

DRAFT



INTOSAI
Working Group
on Environmental
Auditing

The Guidance Material on Auditing the Government's Management of Natural Resource and the Related Impacts on the Environment for Forest

June 2009



Acronyms

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
CREFIAF	Conseil Régional de Formation des ISC Africaines Francophone
EUROSAI	European Organization of Supreme Audit Institutions
IDI	INTOSAI Development Initiative
INCOSAI	International Congress of Supreme Audit Institutions
INTOSAI	International Organization of Supreme Audit Institutions
IEA	International Environment Agreement
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
SPASAI	South Pacific Association of Supreme Audit Institutions
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 lives as they provide such human needs as water, food, shelter, medicine, fuel wood, fodder, and timber. Therefore, their existence should be preserved.

To maintain the sustainability of forest, some key stakeholders are expected to perform their roles responsibly. Government, as the key actor in forest management, has responsibility to produce and implement policies and regulations and institutional framework on forest programs. In performing this role, government may establish necessary institutions, moderate competing schemes, and assure a level playing field in international or domestic trade. As the oversight body of the government, SAI can assist the government in fulfilling its responsibilities, such as by auditing not only the performance and the compliance of government activities but also the soundness of the government accountability systems and practices. Additionally, SAIs can also assist the government in strengthening the government's forest management of internal controls and improving its assessment and mitigation of forest-related risks.

This guideline is developed to assist auditors in conducting audit on forestry and explain why such audit should be conducted. In addition, this guideline provide information and knowledge on forests and forest management that could be used as references., Whenever possible, some cases and examples of SAIs' experiences in conducting forestry audit are presented in the chapter.

To achieve its objective, this guideline is structured as follow:

- Chapter I contains information and a brief explanation on forests, the role of government and supreme audit institutions related to forests, international perceptions on forests, and the importance of protecting forest through audit on forestry.
- Chapter II provides general knowledge on forest, characteristic of forest, type of forest, and functions of forest .
- Chapter III presents information on sustainable forest management. It explains what sustainable forest management is, its characteristics, and its benefits. This chapter presents also key players involved sustainable forest management and examples of unsustainable forest management practices. These information could be used in selecting and determining topics and sub topics and criteria in conducting audit on forestry.
- Chapter IV starts the steps in conducting audit on forestry. It elucidates the basic issues underlying forestry audit and explains different types of audits, tools and methodology used, as well as choosing and designing an audit of forest management. Two approaches for developing a forest management audit are proposed, those are open-ended audit assignment and pre-defined audit assignment. In addition, this chapter details the steps involved in the planning phase, those are:

- Step I :Choose The Primary Audit Topic
- Step II : Decide the sub topic
- Step III : Identify related Risk or Threat
- Step IV :Formulate potential audit objective and researchable questions threat
- Step V : Decide Audit Criteria

- Chapter V concludes this guideline.

Summary of contents

The Guidance Material on Auditing the Government's Management of Natural Resource and the Related Impacts on the Environment for Forest (including deforestation) is divided into five chapters. It begins with an executive summary that summarizes the document's content and how to use it. The first chapter delivers a brief explanation about forests, the role of government and Supreme Audit Institutions, international perceptions of forests, and the importance of protecting forests through forestry audits. The second chapter looks at what constitutes a forest, the characteristics of a forest, types of forests, the function and usage of forests. In chapter three, the documents look closely at what is meant by Sustainable Forest Management (SFM). Using the information from the two preceding chapters, chapter four examines Forest Auditing in more detail. Finally, chapter five provides an overall conclusion and is followed by appendices, glossary and references.

Chapter I

INTRODUCTION

A. Background

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 recreational and aesthetic values.

Governments and forests

All Governments may have a role with regard to forest certification, although the nature and extent of the roles vary widely between countries according to their circumstances and politics.

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 the place necessary institutions
- ❖ Moderator between competing schemes
- ❖ Ensuring a level playing field international trade and domestic markets

(International Tropical Timber Association)

Forests are among 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 1999:41). 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 they help maintain a steady supply of clean fresh water. 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.

On the other hand, forests release the locked carbon into the air when the deforestation occurs. Forests are also important economically. They are a source of livelihood and paid employment for local economies and make a major contribution to national economies through the 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% of world trade¹. In many developing countries, forest-based enterprises provide at least a third of all rural non farm employments, generate income through the sale of wood products, and enrich private companies, governments and rural communities.

¹ Costanza, Robert, d'Arget, Ralph, de Groot, Rudolf, Farber, Stephen, Grasso, Monica, Hannon, Bruce, Limburg, Karin, Naeem, Shahid, O'Neill, Robert V., Paruelo, Jose, Raskin, Robert G., Sutton, Paul and van den Belt, Marjan. 1997. The Value of the World's Ecosystem Services and Natural Capital. Nature 15 (May). Quoted in CIFOR's Strategy 2008–2018, 2008 Center for International Forestry Research

It is not only the 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.

B. The Role of Government

<p style="text-align: center;">Estonia</p> <p>The duties of the state in forestry are: the directing of forestry and the development of a forestry development plan and legislation regulating forestry for this purpose, ensuring the good state of forest, the accounting of forest resource, support to private forestry, administration and management of state owned forests, organisation of state supervision, ensuring the protection of biological diversity of forest. The performance of the duties of state in forestry is co-ordinated by the Ministry of the Environment.</p>
<p style="text-align: center;">Brazil</p> <p>In Brazil, native forests, public or private, are protected by law. The 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, State governments are responsible for all authorizations regarding licensing of potential environmental degrading activities, vegetation suppression and forest management activities.</p> <p>The Federal Government has a specific role in these cases, which is defined by law, such as endorsing forest exploitation in federal forests or national parks and conceding environmental licenses to companies with substantial environmental impacts, such as those placed or developed in two or more states. The municipalities have a residual role, also defined in specific laws and regulations, for example, in endorsing exploitation in public forests of the city.</p>

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. Yet, other benefits from forests, despite being frequently claimed, are illusory.² Balancing these levels of human engagement with forests depends on good policy and, more often than not, requires governments to play the role of judicious arbiter.

In most countries, the way in which forests are managed is determined by the forest policy 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 support, including finance, drafting national standards. They may establish necessary institutions, moderate competing schemes and assure a level playing field in international or domestic trade.

C. The Role of SAI

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

² FAO, 1993, The Challenge of Sustainable Forest Management: What future for the world's forests?, FAO.

In addition to auditing, SAIs can also assist the government strengthen the quality of the government's management of internal controls. SAIs can review the Internal Control System and suggest how to improve it. Moreover, SAIs can also suggest how the government can improve its assessment and mitigation of the risks related to management processes.

As an example, SAIs in a number of countries has conducted several audits related to forests. The aims of their audits have varied, depending on the mandate and the condition of the forest. An SAI audit of a forest management project in Peru's Alexander von Humbolt National Forest focused on verifying how the government protects the national forest. In Indonesia, several audits have looked at how the government conserves the national forest for natural reservations, wildlife reservations, natural park, and protected forest.

The table below describes the role of SAI related to forestry in three countries, Estonia, Brazil, and Indonesia.

