



INTOSAI
Working Group
on Environmental
Auditing



Auditing Forests:

Guidance for Supreme Audit Institutions

2010

This publication was prepared by the INTOSAI Working Group on Environmental Auditing (WGEA). The WGEA aims to encourage the use of audit mandates and audit methods in the field of environmental protection and sustainable development by Supreme Audit Institutions (SAIs). The WGEA has the mandate to

- help SAIs gain a better understanding of environmental auditing issues,
- facilitate exchange of information and experiences among SAIs, and
- publish guidelines and other informative materials.

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Foreword and Acknowledgements

This document, Auditing Forests: Guidance for Supreme Audit Institutions, is a resource for audit practitioners. It provides guidance focused on the forestry sector and covers a range of management and public policy tools used by the government. It describes

- what forests are, why they are important, what the threats to forests are, and what action governments are taking,
- a suggested process for choosing and designing forest audits, and
- practical guidance, information, and case studies related to audits on forests.

This paper was led by the Supreme Audit Office of Indonesia. Many thanks go to individuals who contributed to this paper.



Mihkel Oviir

Auditor General of Estonia
Chair of INTOSAI WGEA

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Hopefully you will find this document useful!



Hadi Poernomo

Chairman of the Audit Board of Indonesia

Acronyms and Abbreviations

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AFROSAI - African Organization of Supreme Audit Institutions

ARABOSAI - Arab Organization of Supreme Audit Institutions

ASOSAI - Asian Organization of Supreme Audit Institutions

CAROSAI - Caribbean Organization of Supreme Audit Institutions

CEPI - Confederation of European Paper Industries

CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora

CREFIAF - Conseil Régional de Formation des ISC Africaines Francophone

EUROSAI - European Organization of Supreme Audit Institutions

FAO - Food and Agriculture Organization of the United Nations

GIS - Geographical Information System

GPS - Global Positioning System

IDI - INTOSAI Development Initiative

ITTO - International Tropical Timber Organization

IEA - International Environment Agreement

IFF - Intergovernmental Forum on Forests

IPF - Intergovernmental Panel on Forests

INCOSAI - International Congress of Supreme Audit Institutions

INTOSAI - International Organization of Supreme Audit Institutions

IUCN - International Union for Conservation of Nature

OLACEFS - Organization of Latin American and Caribbean Supreme Audit Institutions

RBM - Result-based Management

RWGEA - Regional Working Group on Environmental Auditing

SAI - Supreme Audit Institution

PASAI - Pacific Association of Supreme Audit Institutions

UNCED - United Nations Conference on Environment and Development

UNEP - United Nations Environment Programme

UNFCCC - United Nations Framework for Climate Change Convention

WGEA - Working Group on Environmental Auditing

WSSD - World Summit on Sustainable Development

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Executive Summary

Forests are among the most diverse and widespread ecosystems on the earth. They are critical for human life as they provide basic human needs as water, food, shelter, medicine, fuel wood, fodder, and timber.

As such, their existence should be preserved. To maintain the sustainability of forests, key stakeholders are expected to perform their roles responsibly. Government, as the key actor in forest management, is responsible for developing and implementing policies, regulations, and appropriate institutional framework for forest programs. In performing this role, government may need to establish institutions, moderate between competing schemes of forest use, and assure a level of playing field in the area of international and domestic trade.

As the oversight body of the government, a Supreme Audit Institution (SAI) can assist a government in fulfilling those responsibilities. It can do this by auditing not only the performance and the compliance of government activities, but also the soundness of government accountability systems and practices. Additionally, SAIs can also assist governments in strengthening their forest management internal controls, and improving their assessment and mitigation of forest-related risks.

This guideline is developed to assist auditors in conducting forestry audits. It also provides information on forests and forest management that could be used as reference material. Whenever possible, case studies and examples of SAIs' experiences in conducting forestry audits supplement the main body of the text.

There are also a series of appendices designed to give more detailed information on selected aspects. For example, **Appendix 1** presents a series of international case studies (each highlight a particular risk faced by a forest); **Appendix 2** works through practical examples of how to use GIS and GPS; **Appendix 3** discusses how to use a design audit matrix; and **Appendix 4** discusses principles and criteria used in forest audits.

This guideline is structured as follows:

- An introduction contains an overview of forests and their importance, the role of government and SAIs, and key characteristics of good governance.
- **Chapter 1** starts by considering the large range of perceptions that are brought, world-wide, to definitions of a forest. The main categories of forests are described, with a focus on planted forests. Then, the seven types of forest (as defined by the Food and Agriculture Organization of the United Nations - FAO) are summarized. Types of forest ownership and management are described briefly; this is followed by information about the key functions of forests. Finally, the most important international forest initiatives are discussed.
- **Chapter 2** presents information on sustainable forest management: how it is defined; what its various aspects are; how sustainable forest management is at the centre of a number of wider concerns; an outline of some of the benefits of sustainable forestry and some of the key players who are involved; an outline of some of the key risks (and an evaluation of those risks) that relate to sustainable forest management, and key topics that can be used to evaluate those risks.
- **Chapter 3** looks more closely at forestry audits. It sets down the basic issues underlying a forest management audit. It explains different types of audits, the tools and methodology used, as well as issues around choosing and designing an audit. This chapter is designed to help SAIs to tailor and conduct an audit that best suited their specific circumstances to better meet their objectives.

Introduction

Forests are vital to human life. They make our natural environment more livable. They support local livelihoods and contribute to national economies. They enrich the quality of people's lives through their cultural, recreational, and aesthetic values.

Forests are amongst the most diverse and widespread ecosystems on the earth. They are critical in meeting human needs for water, food, shelter, medicine, fuel wood, fodder, and timber. They provide a wide range of environmental services, which include biological diversity conservation, watershed protection, protection of soil, mitigation of global climate change, and protection against desertification (FAO, 1999). Just as significantly, forests provide a range of environmental services fundamental to the planet's wellbeing and environmental sustainability. For example, they play an important role in stabilizing soils and protecting land from erosion by wind and water, and help maintaining a steady supply of clean fresh water. Furthermore, forests are now integral to international efforts to combat climate change, as trees and forest soil lock up atmospheric carbon, one of the main greenhouse gases causing global warming.

Forests are also important economically. They are source of livelihood and paid employment for local economies, and make a major contribution to national economies through domestic and export sales of forest products. It is almost impossible to exaggerate the economic importance of the world's forests. According to the World Bank, 1.6 billion people rely heavily on forests for their livelihoods. In 2003, the international trade in sawn wood, pulp, and boards amounted to almost US\$150 billion, or just over 2 percent of world trade¹. In many developing countries, forest-based enterprises provide at least a third of all rural non-farm jobs, generate income through the sale of wood products, and enrich private companies, governments, and rural communities.

It is not only economic and environmental benefits that make forests essential to human wellbeing. Forests also play a major social role and contribute to people's quality of life. For many diverse groups of indigenous people, forests are much more than an essential source of food and water. Forests are also their spiritual home, inseparable from their cultural identity.

THE ROLE OF GOVERNMENT

Many of the local, national, and global benefits derived from forests depend on the forest being left untouched or subject to minimal interference. On the other hand, many benefits come from quite deliberate interference that can have a major impact on forests, such as clear felling. (Other benefits from forests are often claimed, but are actually false, for example, that forests increase local rainfall, or that forests regulate the flow of streams and rivers by acting as sponges.)

Balancing the different ways that humans engage with forests depends on good policy and, more often than not, requires governments to play the role of judicious arbiter. One of the key tools that governments can use is appropriate national and regional legislation and policies.

Estonia

The duties of the State in forestry are: setting the overall direction of forestry, developing a forestry development plan and putting in place appropriate legislation and regulations, ensuring the good condition of forests, accounting for forest resources, supporting private forestry, administering and managing State-owned forests, organising State supervision, and ensuring the biological diversity of the forest is protected. The performance of the duties of the State in forestry is coordinated by the Ministry of the Environment.

Brazil

In Brazil, native forests, either public or private, are protected by law. Exploitation of these forests must be previously authorized by the State government and forest management must be compatible with ecosystems and arboreal cover. As a rule, the State government is responsible for all authorizations regarding licensing of potential environmental degrading activities, vegetation suppression, and forest management activities.

¹ Costanza, *et al.* (1997)

Roles of government in forestry

The nature and extent of the government roles in forestry will vary widely between countries according to their circumstances and political conditions.

Examples of roles played by governments include:

- forest owner;
- buyer/consumer of forest products;
- contributor to building capacity in the field of certification;
- support, including finance, drafting national standards, and putting in place necessary institutions;
- a moderator between competing schemes; and
- ensuring a level playing field international trade and domestic markets.

Source: Koleva, 2006

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In most countries, how forests are managed is determined by the forest policies and institutional framework established by the government. Governments themselves are often significant forestry actors, as forest owners or as buyers and consumers of forest products. They may also contribute to capacity building

in the forestry sector and provide supports, including finance and drafting national standards. They may establish necessary institutions, moderate between competing schemes, and assure a level playing field (that is, all parties play by the same rules) when it comes to international or domestic trade.

THE ROLE OF SAIS

Supreme Audit Institutions (SAIs) have a significant role in assisting government in fulfilling its forest-related responsibilities. SAIs can audit not only the performance and the compliance of government activities, but also the soundness of government accountability systems and practices.

SAIs can also assist the government by strengthening the way government manages its internal controls, by reviewing these controls and providing suggestions about how to improve them. Moreover, SAIs can also suggest how government can improve the ways it assesses and mitigates risks related to management processes.

Table 1.1
The Role of SAIs

SAI	ROLE OF SAIs
Brazil	To assist the National Congress in the external control of the management of public assets and money. According to the Federal Constitution, a well balanced environment is an asset of common use for the people, essential to good quality of life. It is the role of the public power and society to defend and preserve it. The Federal Constitution also states that the natural resources are assets that belong to the Union. Therefore, the mission of Tribunal de Contas da União (TCU) is not only to control the proper use of public resources in the environmental field, but also to manage the environment at the federal level.
Estonia	To exercise economic control in order to assure the Parliament and the public that the funds of the public sector are used legally and effectively.
Indonesia	To audit the government's management and accountability in the forest sector.

SAIs in a number of countries has conducted several audits related to forests. The aim of their audits varies, depending on the mandate and the condition of the forest. The following table gives examples of the mandate of three SAI, as they relate to forestry, in Estonia, Brazil, and Indonesia.

Government responsibilities around ensuring the quality of sustainable environmental management, usually lead to the relevant SAI being authorized to audit the management of state finances related to the country's natural environment. Meanwhile, in many countries, SAIs play a significant role in encouraging the government to manage the forests sustainably. Case study examples that illustrate the influence and potential impact that SAIs might have, in their respective jurisdictions, can be seen in [Appendix 1](#).

FORESTS ARE GLOBALLY IMPORTANT

As mentioned above, forests play a vital role in human wellbeing. This role is not constrained by regional or national borders. For example, deforestation increases global greenhouse gas levels wherever it takes place. Forests and their management are

Forest fires: national, regional and global impacts

The economic cost of forest degradation and deforestation from Indonesia's fires in 1997/98 cost the country as much as US\$2.7 billion.

Source: Center for International Forestry Research - Indonesia

no longer a domestic matter for national governments. Today forests are very much at the center of international concerns and are increasingly subject to bi- and multilateral discussions and agreements.

The following examples showcase the many diverse impacts that forests can have on the earth and on the human species.

1. Economic impacts

About 75 percent of global demand for paper and wood pulp products comes from industrialized nations. In 1990, world industrial timber production totaled 1,600 million cubic meters, paper production 235 million tones, and wood pulp production

160 million tones. Over 80 percent of both pulp and wood pulp production were in the industrialized world. Over the past decade, demand for these products has grown one to two percent annually. Moreover, forests are also a source of non-wood products such as gums and resin, bamboos, various oils, turpentine, tanning materials, honey, spices, bark and leaves, and medical plants.

2. When deforestation and forest degradation occurs

Since the early 1980s, there has been considerable concern that deforestation and forest degradation causes huge costs to society - measured in lost economic rents, inefficient allocation of resources, degradation of renewable resources (such as soil and forests), disruption of watershed services, social distress and conflict, massive loss of biodiversity, and emission of greenhouse gases.

3. Biodiversity and ecosystem health

Although less than one third of the earth's surface is covered with forests, they are among the most notable storehouses of biological diversity on the land - they house over two-thirds of known terrestrial species. Tropical, temperate, and boreal forests offer a variety of habitats for plants, animals, and micro-organisms. Also, major shares of threatened species depend on forests². Forest biological diversity is innately linked to ecosystem and human well-being. However, forest biodiversity is increasingly threatened as a result of human activity: deforestation, fragmentation, and other stressors.

4. Climate change

Since the release of the landmark Stern's *Review on the Economics of Climate Change* for the UK government in 2006, governments, industries, and people generally are much more aware of the links between forests and climate change. Badly managed, forests can exacerbate climate change by releasing carbon. Carefully managed, forests can serve as effective carbon sinks for helping to mitigate climate change. Already considerable international interests exist in setting up payment schemes for 'Reducing emissions from deforestation and forest degradation' (REDD) as part of a future international climate agreement to replace the current Kyoto Protocol. The carbon-related role of forests is now a major consideration for governments around the world. (For forestry audits related to climate change, auditors can refer to the Guidance Material on Auditing Climate Change, which has been developed by the INTOSAI WGEA in 2010 available at www.environmental-auditing.org).

5. Flood

Each year floods kill thousands of people, destroy people's lives, and inflict enormous costs on society through damage to private and public properties, industries, and infrastructures. The strong possibility that deforestation contributes to flooding must be taken into consideration in decisions and policies that affect forests and water catchments.

6. Forest fires

The economical and environmental impacts of forest fires now attract major international attention, especially since fires related to the El Nino Southern Oscillation (ENSO) in 1997/98 burned about 25 million hectares of forests worldwide. Large forest fires and the haze and smoke they generate are potentially a major threat to sustainable development; they directly impact ecosystems and human health, and contribute to greenhouse gas levels.

Fire is one of disturbances that may disturb the processes of forest ecology. The rate of natural succession is affected whenever a disturbance occurs on the site. The more severe the disturbance, or the more often disturbance occur, the slower will be the natural process of succession. Fires also reduce a forest's ability to sequester carbon.

7. Livelihoods of the poor

A comprehensive World Bank analysis of poverty in Cambodia found that forest products contribute to the livelihoods of almost 85 percent of poor people in Cambodia. Most of Cambodia's forests have been used to provide timber or fuel wood, or have been cleared for agricultural purposes. As forests disappear, the livelihoods of Cambodia's rural poor people are increasingly threatened.³

GOOD GOVERNANCE AND FORESTRY AUDITS

The concept of *governance* is not new. Simply put *governance* means: 'the process of decision-making and the process by which decisions are implemented (or not implemented)'. Governance can be used in several contexts, such as corporate governance, international governance, national governance, and local governance. It can have geopolitical connotations, and can have a quite specific meaning within individual organizations. Consequently, good governance can imply many different things in many different contexts.

This document considers good governance from the perspective of an UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific) article *What is Good Governance*⁴. Good governance has eight major characteristics. They are: participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of society. These characteristics, in more detail, are:

- **Participation.** This is the ability for men and women to take part in an event or activity. Participation could be either direct or through legitimate intermediate institutions or representatives. Participation needs to be informed and organized.

² World Wildlife Fund (2009)

³ Cambodian Development and Research Institute (2006)

⁴ United Nations Economic and Social Commission for Asia and the Pacific (2009)

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- **Transparency.** Transparency means that decisions taken and their enforcement are done in a manner that follows rules and regulations. An activity is considered to be transparent if all information about it is open and freely available. For example, when budgets and financial statements may be reviewed by anyone, when laws, rules and decisions are open to discussion, they are seen as transparent and there is less opportunity for the authorities to abuse the system in their own interest.
 - **Effectiveness and efficiency.** This is when processes and institutions produce results that meet the needs of society while making the best use of resources at their disposal.
 - **Responsiveness.** This is when institutions and processes try to serve all stakeholders within a reasonable timeframe.
 - **Accountability.** This key cornerstone of good governance is the obligation to demonstrate and take responsibility for performance in light of agreed expectations. It applies to governmental institutions as well as 'civil society' (that is, all actors, including the private sector, other than the government and the military). In general, an organization or an institution is accountable to those who will be affected by its decisions or actions. **Note:** There is a difference between responsibility and accountability: responsibility is the obligation to act; accountability is the obligation to answer for an action.

Accountability is a key requirement of good governance. Not only governmental institutions but also the private sector and civil society organizations must be accountable to the public and to their institutional stakeholders. Accountability cannot be enforced without transparency and the rule of law.

- **Consensus oriented.** Good governance requires mediation of the different interests in society to reach a broad consensus (agreement) in society on what is in the best interest of the whole community and how this can be achieved.
- **Equity and inclusiveness.** A society's wellbeing depends on ensuring that all its members feel that they have a stake in it and do not feel excluded from the mainstream of society. This requires all groups, but particularly the most vulnerable, to have opportunities to improve or maintain their wellbeing.
- **Rule of Law.** Fair legal frameworks need to be enforced impartially. The rule of law also requires full protection of human rights, particularly those of minorities. Impartial enforcement of laws requires an independent judiciary and an impartial and incorruptible police force.

When conducting an audit, good governance might be used as audit criteria in terms of eight characteristics mentioned above.

Chapter 1: Forests

1.1 MANY FOREST DEFINITIONS

Many definitions of forest have been developed and proposed by many parties. The definitions differ based on the perspectives, ideologies, and interests of the authors, as well as the diversity of forests and forest ecosystems in the world.

The Food and Agriculture Organization (FAO) (2005) defines forest 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. It doesn't include land that is predominantly under agricultural or urban land use.

Other experts have used definitions that are typically characterized by:

- the area of land;
- the area's function; and
- an ecosystem.

For example, Davis et.al in Forest Management (2001) defined forest as:

An ecosystem characterized by more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species compositions, structure, age class and associated processes, and commonly including meadows, streams, fish, and wildlife. Thus forest could be defined as a set of land parcels that has or could have tree vegetation and is managed as a whole to achieve the objective of the owner.



Other experts have stated that forest can also be defined as a tract of land, not necessarily wooded, reserved to the king or a grantee, for hunting deer and other game. The United Nations Framework Convention on Climate Change (UNFCCC) has defined forest as:

A minimum area of land of 0.5-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 percent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 percent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention, such as harvesting or natural causes but which are expected to revert to forest.

Further examples of how different countries define forests are given in Table 1.1.

Table 1.1
Forest definitions by country

ALBANIA	An area with 30% minimum tree crown cover, minimum 0.1 ha land area value, and 3m of tree potential height. (Fida, 2007)
BRAZIL	Land spanning more than 0.5 ha with trees higher than 5m and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ.
CHINA	The definition of forest in China was adjusted from a minimum of 30 percent to 20 percent of cover in 1994. In 2004, the definition of forest was modified again to include special purpose scrubs, which grow in area with annual rainfall below 400 mm or above; the tree line in a mountain with a minimum canopy cover of 30% and in which its primary function is environmental protection. (Zhang, et.al., 2006)
ESTONIA	A plot of land with an area of at least 0.1ha and woody plants with the height of at least 1.3m and with the canopy density of at least 30 percent grow there.
INDONESIA	An area dominated by a group of trees having height usually more than 5m, with a canopy density of more than 10 percent.
MALAYSIA	The areas under oil palm, rubber and tree crops are frequently regarded as forest. The official definition of a forest used in Malaysia differs from the Food and Agriculture Organization (FAO) definition, which excludes areas under agricultural crops (e.g., oil palm). (JoeangoHutan, 2006)
SOUTH AFRICA	Forest is a continuous stand of trees at least 10m tall, with their crowns interlocking. It is generally multi-layered vegetation unit dominated by trees (largely evergreen or semi-deciduous) whose combined strata have overlapping crowns (i.e. crown cover is > 75 percent). (Bailey, et.al., 1999)

By comparison, the United Nations Environment Programme/Convention on Biological Diversity (UNEP/CBD) (2002), also gives a brief definition of forest as:

A land area of more than 0.5 ha, with a tree canopy cover of more than 10 percent, which is not primarily under agriculture or other specific non-forest land use. In the case of young forest or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m in situ, and of meeting the canopy cover requirement.

The range and diversity of these definitions demonstrate the diverse perceptions that different countries bring to their understanding of what constitutes a forest. Some may view a forest as an ecosystem whereas others may see it as little as more than an area of land suitable for exploitation. In general, these different perceptions will shape the roles and responsibilities ascribed to a particular government in terms of managing the forests. The broader the definition, the broader the government's role and range of responsibility in managing forests, and vice versa.

1.2 FOREST CATEGORIES

However, the many definitions of forests do fit into two more general categories, according to FAO (2005):

1. Naturally regenerated forests

There are two kinds of naturally regenerated forest:

- *Natural regeneration (with assistance)*. Forests established by natural regeneration, with deliberate silvicultural assistance from man. The source of seed or vegetative reproduction is natural so this is a natural forest assisted by man. This is not clearly a man-made or natural forest.
- *Natural regeneration (without assistance)*. Forests established by natural regeneration without deliberate assistance from man. These included virgin forests and those regenerated by natural means. This is clearly a natural forest.

2. Planted forests

Planted forests are generally defined according to the extent of human intervention in the forest's establishment and/or management. And this in turn depends largely on the purpose of growing the forest.

The main categories of planted forest are set out in Table 1.2.

Table 1.2
Categories of planted forest

FOREST CHARACTERISTICS	DEFINITION
PRIMARY FOREST / OTHER WOODED LAND	Primary forest/other wooded land is forest/other wooded land of native species, where there is no clearly visible indications of human activities and the ecological processes are not significantly disturbed, that includes areas where collection of Non Wood Forest Products (NWFPs) occur, provided the human impact is small. Some trees may have been removed.
MODIFIED NATURAL FOREST / OTHER WOODED LAND	Modified natural forest/other wooded land is forest/other wooded land of naturally regenerated native species where there are clearly visible indications of human activities that includes, but is not limited to selectively logged-over areas, naturally regenerating areas following agricultural land use, areas recovering from human induced fires, etc.; areas where it is not possible to distinguish whether the regeneration has been natural or assisted.
SEMI-NATURAL FOREST / OTHER WOODED LAND	Semi-natural forest/other wooded land is forest/other wooded land of native species, established through planting, seeding or assisted natural regeneration that includes areas under intensive management where native species are used and deliberate efforts are made to increase/optimize the proportion of desirable species, thus leading to changes in the structure and composition of the forest. Naturally regenerated trees from other species than those planted/seeded may be present. Semi-natural forest include areas with naturally regenerated trees of introduced species and areas under intensive management where deliberate efforts, such as thinning or fertilizing, are made to improve or optimize desirable functions of the forest. These efforts may lead to changes in the structure and composition of the forest.
PRODUCTIVE PLANTATION (IN FOREST / OTHER WOODED LAND)	Productive plantation is forest/other wooded land of introduced species and in some cases native species, established through planting or seeding, mainly for production of wood or non-wood goods that includes all stands of introduced species established for production of wood or non-wood goods and areas of native species characterized by few species, straight tree lines and/or even-aged stands.
PROTECTIVE PLANTATION (IN FOREST / OTHER WOODED LAND)	Protective plantation is forest/other wooded land of native or introduced species, established through planting or seeding mainly for provision of services that includes all stands of introduced species established for provision of environmental services, such as soil and water protection, pest control and conservation of habitats of biological diversity; areas of native species characterized by few species, straight tree lines and even-aged stands.

Source: FAO Forestry Paper: Global Forest Resources Assessment (2005)

These categories are further represented in the following table. This table can be read from left to right as a continuum, starting from totally natural forest on the left, through to planted plantations and trees outside the forest on the right.

Table 1.3
Planted forests in the continuum of forest characteristics

NATURALLY REGENERATED FORESTS			PLANTED FORESTS			TREES OUTSIDE FORESTS
PRIMARY	MODIFIED NATURAL	SEMI-NATURAL		PLANTATIONS		
		ASSISTED NATURAL REGENERATION	PLANTED COMPONENT	PRODUCTIVE	PROTECTIVE	
Forest native species, where there no clearly visible indications of human activities and the ecological processes are not significantly disturbed.	Forest of naturally regenerated native species where there are clearly visible indications of human activities.	Silvicultural practices by intensive management: 1. weeding, 2. fertilizing, 3. thinning, 4. selective logging	Forest of native species, established through planting or seeding, intensively managed.	Forest of introduced and/or native species established through planting or seeding mainly for production of wood or non-wood goods.	Forest of introduced and/or native species, established through planting or seeding mainly for provision of services.	Stands smaller than 0,5 ha; tree cover in agricultural land (agro forestry systems, home gardens, orchards); trees in urban environments; and scattered along roads and in landscapes

Source: FAO Forestry Paper: Global Forest Resources Assessment (2005)

The first three classes comprise native forest tree species only, with the possible exception of small areas of natural regeneration of introduced or naturalized species in the semi-natural class. Although the origin of primary and modified natural forests is natural regeneration, semi-natural forests are established through assisted natural regeneration, planting or seeding, and all forest plantations are established through planting or seeding.

