry.

The EX-Ante Carbon Balance Tool (EX-ACT) developed by the FAO, is a free, project-level tool used to estimate the effect of agriculture and forestry projects on GHG emissions and carbon sequestration. It is a land-based carbon accounting system that compares "business as usual" with project scenarios for different agriculture and forest management options and estimates carbon levels for each. Outputs can be used in economic analysis, and helps project designers choose options that are the most beneficial economically and for climate change mitigation. The tool may also be used to support policy decisions (weADAPT, 2013).

The World Agroforestry Centre developed a vegetation map as a product of its Vegetation and Climate Change in Eastern Africa (VECEA) project. The map shows vegetation distribution in seven East African countries to predict tree species that will grow well under different climates. The map can be overlaid with other data sets and used as a catalyst to encourage smallholders to plant tree species in their agricultural lands. It can also help assess the impact of climate change on tree species distribution and can be used as a diversification tool. The World Agroforestry Center plans to develop more maps that can be overlaid to show agricultural productivity, payment for ecosystem services, and market access data (Mesiku, 2012).

Certification and "Green" Marketing of Forest Products

For more information on certification standards, see the Forest Stewardship Council, the Program for Endorsement of Forest Certification, the Sustainable Forestry Initiative, and the American Tree Farm System.

CERTIFICATION

FOREST MANAGEMENT CERTIFICATION

Certification of sustainable forest management practices and marketing of "green" forest products allow consumers to look for certification labels and ensure that their purchase comes from a forest that has been responsibly managed. Efforts to improve incentives for forest management have led to the development of accredited, third-party, independent organizations that certify sustainable forest management practices based on set criteria. Several organizations promote forest stewardship via certification and marketing schemes, and a number of schemes have been accepted by the consumer marketplace. Certification standards differ in their criteria, and methods of assessing whether a forest has been sustainably managed also vary (Pool et al., 2002). Certification standards can assist with forest project design by ensuring the relevant chain of custody initiatives meet international legal frameworks, such as the Lacey Act.

Although the benefit has yet to be fully realized in the form of premium prices for certified timber products, certification has given several countries an advantage in the marketplace through product differentiation. Certification, however, costs money, both to finance the forest management measures to meet sustainability criteria and to pay for certification assessments and monitoring. Until a price structure is established on the world market, 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 determine 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.

CHAIN OF CUSTODY

Chain of custody for forest products refers to the process of harvesting, transferring, manufacturing, and distributing wood or wood products to the consumer. Companies that achieve chain of custody certification follow a protocol to source and track wood and wood products from sustainably managed forests and ensure the materials stay separate from non-certified or non-controlled wood. Verification and certification of the chain of custody process is typically done by an independent third party. Certified wood receives a designated label and allows companies to reach a wider market concerned with environmentally and socially responsible purchasing. Labeling also allows consumers to make more informed purchasing decisions. Chain of custody certification incentivizes companies to manage forests in a more sustainable way and is increasingly being mandated in public and private company procurement policies. Advances in technology such as DNA marking of sustainably harvested wood helps ensure the integrity and accuracy of chain-of-custody documentation of tree species and origin (Forest Stewardship Council).