Table 1.1 The Role of SAIs

SAI	Role of SAIs
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.
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 of the people, essential to good quality of life, and it is the role of the public power and of 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 TCU is not only to control the proper use of public resources in the environmental field, but also the management of the environment in the federal scope.
Indonesia	To audit the government management and accountability of forest sector

Government's responsibility for ensuring sustainable environmental management led to the 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 forests sustainably. The influence and potential impact that SAIs might have can be seen in the table below:

Table 1.2 The Title of Forestry Audit Conducted by SAIs

No.	Year	Country	Title
1	2006	Burkina Faso	Control and Audit of Forestry Management
2	2006	Chile	Control of Native Forest Logging Management Plans
3	2006	Poland	Timber harvesting and sales at the State Forest Enterprise
4	2006	USA	Invasive Forest Pests: recent infestations and vulnerabilities at entry ports threat to US forest
5	2006	USA	Wild land fire suppression: Lack of clear guidance raises concerns about cost sharing between federal and nonfederal entities
6	2005	Ecuador	Audit of environmental control in reforestation and conservation projects in the Chongon-Colonche Cordilera, which is

No.	Year	Country	Title
			responsibility of the ministry of the environment
7	2005	Italy	Forest fire prevention and fight
8	2005	Peru	Alto mayo Protected Forest: Water source for the Altomayo valley
9	2004	Brazil	Audit on the federal program: sustainable Amazon
10	2004	Brazil	Evaluation of Brazilian Forestry Policy
11	2004	Brazil	Evaluation of government projects to assure sustainable use of natural resources in Amazon forest
12	2004	Iceland	Afforestation: legal framework for Icelandic forest service and regional afforestation projects
13	2004	Iran	Auditing the conservation of northern forest program
14	2004	Turkey	Activities for protecting national forest
15	2003	Argentina	Environmental management audit of ministry of agriculture, livestock, fisheries and food-forestry project. Component to support small producers for environmental conservation
16	2003	Cameroon	Audit of forest development special fund
17	2003	Japan	Project for maintenance of a forest
18	2003	Switzerland	Forest Policy: Performance audit of investment credit

Source: <http://www.intosai-wgea.org>.

D. International Awareness on Forest

As mentioned above, forests play a significant role in human wellbeing. This role is not constrained by district or national border. For example, deforestation increases global greenhouse gas levels wherever it occurs. Forests and their management are 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.

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. Smoke haze pollution cost Indonesia, Singapore and Malaysia at least US\$674 million. The global costs associated with carbon emissions may have been as much as US\$2.8 billion.

(Center for International Forestry Research)
Bogor, Indonesia

1. Forests for local, national and regional economy

Some 75 percent of global demand for paper and wood pulp products comes from industrialized nations. In 1990, world industrial timber production totalled 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 was 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. Deforestation and forest degradation

Since early 1980s there has been considerable concern that deforestation and forest degradation were occurring at huge costs to society, measured in lost economic rents, inefficient allocation of resources, and 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. Climate change

Since the release of the landmark Stern 'Review on the Economics of Climate Change' for the UK government in 2006, governments, industry, 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 that mitigate climate change. Already considerable international interest exists 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 audit related with climate change, auditor can refer to the guidance Auditing Government Response to Climate Change which has developed by Auditor General of Norway.

4. Flood

Each year floods kill thousands of people, destroy people's lives and inflict enormous costs on society through damage to private and public property, industry and infrastructure.

While science is yet to demonstrate an unequivocal link between large-scale floods and deforestation, the possibility that deforestation contributes to flooding must be taken into consideration in decisions and policies that affect forests and water catchments.

5. Forest fire

The economic and environmental impact of forest fires now attract major international attention, especially since fires related to the El Niño Southern Oscillation (ENSO) burned some 25 million hectares of forests worldwide in 1997/98. Large forest fires and the haze and smoke they generate are potentially a major threat to sustainable development by directly impacting on ecosystems and human health, and contributing to greenhouse gas levels. Smog and haze is almost an annual occurrence and a major problem in Indonesia.

MacKinnon et al., (1996) states that forest fire may disturb five processes of forest ecology which are natural succession, organic materials production and decomposition, chemical substances cycle, hydrologic cycle, and field formation. Fires also affect a forest's climate role by reducing its ability to sequester carbon.

6. Forest and poverty

One of the most potent pressures on forests is poverty. 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 are increasingly threatened.³

³Natural Forests Benefits and Economic Analysis of Natural Forest in Cambodia, Working Paper 33, Cambodian Development and Research Institute, 2006.

E. Good Governance and Forestry Audit

Good governance is generally defined as conducting governmental matters in good practices, although this term originally covers wider dimensional of governance which include more than government related issues. Furthermore, good governance is also described as action or attitude based on values whose character to supervise, control or to get involve in public issues in order to practice those values in real action and daily live. In addition, good governance is also meant as management efficiency in public sector, to create public accountability, the availability of law infrastructure, the information system provided which ensure that society is able to access to any information contain of policies and their transparency. When conducting an audit, good governance might be used as audit criteria in terms of: Participation, Rule of Law, Transparency and Responsiveness.

Chapter II

FOREST

The purpose of this chapter is to provide basic knowledge or general overview of information related to forestry for readers and all of SAls in the world as reference to conduct forestry audit.

Perspectives on forest definition

Many definitions of forest have been developed and acknowledged by institutions and people. These definitions differ based on the different perspectives, ideologies and vested interests of their creators. The differences also reflect the diversity of forests and forest ecosystems in the world and the diversity of human approaches to forests.

The Food and Agriculture Organization (FAO) Corporate Documents Repository (Global Forest Resources assessment update 2005, Term and Definitions) 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.



Beside the FAO definition above, many experts try to define forests based on their approaches and understanding. Such definitions are typically characterized by:

- the area of land,
- the area's function
- an ecosystem.

Lawrence S. Davis and his friends in Forest Management define 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.

Table 2.1 Forest perspective of many countries

Indonesia	An area dominated by a group of trees having height usually more than 5 meters, with canopy larger than 10 percent.
Albania	An area with 30% minimum tree crown cover, minimum 0.1 ha land area value, and 3m of tree potential height. ³
Malaysia	In 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). ⁴
South Africa	Forest is a continuous stand of trees at least 10 m 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%). ⁵
China	The definition of forest in China was adjusted from a minimum of 30 to 20 percent of cover in 1994. In 2004, the definition of forest is modified again to include special purpose scrubs, which grow in area with annual precipitation below 400 mm or above the tree line in a mountains with a minimum canopy cover of 30% and in which its primary function is environmental protection. ⁶
Estonia	A plot of land with an area of at least 0.1 hectares and woody plants with the height of at least 1.3 metres and with the canopy density of at least 30 per cent grow there.
Brazil	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.

Moreover, other experts state 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. In addition to those definitions, United Nations For Climate Change Convention (UNFCCC) defines forest as:

A minimum area of land of 0.05-1.0 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 metres 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 metres 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.