According to FAO (2005), the world's forest cover is dominated (55%) by naturally regenerated forest. However, an analysis of global forest trends in forest characteristics show that between 1990 and 2005, naturally regenerated forests tended to decrease, whereas semi-natural and planted forests tended to

increase. This suggests that if governments do not carry out sustainable forest management, there will be an increasing trend towards planted forests.

1.3 TYPES OF FOREST

FAO (2001) divides the world's forest into the following broad ecological zones based on rainfall patterns, temperature, and humidity: tropical, subtropical, temperate, and boreal. These zones correspond largely to latitudes (although there may well be a wide range of forest types in any one continent or country). The FAO's seven forest types are shown in the following table.⁵

Table 1.4
Types of Forests

MOUNTAIN FORESTS	Mountains and highlands are often covered with unique forest vegetations that are different in structure and species composition from surrounding lowland vegetation. The high mountains in the tropics (for example, the Andes and Himalayas), have a range of forest types determined by altitude and exposure. Their upper limit is typically about 3,000 meters in dry regions, such as the Near East. Natural forests are often confined to the mountains. Overall, mountain forests sustain a great diversity of habitats and are essential for watershed protection and soil conservation.
TROPICAL RAIN FORESTS	Tropical rain forests are found mainly where the climate is hot and humid throughout the year: in the Amazon basin of South America, the Congo basin of Central Africa, and parts of Southeast Asia. They constitute the world's most diverse terrestrial ecosystem, with many rare, endemic, and endangered plants and animal species. The vegetation is rich, with tall, closely set trees that often form a continuous multilayered canopy and emergent trees reaching a height of 50 to 60 meters. Tropical rain forests contain many resources vital for local subsistence and commercial activities, such as timber, rattan, fruits, nuts, medicinal plants, and rubber. These forests are also home to a large number of indigenous peoples.
BOREAL CONIFEROUS FORESTS	Boreal coniferous forests are found mainly at high latitudes in the Northern Hemisphere, where the climate is cold. These forests are the world's major source of commercial softwood. Spruce and fir dominate the forests of North America, northern Europe, and western Siberia, while larch is common in the forests of central and eastern Siberia. The forest canopy cover is often low, and there is commonly an understorey of shrubs, herbaceous vegetation, mosses, or lichens. The Siberian taiga constitutes the earth's largest continuous forest. In this type of forest, biological diversity is low but the level of endemism is high. Wetlands in these areas fulfill important ecological functions, for example, as breeding habitat for many species of waterfowl and shorebirds.
TEMPERATE BROADLEAF DECIDUOUS FORESTS	The temperate broadleaf deciduous forest is the natural vegetation of eastern North America, western Europe, eastern Asia, and parts of Patagonia. This forest type is associated with a humid climate and includes species like oak, beech, birch, hickory, walnut, maple, elm, and ash. Forests vary in structure and composition according to local climate, soils, altitude, and frequency of fires. Many of the hardwood species are highly valued for their wood qualities and most remaining forests are intensively managed. Temperate broadleaf forests are also extensively used for recreation, as many of them are located near densely populated industrialized regions.

⁵ State of The World's Forests 2001

Table 1.4
Types of Forests

MANGROVE	Mangrove forests are common sights on mudflats and banks of tropical and subtropical coasts. Some of the largest areas of mangroves are found in Indonesia, Brazil, and the Sundarbans of India and Bangladesh. Mangroves are highly productive ecosystems and are important as spawning sites, nurseries, and feeding sites for many marine fish and shellfish. Local people use mangrove wood for building materials, fish traps, fuel wood, and charcoal, and they gather a variety of non-wood forest products from the mangroves. Over the past few decades, much of the world's mangroves have been cleared for agriculture, salt ponds, or aquaculture.
TROPICAL DRY FORESTS AND WOODLANDS	Tropical dry forests and woodlands occur in tropical regions with pronounced dry seasons. They are most extensive in eastern and southern Africa. The vegetation is relatively open and is typically made up of deciduous trees 10 to 20 meters tall with a grass understorey. As a result of frequent fires and tree felling, many of these woodlands have been converted to savannah, where grass and shrubs dominate. In Africa, in particular, woodlands and savannah are major habitats for wildlife and also provide local people with valuable products and services such as fuel wood, honey, timber, bush, medicines, and grazing cattle.
SUBTROPICAL DRY FORESTS	The subtropical dry forests, or dry sclerophyll forest, is the natural vegetation of the Mediterranean climate type (mild humid winters, dry summers), found in various regions around the world. The typical tree species have small, leathery evergreen leaves and the vegetation ranges from tall, open forest to sparse woodland and shrubs. A large proportion of the historical Mediterranean forest had been cleared is now dominated by shrubs, whereas many Australian eucalypt tracts and parts of Chile have been converted to plantations. The Cape Region of South Africa harbors a particularly rich flora that includes many endemic species. Important non-wood forest products of commercial value include cork, honey, and olives.

14 The FAO's forests classification above is quite general. Individual countries tend to adapt the FAO's distribution or classification to meet their own needs.

Unlike the FAO, the United Nations Environment Programme (UNEP) classifies forest into 26 types, reflecting climatic zones as well as the principal types of trees. Each of these major types comprises a great range of forests.


These 26 major types can be reclassified into six broader categories. For more information on this classification, please visit www.unep-wcmc.org/forest/fp_background.htm

Basically, forest type may vary based on its status, function, purpose, micro-climate function, aesthetic value, and hydrological attributes.

Some examples of the distribution of type of forest throughout the world can be seen in Table 1.5.

Table 1.5
Types of Forests in Some Countries

BRAZIL



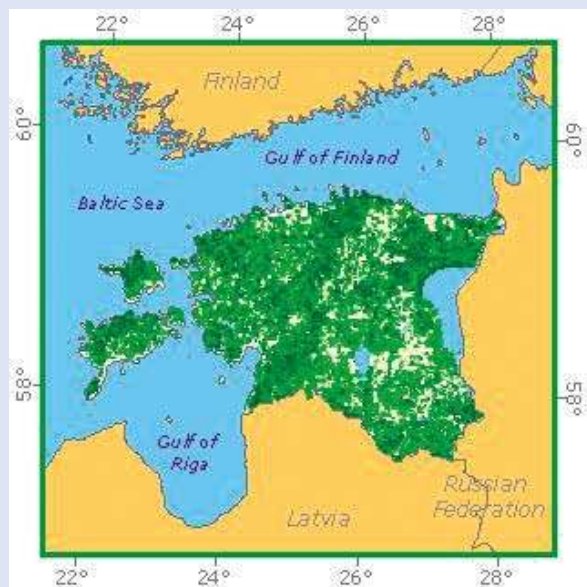
Brazil has many types of forests, and the most important are: tropical moist forests, covering most of the Amazon region; Caatinga, which is a dry forest type covering parts of the northeastern region of the country; Cerrado, a forest type similar to savannah, in the central and southeast region; Atlantic forest, characterized by occurrence of tropical and sub tropical forest along the coast (including forests dominated by *Araucaria angustifolia* in parts of the southeast and south region). The Pantanal biome is the largest swamp area in the world. The pampas is defined by field vegetation set in a plain relief. Forest plantations in Brazil comprise less than 1 percent of the territory (5.5 million hectares), and are dominated by species of *Eucalyptus* and *Pinus*. (Source: SAI of Brazil)

- water
- closed forest
- open / fragmented forest
- other wooded lands
- other land cover

FAO (2007): FAO Forestry Country Profile, available at: www.fao.org/forestry/foris/img/maps/forcov/fc206.gif [Accessed 5 October 2009]

Table 1.5
Types of Forests in Some Countries

ESTONIA



Geobotanically, Estonia belongs to the northern part of the nemoral-coniferous forest subzone of the forest zone of the northern hemisphere. Estonia's climax community is the boreo-nemoral coniferous forest, dominated by Norway spruce (*Picea abies*), silver birch (*Betula pendula*), common aspen (*Populus tremula*), and Scots pine (*Pinus sylvestris*).

Because of the spread of agricultural lands in the 19th century and the draining of bogs and peatland forests in the 20th century, the current distribution of Estonian forests is different from the natural communities of the area. Boreal and hemiboreal natural forest habitats have largely disappeared or have been considerably influenced by human activities in Estonia. (Source: SAI of Estonia)

- water
- closed forest
- open / fragmented forest
- other wooded lands
- other land cover

FAO (2000): Global Forest Resources Assessment, available at: www.fao.org/forestry/5966/en/est/ [Accessed 18 November 2009]

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INDONESIA



In Indonesia, forests are classified according to status, function, purpose, micro-climate role, aesthetic value, and hydrological attributes. State forest can include customary forest and private forest. The forest functions include conservation, protective and productive forest. Specific purposes may include research and development, education, recreation, and religion and culture. The importance of forests may be determined by such elements as the forest's importance at the micro-climate level, its aesthetic qualities, and its ability to absorb water. (Source: SAI of Indonesia)

- water
- closed forest
- open / fragmented forest
- other wooded lands
- other land cover

FAO (2007): FAO Forestry Country Profile, available at: www.fao.org/forestry/foris/img/maps/forcov/fc82.gif [Accessed 5 October 2009]

1.4 TYPES OF FOREST OWNERSHIP AND FOREST MANAGEMENT

The way the forest is managed depends very much on the type of forest ownership. The type of forest ownership will influence the extent to which the government can manage the forests. The greater the level of private control, the more the role of government is constrained.

South Africa

Most of the forest areas are owned by the state. Only in KwaZulu Natal a substantial portion of natural forest is in private ownership.

16

According to FAO (2005), forest ownership, is either:

- *Privately owned.* Land owned by individuals, families, private cooperatives, corporations, industries, private religious and educational institutions, pension or investment funds, and other private institutions. Private owners may be engaged in agriculture or other occupations including forestry;
- *Publicly owned.* Land owned by the state (national, state and regional governments) or government-owned institutions or corporations or other public bodies including cities, municipalities and villages; or
- *Other.* Neither publicly nor privately owned.

1.5 FUNCTIONS OF FOREST

Forest categories and types often vary between regions and countries. These variations do not necessarily influence how forests are utilized. The functions fulfilled by the forest are relatively similar in many countries and continents. FAO, in the State of the World Forests (2007), identifies at least three of these functions:

1. Productive functions

Forests and trees outside the forests provide a wide range of wood and non-wood forest products. This reflects the importance of maintaining an ample and valuable supply of primary forest products while ensuring that production and harvesting are sustainable.

Variables that relate to the productive function of forest resources include: area of forest designated for production; area of productive forest plantations; growing stock and commercial growing stock; removals of wood products; and removals of non-wood forest products (NWFPs).

Forests produce many useful things. Wood can be used as source of energy, not only as solid fuel (for example, fuel wood and charcoal). It can be used as sawn wood (lumber), engineered wood products (particleboard, medium density fiber board, laminated veneer lumber), and plywood (oriented strand board). Wood can also be used as a composite with other materials such as plastics and cement.

Non-wood forest products (NWFP) have many features. NWFPs can sometimes be as or more economically important

Currently, there are about 109 million hectares of productive forest plantations in the world. Productive forest plantations represented 1.9% of global forest area in 1990, 2.4% in 2000 and 2.8% in 2005. The Asia region accounted for 41%; Europe 20%; North and Central America 16%; South America and Africa 10% each, and Oceania 3%. Source: FAO (2005)

than traditional wood products. NWFPs include food and fodder, medicinal plants and animals, aromatics for perfumes and cosmetics, and fibers for construction, craft, and utensils.

Among the ten countries with the greatest area of productive forest plantations (79.5 million hectares or 73% of the total global area of productive forest plantations), China, the United States, and Russia together account for more than half of the world's productive forest plantations.

2. Protective functions

Forests and trees outside the forests help moderate soil, hydrological and aquatic systems, maintain clean water (including healthy fish populations), and reduce risks and impacts of floods, avalanches, erosion, and drought. Forests also contribute to ecosystem conservation efforts and provide benefits to agriculture and rural livelihoods. Other protective functions include:

- **Protection from wind erosion.** Wind-rows and shelterbelts reduce the loss of nutrient-rich topsoil and protect young plants from wind within their zone of influence. They also help stabilize dunes.
- **Coastal protection.** Coastal forests, particularly mangroves, reduce shoreline erosion and siltation and the impacts of storm surges and tsunamis. Mangroves also filter and remove some of the nutrients and heavy metals coming from upstream land uses and industry, immobilizing them in the mud – as long as they prove non-toxic to the mangroves themselves. Salt-spray barriers of salt-tolerant trees have been planted along windward coasts to protect crops.
- **Protection from avalanches.** European countries with alpine zones have considerable experience in using forests as protection from snow avalanches. Many forests are specifically designated for this purpose. As more tourism and infrastructure enters the mountain areas of many countries, this function will become increasingly important.
- **Air-pollution filters.** Trees perform a valuable role in intercepting and trapping windborne particulate matter – again, as long as the pollution does not damage or kill them. This is one of the benefits of urban forests and greenbelts. Dust, ash, pollen, and smoke that adversely affect human health and visibility can be 'raked' from the atmosphere, then washed to the ground by rainfall or snow.
- **Protecting water resources.** Forests protect water by reducing surface erosion and sedimentation, filtering water pollutants, regulating water yield and flow, moderating floods, increasing rainfall (e.g. 'cloud forests') and mitigating salinity.

Related to climate change. Forests are very important in helping control regional, local, and global climate. Locally, trees give shade and store water, giving a cooling effect in

European Alps

A case study of the Ban de Ville forest in Courmayeur (Aosta Valley, Italy) illustrates aspects of silvicultural planning, which is one of the considerations in managing alpine protective forest. Since protecting human populations and activities in the Europe Alps is very important, the most important feature of a protective forest is its stability. That is, its ability to carry out its protective function reliably and continuously and, if this is achieved, its ability to maintain its structure and vitality in the face of internal and external influences.

Source: Motta et.al (2000)

hot weather. They also function as storm preventer and help to reduce energy loss in cold weather. Evaporation from trees is released to the atmosphere and ultimately falls as rain. Globally, trees are an integral part of the carbon cycle. Loss of vegetation reduces carbon dioxide absorption, which in turn contributes to the greenhouse effect.

According to Global Resources Assessment 2005 (FAO), Japan is the world's first country to have the majority of its forest plantations used for protective functions (e.g., headwater conservation and soil run-off prevention).

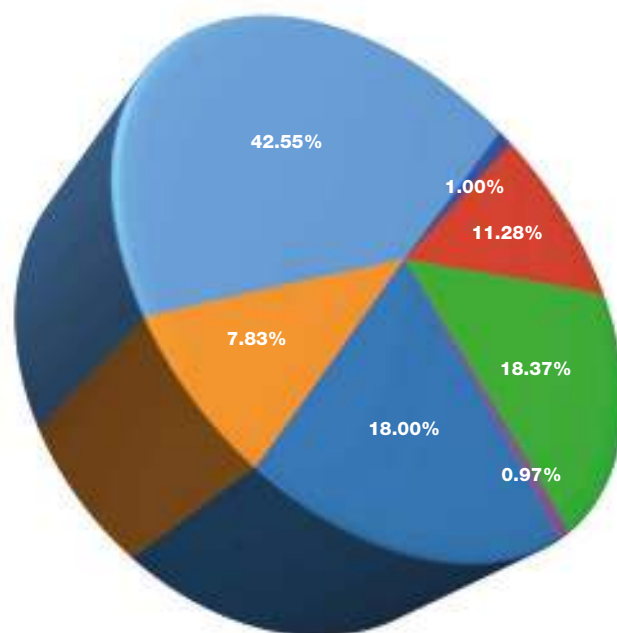
- **Nature protection.** Forests are habitats for many species, at least some of which may be rare or endangered. As a consequence, forest management needs to reflect the natural values in that particular forest.

The International Union for Conservation of Nature (IUCN) has six categories for forest protected areas⁶, which also determine the forest management regimes put in place:

- **Ia:** *Strict nature reserve* – a protected area managed mainly for science;
- **Ib:** *Wilderness area* – a protected area managed mainly for wilderness protection;
- **II:** *National park* – a protected area managed mainly for ecosystem conservation and protection.
- **III:** *Natural monument* – a protected area managed mainly for conservation of specific natural features;
- **IV:** *Habitat/species management area* – a protected area managed mainly for conservation through management intervention;
- **V:** *Protected landscape/seascape* – a protected area managed mainly for landscape/seascape conservation and recreation; and
- **VI:** *Managed resource protected area* – a protected area managed mainly for the sustainable use of natural ecosystems.

A more detailed explanation of those categories can be found in Appendix 5.

Figure 1.1
Forest Protection Split
by IUCN Category in North America



This figure shows the percentage of forest protection area in North America split by IUCN categories. From a total of 9,060,344 km² of forest area in North America, protected forest accounts for 18.8% of that total.

Source : UNEP-WCMC Forest Programme (2000)

3. Socio-economic functions

Forest resources contribute to the overall economy in many ways (for example, through employment, and through processing and marketing of forest products).

Estimates of forestry sector contribution to the GNP (Gross National Product) in Brazil indicate a 4% contribution. The Brazilian Forest Service and the Brazilian Institute of Geography and Statistics (IBGE) are developing a methodology to provide annual, accurate estimates of the "Forestry GNP", based on the national accounts⁷. In Estonia, forestry's share of Gross Domestic Product (GDP), at 2006 basic prices, was 1.0 %, the wood processing industry's share was 2.4 %, the paper and pulp industry's share was 0.3 %, and the furniture industry's share was 1.0 % - for a combined total of 4,7% of GDP⁸.

The level of employment in forestry is an indicator of both the social and economic value of the sector to society. Employment provides income and, as forestry activities occur in rural areas that are often poorer than the average, it gives some indication of the sector's contribution to poverty alleviation. In social terms, the value of employment is in allowing individuals to become productive members of society.

⁶ Phillips (2004)

⁷ Source: SAI of Brazil

⁸ Source: SAI of Estonia

In addition to economic functions, however, forests also host and protect sites and landscapes of high cultural, spiritual, or recreational value. These values (which often have a wealth of traditional knowledge associated with them) need to be acknowledged and included if effective government policies and indigenous and community management systems are to be developed and put in place.

1.6 INTERNATIONAL FOREST INITIATIVES

The importance of forest is recognized by many governments and non-government organizations in a range of sustainable forest management initiatives. Some examples of these are:

- *The International Tropical Timber Organization* (ITTO) has developed guidelines on the conservation of biological diversity in tropical production forests (ITTO, 1993). The guidelines were developed to optimize the contribution of timber-producing tropical forests to the conservation of biological diversity.
- *The FAO's model code of forest harvesting practice* (1996) has been compiled to highlight the wide range of environmentally sound harvesting practices that are available and to enable policy-makers to develop national, regional, or local codes of practice to serve particular needs. Subsequently, regional codes were agreed in Asia and the Pacific in 1999 and West and Central Africa in 2005. National-level codes have been adopted or are under preparation in several countries in Southeast Asia.
- *The FAO's governance principles for concessions and contracts in public forests* compiles critical factors for balancing and safeguarding public and private interests in forest management. The principles also identify new approaches to contractual arrangements for the provision of goods and services from public forests.
- *The ITTO*, in collaboration with partners, developed guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests (ITTO, 2002). This is part of ITTO's series of internationally agreed policy documents for achieving the conservation, sustainable management, use, and trade of tropical forest resources.
- *The Confederation of European Paper Industries* (CEPI) developed Legal Logging, a code of conduct for the paper industry (to combat illegal logging). Best practices for improving legal compliance in the forest sector (FAO/ITTO, 2005) distill the available knowledge that decision-makers could follow when attempting to reduce illegal operations in the forest sector.

Many organizations around the world have been undertaking initiatives to protect or conserve forests for their important ecological functions. These initiatives include but are not limited to:

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This inter-government agreement was drafted as a result of a resolution adopted in 1963 in a meeting of members of IUCN (International Union for Conservation of Nature). CITES aims

to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Today, it accords varying degrees of protection to more than 30,000 species of animals and plants - whether they are traded as live specimens, fur coats, or dried herbs. Participation is voluntary. Although CITES is legally binding on the parties, it does not take the place of national laws. Instead, it provides a framework to be respected by each party. Each country has to then adopt its own domestic legislation to make sure CITES is implemented at the national level. (www.cites.org)

2. Ramsar Convention

Signed in Ramsar, Iran, in 1971, the Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands. It aims to stem the progressive encroachment on and loss of wetlands now and in the future. It recognizes the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. (www.ramsar.org)

3. World Heritage Convention

This was founded by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) in 1972 on the principle of international cooperation. The Convention aims to encourage the identification, protection, and preservation of the earth's cultural and natural heritage. It provides for the protection for those cultural and natural "properties" deemed to be of greatest value to humanity by selecting an international list of the most outstanding of these. It is administered by the World Heritage Committee which consists of 21 elected nations. To date, more than 170 countries have adhered to the Convention. (www.whc.unesco.org)

4. Convention on Biological Diversity (CBD)

This was signed in the Earth Summit in Rio de Janeiro, Brazil, in 1992 and entered into force on 29 December 1993. It is the first global agreement to cover all aspects of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources. (www.cbd.int)

5. United Nations Framework Convention on Climate Change (UNFCCC)

This is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. The Convention entered into force on 21 March 1994. The treaty aims at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) changes to the global climate. This action was aimed primarily at industrialized countries, with the intention of stabilizing their emissions of greenhouse gases at 1990 levels by the year 2000, and other responsibilities will be incumbent upon all UNFCCC parties. (www.unfccc.int)

6. Kyoto Protocol

This international agreement links to the United Nations Framework Convention on Climate Change. The Protocol aims to reduce greenhouse gases as a way of preventing

anthropogenic climate change. It entered into force on 16 February 2005. Countries that ratify this Protocol commit to reducing their emissions of carbon dioxide and five other greenhouse gases, or they commit to engaging in emissions trading if they maintain or increase these emissions. Under the treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol also offers countries an three market-based mechanisms as way of meeting their targets: emissions trading, clean development mechanism, and joint implementation. The mechanisms help stimulate green investment and help Parties meet their emissions targets in a cost-effective way. (www.unfccc.int)

Chapter 2: Sustainable Forest Management

2.1 WHAT SUSTAINABLE FOREST MANAGEMENT IS

Sustainable Forest Management (SFM) is the process of managing forests to achieve one or more clearly specified objectives of management, with regard to the production of a continuous flow of desired forest products and services, without undue reduction of its inherent values and future productivity and without undue desirable effects on physical and social environment (ITTO, 2004).



Source: SAI of Indonesia

SFM aims at ensuring goods and services derived from forests meet current needs while at the same time securing their continuous availability and contribution to long-term development. In a broader sense, forest management encompasses the administrative, legal, technical, economic, social, and environmental aspects of the conservation and use of forests. It implies various degrees of deliberate human intervention, ranging from actions aimed at safeguarding and maintaining the forest ecosystem and its functions, to favoring specific social or economic valuable species or groups of species for the increasing production number of goods and services.

2.2 WHAT MAKES UP SUSTAINABLE FOREST MANAGEMENT

SFM is difficult to define precisely because many aspects and or components need to be considered. Experts from the International Tropical Timber Organization (ITTO) and the FAO have come up with a number of components to consider when facilitating international communication on forest-related issues. These components centre around seven globally agreed 'themes'.

The following is an overview of these themes:

Extent of forest resources

This theme expresses an overall desire to have enough forest coverage and reserves, including trees outside forests, to support social, economic, and environmental aspects of forestry. It recognizes that the existence and extent of specific forest types are important as a basis for conservation efforts. This theme also aims to reduce deforestation and rehabilitate degraded forest landscapes, and includes how forests and trees outside forests contribute to moderating the global climate.

Biological diversity

Biological diversity is concerned with conserving and managing biological diversity at ecosystem (landscape), species, and genetic levels. Conservation efforts include protecting areas with fragile ecosystems, and ensuring diversity of life is maintained. Maintaining diversity also gives rise to opportunities for developing new commercial products (e.g., medicines), or for enhancing forest productivity, for example, through the use of genetics.

Forest health and vitality

Forests need to be managed to mitigate the risks and minimize the impacts of unwanted disturbances, including wildfires, airborne pollution, storm felling, invasive species, pests, diseases, and insects. Such disturbances may affect social, economic, as well as environmental dimensions of forestry.

Productive functions of forest resources

This theme is about maintaining a high and valuable supply of primary forest products, while also ensuring that production and harvesting are sustainable.

Protective functions of forest resources

Forests and trees outside forests help moderate soil, hydrological, and aquatic systems. These moderating functions include maintaining clean water (including healthy fish populations), and minimizing the risks and impacts associated with floods, avalanches, erosion, and droughts. Protective functions of forests also contribute to ecosystem conservation efforts. These functions have strong cross-sectoral aspects, as the benefits to agriculture and rural livelihoods are high.

Socio-economic functions

Forest resources contribute to the overall economy, for example, through employment, processing, and marketing of forest products and energy, and trade and investments in the forest

sector. This theme also addresses the important functions of forest to host and protect sites and landscapes that have high cultural, spiritual, or recreational values. Thus, it includes aspects of land tenure, indigenous and community management systems, and traditional knowledge.