By comparison, the United Nations Environment Programme / Convention on Biological Diversity (UNEP/CBD), 2001, also gives a brief definition of defines 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

³ "Albania's experience with the Clean Development Mechanism, http://siteresources.worldbank.org/INTALBANIA/Resources/Albania_experience_CD_M EFIDA

⁴ "Forest governance in Malaysia An NGO perspective", www.fern.org/media/documents/document_3754_3755.pdf

⁵ "Sustainable Management of Indigenous Forest Resources", www.forestry.unp.ac.za/indigenous%20forest%20definition.pdf

⁶ "Impacts of Aforestation, Deforestation, and Reforestation on Forest Cover in China from 1949 to 2003", www.unc.edu/~csong/Zhang-Song06-JOF.pdf

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 just how complex forests are. People may view a forest as an ecosystem or they may see it as little more than an area of land suitable for exploitation. These different definitions can also shape the roles and responsibilities ascribed to the government in managing the forests. The broader the definition, the broader the government's role and range of responsibilities in managing forests, and vice versa.

B. Characteristics of Forest

Even though there are many definitions of forests but the characteristics of forest can be define into two general categories. According to FAO Forestry Paper: Global Forest Resources Assessment 2005, forests have five basic characteristics, grouped into two general categories:

❖ 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. 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. Clearly a natural forest.

❖ Planted forests

Planted forests are generally 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.

Table 2.2 The five basic characteristics of 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 Characteristics	Definition
	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.

Those characteristics can be clearly seen in the table below:

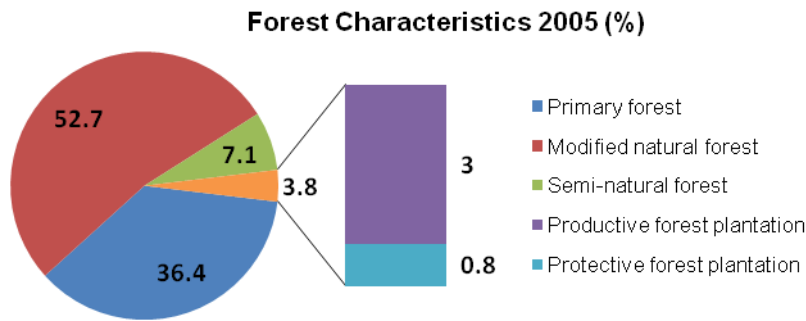
Table 2.3 Planted Forests in the Continuum of Forest Characteristics

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

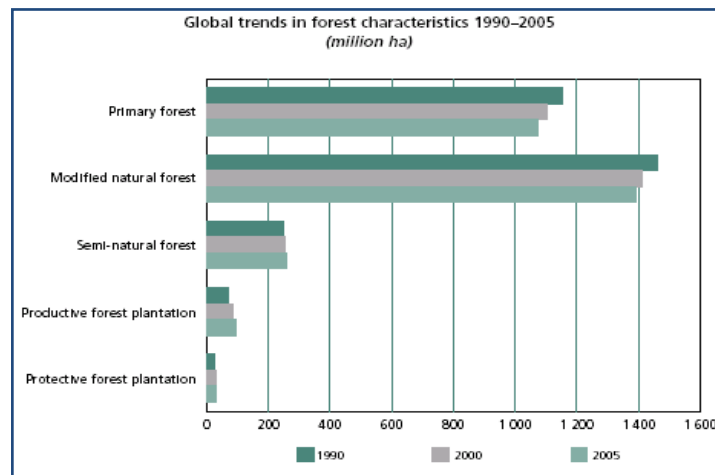
Source : FAO

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. While 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.

Figure 2.1 Forest Characteristics 2005 and Global Trends in Forest Characteristics 1990-2005



Source : FAO



From Figure 2.1, it can be concluded that the world's forest cover is dominated by naturally regenerated forest. However, an analysis of global forest trends in forest characteristics show that in the last fifteen years (between 1990 – 2005), naturally regenerated forests tended to decrease while on the other hand, semi-natural and planted forests tended to increase. Having been looking at these changes, the composition can be shifted into planted forest if the governments are not able to sustain the forest management).

Types of Forest

FAO (2001) in Sands, 2005, divided the world's forest into ecological zones within domains that have been determined on the basis of amount and distribution of rainfall and humidity. The domains are *tropical, subtropical, temperate and boreal*, and are based on temperature variability throughout the year. These correspond largely with latitudes. Types of forest may vary in every country and continents. According to FAO, there are seven types of forests as follows⁷:

⁷

⁷ World's Forests 2001

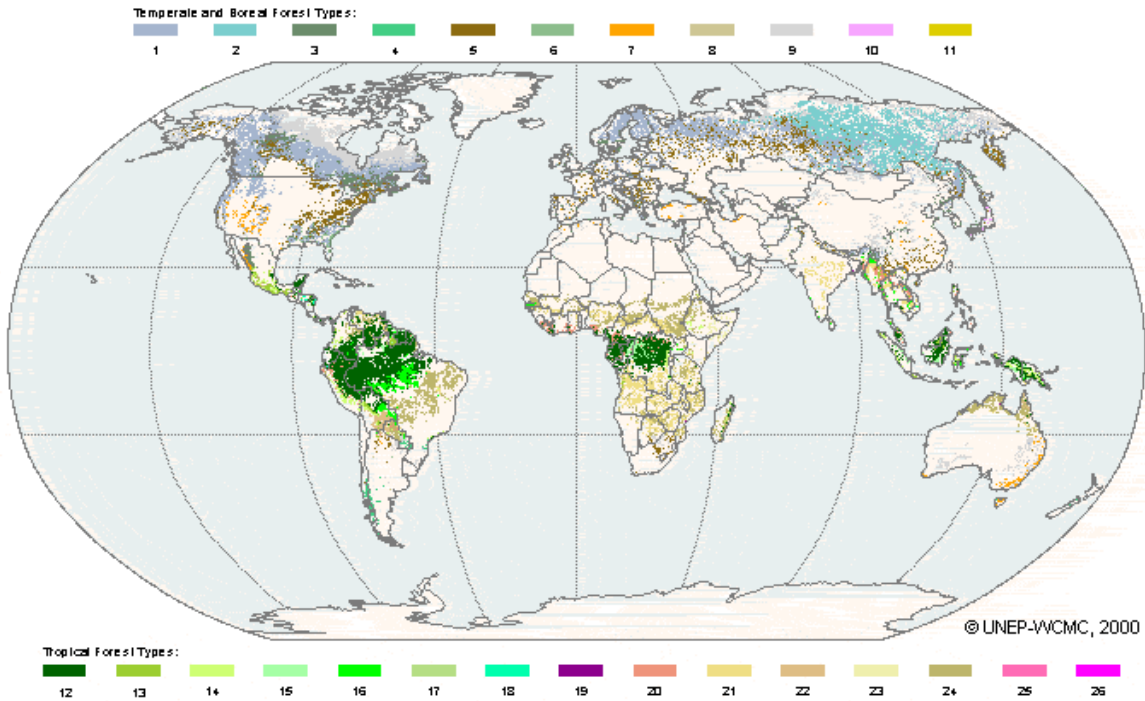
Table 2.4 Types of Forests

<p>1. Mountain Forests</p>	<p>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 instance the Andes and Himalayas, have a range of forest types determined by altitude and exposure. Their upper limit is typically about 3,000 m 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.</p>
<p>2. Tropical Rain Forests</p>	<p>Tropical rain forests are mainly found in the Amazon basin of South America, the Congo basin of Central Africa and insular Southeast Asia where the climate is hot and humid throughout the year. 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 50 to 60 m of height. Tropical rain forests contain many resources for local subsistence and of commercial importance, such as timber, rattan, fruits, nuts, medicinal plants and rubber. These forests are also home to a large number of indigenous peoples.</p>
<p>3. Boreal Coniferous Forests</p>	<p>Boreal coniferous forests are found at high latitudes, mainly in the Northern Hemisphere in which 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 under storey of shrubs, herbaceous vegetation, mosses or lichens is common. 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 fill an important ecological function, for example, as breeding habitat for many species of waterfowl and shorebirds.</p>
<p>4. The Temperate Broadleaf Deciduous Forests</p>	<p>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 such species as 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.</p>
<p>5. Mangrove</p>	<p>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 for the spawning, nursery and feeding of 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 decades, a significant proportion of the world's mangroves have been cleared for agriculture, salt ponds or aquaculture.</p>
<p>6. Tropical Dry Forests and Woodlands</p>	<p>Tropical Dry Forests and Woodlands occur in tropical regions with pronounced dry seasons. They are most extensive in eastern and southern Africa, where woodlands stretch over large areas. The vegetation is relatively open and is typically made up of deciduous trees 10 to 20 m tall with a grass understorey. As a result of frequent fires and tree felling, many of these</p>

	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 around for cattle.
7. 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 including many endemic species. Important non-wood forest products of commercial value include cork, honey and olives.

FAO's forests classification above is a general type of forest. Basically, forest type may vary based on its status, function, purpose, micro-climate function, aesthetic value, and hydrological attributes. Every country may adapt those distribution or classification differently. In general, there are two major categories of forests: Temperate and Boreal Forest Type and Tropical Forest Type. Of those two major categories, forests are grouped into 26 types (see appendix 1).

Figure 2.2 Distribution Map of 26 Types of Forest in the World



The

Figure 2.2 shows the distribution of 26 type of forest in the world which is the branch of 2 categories of forest that mentioned before. Different types of forests per region can be seen in appendix 2.

Several samples of the distribution of type of forest in some countries in the world are as follow:

Table 2.5 Types of Forests in Some Countries

<p>Estonia</p>	<p>Geobotanically, Estonia belongs to the northern part of the nemoral-coniferous forest subzone of the forest zone of the northern hemisphere. In Estonia's climatic and soil conditions, the climax community is the boreo-nemoral coniferous forest, in which Norway spruce (<i>Picea abies</i>), silver birch (<i>Betula pendula</i>), common aspen (<i>Populus tremula</i>) and Scots pine (<i>Pinus sylvestris</i>) are predominant.</p> <p>Because extensive introduction of more fertile lands as agricultural lands in the 19th century and the draining of bogs and peatland forests in the 20th century, the current typological 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.</p>
<p>Brazil</p>	<p>Brazil has many forest types, however the more 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 Savana, with occurrence in center and southeast region; Atlantic Forest, characterized by occurrence of Tropical and Sub Tropical forest along the coast, including also forests with predominance of <i>Araucaria angustifolia</i> in parts of the southeast and south region. The Pantanal biome is the largest swamp area in the world. The Pampa is defined by field vegetation set in a plain relief. Forest plantations in Brazil comprise less than 1% of the territory (5.5 M hectares), predominantly by species of <i>Eucalyptus</i> and <i>Pinus</i>.</p>
<p>Indonesia</p>	<p>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. 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.</p>

D. Types of forest ownership and forest management

Forest management highly depends on the ownership of the forest itself. The type of forest ownership will influence the extent to which the government can manage forests. The role of the government will be increasingly constrained the greater the level of private control.

According to FAO: Global Forest Resources Assessment 2005, forest ownership as seen around the world can be classified as:

1. Private ownership

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.

<p>South Africa</p>
<p>Most of the forest areas are owned by the state. Only in KwaZulu Natal is a substantial portion of natural forest in private ownership.</p>

2. Public ownership

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.

3. Other ownership

Land that is classified neither as public ownership nor as private ownership.

As mentioned above, forest ownership is one of aspects that can influence the extent of government in managing the forest. In general, most forest in the world is owned by government.

E. Function and Usage of Forest

The types of forests and their characteristics often vary between regions and countries. These variations do not necessarily influence how forests function and are used. The functions fulfilled by forest are relatively similar in many countries and continents. FAO in the State of the World Forests 2007 attributes at least three of these to forest:

1. Productive functions of forest resources

Forests and trees outside forests provide a wide range of wood and non-wood forest products. This theme reflects the importance of maintaining an ample and valuable supply of primary forest products while ensuring that production and harvesting are sustainable and do not compromise the management options of future generations.

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

In addition to the functions above, forest also produces many things that can be used and exploited. Wood as a forest product can be utilized for source of energy and wood. As a source of energy, forest produces wood not only as solid fuel that includes fuel wood and charcoal, but also as sawn wood (lumber), engineered wood products (particleboard, medium density fibre board, laminated veneer lumber, and plywood (oriented strand board) that can be pulped to produce paper and cardboard. Besides, wood can be used as a composite with other materials such as plastics and cement.

Non-wood products of forest have many features. NWFPs can sometimes be as economically important as or more important than traditional wood products. The variety of NWFPs is very great. Forest produces food and fodder from plants and animal, medicinal plants and animals from plants and animals, Aromatics for *Perfumes and Cosmetics*, and *fibers for construction, Craft and Utensils*.

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

Figure 2.3 shows that, in 2005, some 36% of global forest (about 4 billion hectares, covering 30% of total global area) are natural forest, 53% are modified forest, 7% are semi-natural forest, and the remaining 4% are forest plantations. Of these forest plantations, productive forest plantations account for 78%.