Legal, policy and institutional framework

Legal, policy and institutional arrangements are necessary to support the previous six themes. These arrangements include participatory decision making, governance and law enforcement, and monitoring and assessment of progress. It also embraces broader societal aspects, including fair and equitable use of forest resources, science research and education, infrastructure arrangements to support the forest sector, transfer of technology and capacity building, and public information and communication.

2.3 SUSTAINABLE FOREST MANAGEMENT IS CENTRAL TO WIDER CONCERNS

Sustainable forest management lies at the junction of a range of economic, social, and environment concerns that underpin how forests are used by people.

As mentioned above, forests help meet people's daily needs and improving their quality of life. Rural people living in or around forests often have a very close relationship with the forest. They may rely on the forest for a range of goods and services, such as timber for housing, livestock enclosures and fencing, fruit for their nutritional needs, sap for brewing beer and wine, bark for making ropes and weaving, and herbs and leaves for medicinal purposes.

Forests also support human life in the economic sense by providing wood for construction, and by supplying wood for wood-based industries such as processed timber and pulp and paper production. Furthermore, forest-related industries are an important source of employment, especially in many developing countries.

Forests also serve a vital social and cultural role. For many forest communities around the world, the forests have significant cultural spiritual, or religious values. In Nepal, for example, 80 plant species are used in cultural festivals (Acharya, 2003).

Forests have been a major theme in international environmental discussions for many years, but perhaps never in the dominant way they feature today. Discussions surrounding forests are now mainly focused on global efforts to combat climate change. According the British Government's Stern Review on the Economics of Climate Change, the "loss of natural forests around the world contributes more to global emissions each year than the transport sector" (Stern, 2006).

Putting climate change aside, there are increasing international environmental concerns centre over the threat that deforestation poses to the world's ecological resources. This is especially in the light of the important eco-services forests provide to

maintain human wellbeing, such as genetic resources that can be used in industry and medicine.

2.4 BENEFITS OF SUSTAINABLE FOREST MANAGEMENT

There seems to be general agreement that forest sustainability comprises three elements: ecological sustainability, social sustainability, and economic sustainability. Ecological sustainability is the role of forest in maintaining biological diversity and the integrity of ecological processes and systems. Social sustainability relates to the forest's role in maintaining the human community that depends upon the forest. Economic sustainability will maintain companies, communities, and families that are economically dependent on forests. Each of these elements can contribute a range of benefits. The following paragraphs illustrate some of these benefits (this is by no means an exclusive list).

Some forest products are valuable export commodities. They include gums and resin, plywood, sawn wood, bamboos, various oils, turpentine, tanning materials, honey, spices, bark and leaves, and medical plants. Rattan, the long thin stem of a climbing palm (mainly *Calamus* sp.), has become an important export commodity for Indonesia, Malaysia, and the Philippines. Portugal, Morocco, and other Mediterranean countries export large quantities of cork derived from the cork oak, *Quercus suber*. The Republic of Korea has built up an export trade in edible forest fungi, while gum Arabic from *Acacia Senegal* has been an important export product from Sudan (FAO, 1993).

Forests and woodlands have an important role in protecting the environment at a local and even regional level. This is particularly true of steeply sloping watersheds where the tree roots are important in binding the soil and protecting it against erosion and landslides (FAO, 2005).

Uncontrolled clearing of forests from such upland areas, in addition to its local effects, can also have major repercussions further downstream. The eroded soil carried by streams and rivers is mainly deposited in reservoirs for irrigation and hydro-electricity; this reduces the capacity and shortens the life of these costly investments.

Locally, trees can provide protection against wind erosion and increase the rate at which rainwater filters into and recharges the groundwater. Used judiciously in farming systems, they help maintaining soil fertility of the soil by recycling (by leaf fall) nutrients drawn up by their roots into the top layers of the soil. They provide shade for animals and humans; the microclimate under trees may be several degrees cooler and more humid than in the open sun. In coastal areas, mangroves protect the land against erosion by the sea and are breeding grounds for fish and shrimps.

Forests also have an increasingly important role as havens for wildlife and as sites for protecting endangered species of plants and animals. Often allied to this is their role in recreation, tourism, and what has come to be known as "ecotourism".

Hiking, camping, nature study, and simply getting out of the city are increasingly important for urban people as a way relieving stress from a polluted world.

2.5 THE KEY PLAYERS

Sustainable forest management is complex. It involves a wide range of disciplines and ideologies. This complexity and diversity of perspectives has major implications for those parties with an interest in the quality of forest management and the roles they play. Some of these parties include:

National/federal governments

In many countries, the future of State-owned industries is likely to be determined by government policies to do with public enterprises. It is probable that the role of federal or national governments will be increasingly one of regulating and establishing frameworks and procedures, including policies. This role is to ensure that all parties can make sustainable use of forests.

Provincial governments

Provincial governments have a very strong interest in ensuring forests are well managed. Forests are integrated to many provincial economy, agriculture, natural resource development, and conservation strategies. The role of provincial governments will continue to evolve as more central governments devolve responsibility for implementing national or federal policies and regulations down to provincial governments.

Local governments

In many countries, local authorities are responsible for providing services in their areas (e.g., for economic and infrastructure development). National/federal government will need to work with primary local authorities to ensure forestry programmes fit into local development plans. Even now, local governments in most developing countries have significant input into forest management; they are at the 'front line' of government in ensuring the implementation of policies and regulations.

The private sector

Through their use of forest resources, corporations and small-to-medium enterprises (SMEs) generate employment, profits for further investment, human resource development, and many other economic and commercial benefits. The strong linkages between forestry and its processing industries offer good opportunities for creating and maintaining rural employment opportunities. Private sector firms need to adapt and innovate in order to remain competitive while meeting environmental standards. Improved efficiency will also be required in order to meet any costs of environmental management (although environmental standards often bring efficiencies as well).

In some countries (e.g., Brazil) the private sector plays an important role in developing research and technology, as well as contributing to country's economy and employment. This can happen through a bidding process on forest concessions, where the successful company has the right to carry out

sustainable exploration of forests products and services in lands under public management.

The private sector in Malaysia helps transforming the country's economy as they rebuild value-added downstream timber processing capabilities to compliment their timber harvesting activities. Whilst investing, the sector contributes to government revenues through log duties, royalties, and other business tax payments. Through their investments, significant employment opportunities have been created for the local population, especially among rural communities (JoeangoHutan, 2006).

However, it is important to note that profitable industry development may not necessarily sit comfortably with sustainable forest management. In fact, private companies can completely destroy forests (through, for example, illegal logging). Sometimes the parties with a duty to protect forests – the police, military, and government, can become corrupted and act against the interests of sustainability.

Non Government Organizations (NGOs)

NGOs can have several roles in the forest sector, for example, as researchers, public opinion setters, and educators (raising public awareness about importance of forest and problems in forestry).

Communities in or near forests

In Indonesia case, communities situated within or close to forests have major influence on forest management. As noted earlier, the wellbeing of these communities is often closely linked to a range of forest products and services. Such communities are in a unique position to conserve, maintain, damage, or destroy forests and their habitats and ecosystems. For example, local residents can choose to protect the forest from encroachment and illegal logging. This has happened in some areas of Indonesia where NGOs have worked with people from local communities (World Resources, 2005). Community forestry management is an increasing trend that may prove beneficial for long term forest management. However, the reality in many developing countries is that illegal logging is a major source of income for people living in forest areas.

The general public

Members of the public may participate in forest management via public hearings carried out during the processing of licensing of potentially polluting activities, and during the processing of forest concessions. Public hearings are an instrument foreseen in legal rulings favoring transparency and social control in activities with environmental impacts. During this process, the public has the opportunity to influence events by exercising their voting rights.

Each of these players will vary between countries in their make-up, presence, roles and degree of influence. This, in turn, will depend on the political, governance, policy, and regulatory environment in different countries.

The role of each party involved in forest management will also vary depending on the level being considered. For example, at

the international level, the national government's role is bigger than that of other party, but at the management level the role of private sector dominates.

2.6 UNSUSTAINABLE FORESTRY MANAGEMENT

Unsustainable forest management can result in a number of risks to forests. For the purposes of this document, 'risk' is taken to be a probability or threat of damage, injury, liability, loss or other negative occurrence, caused by external or internal vulnerabilities and which may be neutralized through pre-mediated action. Forest audits need to anticipate those risks. These major risks to forests include:

Logging as a cause of deforestation

Logging as a cause of deforestation caused by harvesting, transporting, processing and trading of forest products in violation of national law. Depending on the scale of the operation, illegal logging can harm forests and undermine sustainable forest management. Governments need to develop regulations, policies, and mechanisms to mitigate or prevent illegal logging activities.

Commercial clear-cutting and selective logging for timber is, directly or indirectly, responsible for much of this deforestation, especially in Asia. Many countries try to mitigate the effects of logging through regulation and programmes designed to advance sustainable forest management. However, enforcement is often poor, and illegal logging predominates in some regions. In addition to its direct impacts, logging also exposes forest to encroachment and settlement, and other damaging disturbances like hunting and fire.

Sakhalin Island, Russian Far East

In Russia, a dark conifer forest has been deforested by logging and fires. Before exploitation began, bamboo grew as mountain vegetation at higher altitudes than the dark conifer forest (and also grew rather feebly in the undergrowth). Bamboo roots are resistant to high temperatures and it can reproduce extremely well after fire. It can therefore quickly take over a new space, creating a thick, impenetrable carpet.

Huge areas of dark conifer forest have now been transformed into bamboo wilderness in the South part of the island. The inability of dark conifer to reestablish themselves quickly after clear cutting and fires, together with the focus on spruce and fir timber for the paper industry, has led to significant depletion of dark conifer taiga. Logging on Sakhalin has always been accompanied by replanting program. But it has never compensated fully for the amount logged.

Source: Dimitry (2008)

Illegal logging may occur because of a difference between demand and production, weak law enforcement, and socio-economic problems in the human forest communities.

As an example, the gaps between demand and production for a particular country are illustrated in Table 2.1 below.

Table 2.1
Timber's Demand and Production

TIMBER'S DEMAND AND PRODUCTION	VOLUME (million m ³)
Log's demand (1999)	
1. Industries related with Licensed Forest Company (LFC)	50
2. Industries not related with LFC	30
Total demand per year	80
Log's production (1995-1999)	
Average production per year	35
Gaps between demand and production	45

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The pulp and paper industry is currently expanding in tropical Asia, with several huge mills under construction in several countries. Large areas of mature forest are being cleared for pulp fiber then converted to other uses such as oil palm plantations. The recent and accelerating loss of forest has led to a significant number of species being moved to higher threat categories on the IUCN Red List (IUCN Standards and Petitions Working Group, 2008).

Logging's impact on biodiversity

Logging can be selective and well-managed, but often it is not. Even selectively logged forests support consistently fewer forest-specialist bird species than primary forests. Those species that do persist often become rare. Many of them are understorey insectivores and unable to survive in the open forest. In Indonesia, loss of forest habitat due to logging and human settlement threatens the survival of the Sumatran tiger and the Sumatran elephant. The exhibit below documents the specific activities that go to make up illegal logging.

Illegal logging and associated activities

Some examples:

- Logging protected species.
- Duplication of felling licenses.
- Girdling or ring-barking, to kill trees so that they can be legally logged.
- Contracting with local entrepreneurs to buy logs from protected areas.
- Logging in protected areas.
- Logging outside concession boundaries.
- Logging in prohibited areas such as steep slopes, riverbanks and water catchments.
- Removing under-/over-sized trees from public forests.
- Extracting more timber than authorized.
- Logging without authorization.
- Obtaining logging concessions through bribes.

Source: UNECE Timber Committee and FAO European Forestry Commission

The exhibit below documents instances of illegal logging in three different countries.

Indonesia

After carrying out land clearing, the land and the remaining tree roots are usually burned by the private sector, whether domestic or foreign holders. As a result, widely burning fires occur mostly in plantation areas. The negative impact of the palm oil sector has produced a higher risk of 'forest fires', as occurred in the 1990s. Forest burning in 1997 deliberately burned 550,000 ha forest land in Sumatra (Riau and Jambi) and Kalimantan (East and Central Kalimantan). About 46 percent of the hotspots appeared on satellite images on September 28, 1997, were in lands granted for plantations.

Source: Siscawati (2006)

Cameroon

Forest logging in the Dja Reserve is a serious problem due to the reduction of wild fruits for local people and large mammals, and the intensification of commercial hunting in the Reserve. Animals are being hunted for sale, primarily in towns but also in the forest sites. More than 70 percent of the plant species logged in the Dja Region are scattered mostly by animals, which shows the importance of wildlife in the forest regeneration. Timber logging also has a negative impact on the medicinal value of the Dja forest, where about 80 percent of medicinal plants used by the local people are composed of ligneous species, with trees (50%) contributing the major proportion.

Source: Lagarde (2008)

Baltic States

In 2004, 9.5 million cubic meters of round wood were imported to Sweden. Most of this volume was consumed by Swedish pulp and paper industries. The vast majority of this wood comes from the Baltic States and NW Russia. Today, problems associated with illegal logging, other forest crimes and other unsustainable forestry practices are very acute in these countries. Estimates from NW Russia show that 27% of logged timber might have an illegal origin – and, alarmingly, the figure is probably even higher in the region supplying Swedish industry.

Estimates of the scale of the problem in Estonia point to 50%, and in Latvia 20%. These problems are widely considered as a major impediment to the development of a more sustainable forestry in the regions, especially amongst private forest owners in the Baltic States. The strong increase in demand for timber in the Baltic States has also pushed logging levels to very unsustainable levels in both Estonia and Latvia, and has increased the import of round wood from especially Russia to these countries.

Source: Taiga Rescue Network (2005)

Biodiversity and Ecosystem Loss

Human activities are the main cause of biodiversity loss, for example: change in land use and transformation caused by forestry become threats to biodiversity and as a consequences, there is a decline in distribution, size, and genetic diversity of species.

Forest fires

Forest fires may be caused by human activities, such as land clearing using slashing and burning. It is becoming a serious problem for many countries. For example, in Indonesia, forests fires are often the unintended result of small-scale farmers and companies using fire to clear land for agriculture.

Illegal Logging

Illegal Logging risk described as forestry practices or activities connected with wood harvesting, processing and trade that do not conform to law.

Illegal use of land

One example of this is a company or group of people occupying an area of forest without a license or permission from the relevant authority.

Disasters

Natural disaster can exhaust goods and chattels and in a specific scale are harmful to a specific community function.

Conflict

As with competition for a finite resource anywhere, there is always a risk of conflicting interests between different stakeholders over how the forest is managed. Common examples of this include conflict involving groups claiming traditional ownership of land where a company is operating with a legal permit. Or, landowner hostility over regulations telling them what they can or cannot do on their land.

Revenue loss

Where government revenue is derived from taxes and levies on forest activities – often to fund forest rehabilitation activities – there is always the risk of impropriety in the way taxes are collected and the amounts paid. This may be particularly true in developing countries still seeking to establish good governance practices.

Livelihood loss

Loss of livelihood is faced by communities surrounding forests that are economically dependent on those forests.

Social problems

Unsustainable forestry development could profoundly affect many people and communities who rely on forests. Communities may need to be physically moved, bringing with it a host of potential social problems. If communities are no longer involved in forest management activities, their livelihoods could suffer, as well as their cultural and spiritual values. Much traditional knowledge could be lost as well.

Decreased carbon storage

As a consequence of photosynthetic activity, forests absorb the ambient carbon in the air, store that carbon inside the trees, and release oxygen back to the air. Unsustainable forest management would significantly reduce the number of trees. This would cause decrease the amount of carbon dioxide (CO₂) converted into oxygen (O₂). Finally, this would influence the temperature on the earth's surface.

Reduced water quality

Reduced water quality encompasses aspects like flood protection, erosion control, preventing seawater intrusion, and maintaining soil fertility.

Shortage of raw materials for industry

A shortage of raw materials could lead to a decrease in forestry industry downstream.

Appendix 1 highlights case studies that relate to the above list of risks.

2.7 EVALUATING RISKS TO SUSTAINABLE FOREST MANAGEMENT

Developments in forestry during the past two decades have focused on progress towards sustainable forest management (SFM), an approach that encompasses environmental, economic, and socio-cultural objectives of management in line with the "Forest Principles" adopted at the United Nations Conference on Environment and Development (UNCED) in 1992. The proposals for action were adopted by the Intergovernmental Panel on Forests (IPF) and the Intergovernmental Forum on Forests (IFF).

The specific toolset developed to describe and help monitor progress (or lack of it) towards SFM, in particular at the national level, is called Criteria and Indicators (C&I). The development of this tool within regional country-driven initiatives started before UNCED, by the International Tropical Timber Organization (ITTO). It has since spread world-wide.

Since 1992 several eco-regional forestry processes have been established for developing and putting in place C&I. Temperate and boreal forests are covered by the Pan-European and the Montreal Processes. Arid-zone forests are covered by the

Zone Africa Process, the Near East Process, and the Regional Initiative for Dry Forests in Asia. Tropical moist forests are covered by the Lepaterique Process of Central America, the Tarapoto Proposal, the ITTO, and the African Timber Organization (ATO).

Some of the regionally based processes also cover other forest types in the region. Several countries are members of more than one process. Most of these processes involve regular meetings to refine the concept of SFM through the development of C&I, and to follow up progress through country reporting.

Key topics for evaluating risks

The C&I will have implications for forest audits. These audits should, in particular, focus on:

- governmental activities around the establishment of legal and institutional frameworks (including existence and implementation of forest policies); and
- how management practices alter the actual forests.

What follows is a list of the main topics that can be evaluated during the forest audit. The main topics are divided into three main parts: policy and legislation; forest management for multiple uses; and socio-economic, financial, and environmental aspects. Note: different countries will focus on different issues, because each country faces a unique situation.

1. Policy and legislation

The success, or otherwise, of sustainable forest management, depends on having an appropriate framework of policies and legislation at national and regional levels. Considerations in deciding the needs and aspirations of present and future generations of the population; the place of forestry in national economic planning; the various objectives of forest policies (and the relative importance of these); and the land area covered by public and private forests.

The subtopics for this topic are Forest Policy, National Forest Inventory (NFI), Permanent Forest Estate, Protection of Biological Diversity, Soil and Water Protection, Forest Ownership, and National Forest Service.

2. Forest management for multiple uses

Forests earmarked for timber production are able to fulfill a number of important objectives and forest functions, such as environmental protection and, to a varying extent, species and ecosystem conservation. These multiple uses should be safeguarded by applying sound management practices that maintain the potential of the forest to yield its full range of benefits to society.

The subtopics for this topic are planning, harvesting, forest protection, legal arrangement, and monitoring and research.

3. Socio-economic, financial and cultural aspects

A well-managed forest is a self-renewing resource producing a host of economic and social benefits. If sustainably managed, a forest has the potential to make an important contribution to

the overall sustainable development of the country. Sustainable timber production depends on an equitable distribution of incentives, costs and benefits, associated with forest management, between the principal participants, namely the forest authority, forest owners, concessionaires, and local communities. The success of forest management for sustained timber production depends to a considerable degree on its compatibility with the interests of local population.

The subtopics for this topic are relations with local populations and economics, incentives, and taxation.

Management for timber production can only be sustained in the long term if it is economically viable – that is, taking full account in the economic value of all relevant costs and benefits derived from properly conserving the forest.

Each of these topics and subtopics has an associated set of criteria. These criteria are used to make an initial pre-audit assessment of the forestry resource, and to help identify the key points the audit needs to focus on. The criteria can also be used during the audit itself (as can other relevant criteria from other applicable processes and standards). More details about the set of criteria described above can be found in Appendix 4.

The table associated with this section highlights the risks related to each aspect of sustainable forest management described earlier in the section.

Table 2.2
Example of audit topics matrix concerning risks to forestry

NO	TOPICS/SUBTOPICS*	RISK											
		A	B	C	D	E	F	G	H	I	J	K	L
1	POLICY AND LEGISLATION												
1.1	Forest policy		•	•	•		•						
1.2	National forest inventory	•	•	•				•		•			
1.3	Permanent forest estate	•	•	•	•			•				•	
1.4	Protection of biology diversity	•											
1.5	Soil and water protection	•				•						•	
1.6	Forest ownership	•	•	•	•		•	•					
1.7	National forest service				•								
2	FOREST MANAGEMENT												
2.1	Planning	•	•	•					•	•	•		•
2.2	Harvesting	•	•	•				•	•	•	•		
2.3	Protection	•	•	•	•	•	•			•		•	•
2.4	Legal arrangements	•	•	•	•		•	•	•	•			
2.5	Monitoring and research	•	•	•	•	•							
3	SOCIO-ECONOMIC, FINANCIAL, AND ENVIRONMENTAL ASPECTS												
3.1	Relations with local populations	•			•		•		•				
3.2	Economic, incentives, and taxation		•	•	•				•				

*The topic or subtopics can be change along with the development of criteria.

A – Biodiversity and ecosystem loss

B – Forest fires

C – Illegal logging

D – Illegal use of land

E – Disaster

F – Conflict

G – Revenue Loss

H – Livelihood Loss

I – Social problems

J – Decreased carbon storage

K – Reduced Water Quality

L – Shortage of raw materials for industry

Chapter 3: Auditing Forest

This chapter sets down the basic issues underlying a forest management audit. It explains different types of audits, the tools and methodology used, as well as issues around choosing and designing an audit. This chapter is designed to help SAIs to tailor and conduct an audit that best suited their specific circumstances.

3.1 ISSUES

Types of audit

As with all environment-related audits, a forest audit can consider financial and compliance issues as well as performance issues. Its approach is no different to the audit approach commonly practiced by all SAIs, and it encompasses all types of audit.

In the specific context of forest management, however, particular attention may be devoted to aspects like the disclosure of forest assets and liabilities, compliance with legislation and conventions (both national and international), and an assessment of measures put in place by the audited entity to promote economic efficiency and effectiveness.

Methodology and audit tools

A forestry audit uses many methods commonly used in most audits, such as data analysis and evaluation, field observations, interviews, sampling, and internal control system evaluation. In a forest audit, however, it pays to note we are dealing with the proportion of land coverage, not simple numerical data as found in other types of audits. We need to choose the most at-risk land. So, auditors need to be equipped with the most appropriate tools and technologies to achieve the audit objectives.

Computer-based technologies can be exceptionally useful in audits. Two examples of these technologies are GPS and GIS.

Geographical Information System (GIS)⁹

A Geographical Information System (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. Burrough (1998) defined GIS as, "set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes". Meanwhile, Arnoff (1991) defines GIS as, "a computer based system that provides four sets of capabilities to handle geo-referenced data: data input; data management (data storage and retrieval); manipulation and analysis; and data output."

GIS can be used in both planning and conducting the audit. GIS-derived information can be used to precisely identify the area of the forest that will be used for field observations, to locate any deforestation, to investigate illegal logging, and to assess forest fires and illegal land use.

Global Positioning System

The Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defense. It uses a constellation of between 24 and 32 Medium Earth Orbit satellites. These satellites transmit precise microwave signals that enable GPS receivers to determine their current location, the time, and their velocity (including direction).

In a forest audit, GPS precisely locates the area of the forest that is to be audited. An example of the use of GIS and GPS in a forest audit can be seen in Appendix 2.

Example

GIS can be gathered and used as audit evidence. GPS is very effective when it comes to auditing environmental degradation and loss of biodiversity (as was done during an audit on wildlife in protected areas conducted by SAI of Paraguay). GIS and GPS were used in the planning, executing, and reporting phase of a compliance audit done by the SAI of Indonesia on the government's forest planning and management. A better quality audit resulted from the use of these tools.

3.2 A RISK-BASED AUDIT APPROACH

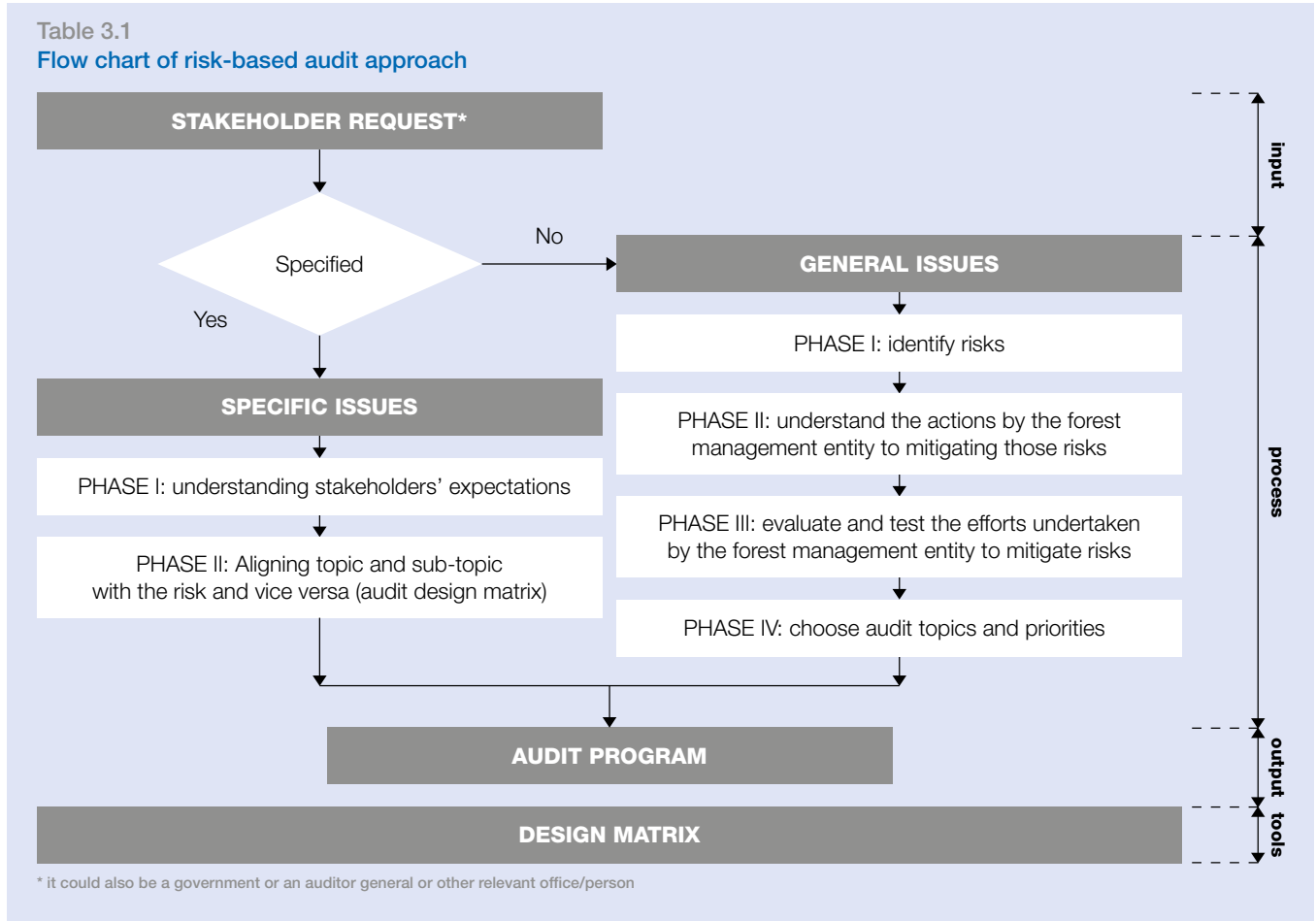
A risk-based audit approach (an approach based on risk assessments) is the best way of conducting a forest audit. This type of auditing applies a method to planning and audit scoping to help appropriately focus the audit resources of SAI.

An audit of forest management covers a large range of topics. To help ensure the audit does not place excessive demands on the SAI's resources, it is advisable to prioritize topics and sub-topics according to the skills and capacity of each unit

⁹ Overview of GIS. Available at www.gisdevelopment.net/tutorials/tuman006pf.htm [Accessed 12 January 2010]

conducting the audit. The following figure shows a flow chart of a risk-based audit approach, on the basis of whether a general or specific audit is required.

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General issues

When audit topic(s) or sub-topic(s) are not clearly specified, the SAI should approach the audit by considering the existing risks, the capacity of the management in mitigating those risks, and then prioritizing topics and sub-topics to be audited.

The Phases of General Issues are described as follows:

PHASE I: Identify risks

At this stage, the SAI is expected to be able to identify risks pertinent to each sub-topic in the audit. In identifying the risks, auditors should take into consideration the special characteristics of forest in question and the key players involved.

<p>Threats/Risks</p> <ul style="list-style-type: none"> • Biodiversity and ecosystem lost • Forest fire risk • Illegal logging risk • Conflict risk • Revenue risk • Illegal use of lands, • etc 	<p>Characteristic to consider</p> <ul style="list-style-type: none"> • Type of forest • Tropical rainforest • Type of ownership <ul style="list-style-type: none"> State owned Privately owned Concessions Traditional community • Function of forest • Status of forest <ul style="list-style-type: none"> Protected forest Productive forest Hunting ground 	<p>Key players</p> <ul style="list-style-type: none"> • The government <ul style="list-style-type: none"> National forest service • Other <ul style="list-style-type: none"> Private companies Local community International community
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How: Risks related to forest management are difficult to assess and complex, and sometimes there is no comprehensive data available. If this happens, SAIs may use external sources to identify risks. These sources include academic papers, studies done by NGOs, interviews with relevant officials and representatives, and information from the media. In addition, SAI may use the risk table in Chapter 2 as a way of identifying possible risks.

Phase II: Understanding the forest management entity's efforts to mitigate risks

What risk

- Biodiversity and ecosystem loss
- Forest fires
- Illegal logging
- Illegal use of land
- Disaster
- Conflict
- Revenue loss
- Unemployment
- Social problems
- Decreased carbon storage
- Destruction on water management
- Shortage of raw materials for industry

How

- Establish policies
- Enact legislation
- Forest biodiversity inventory
- Designate areas for permanent forest
- Establish national forest service
- Designate annual allowable cut (chapter II: Forest policy)

The forest management entity may already be undertaking efforts to resolve the various issues it faces. With this in mind, the SAI should gain an understanding of the steps taken by the management entity and other key players involved.

How: The SAI could get an understanding of the management entity's efforts to mitigate risks by reviewing legal regulations, standard operating procedures, policies, and instruments set out by the government; and by interviewing some 'key players'.

Phase III: Evaluate and test the capacity of the management entity to mitigate risks

This phase is connected closely to Phase II. The SAI's capacity is crucial when it comes to identifying risks and assess the entity's effort in mitigating those risks. Phase 3 should result in the SAI having an understanding of what the management entity has done to mitigate the risks, as well as information on important topics and sub-topics, and whether the entity's

control systems are inadequate or have the potential to create further risks.

How: Relevant staff and senior officials of the forest management entity should be interviewed. During interviews, the entity's various controls systems and procedures could be discussed in order to gain a better understanding. Additionally, sample-testing could also be undertaken to check whether the systems and procedures are sufficiently effective and reliable.

Phase IV: Choose audit topics and priorities

This is the most important and crucial stage. As with Part III, the SAI's capacity is very important when it comes to choosing audit topics and priorities. The SAI needs to consider the auditors' capacity to answer questions about the audit and its findings, the level and nature of public attention surrounding the subject, the amount of money involved, and the nature and extent of the impact that might result from the audit findings.

How: SAIs could conduct interviews with government officials, analyze previous audit reports, and research on public opinion regarding the topic and sub-topics to be audited.

After Phase IV, the SAI is advised to refer to the stages in the design matrix in Appendix 3.

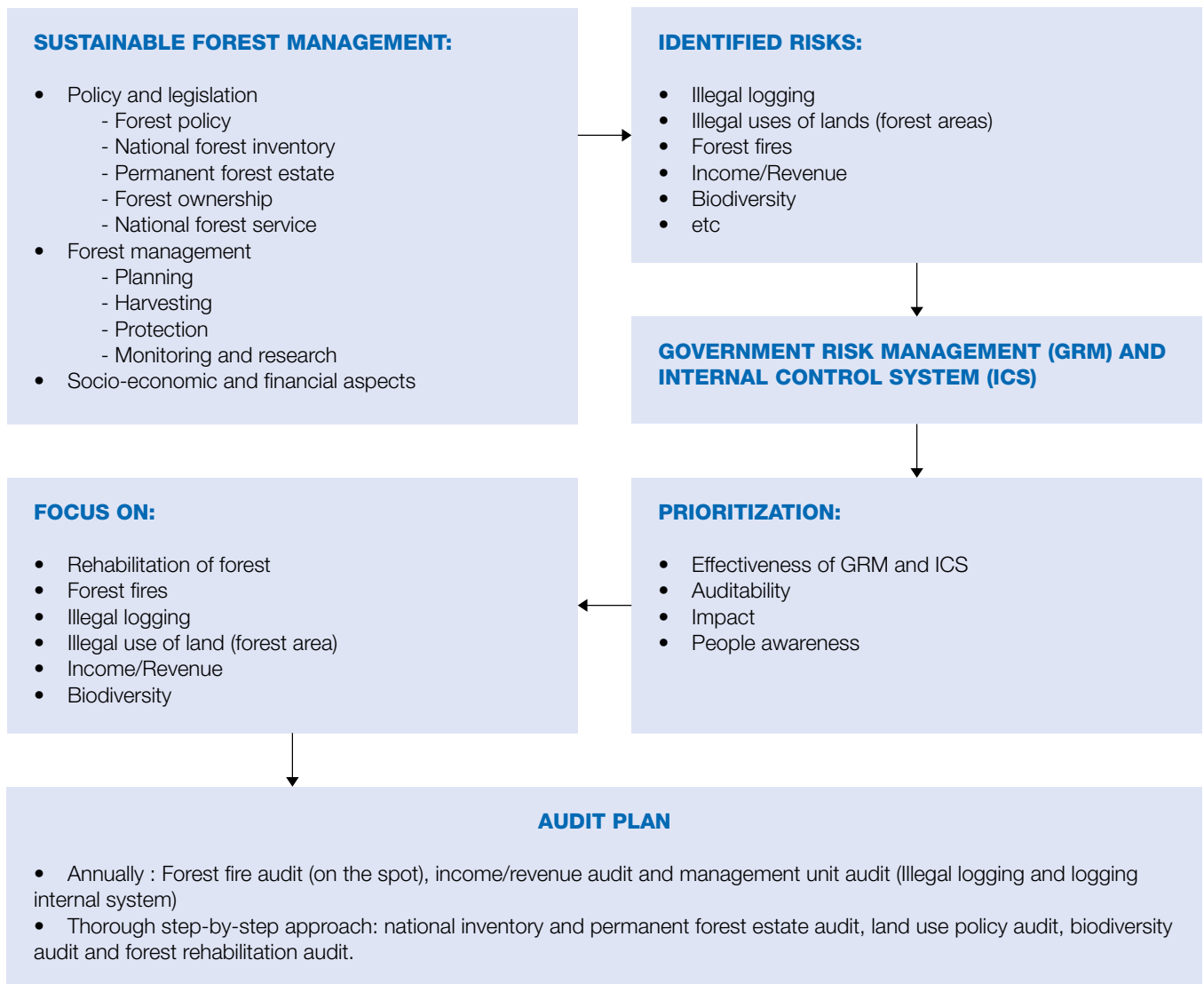
Specific issues

Where the stakeholder clearly specifies the topics and sub-topics to be audited, the SAI may choose to omit the risk identification process and immediately conduct the audit as requested. The phases of specific issues are described as follows:

- **Phase I: Understanding stakeholder's expectation.** This phase involves the SAI formulating the stakeholder's request into relevant topics and sub-topics. This includes determining specific risks that relate to the identified topics and sub-topics. It is also worth noting that, sometimes, stakeholder requests are described in terms of areas of risk rather than key areas of interest.
- **Phase II: Aligning topic and sub-topic with the risk and vice versa.** This phase is about establishing audit procedures. To do this, a SAI may wish to use the design audit matrix described in Appendix 3.

Figure 3.2, Tables 3.1 and Table 3.2 all illustrate how a risk-based audit approach can be implemented. Figure 3.2 represents, in diagrammatic form, the general forest management case study discussed in Table 3.2. Table 3.1 provides a case as example of forest destruction caused by tin mining activity on an island in Indonesia. The opening of tin mining in this instance was done by the private sector and the local communities in the area. Forest sustainability was ignored.

Figure 3.2
Risk based audit strategy to audit management of forest – a case study



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Table 3.1
Sample case for specific issues

The House of Representatives asked SAI to conduct an audit related to forest destruction caused by tin mining (illegal use of land). The SAI was also asked to consider forest policy. The SAI could refer to Appendix 3 (audit design matrix) to establish procedures that will be applied when conducting the audit for both requests. Considering those risks, SAI could directly refer to the topic and sub-topics related to illegal use of land, before setting audit procedures by referring to Appendix 3 the (audit design matrix). The next step would be to develop an audit programme or audit plan memorandum.

Table 3.2
Sample case for general issues

The House of Representatives asks the SAI to conduct a forest management audit of a specific area. When accepting the assignment, SAI should determine audit topic related to that issue. To do this, the auditor would discuss the issue with the House of Representatives and other relevant parties. In order to design the audit program, the SAI will follow the following phases:

PHASE I: Identify risk

After receiving the request from the House of Representatives, the SAI can formulate the risk(s) related to forest management by conducting interview, analyzing the previous reports, and conducting research on public or other parties opinion. The SAI also can use the risk table in Chapter 2 to identify risk related to forest management.

Table 3.2
Sample case for general issues

The risks related to forest management are follows: biodiversity and ecosystem loss; forest fires; illegal use of land; disaster; conflict; revenue loss; unemployment; social problems; decreased carbon storage; damage to water management; and shortage of raw materials for industry.

The output of this phase is the list of risks related to forest management.

PHASE II: Understanding the forest management entity's efforts to mitigate risks

The list of risks completed during Phase I will relate to many of the sub-topics in forest management. In order to choose the sub-topic(s), the SAI will need to understand the entity's effort to mitigate each risk. To do this the SAI can review legal regulation, standard operation procedures, policies, and instruments set out by the entity; and interview key players.

PHASE III: Evaluate and test the capacity of management entity effort to mitigate risk

In this step, the SAI will test and review the government risk management (GRM) and internal control system (ICS).

In this example the highest priority was given to illegal logging and illegal use of land (and also to risks with weak mitigation efforts and/or management control systems applied to them).

The output of this step is a prioritized list of risks.

PHASE IV: Choose audit topics and priorities

After choosing the highest priority risks, the SAI can use the audit design matrix (Appendix 3) to choose the sub-topics that relate to those risks. In the matrix, SAI will find the:

- sub-topics that relate to illegal logging are: planning, harvesting, forest protection, legal arrangements and monitoring and research; and
- sub-topics relate to illegal used of land are: forest protection, legal arrangements, and monitoring research.

PHASE V: How to formulate potential audit objective and researchable questions

The audit objective and researchable questions for the audit should be based on topics, sub-topics and associated risks. The design audit matrix in Appendix 3 can be used to assist the auditor. For example, for the topic of forest policy and legislation, with the sub-topic of forest policy related to forest destruction caused by tin management, the audit objective is to determine: **Does the government have an appropriate forest policy in place to ensure that development in the forest sector related to tin mining activity is effective and sustainable?**

To achieve the audit objective, possible research questions are:

1. Is there a strong and continued political commitment, related to tin mining activity, at the highest level?
2. Is there an agreed forest policy (supported by appropriate legislation) that is in harmony with laws concerning related sectors?
3. Is there a mechanism for regular revision of policy in the light of new circumstances and/or availability of new information?

PHASE VI: How to decide audit criteria

In the case of forest destruction caused by tin mining activities, the auditor should determine the audit criteria to be used by making a comparison between practices which have been implemented and what is stated in the regulated standards. In Indonesia, the criteria used are Act No. 41 of 1999 on Forestry and and ITTO criteria of 2005 on Sustainable Forest Management.

Possible criteria for topic and sub-topics policy and legislation are as followed:

1. *Does a strong and continued political commitment related to tin mining activity at the highest level exist?*
 - A national land use policy aiming at the sustainable use of all natural resources, including the establishment of a permanent forest base.
 - A national forest policy forming an integral part of the national land use policy, assuring a balanced use of forest, should be formulated by means of a process seeking the consensus of all the actors involved: government, local population, and the private sector.
2. *Does an agreed forest policy (supported by appropriate legislation) be in harmony with laws concerning related sectors?*
 - Laws and regulations at appropriate national and local government levels should be enacted, or revised as needed, to support the established forest policy, in harmony with policies, laws, and regulations in related sectors.
 - Laws and regulations are worked out based on analyses about solving country's forestry problems and about achieving goals described in the country's Forest Policy.
 - A legal/regulatory framework maintains forest resources and prevents forest degradation.
3. *Does a mechanism for regular revision of policy in the light of new circumstances and/or availability of new information exist?*
 - Provision of adequate funds for research and monitoring to allow updating of policies.
 - Research on evaluation of full economic benefits (total of marketed and non-marketed goods and services), provided by forests primarily managed for timber production, to enable foresters to better state the case for natural forest management for sustained timber production.

Lastly, the SAI should develop audit program based on the needs of forestry audit in each country.

Appendix 1: Forestry Audit Case Studies

This Appendix presents nine case studies – each one relating to a particular risk faced by forests. The case studies are examples taken from around the world. Whenever possible, the examples include information on the audit objectives, scope, findings, and recommendations. The case studies cover the following topics:

- Illegal used of land;
- Biodiversity and ecosystem loss;
- Forest fires;
- Deforestation and forest degradation;
- Climate change;

- Revenue loss;
- Social problems;
- Shortage of raw materials for industry; and
- Water management.

Each section contains one case study.

The table below gives an indication of the sorts of forest audits that are conducted by SAIs around the world.

Examples of Forestry Audit Conducted by SAIs

NO	YEAR	COUNTRY	TITLE
1	2009	Mexico	Performance Audit to the Actions Implemented for the Management of Forestry Resources.
2	2008	Costa Rica	Application of policies and rules on forestry.
3	2008	Russian Federation	Audit of the effective use of land and forest resources in Forest management office for Moscow area and Moscow city.
4	2008	Estonia	Protection of valuable forest habitats in the Natura 2000 network areas.
5	2008	United States	Forest Service: Better Planning, Guidance, and Data Are Needed to Improve Management of the Competitive Sourcing Program.
6	2007	Indonesia	Audit of Forest Fire Control System.
7	2007	Chile	Auditory of the project of sustainable management of native forest.
8	2007	Australia	Tasmanian Forest Industry Development and Assistance Programs.
9	2007	Poland	Use of public resources allocated for farmland forestation.
10	2006	Burkina Faso	Control and Audit of Forestry Management.
11	2006	Japan	Project for forest environment preservation.
12	2006	Poland	Timber Harvesting and Sales at the State Forest Enterprise of “the State Forests”.
13	2005	Ecuador	Audit of Environmental Control in Reforestation and Conservation Projects in the Chongon-Colonche Cordillera, which is the Responsibility of the Ministry of the Environment.
14	2005	Italy	Forest Fire Prevention and Fight.
15	2005	Malaysia	Management of Recreational Forest.
16	2004	Iceland	Afforestation: the Legal Framework of the Icelandic Forest Service and Regional Afforestation Projects.
17	2004	Brazil	Audit on the Federal Program: Sustainable Amazon.
18	2004	Iran	Auditing the Conservation of Northern Forests Program.

Source: INTOSAI WGEA. 2008. [Online] Available at: www.environmental-auditing.org/

1. ILLEGAL USE OF LAND

Title: “Report on Protection of Forests”

(Turkish Court of Accounts, 2004)

Audit objectives

Objectives of this audit are to ensure:

1. Identifying legal and administrative regulations preventing effective and efficient conduct of forest protection activities, together with identifying risk factors that influence the implementation of those activities.
2. That the General Directorate of Forestry carries out its activities in line with realistic and clear aims and objectives.
3. Activities lead to more effective protection of forest assets.

Audit Scope

The implementation of activities to safeguard forests (mainly relating to the General Directorate of Forestry) in a more effective and efficient manner, by clearly identifying risks to forests.

Audit Criteria

1. General Directorate of Forestry with the “Law no. 3234 on Amendment and Adoption of the Decree Law on the Organization and Functions of the General Directorate of Forests”.
2. Article 31 of the Law no. 4856 on the Organization and Functions of the Ministry of Environment and Forestry.
3. Article 16 of the “Regulation on Forest Survey in accordance with the Forest Law no. 6831”

Findings

1. In the *Milas Forest Management Directorate*, 109,747 of the overall 154,767 hectares of forest area were surveyed. However, no surveys were done in six villages undergoing the most intervention due to the prevalence of property conflicts and stone pine. Approximately 215 hectares of the 2,072 hectares excluded from the forest area could be registered with the registry office. A total of 145 cases were still processed only by the cadastral court.
2. Within the *Maramis Forest Management Directorate*, the number of cases still processed with the cadastral court was 59 and the number of relevant cases being processed with the civil court of first instance was 142. Approximately 182 of the 243 hectares of land excluded from the forest area was within sub-provincial boundaries.

Source: Turkish Court of Account, 2004. Report on protection of forest.
[Online]Turkish Court of account. Available at: www.environmental-auditing.org/

2. BIODIVERSITY AND ECOSYSTEM LOSS

Title: “Audit Report of the Court of Audit of Republic of Slovenia and State Audit Office of the Republic of Croatia on the Conservation of Biodiversity on

the Area of the Planned Regional Parks Snežnik and Kočevko Kolpa and in Risnjak National Park”.

(The Court of Audit of the Republic of Slovenia and the State Audit Office of the Republic of Croatia, 2007)

History

Croatia and Slovenia are countries with relatively high biodiversity levels; their biodiversity index (NBI) ranks them in the first quarter of the European countries. Both countries ratified the Convention on Biological Diversity in 1996 and agreed to implement its objectives in order to efficiently protect biodiversity. The SAIs of the two neighboring countries decided to contribute to the implementation of the Convention on Biological Diversity by: auditing the establishment or management of the protected areas, and by auditing the efficiency of the implementation of measures for conserving biodiversity. Because the audit findings and the conclusions were comparable, the SAIs published a joint audit report on the protected areas; i.e. Risnjak National Park in Croatia, and planned regional parks Snežnik and Kočevsko Kolpa in Slovenia.

Audit objectives

To assess the appropriateness of the institutional framework for protecting biodiversity, and testing how efficiently the management of the protected areas was established.

Audit Scope

1. Establishment of management of the protected areas.
2. Implementation of measures for protecting the forest large carnivores.

Audit Criteria

1. Article 119 item 5 of The Nature Protection Act; this regulates actions and interventions which a legal entity or person must take to prevent damage, and regulates expert methodology and provides rules for proceeding with damage assessment and compensation rates.
2. Ordinance of Minister which regulates the compensation calculation criteria.

Findings

1. There is cooperation between the two countries in terms of research and individual projects. However, there is less cooperation at the institutional level in relation to contributing to defining suitable sustainable development policies.
2. There is cooperation between countries in terms of managing large carnivores, mainly through scientific and research activities, and through the carrying out of projects. Currently, for example, the two countries cooperate in a project for monitoring lynx populations in both countries
3. However, cooperation between the two countries is not institutionalized when it comes to conserving and protecting the forest resources.

Recommendations

The SAIs recommended to the responsible institutions that:

1. their strategic documents should focus on articulating an appropriate and sufficient basis for cooperating on protected areas (important for the long-term conservation of biodiversity and landscape diversity); and
2. after the regional parks (Snežnik and Kočevsko Kolpa) are founded they should start undertaking activities to develop a common management plan of Risnjak National Park and both regional parks, and then they should define joint objectives and measures for managing the protected area.

The SAIs recommended to the authorized bodies that they:

1. prepare and adopt common bases for management plans relating to all three large carnivores. These bases should define measures that provide for stable carnivore populations, and contain measures warding off wild animals from settlements, and preventing damage caused by the large carnivores (thereby contributing to a more peaceful co-existence between wild animals and the local people); and
2. prepare and adopt common bases for monitoring the three large carnivores, and for exchanging data. They should define methods for assessing the size and conditions of carnivore populations that are based on the expertise of those who have to undertake that assessment.

Source: The Court of Audit of the Republic of Slovenia and the State Audit Office of the Republic of Croatia, 2007. Audit Report of the Court of Audit of the Republic of Slovenia and the State Audit Office of the Republic of Croatia on the Conservation of biodiversity on the area of the planned regional parks Snežnik and Kočevsko Kolpa and in Risnjak National Park. [Online]. The Court of Audit of the Republic of Slovenia and the State Audit Office of the Republic of Croatia. Available at: [www.rs-rs.si/rsrs/rsrseng.nsf/1/KDC8C58B728C26136C125747C002C35B8/\\$file/SneznikKolpa96-05_INT.pdf](http://www.rs-rs.si/rsrs/rsrseng.nsf/1/KDC8C58B728C26136C125747C002C35B8/$file/SneznikKolpa96-05_INT.pdf) [Accessed May 2009]

3. FOREST FIRES

Title: “Case Study of an Environmental Audit Regarding Forecasting, Preventing and Actively Combating Forest Fires”

(Italian Court of Auditors, 2006)

History

During the past 10 years, Italy has seen a steady rise in the number of forest fires, despite greater financial and organizational commitments to addressing them. Forest fires have numerous repercussions, especially as woodlands are a fundamental element in biodiversity conservation, hydro-geological protection, climate stability, the water and air cycle, landscapes values, and for generally enhancing the quality of peoples’ life. Forest fires have also caused huge economic loss and damage to both property and business, particularly in the country’s tourism areas. Finally, there are issues around the safety of the public and the personnel operating in this sector.

The European Community has classified many areas in the Italian regions as high fire-prone zones. The European Community has acted to combat forest fires by adopting measures under annual woodlands fire-protection programs, and instituting a monitoring system throughout the Community.

Audit objectives

To measure results achieved in terms of environmental education on all the aspects provided for by Italian legislation. This includes procedures for procuring fire fighting aircraft; how unspent government budgetary allocations to assignees are supervised and reused; and monitoring statutory formalities by the Civil Protection Department.