Figure 2.3 Global Forest Characteristic 2005

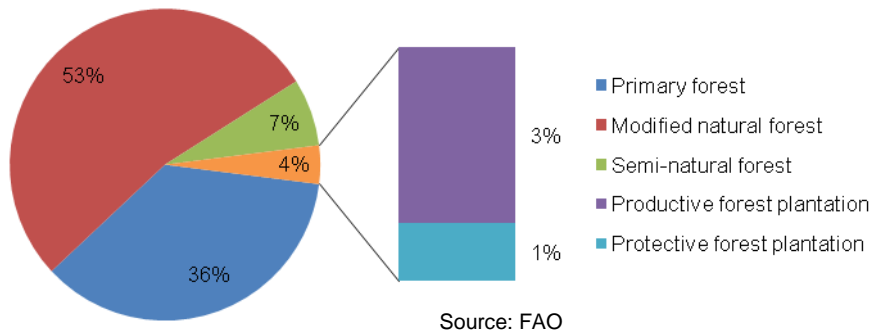
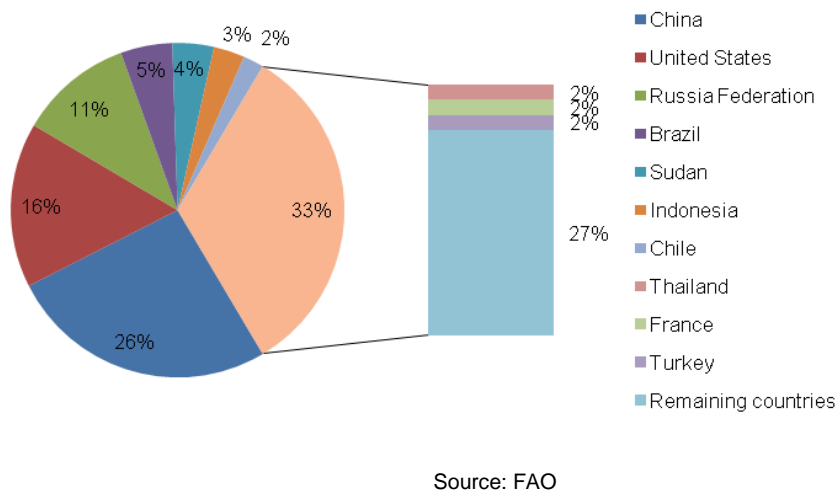


Figure 2.4 Ten Countries with Largest Area of Forest Plantation 2005 (%)



The ten countries as shown in Figure 2.4 with the greatest area of productive forest plantations accounted for 79.5 million hectares or 73% of the total global area of productive forest plantations. China, the United States, and the Russian Federation together accounted for more than half of the world's productive plantations.

2. Protective functions of forest resources

Forests and trees outside 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. Protective functions of forest resources also contribute to ecosystem conservation efforts and provide benefits to agriculture and rural livelihoods.

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. The Alpine countries in Europe have had much experience with protection from snow avalanches by forests and have many forests designated for this purpose. As more tourism and infrastructure enter the mountain areas of other countries, this function of forests should be increasingly recognized.

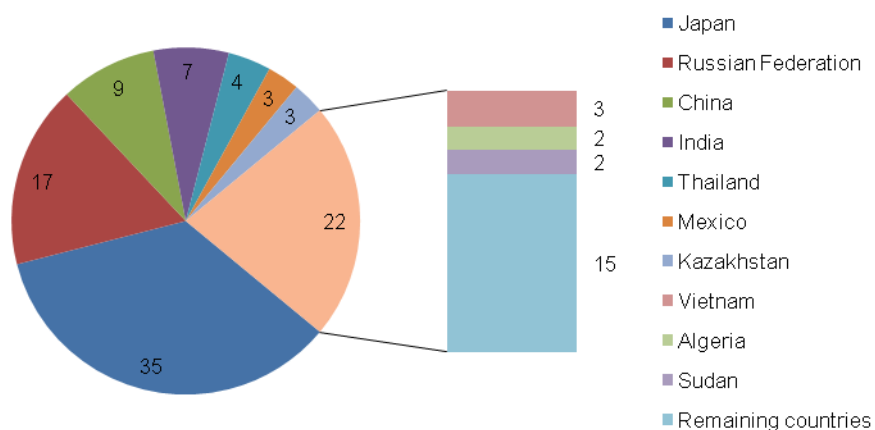
Air-pollution filters. Trees perform a valuable role in intercepting and trapping windborne particulate matter – again, as long as the pollution does not damage or kill them. This is one of the benefits of urban forests and greenbelts. Dust, ash, pollen and smoke that adversely affect human health and 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, enhancing precipitation (e.g. ‘cloud forests’) and mitigating salinity.

Related to climate change, forest is very important to control regional, local, and global climate. At local level, plants give protection and keep water giving cooling effect in hot weather. They also function as storm preventers and loss energy reducer in cold weather. At regional level, plants evaporation is released to the atmosphere and falls as rain. At global level, the plants growth relates to the carbon cycle. The loss of vegetation layer causes the decrease of carbon dioxide absorption causing greenhouse effect.



Figure 2.5 Ten countries with largest area of protective forest plantations 2005 (%)



The Figure 2.5 above shows the top ten countries which have the largest area of protective forest plantation. Japan has the largest area of protective forest plantation (35%) followed by Russian Federation 17% and China 9%.

Slovakia

Forests on extreme sites - their chief function is to protect soil against erosion, less often also against wetting.

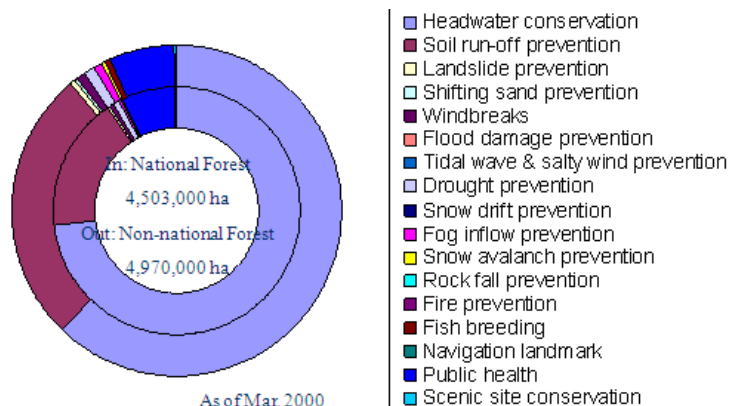
Mountain forests beneath the upper tree line - their main function is to protect lower altitude forest stands and land against avalanches.

Forests located in a dwarf pine zone - their main function is equal to the previous category.

Other forests with prevalent soil protection function - their chief function is to protect soil against erosion, in exceptional cases also against wetting

Source: "Forest functions and their categories"
http://www.lesoprojekt.sk/english/lesop_tour/subory/kateg.html

Figure 2.6 Types of Protection Forest in Japan⁶



⁶Source: Area and percent of forest land managed primarily for protective function in Japan" http://www.rinya.maff.go.jp/mpci/other/portland/PortWSJp_4b.pps#261,7

As can be seen in Figure 2.6, Japan as the first country who has the largest area of protective forest plantation has varieties of protection functions. The most protective functions of forest are for headwater conservation and soil run-off prevention.

3. Socio-economic functions

Forest resources contribute to the overall economy in many ways such as through employment, values generated through processing and marketing of forest products, energy, trade and investment in the forest sector. They also host and protect sites and landscapes of high cultural, spiritual or recreational value. This theme thus includes aspects of land tenure which is essential to the formulation of effective policies by governments, indigenous and community management systems, and traditional knowledge.

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.