Audit Scope

The management measurement in forecasting, preventing and combating forest fires launched on 16 December 2003, under Resolution No 26/2006 adopted by the Central Audit Division of the Court of Auditors, was designed to take stock of progress with implementing Framework Law No 353 and 21 November 2000 on forest fires.

Audit Criteria

1. Framework Law No 353 and 21 November 2000 on forest fires.
2. Article 117 of the Italian Constitution vests the Ordinary Statute Regions with lawmaking powers to combat forest fires which was essentially confirmed by Law No 3 of 18 October 2001.

Findings

1. The Civil Protection Department has failed to carry out a thorough monitoring of the formalities required by Law No 353/2000, and has not provided Parliament with the information it requires to make the necessary adjustments to the legislation.
2. The Department has also failed to acquire prompt and reliable accounts of expenditures. The training and information schemes designed to prevent and to combat forest fires also require a coherent plan at the general level, to be drawn up by experts in this sector.
3. Due to the shortcomings, inadequacies, critical factors, and tardiness found in managing the forest fire-fighting programmes, an adequate assessment of the level of the efficiency, effectiveness, and cost-effectiveness in actively combating forest fires has not been possible.

Source: EUROSAI Working Group on Environmental Auditing, 2006. [Online]. EUROSAI Working Group on Environmental Auditing. Available at www.environmental-auditing.org

4. DEFORESTATION AND FOREST DEGRADATION

Title: “Audit of Forest and Land Rehabilitation Program - Badan Pemeriksa Keuangan”.

(Audit Board of the Republic of Indonesia, 2008)

Audit Objectives

To assess the appropriateness of fund allocation, distribution, and usage in the Forest and Land Rehabilitation Program, as well as its economic efficiency.

Audit Scope

1. Cimanuk-Citanduy and Citarum-Ciliwung River Basin Management.
2. Province Forestry of Jawa Barat.
3. Province Agribusiness of Bogor.
4. The period audited was from 2003-2007.

Audit Criteria

1. Environmental Management Regulation - Regulation No.23, 1997.
2. Forestry Regulation - Regulation No.41, 1999.
3. Reforestation Regulation – Government Regulation No.104, 2000.
4. Guidance on Performing Forest and Land Rehabilitation.

Findings

1. The program funded in 2003-2006 reaches only 200,005 ha of land. This means the reforestation program has not reduced the critical area of forest and land in Jawa barat significantly (the target was reducing 580,397 ha of critical area).
2. Inefficiency of fund usage on Forest and Land Rehabilitation Program because of poor planning and procurement of seeds.
 - a) There was inefficient green city development in Bogor and Sumedang City, amounting to Rp84,831,050,00 on. This is because a local government did not refer to the appropriate regulations when choosing the reforestation area.
 - b) Seed procurement amounting to Rp2,570,911,200.00 was not optimal. This meant the government lost a chance to improve environmental quality, especially in terms of forest and land area. This was because the Forestry Ministry did not pay attention to and consider the early policy strategy of Reforestation Program.
 - c) Tree planting at the Cipularang by-pass in 2006 was not done in a manner appropriate to the regulations. Consequently, the government lost a chance to improve environmental quality. This happened because the procurement of tree planting did not refer to the appropriate regulation.
 - d) There was inefficiency in seeds procurement amounting to Rp979,775,650.00. This happened because the Head of river basin management did not refer to the price standard established by Forestry Ministry, and weakness in the control systems.

Source: The Audit Board of The Republic of Indonesia.2008.Audit Report of Forest and Land Rehabilitation Program.[Online].The Audit Board of The Republic of Indonesia. Available at: www.environmental-auditing.org

5. CLIMATE CHANGE

Title: “Evaluation of Impact of Key Ecological Forest Construction on Ecological Environment”

(National Audit Office of the People’s Republic of China, 2008)

Audit objectives

To evaluate the effect of setting up an ecological forest on the surrounding environment. This was done by investigating the capital inflow from all governments involved, as well as by investigating the management and protection of the forests by governments, collectives, and foresters. The attention and awareness of governments and the general public to the setting up of ecological forests was assessed. An assessment was also made on the effect that the setting up of an ecological forest had on local and downstream environments. Finally, the effects that such forests have on foresters’ incomes was also investigated.

Audit scope

1. Appropriation and use of compensation funds.
2. Management of ecological forests.
3. Evaluation of the effect of ecological forest on its environment (including effects on climate change, bio-diversity, water and soil erosion, geological disasters, and forest tourism).

Findings

Audit results showed that ecological forest construction is important for improving the ecological environment.

1. **Compensation system has been established.** Eco-compensation funds of provinces, cities, and counties are listed in the annual financial budget. Compensation funds have increased year by year consistent with economic development. There is a mechanism for increasing the compensation fees received by foresters.
2. **Forests are better managed.** An Ecological Forest Division was set up, and responsibility papers were signed between various levels of governments. The papers signed related to forest felling, environmental protection, fire prevention, and pest control. 19400 rangers and 2323 inspectors were employed around the province. Remote video monitoring systems were put in place. Global Information System (GIS) was set up.
3. **There are ecological benefits.** Investigation of 1.97 million hectares of ecological forest in 2007 by forestry research institutions demonstrated that such forests increase aeronian concentration and humidity, and play an active role in controlling climate change and improving water quality. Twenty provincial nature reserves and eight wetlands have been set up in different ecological forests of the province, benefiting endangered wild flora and fauna. The “Bulletin of Monitoring on Water and Soil Conservation”, issued by the Water Resources Department and the Water and Soil Conservation Committee, reported that areas of water and soil erosion decreased by 15.38% from 2000 to 2005. Ecological forests construction also brings tourism opportunities.
4. **There are deficiencies.** The audit demonstrated deficiencies in funding, and management quality. For example, areas in key ecological forests are still susceptible to forest fires, there also damage due to pine wilt disease and over-felling. Because of the relatively small area of ecological forest, the large proportion of conifer, and the low quality of the forest structure, the rate of improvement could not keep pace with environment pollution caused by economic development. Some governments did not appropriate compensation funds in the stipulated time.

Recommendations

1. Increase ecological forest area to 3,333 million hectares.
2. Decrease air and water pollution.
3. Compensation fee to foresters need increasing (10% per year), in order to increase personal income and meet the demands of local economic development. In addition, compensation funds are proposed to be allocated by provincial government as a way of decreasing the financial burden of mountainous counties.
4. Establishing management teams for ecological forests. This should enhance the strength of key ecological forest management activities and make sure the team strength accords to the district's needs and forest coverage. Training on pest control and forest fire prevention should be strengthened, with prominence given to emergency procedures to safeguard key ecological forests.

Source: National Audit Office of the People's Republic of China, 2008. Evaluation of Impact of Key Ecological Forest Construction on Ecological Environment. [Online] National Audit Office of the People's Republic of China. Available at: www.environmental-auditing.org

6. REVENUE RISK

Title: "Planning of logging in State Forest Management Centre"

(National Audit Office of Estonia, 2007)

Background

Forest covers half of Estonia. Just over a third of that forest belongs to the State. In the State forest (administered by the Ministry of the Environment) reforestation, tending, use, and forest protection is organized by a profit-making State agency, the State Forest Management Centre (hereinafter RMK).

RMK's expenses in managing the state forest are covered by its revenue from selling the products of state forest assigned to its administration. The RMK transfers 26% of its revenue from the sale of the forest harvested for regeneration into the State budget. Sustainable forest management implies making sure that current cutting volumes do not damage the environment and decrease the prospects of future logging.

Audit Objectives:

1. To assess logging planning in the State forest administered by the Ministry of the Environment.
2. To determine whether or not the State Forest Management Centre manages the State forest in a way in which retains its diverse values.

Audit Scope

1. The Ministry of the Environment and the State Forest Management Centre as its subordinate agency. Audit data were also collected from the Centre of Forest Protection and Silviculture, the Environmental Inspectorate, and County Environmental Departments.
2. The period audited was from 2003 to 2006.

Audit Criteria

1. The internal control system of RMK ensures that the data on state forest and effected cuttings is reliable and correct.
2. The state forest management is planned efficiently and in compliance with current requirements.
3. The RMK has complied with the law in its forest management activities and adhered to its plans.

Findings

1. RMK's accounting of cuttings in state forest is not accurate.
2. State forest management is only planned on a short-term basis.
3. In planning logging in the State forest, RMK does not meet several requirements of forest management planning. It also uses data that shows, incorrectly, a larger area of standing crop than actually exists.
4. Planning of logging in RMK is not transparent and the exchange of information between different administrative levels is not coherent.
5. The Centre of Forest Protection and Silviculture (hereinafter CFPS) has not fulfilled its purposes in terms of establishing State forest management plans.
6. The maximum annual volumes permitted to be cut from the state forest, as proposed to the Government of the Republic for its approval, are not based on data that is sufficiently reliable.
7. In all seven audited forest districts, the audit identified cases of forest stands - where RMK had planned cuttings - that violated the requirements of forestry law.

Recommendations

1. To organize the management of RMK so its internal control system can ensure reliable and correct accounting of the areas and volumes of cuttings.
2. To analyze and, if necessary, rearrange the organization of State forest inventories, preparation of forest management plans and forest management in a way that eliminates possible conflicts of interest
3. To recommence forest management planning in the state forest managed by RMK, thereby effecting the preparation of long-term forest management plans on the basis of a total area forest inventory as follows from the Forest Act.
4. To ensure that CFPS fulfils the duties assigned to it and requests RMK for formal forest management plans.
5. To improve the performance of County Environmental Departments and the Environmental Inspectorate in preventing violations of the Forest Act relating to State forests.
6. To more consistently assess the effect of State forest management on the value of State forest as biological assets. Depending on the results of this analysis, to adjust the forest management accordingly.

Source: National Audit Office of Estonia, 2007. Planning of Logging in State Forest Management Centre. [Online]. Available at: www.environmental-auditing.org

7. SOCIAL PROBLEMS

Title: “Opportunities Exist to Enhance Federal Participation in Collaborative Efforts to Reduce Conflicts and Improve Natural Resource Conditions”.
(The Government Accountability Office, The United States, 2008)

Background

Conflict over the use of our nation’s natural resources, along with increased ecological problems, has led land managers to seek cooperative means to resolve natural resource conflicts and problems. Collaborative resource management is one such approach that communities began using in the 1980s and 1990s. A 2004 Executive Order on Cooperative Conservation encourages such efforts.

Audit Objectives

1. To determine experts views on collaborative resource management.
2. To determine how selected collaborative efforts have addressed conflicts and improved natural resources.
3. To determine challenges that agencies face as they participate in such efforts and how the Cooperative Conservation initiative has addressed them.

Audit Criteria

1. Endangered Species Act.
2. National Environmental Policy Act.
3. Criteria established in the Uncompahgre Plateau Project Plan.

Findings

1. A number of collaborative practices, such as seeking inclusive representation, establishing leadership, and identifying a common goal among the participants have been central to successful collaborative management efforts. The success of these groups is often judged by whether they increase participation and cooperation or improve natural resource conditions. Many experts also note that there are limitations to the approach, such as the time and resources it takes to bring people together to work on a problem and reach a decision.
2. Most of the seven collaborative resource management efforts GAO studied in several states across the country were successful in achieving participation and cooperation among their members and improving natural resource conditions. In six of the cases, those involved were able to reduce or avoid the kinds of conflicts that can arise when dealing with contentious natural resource problems. All the efforts, particularly those that effectively reduced or avoided conflict, used at least several of the collaborative practices described by the experts.
3. Federal land and resource management agencies - the Department of the Interior’s Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service, and the Department of Agriculture’s Forest Service - face key challenges to participating in collaborative resource manage-

ment efforts, according to the experts, federal officials, and participants in the efforts GAO studied. For example, the agencies face challenges in determining whether to participate in a collaborative effort, measuring participation and monitoring results, and sharing agency and group experiences. As a part of the interagency Cooperative Conservation initiative led by the Council on Environmental Quality (CEQ), the federal government has made progress in addressing these challenges. Yet, additional opportunities exist to develop and disseminate tools, examples, and guidance that further address the challenges, as well as to better structure and direct the initiative to achieve the vision of Cooperative Conservation, which involves a number of actions by multiple agencies over the long term. Failure to pursue such opportunities and to create a long-term plan to achieve the vision may limit the effectiveness of the federal government’s initiative and collaborative efforts.

Recommendations

1. Disseminate, more widely, tools for the agencies to use in assessing and determining if, when, and how to participate in a particular collaborative effort and how to sustain their participation over time.
2. Identify examples of groups that have conducted natural resource monitoring, including at the landscape level, and develop and disseminate guidance or protocols for others to use in setting up such monitoring efforts.
3. Hold periodic national or regional meetings and conferences to bring groups together to share collaborative experiences identify further challenges, and learn from the lessons of other collaborative groups.
4. Identify and evaluate, with input from the Office of Management and Budget (OMB) legal and policy changes concerning federal financial assistance that would enhance collaborative efforts.
5. Identify goals, actions, responsible work groups and agencies, and time frames for carrying out the actions needed to implement the Cooperative Conservation initiative, including collaborative resource management, and document these through a written plan, memorandum of understanding, or other appropriate means.

Source: United States Government Accountability Office, 2008. Natural Resource Management-Opportunities Exist to Enhance Federal Participation in Collaborative Efforts to Reduce Conflicts and Improve Natural Resource Conditions.

8. WATER MANAGEMENT

Title: “The Impact of Eucalyptus Plantations on the Environment under the Social Forestry Project Malakand-Dir”.

(Office of the Auditor General of Pakistan, 2002)

Background

The Social Forestry Project Malakand ran from February 1987 to January 1992. Under the auspices of this project, large-scale plantations of *Eucalyptus Camaldulensis* were carried out in the Malakand-Dir region on an area of 22,071.29 hectares (54,497 acres).

The environmental audit theme was initially based visual inspection of a watercourse in the Malakand hills. The water that once flowed out of a perennial mountain spring was observed to have run dry over the past few years. That preliminary survey led to the belief that widespread plantations of *Eucalyptus* species had possibly depleted all the water resources. The inhabitants of Malakand Agency vocally expressed their anger at the loss of water resource that was once plentiful in the entire area. Hence the loss of water formed the basic theme for this study.

Audit Objectives

The long-term objectives of the project:

1. To assess the sustainability and the likely impacts of all project activities and programs on the environment.
2. Restore suitable vegetation to the denuded hillsides and marginal farmlands to create an ecologically and economically improved living environment on a sustainable basis.
3. Further develop an extension approach for these field activities.
4. Stimulate institutionalization of this extension approach at local level and within the N-W.F.P Forest Department.

In addition to the above objectives the project also emphasized institutional developmental, community organization, rangeland improvement, women in forestry, and the training role of the project for forest staff in and outside the project - with a view to support the expansion and institutionalization of social forestry in the Forest Department.

Audit Scope

Plantations of *Eucalyptus camaldulensis* in Malakand-Dir region over an area of 22,071.285 ha (54,497 acres) planted with over 14.723 million *Eucalyptus*.

Audit Methodology

1. *Project Study.* Project documents such as PC-1, Progress reports, Technical Analysis Papers, Final report, and Financial Data acquired from the Forest Department were examined.
2. *Library Study.* Library books, scientific journals and periodicals, research papers, and theses related to the subject were reviewed.
3. *Field visits and surveys.* Field visits to made to the project area to record interviews, take photographs of plantations, and prepare video-clips for future CD ROM Development.

Findings

1. Hydrology

In the Social Forestry Project Malakand-Dir, water shortage has appeared in the project area and dug wells and tube wells are running dry due to lowering of water table. This shortage is attributed to *Eucalyptus* planting over the past 13 years.

Eucalyptus camaldulensis can survive in desert conditions as well as on waterlogged and saline soils. Its elaborate tap root system

enables it to "mine" for water in semi-arid and arid conditions (thus draining the water resources).

2. Nutrient loss

Eucalyptus is a fast producer of biomass because of its large water and nutrient intake (compared to all local plants and trees). There is also very little return of humus to the soil because of slow decomposition of leaves. There is rapid loss of nutrient reserves from the soil due to short rotation cropping.

3. Allelopathy

Allelopathy is a biological phenomenon of some plants, algae, bacteria, coral and fungi by which they produce certain biochemicals that influence the growth and development of other organisms. *Eucalyptus* has negative allelopathic effects on agricultural crops and other plants; its leaf litter makes the soil toxic for seed germination and plant growth, reducing the yield potential of most agricultural crops, certain grasses and even young *Eucalyptus* saplings.

4. Ecological and Social Hazards

Eucalyptus is a big fire hazard due to its inflammable leaf litter. In Australia, the USA, and India, fires have devastated huge plantations. The roots of *E. camaldulensis* have damaged the underground utility services in the Hayatabad Township, Peshawar, where they choked and broke the underground water supply, sewer, and drainage pipes. Roadside plantations of *E. camaldulensis* are a threat to road travelers and traffic because the tree tends to break during strong winds. The trees have protruded into the drinking wells in the project area, contaminating the water.

5. Birds and Animals

The numbers and diversity of animals, birds and insects are less in exotic *Eucalyptus* than in natural forests. The tree does not support nesting and association of most birds because of its oily smell. Its leaves are not consumed by animals so it has no fodder value.

6. Tree Economics

E. camaldulensis spreading over 22,071.29 ha of nutrient rich land and hills in Malakand-Dir area should have a definite value in economic terms. However, it has been established that *E. camaldulensis* is very poor timber due to its short, twisted and knotted fibres being highly susceptible to breaking under stress. The locals say that compared to other trees, it has a very low sale price in the market. They do not like using *Eucalyptus* as fire wood, since people claim it emits smoke, has a disagreeable odour, and burns to ash (meaning it has a low heat value).

7. Soil Erosion

The tree contributes to soil erosion as the leaves do not decompose quickly and are washed away by wind and rain from the hill slopes - leaving the soil barren and exposed to erosion. In Malakand-Dir as well as in many other sites studied, *Eucalyptus* has been found to contribute to soil erosion due to poor or no ground vegetation (due to its allelopathic effects).

8. Pests and Disease

Eucalyptus is susceptible to termite attacks. Other diseases might be introduced in the new ecological settings of Malakand-Dir region.

9. Climate

Monoculture (i.e. single-tree plantations) has an adverse effect on the environment through creating an imbalance in the biodiversity cycle. The plantations affect the microclimate of the locality because of greater evapotranspiration, and changes in soil moisture and air humidity. The tree is ultimately bringing about an imperceptible yet definite change in the microclimate of the area.

10. Poor Planning and Achievements

The planners and implementers of the project have failed to foresee the multiple problems associated with *Eucalyptus* plantations. Efforts were not made to provide information to stakeholders, including community members, on research findings and experiences relating social forestry *Eucalyptus* plantations in other countries. The project failed, by and large, to achieve its long-term objectives as written in the project profile.

11. Results of Field Surveys

Statistical analysis of the data collected through standardized questionnaires (from 11 villages involving 164 respondents) showed that the majority respondents thought that *Eucalyptus* plantations had lowered both fertility and the water table. Most respondents also believed that *Eucalyptus* had allelopathic effects on the environment and, overall, was a problematic tree that carried very little value beyond its use/need as fuel wood.

Recommendations

1. *Eucalyptus*, being a high consumer of water and soil nutrient, should be planted in rain fed areas with over 700 mm of annual rainfall, and only after proper planning and assessment.
2. Careful planning and study is required to determine the water requirements of other trees, plants, animals, and human beings before undertaking *Eucalyptus* plantations and deciding on the number of *Eucalyptus* trees per unit area. The nature and quantity of the ground water resources need also be determined.
3. Adequate thinning should be done in monoculture plantations to reduce the number of trees and also to widen the gaps between them. Indigenous trees species like Phulai (*Acacia modesta*), Kau (*Olea cuspidata*), Chir pine (*Pinus roxburghii*) and Oak (*Quercus ilex*) should be planted to end the monoculture. As a matter of policy monoculture should be disallowed. Fruit orchards and economic olives need to be planted. Certain shrubs like *Dodonaea viscosa* (Gharraskay or Sanatha) need be planted and properly managed to help bring about economic uplift of the people and fulfill firewood requirements.
4. To prevent even further nutrient depletion tree leaves and bark should not be removed from the forest floor. Periodic laboratory testing should be done to monitor the soil nutrient balance even in the converted mixed plantations. Leguminous plants may be intercropped to assist in maintain

the balance of soil organic matter and nitrogen.

5. Sustainability issues need be linked to feasibility studies; this should be compulsory.
6. Rehabilitation of the damaged ecosystem be ensured through mitigation measures, thereby arresting further decline of resources.
7. Problematic, waterlogged, and saline areas should be reclaimed by planting *Eucalyptus* trees at scientifically planned proper intervals.
8. *Eucalyptus* plantations for shelterbelts and windbreaks need also be established in a planned manner.
9. Forest policies need be invoked to make environmental impact studies mandatory and to establish sustainability models, before approving forestation projects that promise long-term social and economic benefits to the community.
10. The restoration and rehabilitation of the damaged ecosystem be ensured through mitigation measures through community participation..
11. Rotation and diversification of crops may also serve to replenish depleted soils.
12. The overall impact on the national environment caused by the tremendous number of *eucalyptus* trees growing in the country needs be critically examined. And, a policy needs to be framed to regulate their numbers to a more appropriate level.

Source: Office of the Auditor General of Pakistan, 2002. The Impact of *Eucalyptus* Plantations on the Environment under the Social Forestry Project Malakand-Dir. [Online] Available at: www.environmental-auditing.org

9. SHORTAGE OF RAW MATERIALS FOR INDUSTRY

Title: Performance Audit Inbrief; "Sustaining Native Forest Operations-Forest NSW".

(Audit Office of New South Wales, Australia, 2009)

Background

Forest NSW is a public trading enterprise within the NSW Department of Primary Industries. Its key role is to sustainably manage state forest and maintain timber supply. It also provides community amenities such as camping areas and picnic grounds. In order to achieve this, Forest NSW must balance resource management with conserving the natural environment, as well as comply with the many laws and regulations that control where and what is to be logged.

Audit Objectives

To assess whether Forests NSW manages the supply of hardwood to meet wood supply commitments and sustain our native forests. Specifically, the audit objectives are to find out whether Forest NSW:

1. knows how much native forest and plantation hardwood is available for harvesting (now and in the future); and
2. has promised to sell more native forests and plantation hardwood than it can sustainably supply.

Audit Scope

Hardwood timber species and cypress pine, including all hardwood products supplied by Forest NSW, yield estimates and wood supply commitments for the life of the wood supply agreements (up to 20 years). The audit did not involve a detail review of:

- softwood plantation and associated supply obligations;
- contract processes; and
- governance arrangements within Forest NSW

Audit Criteria

1. For line inquiry 1, an assessment of the extent that Forest NSW:
 - has reasonable and reliable data on existing native and plantation hardwood stocks;
 - has reasonable and reliable estimates of future native and plantation hardwood stocks which it is used to inform wood supply agreements; and
 - compares harvesting results to its original estimates of hardwood stocks (i.e., available harvest).
2. For line inquiry 2, an assessment of the extent that Forest NSW:
 - has accurate and complete information on current and future obligation for hardwood supply;
 - identifies risks which may affect its ability to supply hardwood;
 - manages these risks to ensure its business is sustainable; and
 - is able to meet its commitments to supply hardwood timber.

Findings

1. Forests NSW has adequate estimates of how much timber is available from native forests. It uses an industry-accepted process to develop estimates, but more could be done to improve its reliability.
2. Forests NSW has developed and implemented inventory procedures to estimate yield of high quality large sawlogs from native forests. It has produced yield estimates for three of its four regions, with estimates for western region still to be finalised. Forests NSW advises that it also has yield estimates for high quality small sawlogs, low quality sawlogs and pulpwood. However, it has not made these estimates public for all regions and products.
3. Forests NSW appears to use an adequate number of sample plots to estimate the number, species and size of trees in the forest. Recent internal audits indicate that plot measurements are reasonable. However, it needs to do more to ensure all plots are regularly measured to capture changes in the forest. It also needs to review the parameters it uses to adjust harvest areas for unknowns such as threatened species.
4. Forests NSW does not routinely compare harvesting results to its yield estimates. It advises that this is because these cannot be used at an operational level given yield variability across harvest areas. However, we consider these reviews necessary to test the validity of its estimates.

5. Forests NSW should have sufficient timber to meet its wood supply commitments which are fixed for periods up to 2023 using both native and plantation hardwood. However, the cost and difficulty of harvesting and hauling this timber is likely to increase over time. This presents a significant management challenge for Forests NSW.
6. Forests NSW have comprehensive information on its wood supply commitments, and it regularly monitors performance against allocations.
7. Over the last five years, not all contractual commitments for sawlogs have been met, although the results vary by product and region. Forests NSW advise that the gap exists due to production lags and downturns in the industry, rather than insufficient timber resources. In some cases, demand has been met through the substitution of smaller logs instead of the premium large sawlogs - is allowable under a number of contracts.
8. Forests NSW identify risks which may affect its ability to supply hardwood, both at a corporate and regional level. It has strategies in place to address its key supply risks, but has had mixed success. It manages bushfires and salvages timber after major fires. However, it has not met its targets for sourcing timber from private properties.

Recommendations

To improve its knowledge of timber availability:

1. By December 2010, upgrade its forestry management system for native forests to capture all harvesting results and other events which impact on yield.
2. By September 2009, finalize its net area and strike-rate modifier studies to improve the accuracy of its estimates.
3. By June 2010, undertake and publicly report the results of:
 - a review of yield estimates for native forests in Southern Region including Eden, South Coast and Tumut; and
 - a review of yield estimates for hardwood plantations.
4. By June 2010, for each region, publicly report the results of yield estimates for high quality large sawlogs, high quality small sawlogs, low quality logs, and pulpwood.
5. Compare harvest results against its yield estimates over five-year periods as a means of testing the accuracy of estimates.
6. Report the results annually starting June 2010.

To address business risks:

1. Investigate the reason for not meeting its private property targets for hardwood timber and develop better ways of addressing these.
2. Investigate the potential for developing commercial markets for forest waste.
3. Simplify and improve timber pricing by introducing a new pricing system by December 2009 that:
 - ensures log production costs are recovered; and
 - pricing is transparent.

4. The Minister responsible for native forest operations include, in all future wood supply agreements, yield review requirements that allow for non-compensable reduction in allocation.

Source: Audit Office of New South Wales, April 2009. Sustaining Forest Native Forest Operation: Forest NSW, [Online] Available at: www.audit.nsw.gov.au/publications/reports/performance/2009/forests/forests.pdf [Accessed May 2009]

Appendix 2: Using GIS and GPS in Forests Audits

GEOGRAPHICAL DATA INTRODUCED

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Geographical data is the data or information that identifies the geographic location of features and boundaries on earth, usually stored as coordinate and topology. The data can be mapped. Geographic position refers to the fact that each feature has a location that must be specified in a unique way. To specify the position in an absolute way a coordinate system is used.

Geographical data are organized in a geographic database. This database can be considered as a collection of spatially referenced data that acts as a model of reality. There are two important components of this geographic database: its geographic position, and its attributes or properties. In other words, spatial data (where is it?), and attribute data (what is it?).

In fact, geographical data can be used for many applications, such as:

- *Different streams of planning.* Can be used for urban planning, housing, transportation planning, architectural conservation, and urban and landscape design.
- *Street Network Based Applications.* Can be used for addressed-matched applications like vehicle routing and scheduling, location and site selection, and disaster planning.
- *Natural Resource Based Applications.* Can be used for management and environmental impact analysis of wild and scenic recreational resources, flood plain, wetlands, aquifers, forests, and wildlife.
- *Viewshed Analysis.* Can be used for planning the location of hazardous or toxic factories, and for groundwater modeling. Could be used for wildlife habitat studies and for looking at migration routes.
- *Land Parcel Based.* Can be used for zoning, sub-division plan reviews, land acquisition, environment impact analyses, nature quality management, and maintenance etc.
- *Facilities Management.* Can be used for locating underground pipes and cables for maintenance, planning, tracking energy use.

This Appendix focuses on natural resource based application, especially in forestry. We need geographical data on forestry because forests cover very large areas of land. The demands of forest analysis mean that we need a Geographical Information System (GIS).

WHAT IS GIS?

A geographic information system (GIS) integrates hardware, software, and data to capture, manage, analyze, and display all forms of geographically referenced information. GIS can be defined as information systems used to input, store, retrieve, process, analyze, and produce data in geographical or geospatial form, to support decision making in planning and managing field utilization, natural resources, transportation, public utilities, and other public services. For more information, please visit www.esri.com/what-is-gis/index.html

WHY GIS IS USED, AND BY WHO

A forest can be vast and sometimes barely accessible. Conventional methods cannot be used by auditors when dealing with land on this scale and remoteness. GIS is very helpful in these situations. Using GIS we can gather a huge range of information that can be used when undertaking a forest audit. This information includes data about land coverage, the boundary of a Licensed Forest Company (hereinafter called an 'LFC'), and the physical forest boundary of a forest. This information, and other information like it, enables auditors to determine, for instance, whether or not a plantation or mining activities is complying with its license.

The users of GIS usually are those who need spatial information. Each user has their needs on how to utilize GIS.

GIS is used commonly in forestry. For such developed countries as US and Canada, the use of GIS in forestry is common. To get more description on this, please visit:

<http://maps.unomaha.edu/Peterson/gis/FinalProjects/1997/KKane/Project.html>

WHAT IS GPS

The Global Positioning System (GPS) is a U.S. space-based global navigation satellite system. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth which has an unobstructed view of four or more GPS satellites.

GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, tracking and surveillance, and hobbies such as geocaching and waymarking.

A GPS receiver calculates its position by carefully timing the signals sent by the constellation of GPS satellites high above the Earth. Each satellite continually transmits messages containing the time the message was sent, a precise orbit for the satellite sending the message, and the general system health and rough orbits of all GPS satellites. These signals travel at the speed of light through outer space, and slightly slower through the atmosphere.

The receiver uses the arrival time of each message to measure the distance to each satellite thereby establishing that the GPS receiver is approximately on the surfaces of spheres centered at each satellite. The GPS receiver also uses, when appropriate, the knowledge that the GPS receiver is on (if vehicle altitude is known) or near the surface of a sphere centered at the earth center. This information is then used to estimate the position of the GPS receiver as the intersection of sphere surfaces. The resulting coordinates are converted to a more convenient form for the user such as latitude and longitude, or location on a map, then displayed.

For more information see www.gps.gov

HOW TO USE GIS AND GPS IN FORESTRY AUDITS

The main phases in forestry audits are planning, execution, and reporting. GIS could be used in planning whereas GPS could be used in execution phase as a supporting tool.

During planning, GIS could be used to select samples to be audited, and help us to select from various objects that are relevant to the audit objective/s. For example, we could use GIS to determine which LFC has the highest hotspot which is a section of forest or woods where fires frequently occurred on the forest area that has highest level of deforestation (along with its precise location).

During the execution phase, GPS can provide evidence on the results of planning from using GIS analysis, and it enables us to locate the precise point where there is a problem.

SOME EXAMPLES

How to utilize GIS in forestry audits depends on the research question we ask. The following examples show how GIS and GPS can be used to answer a range of research questions.

1. RESEARCH QUESTION: Have fire prevention activities performed by UPT PHKA, local forest agency, and LFC been conducted in accordance with the regulations and were effective in reducing fire incidence?

Minimum data requirement:

- Spatial hotspot data containing the point where the hotspot occurs (time series data).

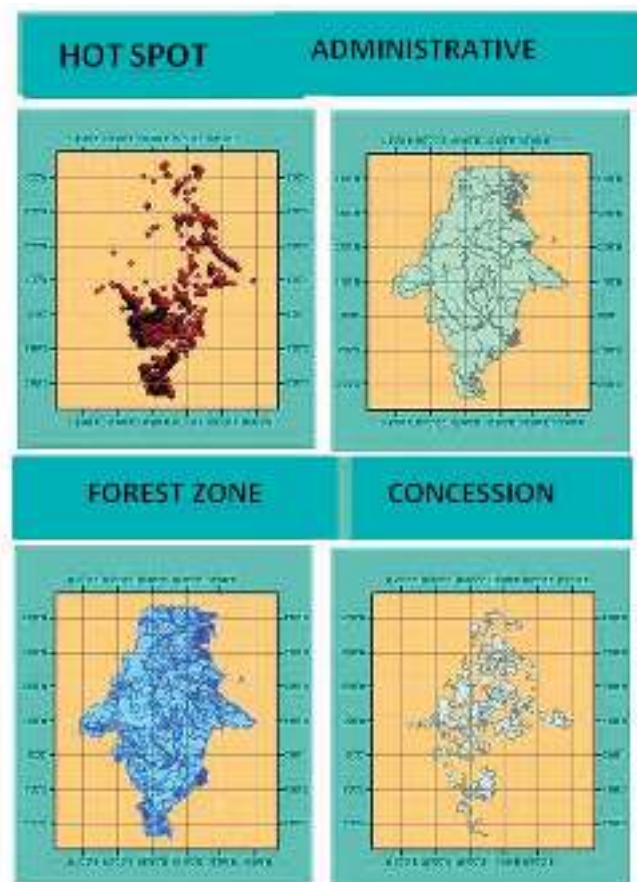
- Spatial data on the administrative boundary of a district.
- Spatial data regarding forest zone.
- Spatial data regarding the LFC boundary.

Data processing:

- If hotspot data is still in excel, it needs to be firstly transformed to spatial data. Use the add XY tool provided in GIS. This tool will transform X and Y data (hotspot coordinates) in excel into map coordinates for use in further analysis.
- Then, intersect the hotspot spatial data with district administrative spatial data, forest zone spatial data, and LFC spatial data. This intersection will provide new spatial data showing in what district the hotspot occurs, in what forest zone, and in what company.
- Classify the hotspots based on the number of spots in each district. Use the summarize tool in GIS software to give output in database format (.dbf).
- This database can then be presented as a table of hotspots for each district and each forest area. The example of the result is shown in the following three tables.

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Data Requirement for Analysis



Number of Hotspots in 2006

DISTRICT	HOTSPOT	NON FOREST ZONE	WILDLIFE CONSERVE	NATIONAL PARK	TOURISM FOREST	PROTECTED FOREST	PRODUCTIVE FOREST	LIMITED PRODUCTIVE FOREST
AA	330	168	0	0	0	1	120	41
BB	200	120	0	0	0	3	52	25
CC	1324	827	6	0	0	11	414	66
DD	922	420	0	10	24	3	453	12
EE	274	193	0	3	0	1	69	8
FF	52	7	0	20	0	10	4	11
GG	124	67	0	5	0	21	26	5
HH	1002	748	97	0	0	26	85	46
II	215	140	0	0	0	0	75	0
JJ	2	1	0	0	0	1	0	0
KK	4	4	0	0	0	0	0	0
TOTAL	4449	2695	103	38	24	77	1298	214

Note: numbers in pink color indicate the highest number

Number of Hotspots in 2007

DISTRICT	HOTSPOT	NON FOREST ZONE	WILDLIFE CONSERVE	NATIONAL PARK	TOURISM FOREST	PROTECTED FOREST	PRODUCTIVE FOREST	LIMITED PRODUCTIVE FOREST
AA	232	107	0	0	0	2	90	33
BB	295	229	0	0	0	2	37	27
CC	537	319	12	0	0	7	167	32
DD	321	166	0	3	20	7	123	2
EE	259	177	3	14	0	2	57	6
FF	85	33	0	9	0	4	13	26
GG	45	23	0	2	0	0	6	14
HH	107	74	0	0	0	4	15	14
II	44	24	0	0	4	0	16	0
JJ	1	1	0	0	0	0	0	0
KK	1	1	0	0	0	0	0	0
TOTAL	1927	1154	15	28	24	28	524	154

Note: numbers in pink color indicate the highest number

Hotspot changes, 2006-2007

DISTRICT	HOTSPOT	NON FOREST ZONE	WILDLIFE CONSERVE	NATIONAL PARK	TOURISM FOREST	PROTECTED FOREST	PRODUCTIVE FOREST	LIMITED PRODUCTIVE FOREST
AA	-98	-61	0	0	0	1	-30	-8
BB	95	109	0	0	0	-1	-15	2
CC	-787	-508	6	0	0	-4	-247	-34
DD	-601	-254	0	-7	-4	4	-330	-10
EE	-15	-16	3	11	0	1	-12	-2
FF	33	26	0	-11	0	-6	9	15
GG	-79	-44	0	-3	0	-21	-20	9
HH	-895	-674	-97	0	0	-22	-70	-32
II	-171	-116	0	0	4	0	-59	0
JJ	-1	0	0	0	0	-1	0	0
KK	-3	-3	0	0	0	0	0	0
TOTAL	-2522	-1541	-88	-10	0	-49	-774	-60

Note: numbers in pink color indicate the highest number

If we refer to table hotspot change during 2006-2007, the selected sample seems to be the BB district (as it has 109 additional hotspots). However, the largest contribution to this is Non Forest Zone. Therefore, the second alternative to be selected as a sample is FF district (Limited Productive Forest) with 15 hotspot increases.

Ground check:

- To get evidence of our GIS analysis, we use GPS.
- Enter the coordinate of hotspot we would like to visit.
- Use the GPS to navigate us to the predetermined hotspot point.
- When we arrive at the destination, prepare the observation report.

2. RESEARCH QUESTION: Did the company cut the tree/timber outside allowed areas?

Minimum data required:

- LFC spatial data.
- Block map of company's Annual Cutting (in JPEG format, however, it would be better in .shp file).
- Land coverage spatial data (in time series).

Data processing:

- To determine which LFC cut trees outside its annual cutting block from many LFCs, we analyze the deforestation per LFC.
- Intersect time series data with land coverage to obtain the land coverage condition for the beginning of the year and for the end of the year.
- Then, this spatial data is filtered according to data attributes. Since we are interested in deforestation data, we would seek to identify land coverage data in the form of primary forest in the beginning of the year, and compare that with the amount underbrush present at the end of the year. This would be a measurement of the deforestation that has occurred.
- We then intersect this data with spatial data from LFCs; this will help us to find out in which LFCs deforestation has occurred.
- We then calculate the area of deforestation for each LFC. After deciding which LFC that has the largest deforestation area, we identify the fell outside block annual cutting.
- If the block map of company annual cutting is in JPEG format, this file needs to be processed first (this is called geo-referencing). (This process provides coordinate data for every pixel in the JPEG file.)
- The output of geo-referencing is a JPEG file with coordinates. This new data could be overlaid with deforestation spatial data.
- Overlay deforestation spatial data with geo-referenced JPEG annual cutting data.
- Determine whether the deforestation area is inside or outside the annual cutting block. Select area with deforestation outside the annual cutting block.

The following are examples of the output:

Figure 1a
Deforestation outside allowed area

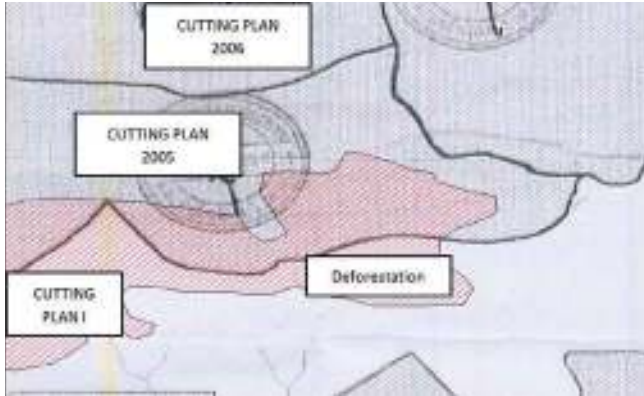


Figure 1b
Deforestation outside allowed area



3. RESEARCH QUESTION: Has illegal deforestation occurred in the national park, conservation area, wildlife reserve, protected forest, and other conserved areas?

Minimum data required:

- Spatial data of forest zone determination.
- Spatial data of area coverage (time series).
- Spatial data of boundary of districts.

Data processing:

- Intersect spatial data of area coverage at the beginning of the year with data taken from at the end of the year. This new spatial data indicates the condition of the forest over a particular area at the beginning and the end of the year.
- From this spatial data, do a selection based on certain attributes. Select data which has the attribute of primary forest in the beginning of the year and underbrush in the end of the year.
- This selection results in spatial data that are a good indicator of the amount of deforestation that has occurred.
- Intersect this spatial deforestation data with spatial data of forest zone determination, to obtain deforestation data complemented with in which area deforestation occurred.
- To identify in which district the deforestation occurred, intersect the deforestation data with spatial data of district boundaries. This intersection will show in which forest zone and in which district deforestation occurred.
- Then, calculate the area, by changing the projection mode first to Projected Coordinate System appropriate for such area.
- Then, summarize the data to obtain a table showing the area of deforestation for each forest zone and in which district that deforestation occurred.
- An example showing typical results follows:
 - From the GIS output, we see that Protected Forest should be the object of the audit as it has the highest deforestation.
 - It also could be seen that there is deforestation covers 58,50 acres in National Park. Then, select one location in deforestation area (area in green circle in Figure 2 below).
 - After obtaining deforestation area in green circle, we further observe the area by utilizing Google Earth. Google earth enables to zoom into those detected deforestation area.
 - This will give satellite photos that identify which area that are no longer primary forest (Figure 3).

Ground check:

- To validate our analysis, we use GPS.
- Enter the deforestation area coordinates we would like to visit into the GPS.
- Use GPS to navigate us to the area of deforestation.
- Once we arrive at the area, prepare the observation report.

Location of deforestation

DISTRICT	DEFORESTATION AREA (ACRE)						
	NON FOREST ZONE	PROTECTED FOREST	PRODUCTIVE FOREST	LIMITED PRODUCTIVE FOREST	WILDLIFE CONSERVE	CONSERVATION	NATIONAL PARK
AA	3.32	774.00	663.00				
BB	10.95		167.00				
CC	11.10	1.01	26.31	2.26	2.73		
DD	12.25	9.74	22.44	10.35		2.72	
EE	21.28	1.21	26.05	9.40			2.34
FF	3.79	4.83	7.26	17.55			3.53
GG	234.00	36.41	301.70	200.71			39.99
HH	166.23	1.89	297.55	48.24	29.63		12.65
II	122.34	4.20	132.71	38.46		1.85	
JJ	38.98	2.90	46.29	32.46			
KK		2.53					
TOTAL	624.25	838.71	1690.31	359.42	32.355	4.56	58.50

Note: numbers in pink color indicate the highest number

Figure 2
Deforestation on national park

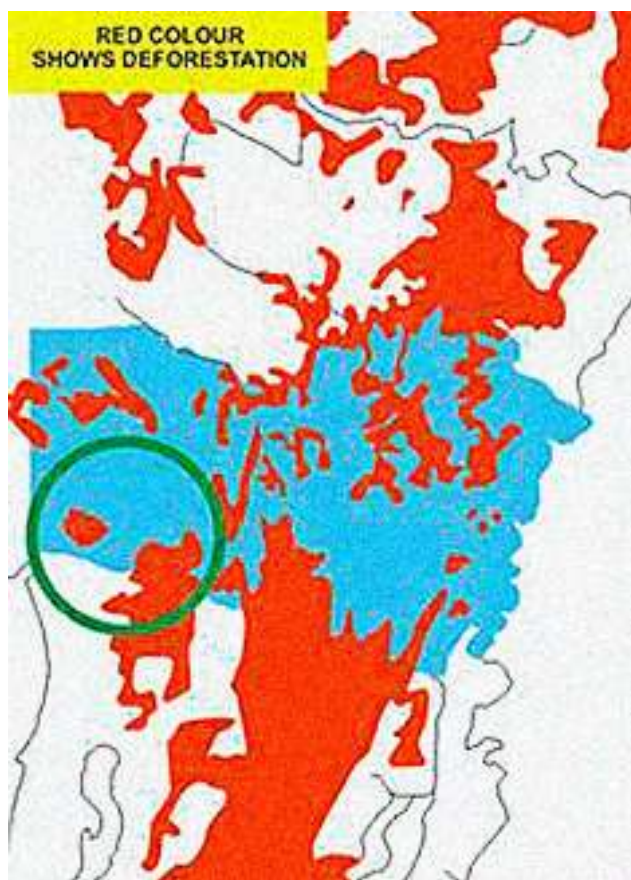


Figure 3
Deforestation on national park as shown by Google Earth



Ground check:

- To get physical evidence on GIS result, we could use GPS.
- Enter the coordinate of deforestation area into GPS.
- Use GPS to navigate us to the determined area.
- After arriving at the area, prepare the report.

4. RESEARCH QUESTION: Is there land overlapping and inappropriate land utilization?

Minimum data required:

- Spatial data of forest zone.
- Spatial data of LFC.
- Spatial data of farm.
- Spatial data of mine.

Data analysis:

- Intersect gradually the above data to obtain new spatial data that indicates overlapping land.
- For example, intersecting spatial data of farm with spatial data from LFC results in new spatial data indicating farm areas that are also LFC.
- Select area where there is overlapping land use.

The result can be seen in the following figure:

Figure 4
Overlapping of land utilization



From the Figure 5, it can be seen that overlapping has occurred between farm area and LFC, and, after referring to the database, the overlapping was found to occurred in the production forest area.

Ground check:

- To get physical evidence on GIS result, we could use GPS.
- Enter the coordinate of the overlapping area into GPS.
- Use GPS to navigate us to the determined area.
- After arriving at the area, prepare the report.

5. RESEARCH QUESTION: Is there plantation in forest zone?

Minimum data required:

- Spatial data of forest zone.
- Spatial data of land coverage.
- Spatial data of plantation area.

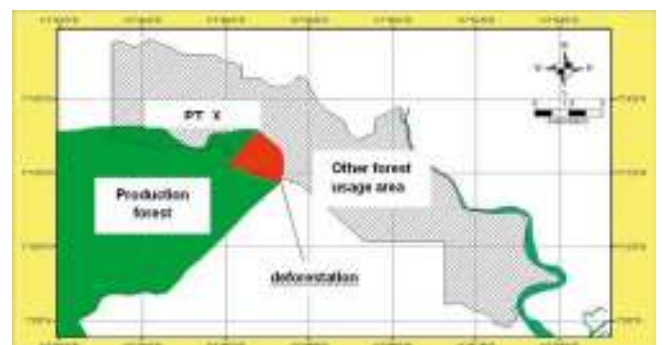
Data analysis:

- Intersect spatial data of coverage area at the beginning of the year with data taken from the end of the year, to obtain new spatial data regarding the condition of area coverage between the two parts of the year.
- From this spatial data, do a selection based on certain attributes. Select data which has the attribute of primary forest in the beginning of the year and plantation in the end of the year.
- Then, intersect this spatial data with spatial data of forest area. This will show which areas of primary forest contains plantations.
- To identify plantation industry responsible for the deforestation, overlay spatial data of plantation with the above analysis results.

Ground check:

- To get physical evidence on GIS result, we could use GPS.
- Enter the coordinate of plantation area inside the protected forest into GPS.
- Use GPS to navigate us to the determined area.
- After arriving at the area, prepare the report.

Figure 5
Plantation on forest zone



LIMITATIONS OF GIS

There are some limitations in using GIS. Some of the limitations are outlined below. And also show what the BPK (Badan Pemeriksa Keuangan - Audit Board of the Republic of Indonesia) did to get around some of these limitations.

- **Data.** Remote sensing data used as database in GIS is limited and expensive (especially for updated version).

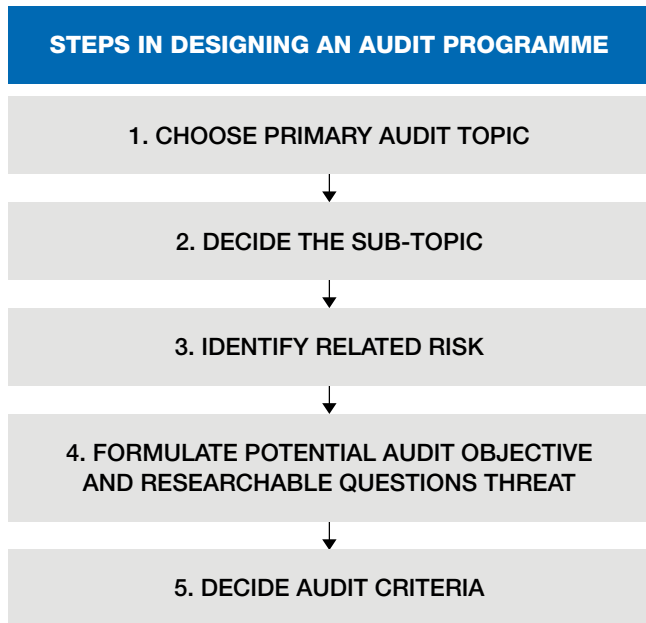
Because of this limitation, it is useful to try and get already available data. For example, BPK uses Spatial data of land coverage can be obtained from The Ministry of Forestry, Land Sat imagery is obtained from LAPAN (National Institute of Aeronautics and Space), and Google Earth is used wherever possible.

- **Hardware.** Building a complete GIS laboratory is very expensive. BPK has started using GIS using a laptop with only 2GB DDRAM.
- **Software.** A software license is expensive. But, there is open-source GIS software. BPK opted to use one single user licensed software, and relies on open-source software for the rest.
- **People.** The use of GIS requires specific skills and not all auditors can use it. BPK has five auditors who have capabilities of using GIS, one auditor is GIS Manager, one auditor is GIS Analyst, and the rest are GIS Operators.
- **Methodologies.** The methodologies depend largely on the availability of data and auditors creativity during data analysis. BPK always uses intersect method during GIS analysis for forestry.

Appendix 3: **Audit Design Matrix**

This matrix is designed as a tool to assist an auditor design an audit program. In designing an audit program, auditor may follow these steps:

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1. Choose the primary audit topic

This is most important step in the audit process. The SAI needs to identify key forest issue of greatest importance for the recipients of the report. This should be done in consultation with the client to ensure both parties agree and clearly understand the main purpose of the audit. A selection of important audit topics can be found in Chapter II.