Table 2.6 Forests Contribution to GDP in Some Countries

Countries	Forest Contribution to GDP in Some Countries
Bosnia and Herzegovina, Serbia, Russia	Commercial forestry is the dominant economic use of forests, although they also provide fuelwood and non-timber products for the rural population. Forest's contribution to GDP ranges from a high of 2-3% in Bosnia and Herzegovina, Russia, and Serbia to a low of 0.5 in Armenia and Kyrgyzstan. ⁸
Georgia	According to official statistics the forestry sector's current contribution to GDP (forest management, harvesting and processing) is around 1.5% or 2% compared with 4% to 5% during the period of central planning. These figures do not include the value of non-timber forest products. ⁹
Estonia	<p>50 % of Estonia is forested. Total forest area is 2.2 million hectares. State owns ~40% of forests, and rest of it belongs to private persons and companies. An average management unit in private forests is relatively small, ~10 ha.</p> <p>Forestry's share of GDP in 2006 at basic prices was 1.0 %, wood processing industry's share was 2.4 %, paper and pulp industry's share was 0.3 % and furniture industry's share was 1.0 %; all together 4,7% of GDP.</p> <p>Based on Forest Act, the ways of forest use are: obtaining of timber; maintenance of protected natural objects; protection of a landscape, soil and water; protection of people against the pollution spreading from industrial production sites and vehicles, and against the harmful effects of weather; recreative use; use of by-products, such as gathering of tree seeds, forest berries, mushrooms, herbs and ornamental plants and parts thereof, moss, lichen, nuts, hay, branches, ornamental trees, bark and tree roots, resin and birch sap, the location of beehives and grazing of animals; research and education; hunting; national defense.</p>
Brazil	<p>Estimates for Forestry sector contribution to the GNP indicate 4% contribution. The Brazilian Forest Service and the Brazilian Institute of Geography and Statistics (IBGE) are developing a methodology to provide annually and accurately estimates of the "Forestry GNP", based on the national accounts.</p> <p>According to the 2000 census, the rural population is 31.95 million people, representing 18.8% of the total population of the country (169.9 million).</p>

⁸ Source: "Europe and Northern Asia Forest Law Enforcement and Governance - FACT SHEET", http://siteresources.worldbank.org/INTFORESTS/Resources/ENAFLEG_Fact_Sheet.pdf

⁹ "Ensuring Sustainability Of Forests And Livelihoods Through Improved Governance And Control Of Illegal Logging For Economies In Transition", <http://siteresources.worldbank.org/EXTFORESTS/Resources/985784-1217874560960/SAVCORGeorgia.pdf>

F. International Forest Initiatives

Forests play an important role in human life and activities. They store carbon and are closely linked to climate change. Forests are also an important source of products and services that enhance people's wellbeing.

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

- a. International Tropical Timber Organization (ITTO) has developed guidelines on the conservation of biological diversity in tropical production forests (ITTO 1993). The guidelines were developed in order to optimize the contribution of timber-producing tropical forests to the conservation of biological diversity.
- b. The FAO model code of forest harvesting practice (FAO, 1996) was compiled to highlight the wide range of environmentally sound harvesting practices available and 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 (FAO, 1999) and West and Central Africa (FAO, 2005c). National-level codes have been adopted or are under preparation in several countries in Southeast Asia.
 - a.
- c. Governance principles for concessions and contracts in public forests (FAO, 2001b) compiles critical factors in balancing and safeguarding the public and private interest in forest management and identifies new approaches to contractual arrangements in the provision of goods and services from public forests.
 - b.
- d. ITTO, in collaboration with partners, developed guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests (ITTO, 2002), which is part of ITTO's series of internationally agreed policy documents for achieving the conservation, sustainable management, use and trade of tropical forest resources.
 - c.
- e. The Confederation of European Paper Industries (CEPI) developed Legal logging: code of conduct for the paper industry (CEPI, 2005) to combat illegal logging. Best practices for improving law compliance in the forest sector (FAO/ITTO, 2005) distill the available knowledge that decision-makers could follow in reducing illegal operations in the forest sector.
 - d.

Many organizations around the world are undertaking initiatives to protect or conserve forests for their important ecological functions. This diverse fora of agencies, initiatives and treaties includes but is not limited to:

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
CITES is an international agreement between governments. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of IUCN (The World Conservation Union). Its aim 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. Rather, it provides a framework to be respected by each party,

which has to adopt its own domestic legislation to make sure CITES is implemented at the national level.

For more information: www.cites.org

2. Ramsar Convention

The Convention on Wetlands, signed in Ramsar, Iran, in 1971. The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands, i.e. to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.

For more information: www.ramsar.org

3. World Heritage Convention

The World Heritage Convention was founded by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) in 1972 on the principle of international cooperation. 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. 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 list of the most outstanding of these from an international viewpoint. For more information: whc.unesco.org

4. Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) was signed at 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.

For more information: www.cbd.int

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

The United Nations Framework Convention on Climate Change (UNFCCC) 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 is aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate change. This action is aimed primarily at industrialized countries, with the intention of stabilizing their emissions of greenhouse gasses at 1990 levels by the year 2000, and other responsibilities will be incumbent upon all UNFCCC parties.

For more information: www.unfccc.int

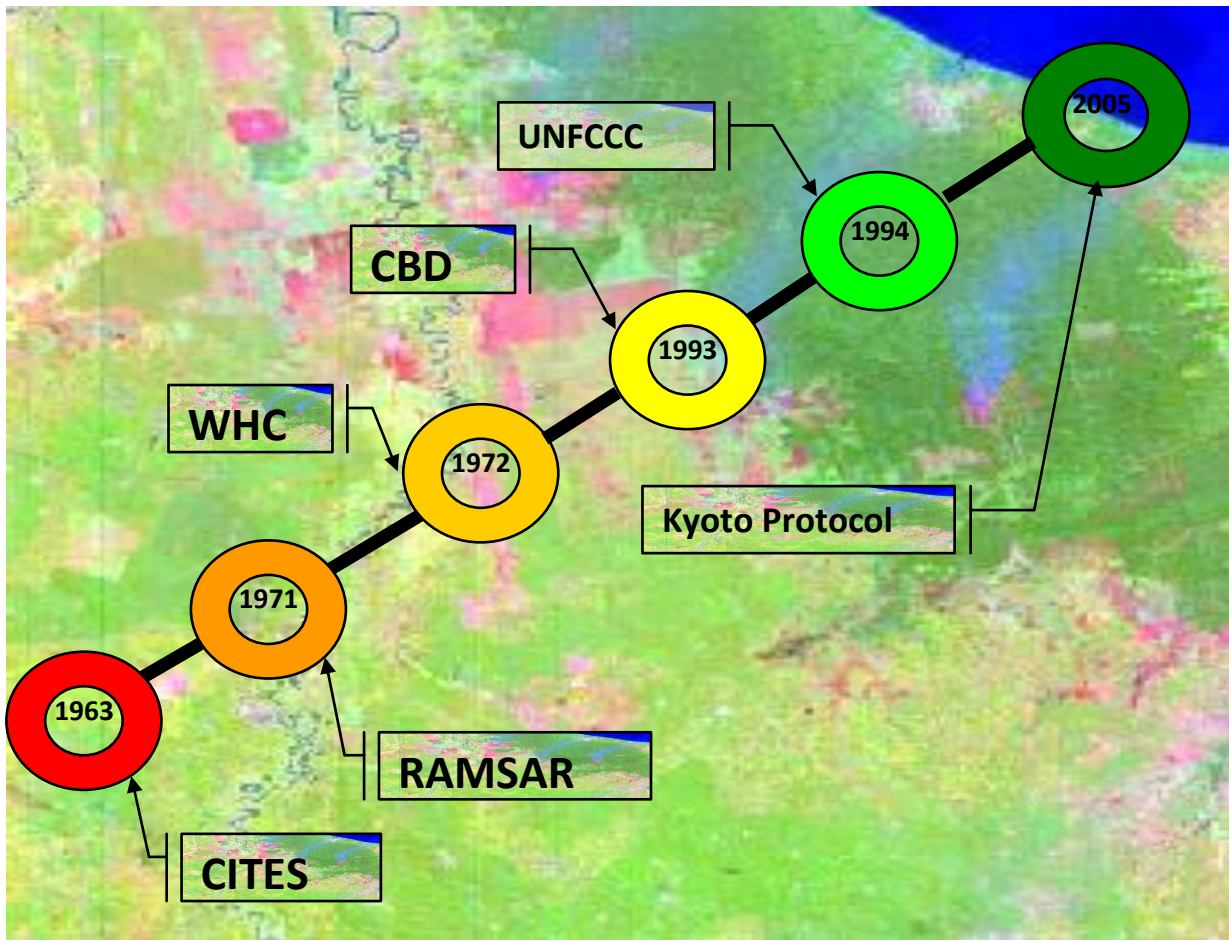
6. Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change with the objective of reducing greenhouse gases in an effort to prevent anthropogenic climate change. It was adopted for use on 11 December 1997 by the 3rd Conference of the Parties, which was meeting in Kyoto, and 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 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 offers them an additional means of meeting their targets by way of three market-based mechanisms: 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.