2. Decide the sub-topic

The primary topic is a concise statement of the audit’s mission or purpose. Once confirmed, sub-topics needs to be segmented into to facilitate planning the audit, including the risk analysis, internal controls and the roles of each SAI unit working on the audit. A list of sub-topics is presented in Appendix 4.

3. Identify related risk

After deciding on the topic and sub-topics, the SAI then needs to begin identifying the risk or risks with the potential to influence the direction and aims of both the audit and the work of each of the units working on the sub-topics. The identified risks have the potential to become part of the audit’s ultimate findings. A list of potential risks and threats related to each sub-topic is presented in Chapter II. We can use Environmental Impact Assessment as an information resource to identify forest risks.

4. Formulate potential audit objective and researchable questions

Risk identification enables the SAI to develop a clearer picture of the audit’s direction and possible findings. This helps the SAI to formulate the audit’s principal objective. Once a potential audit objective is formulated, the next step is to develop the kinds of research questions or lines of inquiry that are likely to guide the investigation towards achieving this objective. The questions must be sufficiently comprehensive to enable the auditors to fulfill the potential audit objective.

5. Decide Audit Criteria

Auditors will then examine the ways in which these questions can be answered. This is crucial to determining the audit’s criteria. Each question will require corresponding and measurable criteria to determine the degree of compliance of the entity being audited. Audit criteria may be developed from international conventions agreements (bilateral and multilateral), national regulations, policies, best practices, and benchmarks (see Chapter II for more information).

THE AUDIT DESIGN MATRIX

Each of the preceding steps is presented in audit design matrix below. This matrix could be used to determine audit objectives, scope, and criteria. Although these are steps presented linearly, in fact the steps are all interrelated to a greater or lesser degree.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
Policy and Legislation	Forest Policy	Forest fires. Illegal logging. Illegal use of land. Conflict.	Does the government have a forest policy ensuring that development in the forest sector is effective and sustainable?	Does a strong and continued political commitment at the highest level exist?	<ul style="list-style-type: none"> • A national land use policy aiming for the sustainable use of all natural resources, including the establishment of a permanent forest base. • A national forest policy forming an integral part of the national land use policy, assuring a balanced use of forest – one formulated through a process that seeks the consensus between all the actors involved: government, local population, the private sector, and NGOs. • Information systems with the means to recognize the full range of forest values and potentials, with periodic forest-related planning and assessment of national forest resources. • A legal/regulatory framework providing an overall policy framework for conservation and sustainable management of forests, handling all aspects of sustainable forest management. • A legal framework that governs national objectives for forestry including production, conservation protection, and economic investment. • An economic policy framework and financial instruments that permit the flow of capital in and out of the forest sector in response to market signals and public policy decisions.
				Does an agreed forest policy (supported by appropriate legislation) exist, one that is in harmony with laws concerning related sectors?	<ul style="list-style-type: none"> • Appropriate national and local government laws and regulations enacted, or revised as needed, to support the established forest policy, in harmony with policies, laws, and regulations in related sectors. • Laws and regulations based on analyses aimed at solving the country's forestry problems and achieving the goals described in the country's Forest Policy. • A legal/regulatory framework maintaining forest resources and preventing forest degradation.
				Does a mechanism exist for regularly revising policy in the light of new circumstances and/or availability of new information?	<ul style="list-style-type: none"> • Provision of adequate funds for research and monitoring to allow updating of policies. • Research on evaluation of full economic benefits (total of marketed and non-marketed goods and services), provided by forests primarily managed for timber production, to enable foresters to better state the case for natural forest management for sustained timber production. • A legal/regulatory framework maintaining forest resources and preventing forest degradation.
	National Forest Inventory	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Revenue loss. Social problems.	Does the government conduct a comprehensive, regular and flexible national forest inventory?	Is a National Forest Inventory carried out regularly to collect data on the current status of national forest resources and monitoring any changes in that status?	<ul style="list-style-type: none"> • A legal/regulatory framework allowing for collecting and maintaining information about forest area, growing stocks, and stand descriptions. • Area of country's forest and other wooded land during certain period (for example 5, 10, 20 etc. years) is stable or changes in area are reasonable. If appropriate, area should be classified according to forest and vegetation type, ownership structure, age structure, origin of forest etc. • Total volume of the growing stock, mean volume of the growing stock and age structure/diameter distribution on forest land during certain period (for example 5, 10, 20 etc. years) are stable or any changes are reasonable. If appropriate, forest land should be classified according to forest and vegetation type, site classes, ownership structure, and origin of forest etc. • There are flexible provisions for inventories to be broadened to include information not previously covered, if and when needed.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
	Permanent Forest Estate	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Illegal use of land. Revenue loss. Damage to water management.	Are sufficient land categories kept under permanent forest cover to secure their optimal contribution to national development?	Are the categories of land to be kept under permanent forest cover differentiated on the basis of their objectives?	<ul style="list-style-type: none"> • The different categories of land to be kept under permanent forest are: land to be protected; land for nature conservation; land for production of timber and other forest products; and land intended to fulfill combinations of these objectives. • The various categories of the Permanent Forest Estate are identified, surveyed and their boundaries marked in consultation with surrounding populations, taking into account their present and future needs for agriculture and customary use. • Total carbon storage in forest stands and in soil is increasing or stable, compared to a previous time (for example 5, 10, 20 etc. years ago). The methods of measurement are understandable and acceptable at the international level.
				Are the lands destined for conversion to other uses handled properly?	<ul style="list-style-type: none"> • Land destined for conversion to other uses (agriculture, mines, etc.) and any land for which the final use is uncertain, should be kept under managed forest until the need for clearing arises.
	Biodiversity and ecosystem loss.	Biodiversity and ecosystem loss.	Does the government establish and manage a system of protected areas to conserve ecosystem biodiversity?	Does forest management conserve biological diversity, unique and fragile ecosystems, and landscapes in order to maintain the ecological function and the integrity of the forest?	<ul style="list-style-type: none"> • A national agency or an institutional framework maintains awareness of the need to establish different types of protected areas (IUCN categories I-VI) to maintain biological diversity and ecosystem stability. • A legal/regulatory framework providing for legal instruments to protect representative, rare, or vulnerable forest ecosystems and threatened species. • There are implemented procedures to identify high conservation value forests and endangered, rare, and threatened forest types. • There are implemented procedures to identify and protect endangered, rare and threatened species of forest-dependent flora and fauna. • A legal/regulatory framework describes management measures and procedures for protecting and monitoring biodiversity in production forests. • Special inventories showing the presence of an established network of protected areas, and that the management of these areas enables the maintenance or restoration of a favorable conservation status of natural forest habitat types and the species' habitats. If not all forest types are represented appropriately in protected areas, a national agency or an institutional framework has an action plan to improve the situation. • A legal/regulatory framework describes measures for conservation of genetic variation within commercial, endangered, rare, and threatened species of forest flora and fauna.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
	Soil and water protection	Biodiversity and ecosystem loss. Disaster. Damage to water management.	Does forest management damage soils and water resources?	Does forest management damage soils and water resources?	<ul style="list-style-type: none"> • A legal/regulatory framework provides for legal instruments to regulate or limit forest management practices in areas with vulnerable soils in favor of water conservation or protection of water resources. • A national agency or institutional framework with the capacity to strengthen institutional instruments to regulate or limit forest management practice in favor of soil and water protection, and to effectively supervise it . • A national agency or institutional framework with the capacity to conduct inventories and research on soil erosion and water quality. • Special inventories to show that implemented measures supporting soil and water protection have appropriate results. If not, then a national agency or institutional framework has an action plan to improve the situation. • If appropriate, a legal /regulatory framework setting out requirements for technology used in forest management operations.
	Forest Ownership	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Illegal use of land. Conflict. Revenue loss.	Does the government also regulate privately owned or customarily held forest?	Does the regulation and rule equally regulate national forest and privately owned or customarily held forest?	<ul style="list-style-type: none"> • A legal/regulatory framework that clarifies property rights and obligations, and provides for appropriate land tenure arrangements. • A legal/regulatory framework that clarifies participation opportunities of local communities and other stakeholders in forest management planning and operations.
	National Forest Service	Illegal use of land	Is sustainable forest management undertaken by adequate institutions and personnel?	Is there any national agency or institutional framework capable of managing the government forest estate and assisting in the management of private and customarily held forests, according to the objectives laid in the national forest policy?	<ul style="list-style-type: none"> • A national agency or institutional framework with the capacity to provide guidelines for national plans or programs. • A national agency or institutional framework with the capacity to undertake and develop regular assessment of forest resources. • A national agency or institutional framework with the capacity to develop programs for enhancing the use of forest products for energy. • A national agency or institutional framework with the capacity to develop mechanisms for controlling the occurrence of serious forest damage. • A national agency or institutional framework with the capacity to analyze changes in forest area, growing stock, age structure, diameter distribution etc. • A national agency or institutional framework with the capacity to integrate land-use planning and forest management. • A national agency or institutional framework with the capacity to provide assistance to customary rights holders and private forest owners to manage the forest sustainability.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
Forest Management	Planning	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Unemployment. Social problems. Decreased carbon storage. Shortage of raw materials for industry.	Have the planning procedures been sound and effective?	Is the management plan appropriate to the scale and intensity of the operations, up to date, clearly stated, and applicable?	<ul style="list-style-type: none"> • All administrative levels have appropriate capacity for planning sustainable forest management, in consideration of all thematic elements of sustainable forestry. • A legal/regulatory framework gives forest owners and managers with the power to assemble or to order forest management plans. • All forests (despite ownership) are managed according to a management plan. If not, then the percentage of forest area managed according to a management plan is increasing compared to the previous situation (for example 5, 10, 20 etc. years). • Management objectives are set rationally for each management unit. Objectives should be flexible enough to allow the forest manager to adapt to present and future variations in physical, biological, and socio-economic circumstances - keeping in mind the overall objectives of sustainability. • If appropriate, the size of each production forest management unit should preferably be a function of the felling cycle, the average harvested volume per hectare and annual timber outturn target of the operating agency (state forest enterprises, concessionaire, etc.) • A legal/regulatory framework regulates public participation in forest management planning, decision-making, data collection, monitoring and assessment.
			Does the planning include a forest inventory?	Does a detailed inventory allow planning of forest management and timber harvesting operations?	<ul style="list-style-type: none"> • A legal/regulatory framework describes the requirements for forest mapping and the methods of forest inventory. • Sufficient forest inventories exist for keeping track of both the current and potential quantities of commercial tree species for any future timber production. • If appropriate, representative series of permanent sample plots are established. • A national agency or institutional framework with the capacity to supervise the existence and quality of forest inventories.
			Does the silvicultural concept exist?	Is the choice of silvicultural concept aimed at sustained yield at minimum cost, enabling harvesting now and in the future, while respecting recognized other forest management objectives?	<ul style="list-style-type: none"> • The silvicultural guidelines for timber and non-wood forest products exist and are implemented. • Information, which provides the basis for rational choice of silvicultural practices (inventories and measurements from growth and yield plots, as well as data on market demand for various end uses of timber products), is gathered. • A progressive silvicultural system should be developed, one that allows for gradual improvements in practices as better information becomes available. The harvesting intensity and the design of harvesting should be integral parts of the silvicultural concept.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
				Does the yield regulation exist?	<ul style="list-style-type: none"> • A legal/regulatory framework describing methods of calculating Annual Allowable Cut (AAC) should be made compulsory for each forest management unit. • In order to ensure a sustained production of timber from each forest management unit, a reliable method for controlling timber yield must be adopted. • A national agency or institutional framework with the capacity to carry out supervision of timber yield and to compare it with timber replacement levels. • The rate of harvest of forest products should not exceed levels which can be permanently sustained. If appropriate, yield and replacement should be analyzed according to forest types, tree species, ownership, origin of forest etc. There should be balance between growth and removals of wood and non-wood forest products over an appropriate period (for example, 3, 5 or 10 years). • Regular reviews of AAC occur (5-yearly) in order to take account of replacement of original forests by managed forests and the transfer of conversion forest to other uses. In the longer term, stand modeling should be introduced to ensure efficient and responsible yield regulation.
			Does biodiversity conservation exist in production forests?	Does forest management in production forests take into consideration aspects of biodiversity protection?	<ul style="list-style-type: none"> • A legal/regulatory framework ensuring that management planning takes into account maintaining or re-establishing biodiversity in production forests. • A legal/regulatory framework to provide for legal instruments to order appropriate regeneration of managed forests. • A national agency or institutional framework with the capacity to maintain, conserve and appropriately enhance biological diversity at the ecosystem and species levels in production forests. • A national agency or institutional framework with the capacity to conduct inventories on the proportion of land covered by trees significantly older than the acceptable age of exploitation. • A national agency or institutional framework with the capacity to conduct inventories and/or assessments on bio-indicators. • Special inventories to show that legal requirements for protecting biodiversity in production forests are followed and elements important for biodiversity are maintained.
			Does a working plan exist in field operations?	Does the working plan guarantee the respect of environmental standards in field operations?	<ul style="list-style-type: none"> • A national agency or institutional framework with the capacity to supervise preparing and implementing working plans. • Management inventories needed for preparation of working plans for each forest management unit, supported by detailed maps, are made. • Working plans are prepared and implemented.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
			Does the environmental impact assessment exist?	Does the environmental impact assessment complete and adequately integrate into the management system?	<ul style="list-style-type: none"> • A legal/regulatory framework provides for legal instruments for Environmental Impact Assessment (EIA). • A national agency or institutional framework with the capacity to assure implementation of EIA and to carry out appropriate supervision.
	Harvesting	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Revenue loss. Unemployment. Social problems. Decreased carbon storage.	Does harvesting consider sustainable practice?	Do harvesting operations fit into the silvicultural concept? And even if plans are well planned and executed, do they help to provide conditions for successful regeneration?	<ul style="list-style-type: none"> • A legal/regulatory framework that enacts requirements for harvesting operations to ensure that all forestry operations are carried out according to high standards (thus ensuring economic viability and avoiding negative environmental, economical, and social impacts). • A national agency or institutional framework with the capacity to control quality of harvesting operations. • Supervision and monitoring activities to ensure that information about harvest operations and actual cut is accurate.
			Does the pre-harvest prescription exist?	Does the pre-harvest prescription sustain the forest after harvesting?	<ul style="list-style-type: none"> • A legal/regulatory framework setting out requirements for pre-harvest prescription. • Detailed prescriptions in place for a range of measures (for example, climber cutting, marking of trees to be felled/retained, handling residuals to be retained, indications of extraction direction, and felling directions). • If appropriate, the growing stock of stands are measured before harvest, to be sure that logging companies' reports are accurate and timber thefts are avoided. • If appropriate, there are requirements for forest owners or managers to prepare a logging plan, which should include: <ul style="list-style-type: none"> • Areas where logging is subject to special restrictions or forbidden (flora and fauna conservation and soil protection areas, buffer strips, sites of cultural interest); • Specifications for constructing and restoring of skidding tracks, watercourse crossings and log landing (including drainage); • Wet weather limitations; • Allowed harvesting equipment; and • Machine operator responsibilities (directional felling, etc) marking of trees to be retained, and trees to be removed.
			Does road and timber extraction consider environmental damage?	Does the planning, location, design, and construction of roads, bridges, causeways and fords minimize environmental damage?	<ul style="list-style-type: none"> • A legal/regulatory framework specifying limits to road dimensions and grades, drainage requirements, conservation of buffer strips along streams, and other appropriate requirements for road construction. • A legal/regulatory framework sets requirements to avoid damage during timber extraction. • A national agency or institutional framework with the capacity to control quality of road construction and timber extraction, and to assure compliance to laws and regulations.
			Is post-harvest stand management sustainable?	Does post-harvest stand management secure the sustainability of forest?	<ul style="list-style-type: none"> • A legal/regulatory framework setting out requirements for post-harvest forest management. • A national agency or institutional framework with the capacity to carry out post-harvest inventory, to assess logging damages and success of reforestation, and if appropriate, to establish the need for silvicultural interventions.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
	Forest Protection	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Illegal use of land. Disaster. Conflict. Social problems. Damage to water management. Shortage of raw materials for industry.	Is forest protected from disaster?	Does forest have forest protection from fire and chemical accidents?	<ul style="list-style-type: none"> • A legal/regulatory framework setting out requirements to avoid forest fires, and if appropriate, to prepare and implement a fire management plan. • A national agency or institutional framework with the capacity to supervise the preparing and implementation of fire management plans. • A national agency or institutional framework with the capacity to fight forest fires.
				Is forest protected from chemical accidents, in order to secure personnel safety and avoid environmental pollution?	<ul style="list-style-type: none"> • Instructions for handling and storage of chemicals and waste oils are provided and enforced. Special restrictions are applied near watercourses and other sensitive areas.
	Legal Arrangements	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Illegal use of land. Conflict. Revenue loss. Unemployment. Social problems.	Do legal arrangements exist in the forest management?	Does any concession agreement ensure sustainable forest management?	<ul style="list-style-type: none"> • Concession legislation is adopted or reinforced to cover the following aspects: the responsibilities and authority of the forest service and the responsibility of the concessionaires; the size and duration of concession or license; and conditions for renewal and termination.
			Is the forest protected from activities incompatible with sustainable timber production?	Is forest protected from activities incompatible with sustainable timber production?	<ul style="list-style-type: none"> • A legal/regulatory framework includes measures to avoid illegal logging and illegal timber-trade. • A national agency or institutional framework with the capacity to protect forests from activities incompatible with sustainable timber production. • A log-tracking systems, machinery with GPS-equipment, or similar control mechanisms, are established. • A national agency or institutional framework with the capacity to supervise logging permits.
	Monitoring and research	Biodiversity and ecosystem loss. Forest fires. Illegal logging. Illegal use of land. Disaster.	Does monitoring and research exist?	Is monitoring and research appropriate and effective?	<ul style="list-style-type: none"> • A national agency or institutional framework with the capacity and mechanisms for periodic monitoring, evaluation, and feedback on progress. • If appropriate, design for Permanent Sample Plot (PSP) procedure (distribution, number, design, minimum measurements), and for monitoring of PSPs to increase accuracy of Annual Allowable Cut calculations is developed and implemented. • There is implemented assessment of compatibility of management practices and silvicultural systems by carrying out regeneration surveys, and studies on need for post-harvest stand treatment and other relevant subjects. • There is implemented assessment of compatibility of logging practices with declared secondary objectives such as conservation and protection, and with the overall principle of sustainability.

TOPIC	SUB-TOPIC	RSIK	RESEARCHABLE QUESTION	RESEARCHABLE SUB-QUESTION	CRITERIA
Socio-economic, Financial and cultural aspects.	Relationships with local population	Biodiversity and ecosystem loss. Illegal use of land. Conflict. Unemployment.	Does forest management consider relationships with local populations?	Does forest management consider relationships with indigenous people?	<ul style="list-style-type: none"> • A legal/regulatory framework that clarifies indigenous peoples' rights to control forest management on their lands and territories. • Sites of special cultural, ecological, economic, or religious significance to indigenous peoples are clearly identified in cooperation with such peoples, and recognized and protected by forest managers.
				Does forest management consider the long term social and economic well-being of forest workers and local communities?	<ul style="list-style-type: none"> • Conflict resolution mechanisms for resolving disputes between forest stakeholders exist and have been implemented. • The local communities within, or adjacent to, the forest management area have opportunities for employment, training, and other services. • Provisions are made for: consulting with local people, starting in the planning phase before road building and logging commences; for continued exercise of the customary rights; and for concession agreements and other logging permits to cover the extent of assistance, employment, compensation, etc., to be provided.
	Economics, incentives, taxation	Forest fires. Illegal logging. Illegal use of land. Unemployment.	Does the timber management of timber production consider economic aspects?	Does management for timber production take full account in the economic value of all relevant costs and benefits from the conservation of the forest and its ecological and environmental influences?	<ul style="list-style-type: none"> • In order to realize highest possible value of forest products and improve utilization of the resources from sustainably managed forests, national and international marketing efforts are undertaken. • Forest management and marketing operations encourage the optimal use and local processing of the forest's diversity of products. • Forest management strives to strengthen and diversify the local economy, avoiding dependence on a single forest product. • A national agency or institutional framework with the capacity to assure that all applicable and legally prescribed fees, royalties, taxes, and other charges are paid.

Appendix 4: Principles and criteria in forestry audits

Principles on the forestry audit is defined as an aspect of forest management that is considered important and by which sustainable forest management may be assessed and criteria is defined as a quantitative, qualitative or descriptive attribute that, when measured or monitored periodically, indicates the direction of change in a principles. These following tables give us information about principles and criteria (Higman, Sophie, et.al., 1999) that can be used by auditors in designing audit program.

1. POLICY AND LEGISLATION

1.1 Forest policy

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PRINCIPLE 1	A strong and continued political commitment at the highest level is indispensable for sustainable forest management to succeed.
POSSIBLE CRITERIA:	
1.1	A national land use policy aiming for the sustainable use of all natural resources, including the establishment of a permanent forest base.
1.2	A national forest policy forming an integral part of the national land use policy, assuring a balanced use of forest – one formulated by means of a process seeking the consensus between all the actors involved: government, local population, the private sector, and NGOs.
1.3	Information systems with the means to recognize the full range of forest values and potentials with periodic forest-related planning and assessment of national forest resources.
1.4	A legal/regulatory framework that provides an overall policy framework for conservation and sustainable management of forests, handling all aspects of sustainable forest management.
1.5	A legal framework that governs national objectives for forestry including production, conservation protection, and investment.
1.6	An economic policy framework and financial instruments that permit the flow of capital in and out of the forest sector in response to market signals and public policy decisions.

PRINCIPLE 2	An agreed forest policy should be supported by appropriate legislation which should, in turn, be in harmony with laws concerning related sectors.
POSSIBLE CRITERIA:	
2.1	Appropriate national and local government laws and regulations enacted, or revised as needed, to support the established forest policy, in harmony with policies, laws, and regulations in related sectors.
2.2	Laws and regulations based on analyses aimed at solving the country's forestry problems and achieving the goals described in the country's Forest Policy.
2.3	A legal/regulatory framework maintains forest resources and prevents forest degradation.

PRINCIPLE 3	There should be a mechanism for regular revision of policy in the light of new circumstances and/or availability of new information.
POSSIBLE CRITERIA:	
3.1	Provision of adequate funds for research and monitoring to allow updating of policies.
3.2	Research on evaluation of full economic benefits (total of marketed and non-marketed goods and services), provided by forests primarily managed for timber production, to enable foresters to better state the case for natural forest management for sustained timber production.
3.3	A legal/regulatory framework maintaining forest resources and preventing forest degradation.

1.2 National Forest Inventory (NFI)

PRINCIPLE 4	A National Forest Inventory should be carried out regularly to collect data on the current status of national forest resources and for monitoring any changes to that status. Without proper data management and timely updates to a forest inventory on national level, monitoring at the local level can quickly become relatively expensive and not representative to assess sustainability of country's forestry.
POSSIBLE CRITERIA:	
4.1	A legal/regulatory framework allowing for collecting and maintaining information about forest area, growing stocks, and stand descriptions.
4.2	Area of country's forest and other wooded land during certain period (for example 5, 10, 20 etc. years) is stable or changes in area are reasonable. If appropriate, area should be classified according to forest and vegetation type, ownership structure, age structure, origin of forest etc.
4.3	Total volume of the growing stock, mean volume of the growing stock and age structure/diameter distribution on forest land during certain period (for example 5, 10, 20 etc. years) are stable or any changes are reasonable. If appropriate, forest land should be classified according to forest and vegetation type, site classes, ownership structure, and origin of forest etc.
4.4	There are flexible provisions for inventories to be broadened to include information not previously covered, if and when needed.

1.3 Permanent forest estate

PRINCIPLE 5	Certain categories of land, whether public or private, need to be kept under permanent forest cover to secure their optimal contribution to national development. The different categories of land to be kept under permanent forest are: land to be protected; land for nature conservation; land for production of timber and other forest products; and land intended to fulfill combinations of these objectives.
POSSIBLE CRITERIA:	
5.1	The various categories of the Permanent Forest Estate are identified, surveyed and their boundaries marked in consultation with surrounding populations, taking into account their present and future needs for agriculture and customary use.
5.2	Total carbon storage in forest stands and in soil is increasing or stable, compared to a previous time (for example 5, 10, 20 etc. years ago). The methods of measurement are understandable and acceptable at the international level.
5.3	Land destined for conversion to other uses (agriculture, mines, etc.) and any land for which the final use is uncertain, should be kept under managed forest until the need for clearing arises.

1.4 Protection of biological diversity

PRINCIPLE 6	Forest management shall conserve biological diversity, unique and fragile ecosystems and landscapes, and by so doing, maintain the ecological functions and the integrity of the forest. Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests.
POSSIBLE CRITERIA:	
6.1	A national agency or an institutional framework maintains awareness of the need to establish different types of protected areas (IUCN categories I-VI) to maintain biological diversity and ecosystem stability.
6.2	A legal/regulatory framework providing for legal instruments to protect representative, rare, or vulnerable forest ecosystems and threatened species.
6.3	There are implemented procedures to identify high conservation value forests and endangered, rare, and threatened forest types.
6.4	There are implemented procedures to identify and protect endangered, rare and threatened species of forest-dependent flora and fauna.
6.5	A legal/regulatory framework describes management measures and procedures for protecting and monitoring biodiversity in production forests.
6.6	Special inventories showing the presence of an established network of protected areas, and that the management of these areas enables the maintenance or restoration of a favorable conservation status of natural forest habitat types and the species' habitats. If not all forest types are represented appropriately in protected areas, a national agency or an institutional framework has an action plan to improve the situation.
6.7	A legal/regulatory framework describes measures for conservation of genetic variation within commercial, endangered, rare, and threatened species of forest flora and fauna.

1.5 Soil and water protection

PRINCIPLE 7	Forest management shall not damage soils and water resources.
POSSIBLE CRITERIA:	
7.1	A legal/regulatory framework provides for legal instruments to regulate or limit forest management practices in areas with vulnerable soils and in favor of water conservation or protection of water resources.
7.2	A national agency or institutional framework with the capacity to strengthen institutional instruments to regulate or limit forest management practice in favor on soil and water protection and to supervision on it.
7.3	A national agency or institutional framework with the capacity to conduct inventories and research on soil erosion and water quality.
7.4	Special inventories to show that implemented measures supporting soil and water protection have appropriate results. If not, then a national agency or an institutional framework has an action plan to improve the situation.
7.5	If appropriate, a legal /regulatory framework setting requirements for technology used in forest management operations.

1.6 Forest ownership

PRINCIPLE 8	The principles and recommendations for sustainable forest management apply equally to national forests and privately owned or customarily held forests.
POSSIBLE CRITERIA:	
8.1	A legal/regulatory framework that clarifies property rights and obligations, and provides for appropriate land tenure arrangements.
8.2	A legal/regulatory framework that clarifies participation opportunities of local communities and other stakeholders in forest management planning and operations.

1.7 National forest service

PRINCIPLE 9	There should be a national agency or an institutional framework capable of managing the government forest estate and assisting in the management of private and customarily held forests, according to the objectives laid in the national forest policy.
POSSIBLE CRITERIA:	
9.1	A national agency or with the institutional framework with the capacity to provide guidelines for national plans or programs.
9.2	A national agency or institutional framework with the capacity to undertake and develop regular assessment of forest resources.
9.3	A national agency or institutional framework with the capacity to develop programs for enhancing the use of forest products for energy.
9.4	A national agency or institutional framework with the capacity to develop mechanisms for controlling the occurrence of serious forest damage.
9.5	A national agency or institutional framework with the capacity to analyze changes in forest area, growing stock, age structure, diameter distribution etc.
9.6	A national agency or institutional framework with the capacity to integrate land-use planning and forest management.
9.7	A national agency or institutional framework with the capacity to provide assistance to customary rights holders and private forest owners to manage the forest sustainability.

2. FOREST MANAGEMENT

2.1 Planning

PRINCIPLE 10	A management plan – appropriate to the scale and intensity of the operations – shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.
POSSIBLE CRITERIA:	
10.1	All administrative levels have appropriate capacity for planning sustainable forest management, in consideration of all thematic elements of sustainable forestry.
10.2	A legal/regulatory framework gives forest owners and managers with the power to assemble or to order forest management plans.
10.3	All forests (despite ownership) are managed according to a management plan. If not, then the percentage of forest area managed according to a management plan is increasing compared to the previous situation (for example 5, 10, 20 etc. years).
10.4	Management objectives are set rationally for each management unit. Objectives should be flexible enough to allow the forest manager to adapt to present and future variations in physical, biological, and socio-economic circumstances - keeping in mind the overall objectives of sustainability.
10.5	If appropriate, the size of each production forest management unit should preferably be a function of felling cycle, the average harvested volume per ha and annual timber outturn target of the operating agency (state forest enterprises, concessionaire, etc.)
10.6	A legal/regulatory framework regulates public participation in forest management planning, decision-making, data collection, monitoring and assessment.

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a) Forest Inventory

PRINCIPLE 11	The forests earmarked for timber production should be the subject of a detailed inventory to allow planning of forest management and timber harvesting operations. The question of type and quantity of data to be gathered should be the subject to cost-benefit analysis.
POSSIBLE CRITERIA:	
11.1	A legal/regulatory framework describes the requirements for forest mapping and the methods of forest inventory.
11.2	Sufficient forest inventories exist for keeping track of both the current and potential quantities of commercial tree species for any future timber production.
11.3	If appropriate, representative series of permanent sample plots are established.
11.4	A national agency or institutional framework with the capacity to supervise the existence and quality of forest inventories.

b) Choice of silvicultural concept

PRINCIPLE 12	The choice of silvicultural concept should be aimed at sustained yield at minimum cost, enabling harvesting now and in the future, while respecting recognized other forest management objectives.
POSSIBLE CRITERIA:	
12.1	The silvicultural guidelines for timber and non-wood forest products exist and are implemented
12.2	Information, which provides the basis for rational choice of silvicultural practices (inventories and measurements from growth and yield plots, as well as data on market demand for various end uses of timber products), is gathered.
12.3	A progressive silvicultural system should be developed, one that allows for gradual improvements in practices as better information becomes available. The harvesting intensity and the design of harvesting should be integral parts of the silvicultural concept.

c) Yield regulation, Annual Allowable Cut (AAC)

PRINCIPLE 13	<p>The production of forest products is sustainable, while the harvest rate does not exceed the rate of replacement (natural and/or artificial) of similar forests or forest products in a given area over the long term.</p> <p>The Annual Allowable Cut (AAC) should be set conservatively on the regeneration and growth dynamics of tree species and changes of habitats, and if appropriate, especially with regard to diameter increment and response to the effect of logging on trees and soil. This applies both to tree species which, under current market conditions, are desirable or which have the potential to become commercially attractive in the future, recognizing that domestic and world markets for forest produce are under very dynamic development. In practice, this will often mean conservative setting of rotation length, felling cycle and firth limits. As and when permanent sample lots begin to yield more reliable information about dynamics of desirable species, a reassessment of AAC should be considered.</p>
POSSIBLE CRITERIA:	
13.1	A legal/regulatory framework describing methods of calculating Annual Allowable Cut (AAC) should be made compulsory for each forest management unit.
13.2	In order to ensure a sustained production of timber from each forest management unit, a reliable method for controlling timber yield must be adopted.
13.3	A national agency or institutional framework with the capacity to carry out supervision of timber yield and to compare it with timber replacement levels.
13.4	The rate of harvest of forest products should not exceed levels which can be permanently sustained. If appropriate, yield and replacement should be analyzed according to forest types, tree species, ownership, origin of forest etc. There should be balance between growth and removals of wood and non-wood forest products over appropriate period (for example, 3, 5 or 10 years).
13.5	Regular reviews of AAC occur (5-yearly) in order to take account of replacement of original forests by managed forests and the transfer of conversion forest to other uses. In the longer term, stand modeling should be introduced to assure efficient and responsible yield regulation.

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d) Biodiversity conservation in production forests

PRINCIPLE 14	Forest management in production forests takes into consideration aspects of biodiversity protection, to make an important contribution to the conservation of biodiversity by contributing to forest quality and making conservation in neighboring protected areas more effective.
POSSIBLE CRITERIA:	
14.1	A legal/regulatory framework ensuring that management planning takes into account maintaining or re-establishing biodiversity in production forests.
14.2	A legal/regulatory framework to provide for legal instruments to order appropriate regeneration of managed forests.
14.3	A national agency or institutional framework with the capacity to maintain, conserve and appropriately enhance biological diversity at the ecosystem and species levels in production forests.
14.4	A national agency or institutional framework with the capacity to conduct inventories on the proportion of land covered by trees significantly older than the acceptable age of exploitation.
14.5	A national agency or institutional framework with the capacity to conduct inventories and/or assessments on bio-indicators.
14.6	Special inventories to show that legal requirements for protecting biodiversity in production forests are followed and elements important for biodiversity are maintained.

e) Working plans

PRINCIPLE 15	Working plans should guarantee the respect of environmental standards in field operations. Working plans should include sequence of annual harvesting areas and allocation of all-weather and dry-weather areas; areas to be excluded from harvesting; road and extraction track layout, details of marking, harvesting, post-harvesting inventory, silvicultural treatments and a fire management plan.
POSSIBLE CRITERIA:	
15.1	A national agency or with the institutional framework with the capacity to supervise preparing and implementing working plans.
15.2	Management inventories needed for preparation of working plans for each forest management unit, supported by detailed maps, are made.
15.3	Working plans are prepared and implemented.

f) Environmental impact assessment

PRINCIPLE 16	Assessment of environmental impacts shall be completed – appropriate to the scale, intensity of forest management and the uniqueness of the affected resources – and adequately integrated into management systems. Assessments shall include landscape level considerations as well as the impacts of on-site processing facilities. Environmental impacts shall be assessed prior to commencement of site-disturbing operations.
POSSIBLE CRITERIA:	
16.1	A legal/regulatory framework provides for legal instruments for Environmental Impact Assessment (EIA).
16.2	A national agency or institutional framework with the capacity to assure implementation of EIA and to carry out appropriate supervision.

2.2 Harvesting

PRINCIPLE 17	Harvesting operations should fit into the silvicultural concept, and may, if they are well planned and executed, help to provide conditions for successful regeneration. Efficiency and sustainability of forest management depend to a large extent on the quality of harvesting operations. Inadequately executed harvesting operations can have far-reaching negative impacts on the environment, such as erosion, pollution, habitat disruption, and reduction of biological diversity, and may jeopardize the implementation of silvicultural concept.
POSSIBLE CRITERIA:	
17.1	A legal/regulatory framework that enacts requirements for harvesting operations to ensure that all forestry operations are carried out according to high standards (thus ensuring economic viability and avoiding negative environmental, economical and social impacts).
17.2	A national agency or institutional framework with the capacity to control quality of harvesting operations.
17.3	Supervision and monitoring activities to ensure that information about harvest operations and actual cut is accurate.

a) Pre-harvest prescriptions

PRINCIPLE 18	Pre-harvest prescriptions are important to minimize logging damage to the residual stand, to reduce health risks for logging personnel and to attune harvesting with silvicultural concept.
POSSIBLE CRITERIA:	
18.1	A legal/regulatory framework setting out requirements for pre-harvest prescription.
18.2	Detailed prescriptions in place for a range of measures (for example, climber cutting, marking of trees to be felled/retained, handling residuals to be retained, indications of extraction direction and felling directions).
18.3	If appropriate, the growing stock of stand are measured before harvest, to be sure that logging companies' reports are accurate and thefts are avoided.
18.4	If appropriate, there are requirements for forest owners or managers to prepare a logging plan, which should include: <ul style="list-style-type: none"> • Areas where logging is subject to special restrictions or forbidden (flora and fauna conservation and soil protection areas, buffer strips, sites of cultural interest); • Specifications for construction and restoration of skidding tracks, watercourse crossings and log landing (including drainage); • Wet weather limitations; • Allowed harvesting equipment; and • Machine operator responsibilities (directional felling, etc) marking of trees to be retained, and trees to be removed.

b) Roads and Timber Extraction

PRINCIPLE 19	Planning, location, design, and construction of roads, bridges, causeways and fords should be done so as to minimize environmental damage. As extraction frequently involves the use of heavy machinery, therefore pre-cautions must be taken to avoid damage to roads, forests, soils and water.
POSSIBLE CRITERIA:	
19.1	A legal/regulatory framework specifies limits to road dimensions and grades, drainage requirements, conservation of buffer strips along streams, and other appropriate requirements for road construction.
19.2	A legal/regulatory framework sets requirements to avoid damage during timber extraction.
19.3	A national agency or institutional framework with the capacity to control quality of road construction and timber extraction, and to assure compliance to laws and regulations.

c) Post-harvest stand management

PRINCIPLE 20	Post-harvest operations are necessary to assess logging damage, the state of forest regeneration, the need for releasing and other silvicultural operations to assure the future timber crops.
POSSIBLE CRITERIA:	
20.1	A legal/regulatory framework setting out requirements for post-harvest forest management.
20.2	A national agency or institutional framework with the capacity to carry out post-harvest inventory, to assess logging damages and success of reforestation, and if appropriate, to establish the need for silvicultural interventions.

2.3 Forest protection

a) Fire

PRINCIPLE 21	Forest should be protected from forest fire disasters. A fire management plan should be established for each management unit, taking into account the degree of risks. The fire management plans may include regular clearing of boundaries between the forest estate and other areas, and between forest blocks within the forest estate. In areas being logged or already logged, additional safety measures such as restrictions on use of fire, keeping corridors between blocks free of logging debris, etc., should be specified. Advance warning systems, including those that are satellite based, should be used.
POSSIBLE CRITERIA:	
21.1	A legal/regulatory framework sets requirements to avoid forest fires, and if appropriate, to prepare and implement a fire management plan.
21.2	A national agency or institutional framework with the capacity to supervise the preparing and implementation of fire management plans.
21.3	A national agency or institutional framework with the capacity to fight forest fires.

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b) Chemicals

PRINCIPLE 22	Chemicals, such as the ones used in silvicultural treatment, constitute risks both in term of personnel safety and environment pollution.
POSSIBLE CRITERIA:	
22.1	Instructions for handling and storage of chemicals and waste oils are provided and enforced. Special restrictions are applied near watercourses and other sensitive areas.

2.4 Legal arrangements

a) Concession agreements

PRINCIPLE 23	There should be incentives to support long term sustainable forest management for all parties involved. Concessionaires should have the long term viability of their concession provided for (mainly by government controlling access to forest); local population should benefit from forest management; and government should receive sufficient revenue to continue its forest management operations.
POSSIBLE CRITERIA:	
23.1	Concession legislation is adopted or reinforced to cover the following aspects: the responsibilities and authority of the forest service and the responsibility of the concessionaires; the size and duration of concession or license; and conditions for renewal and termination.

b) Logging permits and avoidance of illegal activities

PRINCIPLE 24	Forests should be protected from activities that are incompatible with sustainable timber production, such as illegal logging, inappropriate technology etc.
POSSIBLE CRITERIA:	
24.1	A legal/regulatory framework includes measures to avoid illegal logging and illegal timber-trade.
24.2	A national agency or institutional framework with the capacity to protect forests from activities incompatible with sustainable timber production.
24.3	Log-tracking systems, machinery with GPS-equipment, or similar control mechanisms, are established.
24.4	A national agency or institutional framework with the capacity to supervise logging permits.

2.5 Monitoring and research

PRINCIPLE 25	Monitoring shall be conducted – appropriate to the scale and intensity of forest management – to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.
POSSIBLE CRITERIA:	
25.1	A national agency or institutional framework with the capacity and mechanisms for periodic monitoring, evaluation, and feedback on progress.
25.2	If appropriate, design for Permanent Sample Plot (PSP) procedure (distribution, number, design, minimum measurements), and for monitoring of PSPs to increase accuracy of Annual Allowable Cut calculations is developed and implemented.
25.3	There is implemented assessment of compatibility of management practices and silvicultural systems. This is done by carrying out regeneration surveys, and studies on need for post-harvest stand treatment and other relevant subjects.
25.4	There is implemented assessment of compatibility of logging practices with declared secondary objectives such as conservation and protection, and with the overall principle of sustainability.

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3. SOCIO-ECONOMIC, FINANCIAL AND CULTURAL ASPECTS

3.1 Relationships with local populations

PRINCIPLE 26	The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.
POSSIBLE CRITERIA:	
26.1	A legal/regulatory framework that clarifies indigenous peoples' rights to control forest management on their lands and territories.
26.2	Sites of special cultural, ecological, economic or religious significance to indigenous peoples are clearly identified in cooperation with such peoples, and recognized and protected by forest managers.

PRINCIPLE 27	Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.
POSSIBLE CRITERIA:	
27.1	Conflict resolution mechanisms for resolving disputes between forest stakeholders exist and have been implemented.
27.2	The local communities within, or adjacent to, the forest management area have opportunities for employment, training, and other services.
27.3	Provisions are made for: consulting with local people, starting in the planning phase before road building and logging commences; for continued exercise of the customary rights; and for concession agreements and other logging permits to cover the extent of assistance, employment, compensation, etc., to be provided.

3.2 Economics, incentives, taxation

PRINCIPLE 28	A share of the financial benefits accruing from timber harvesting should be considered and used as funds for maintaining the productive capacity of the forest resource.
POSSIBLE CRITERIA:	
28.1	In order to realize highest possible value of forest products and improve utilization of the resources from sustainably managed forests, national and international marketing efforts are undertaken.
28.2	Forest management and marketing operations encourage the optimal use and local processing of the forest's diversity of products.
28.3	Forest management strives to strengthen and diversify the local economy, avoiding dependence on a single forest product.

PRINCIPLE 29	Forest fees and taxes should be considered as incentives to encourage more rational and less wasteful forest utilization and the establishment of an efficient processing industry, and to discourage high-grading and logging of forests which are marginal for timber production. Taxation procedures should be as simple as possible and clear to all parties involved.
POSSIBLE CRITERIA:	
29.1	A national agency or institutional framework with the capacity to assure that all applicable and legally prescribed fees, royalties, taxes and other charges are paid.

Appendix 5: IUCN definitions of protected area management categories

In 1994, the International Union for Conservation of Nature (IUCN) defined the following six protected area management categories, based on management objectives (Phillips, A. 2004):

CATEGORY IA: STRICT NATURE RESERVE

Protected area managed mainly for science

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

CATEGORY IB: WILDERNESS AREA

Protected area managed mainly for wilderness protection

Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Category I sites are typically remote and inaccessible, and are characterized by being 'undisturbed' by human activity. They are often seen as benchmark, or reference sites, and access is generally restricted or prohibited altogether. They range in size from vast areas to very small units (typically a 'core' of a larger protected area). Selection should be on the basis of quality and significance.

CATEGORY II: NATIONAL PARK

Protected area managed mainly for ecosystem conservation and protection

Natural area of land and/or sea, designated to: (a) protect the ecological integrity of one or more ecosystems for present and future generations; (b) exclude exploitation or occupation inimical to the purposes of designation of the area; and (c) provide a

foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category II covers national parks and equivalent reserves. Category II sites are characterized by the experience of 'naturalness'. While managed to protect ecological integrity, Category II sites tend to serve as areas that facilitate appreciation of the features protected, and typically include provisions for human visitors. Selection should be on the basis of representativeness and /or special significance, and sites should be large enough to contain one or more (relatively intact) ecosystems.

CATEGORY III: NATURAL MONUMENT

Protected area managed mainly for conservation of specific natural features

Area containing one or more specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities, or cultural significance.

Category III covers areas that are typically not of the scale of Category II sites, but can be important as protected components within a broader managed landscape for the protection of particular forest communities or species. Selection should be on the basis of the significance of the features, and should be of a scale that protects the integrity of that feature and its immediately related surroundings.

CATEGORY IV: HABITAT/SPECIES MANAGEMENT AREA

Protected area managed mainly for conservation through management intervention

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Category IV covers areas managed mainly for conservation through management intervention; habitats and other features may be manipulated to enhance the presence of species or communities of species, through, for example, artificial wetlands or the cultivation of preferred food crops. Category IV sites do not include production units primarily for exploitation, such as forest plantations. Category IV sites should be selected on the basis of importance as habitats to the survival of species of local or national significance, where conservation of the species or habitat may depend upon its manipulation.

CATEGORY V: PROTECTED LANDSCAPE/SEASCAPE

Protected area managed mainly for landscape/seascape conservation and recreation

Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biodiversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Category V areas are characterized by a long-term socio-ecological interaction commensurate with high biodiversity values. Category V areas should be selected on the basis of diversity of habitats of high scenic quality combined with manifestations of unique or traditional land-use patterns and opportunities for public enjoyment through recreation and tourism.

CATEGORY VI: MANAGED RESOURCE PROTECTED AREA

Protected area managed mainly for the sustainable use of natural ecosystems

Area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biodiversity, while at same time providing a sustainable flow of natural products and services to meet community needs.

Category VI areas are characterized by predominately unmodified 'natural systems' that are managed to provide both maintenance of biological diversity and a sustainable flow of natural products and services. The expression 'natural system' can be interpreted many different ways. For purposes of the IUCN categories it can be taken to mean ecosystems where, since the industrial revolution (1750), human impact: (a) has been no greater than that of any other native species; and (b) has not affected the ecosystem's structure. Climate change is excluded from this definition. For an area to qualify for Category VI designation, not only must the site meet the definition of a protected area, but at least two-thirds of the site should be, and is planned to remain, in a natural condition. Large commercial plantations must not be included, and, as in all categories, a management authority must be in place. Category VI sites should also be large enough to absorb sustainable resource uses without detriment to sites' overall long-term natural values.

Because many protected areas, particularly forest areas, are established for multiple objectives, at least three-quarters of a designated area must be managed primarily for one of the above management objectives in order for it to be listed under the corresponding category. The management of the remaining area must not be listed under the corresponding category. The management of the remaining area must not be in conflict with that primary purpose. In cases where parts of a single management unit are classified by law as having different management objectives or where one area is used to 'buffer' or surrounded another, they would be listed separately.

All protected areas must meet a test of management responsibility and ownership. Management authority may be through national government, local authority, informal community group, non-governmental organization or private ownership, provided it has the capacity to achieve the given management objective. In general, more strictly protected sites require State power for full protection, but recent experiments in vesting legal power in private entities for nature conservation objectives leave open the possibility of exceptions. Ownership of a unit must also be compatible with achievement of management objectives in order for the site to be listed.

Glossary

BIODIVERSITY:

The variation of life forms within a given ecosystem, biome, or for the entire Earth.

CLIMATE CHANGE:

Any long-term significant change in the expected patterns of average weather of a specific region over an appropriately significant period of time.

CONSERVATION:

The preservation, management, and care of natural and cultural resources.

COST BENEFIT ANALYSIS:

Process that involves weighing the total expected cost against the total expected benefits of one or more actions in order to choose the best or most profitable option.

DEFORESTATION:

Logging or burning trees in forested areas.

ECOLOGICAL SUSTAINABILITY:	The role of forest in maintaining biological diversity and the integrity of ecological processes and systems.
ECOLOGICAL ZONES:	A land resource mapping unit, defined in terms of climate, landforms, and soils, and or land cover, and having a specific range of potentials and constraints for land use.
ECONOMIC SUSTAINABILITY:	Occurs when development, which moves towards social and environmental sustainability, is financially feasible.
ECOSYSTEM:	A natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all of the non-living physical factors of the environment.
ENVIRONMENTAL SUSTAINABILITY:	This requires that natural capital remains intact. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity of the environment to assimilate wastes should not be exceeded.
EROSION:	The gradual wearing away of rock or soil by physical breakdown, chemical solution, and transportation of material, as caused, e.g. by water, wind, or ice.
FOREST:	An area with high density of trees.
FOREST DEGRADATION:	The loss of forest cover.
FOREST OWNERSHIP:	Areas owned by private or State or others.
FOREST PRODUCT:	Commodities derived from forests, for example, gums and resin, plywood, sawn wood, bamboos, various oils, turpentine, tanning materials, honey, spices, bark and leaves, and medical plants.
DEFORESTATION:	Logging or burning of trees in forested areas.
GEOGRAPHICAL INFORMATION SYSTEM:	An information system for capturing, storing, analyzing, managing and presenting data which is spatially referenced (linked to location), and used to support decision making in planning and managing field utilization, natural resources, transportation, public utilities, and other public services.
GLOBAL POSITIONING SYSTEM:	The Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defense.
GREENHOUSE GASSES:	Gasses in atmosphere that absorb and emit radiation within the thermal infrared range.
HABITAT:	A place for a species to live in and grow.
ILLEGAL LOGGING:	The harvest, transportation, purchase or sale of timber in violation of laws.
INDICATOR:	Something observed or calculated that is used to show the presence or state of a condition or trend.
KEY PLAYER:	A 'player' is an individual or parties involved such as national/federal government, provincial government, local government, private sector, NGO, and communities in or near forest. A 'key player' is one of the most important of those parties.
MITIGATION:	An effort to make something less harsh, severe, or violent.
NATURALLY REGENERATED FOREST:	Forests established by natural regeneration.
PLANTED FOREST:	Forest that is defined according to the extent of human intervention in the forest's establishment and/or management, which depends, to a large extent, on the purpose of growing the forest.
POPULATION EXTINCTION:	The elimination of a species from a specific area or region.
PRODUCTIVE FOREST:	Forests capable of producing a merchantable stand, such as providing a wide range of wood and non-wood forest products.
PROTECTIVE FOREST:	Forests contribute to moderate soil, hydrological and aquatic systems, maintain clean water (including healthy fish populations) and reduce risks and impacts of floods, avalanches, erosion and drought.
RISK BASED AUDIT:	This type of auditing is mainly defined by applying a method to planning and audit scoping to help appropriately focus the resources of an organization to mitigate the overall risk or risks.
SEDIMENTATION:	The motion of molecules or particles in response to an external force. "the process by which particles in suspension in a liquid form sediment" or "the process by which rocks are formed by the accumulation of sediment."
SILVICULTURE:	The study, cultivation, and management of forest trees land.

SOCIAL SUSTAINABILITY:

Requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met.

WOODLANDS:

An area covered in trees, usually at low density, forming an open habitat, allowing sunlight to penetrate between the trees, and limiting shade.

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