For more information: www.unfccc.int

Figure 2.7 International Forest Initiatives



Source: Illustration of International Forestry Conventions Timelines

Chapter III

SUSTAINABLE FOREST MANAGEMENT

A. Description of Sustainable Forest Management

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).



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 the 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.

B. Characteristics of Sustainable Forest Management

SFM is difficult to define because many aspects and or components need to be considered. Experts from ITTO/FAO have suggested a number of components in facilitating international communication on forest-related issues which centre around seven globally agreed thematic areas. The following provides a modified overview of these components:

1. [Extent of forest resources](#)

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

2. [Biological diversity](#)

Biological diversity is concerned with the conservation and management of biological diversity at ecosystem (landscape), species and genetic levels. Such conservation includes protecting areas with fragile ecosystems, ensuring diversity of life is maintained, and providing opportunities to develop new products, for example medicines recovery in the future needs. Genetic improvement is also a means

to enhance forest productivity, for example to ensure a high quality of wood production in managing forests intensively.

1. 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.

2. Productive functions of forest resources

Forests and trees outside forests provide a wide range of wood and non-wood forest products. This theme covers the objective of maintaining a high and valuable supply of primary forest products, while at the same time ensuring that production and harvesting are sustainable.

3. Protective functions of forest resources

The theme delivers the role of forests and trees outside forests to help moderate soil, hydrological and aquatic systems. This includes maintaining clean water, including healthy fish populations, as well as minimizing the risks and impacts associated with floods, avalanches, erosion and droughts. Protective functions of forest resources also contribute to ecosystem conservation efforts. Protective functions of forest resources have strong cross-sectoral aspects, as the benefits to agriculture and rural livelihoods are high.

4. 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. The 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.

5. Legal, policy and institutional framework

Legal, policy and institutional arrangements are necessary to support the previous six themes, including 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.

C. Sustainable Forest Management at the nexus of economic, social, and environmental concerns

Sustainable forest management mediates a range of economic, social and environment concerns that underpin for the continuity of forests' utilization and optimal exploitation on its natural resources.

Economic: As mentioned above, forests are beneficial for human life in facilitating 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.

Woodlands also support human life in a more explicitly economic sense by providing wood for construction, such as housing and important infrastructure, 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. This is particularly true in many developing countries.

Social: Forests also serve a vital social and cultural role. For many forest communities around the world, the forests have significant cultural for its products and services, spiritual or religious values. In Nepal, 80 plant species are used in socio-cultural festivals.¹⁰

Environmental: Forests have been a major theme in international discussions about the environment for many years, but perhaps never in the dominant way they feature today. 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."¹¹ Put the climate change aside, forests are also increasingly the attention of international environmental concerns centre over the threat deforestation poses to the world's ecological resources and the important eco-services they provide to maintain human wellbeing, such as providing a wealth of genetic resources used in industry and medicine.

D. The Key Players

SFM is complex. It is multi-faceted and involves a range of disciplines and ideologies. SFM's complexity and diversity of perspectives has major implications for the players interested in the quality of forest management and the roles they play. Some of these include:

1. National/federal governments

The future of state-owned forest industries in many countries is likely to be determined by government policy on restructuring of 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 policy, to ensure all related parties are able to make use of forests, while also ensuring this is done sustainably.

2. Provincial governments

Oversight of forests has increasingly devolved over recent years from central to provincial and district level governments, with forestry management in some 60 developing countries now in the hands of local and provincial-level authorities¹². Provincial governments have a very strong interest in ensuring forests are well managed. For many, forests will be integral to their economic, agricultural, natural resource development and conservation strategies. Central governments are and will continue to be involved in the devolution of forestry oversight, particularly in regards to the implications for national policies. Where constitutionally applicable, it will be incumbent on provincial governments to ensure federal regulations and policies are implemented properly.

3. Local governments

¹⁰ Religious and Spiritual Values of Forest Plants in Nepal , <http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0087-A1.HTM>

¹¹ http://www.hm-treasury.gov.uk/press_stern_06.htm

¹² Indonesia-Switzerland country led initiative, Interlaken, 2004.
http://www.cifor.cgiar.org/PressRoom/MediaRelease/2004/2004_04_26.htm

Local authorities are usually responsible for the provision of services in their areas, and local economic development, infrastructure development, and so forth. Therefore, the National/Federal Government will work with primary local authorities, such as rural councils or their equivalents, local coordinating bodies, and community development facilitators to ensure forestry programmes fit into local development plans. 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.

4. 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 the creation and maintenance of rewarding employment opportunities in rural districts.¹³ Firms in the private sector need to adapt and innovate to remain competitive while meeting environmental standards. Improved efficiency will be required to meet any costs of environmental management (though environmental standards often bring efficiencies too), to increase forest product yields and improve the efficiency of processing raw materials.

Table 3.1 Private Sector's Role on Forest Sector in Some Countries

Countries	The Role of Private Sector in Forest Sector
Estonia	More than half of forest area in Estonia belongs to private persons and companies and it means that one of private sectors' roles is forest owner and manager. Also all logging companies and most of forest survey companies are private enterprises.
Brazil	<p>The private sector has legal obligations to comply with inside their rural properties regarding preservation of forested areas. They should maintain native forest on part of their land (legal reservation), in addition to conserving areas of permanent preservation, such as the river sources and the areas along them. Besides, the private sector must comply with forestry regulations and provide information at Forest Management Unit level, as well as forest product transportation and trade.</p> <p>Forest Plantations: The private sector plays an important role since 1970's, developing research and technology, as well as contributing to the country economy and employment.</p> <p>Forest Concession: through a bidding process, companies may carry out sustainable forest management for the exploration of products and services in a unit of management in public lands, by making a payment and during a predetermined period.</p>

¹³ <http://www.timberwatch.org.za/archives/20011110whitepaper.htm>.

Ironically, the profitable forest industry development is not inline with sustainable environment management. After exploring natural resources from forest, wood companies left the forest in bold condition and totally useless. Private sector is not only beneficiary of forest but also potential destroyer of forest, for example illegal logging action. The authorized parties of forest which are supported then cooperate with police, military and corrupted government are the responsible parties in illegal logging practices.

5. Non Government Organizations (NGOs)

Other than government and private sectors, NGO also has significant role in sustaining the forest management. NGOs have several roles in the forest sector, such as researcher, public opinion setter, educator, and other relevant role.

Table 3.2 NGO’s role on Forest Sector in Some Countries

Countries	The Role of NGOs in Forest Sector
Estonia	NGOs' (Non-governmental Organizations) role in Estonia like elsewhere is to participate in processes making national forest development plans, to carry out different inventories, and to rise public awareness about importance of forests and problems in forestry.
Brazil	The Non-Governmental Organizations have an important role in forest management by developing studies and researches, controlling and monitoring the impact of the public and private activities on the environment and by providing environmental education for the local communities and for the society in general.

The civil society participates in forest management through public hearings that are carried out during the processing of licensing of potentially polluting activities and during the process of forest concession. The public hearings are an instrument foreseen in legal rulings that favor transparency and social control in activities with environmental impact.

6. Communities in or near forests

In Indonesia’s case, communities situated within or close to forests are a 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.¹⁴ However, the reality in many developing countries is that illegal logging is a major source of income for people living in forest areas. On the other hand, community forestry management is an increasing trend that may prove beneficial for long term forest management.

¹⁴ See “Bearing Witness: Empowering Indonesian Communities to Fight Illegal Logging” <http://www.grida.no/wrr/049.htm>

Each of the above players will vary between countries in their make-up, presence, roles and degree of influence. The extent to which this varies will depend on the political, governance, policy and regulatory environment in different countries.

Canadian Forest Management

Public involvement (PI) plays an increasingly important role in Canadian forest management. Requirements to conduct PI, previously the realm of government, are now being passed on to the forest industry, which is recognizing that a 'social licence' to practice forestry is needed in conjunction with the conventional legal licence. Mistik Management Ltd. is a 50% aboriginal-owned forestry company operating in the boreal forest of Northwestern Saskatchewan. Over the past decade, Mistik has undertaken a unique and successful PI process of 'co-management' with nine local aboriginal and non-aboriginal communities.

The Mistik PI process began as a direct result of conflict over a historic lack of public involvement in forest management, and an 18-month long logging road blockade by the Canoe Lake First Nation. After meeting with local groups including Elders, First Nations Chiefs and elected representatives of northern communities, 'forest co-management' was identified as the vehicle to involve the public and mitigate and resolve any future conflict over forest operations and management. Co-management board boundaries were aligned with the existing Fur Conservation Areas (FCA), which were established in the 1940s and roughly correspond to communities' traditional land use patterns.

It is important to note here that while the parties involved call their process 'co-management', their experience falls short of what many consider to be "true" co-management. For some, nothing short of an institutionalized partnership of parties with roughly equal power can qualify as "true" co-management. In the Mistik case, only one of the partners (industry) really holds legal management authority. This is because under the Canadian system the provincial government holds ultimate responsibility for the resource and has only allocated property rights to industry. In the absence of a comprehensive land claims agreement, 'co-management' implies only a right for local resource users to participate in managing forest resources on Crown lands under provincial jurisdiction (Robinson and Ross 1997:604). In less formal agreements, such as the Mistik case, government retains the final authority to allocate resource access rights, to determine the terms and conditions of resource tenures, and to collect the royalties levied (ibid.).

Major successes include increased trust among managers and stakeholders, reduction of forest-based conflict, community capacity building and employment, and incorporation of traditional knowledge in forest planning and management. Concerns with the process include a lack of government support, the absence of independent and long-term funding, possible conflict of interest and questions as to whether all stakeholders are participating.

Source : "Public involvement in Canadian forest management: a case study of Mistik Management Ltd", <http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0827-A5.HTM>

E. Unsustainable Forestry Development

The sustainable development of forests is crucial both domestically and internationally, for a range of economic, environmental and social considerations. The importance of forests requires all parties to consider forest management from a number of perspectives so as to avoid – intentionally or unintentionally – unsustainable development in the forestry sector. Unsustainable forest management can cause risk that need to be anticipated. Generally, risk is 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. In forest audit the probable risks are as follows: Concerns about unsustainable development and forests have focused in a number of areas in recent years, including:

1. Logging as a cause of deforestation

Illegal logging risk is a risk that is caused by harvesting, transporting, processing and trading of forest products in violation of national law. Depending on the scale of the operation, illegal logging is

potential to harm forests and undermine sustainable forest management. Governments need to develop regulations, policies and mechanisms to mitigate or prevent illegal logging activities.

It is estimated that, over the centuries, the world has lost 40% of its original 60 million km² of forest coverage through human activity. Approximately 12 million hectares are destroyed each year, an area roughly the size of Malawi, Nicaragua or North Korea. 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 program designed to advance sustainable forest management, but enforcement is often poor, and illegal logging predominates in some regions. In addition to its direct impacts, logging also rises up the possibility of forest to [encroachment and settlement](#), and other damaging disturbance, such as [hunting](#) and fire.¹⁵

Sakhalin Island, Russian Far East
<p>In Russia, a dark conifer forest has been deforested by logging and fires. Before the starts of exploitation, bamboo grew as mountain vegetation higher than the dark conifer forest, and also grew rather feebly in the undergrowth. Bamboo roots are resistant to high temperatures and it is able to reproduce wonderfully after fire, therefore it can quickly take over a new space, creating a thick, impenetrable 'carpet'. Huge areas of dark conifer forest have 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.</p> <p>Source: "Forest and water on Sakhalin Island: an example of the unsustainable forestry management" www.rinya.maff.go.jp/faw2002/14%20Mr.%20Dmitry%20Lisitsyn.pdf</p>

Illegal logging occurred because of indifference between demand and production, the weakness of law enforcement, and many socio-economic problems of the forest communities. In Indonesia, the gaps between demand and production are shown in Table 3.3 below.

Table 3.3 Timber's Demand and Production in Indonesia

Timber's demand and production	Volume (million m ³)
Log's demand (1999)	
1. Industries related with HPH	41,09
2. Industries not related with HPH	17,15
Total demand per year	25,36
Log's production (1995-1999)	
Average production per year	25,36
Gaps between demand and production	32,88

Source: Strategic Planning of Forestry Department 2001-2005

Forestry Department had conducted an inventory on the indication of forest coverage and critical land areas in 2000 and 2003. The result shows rapid forest growth and critical land areas rate which are 177% from 56,98 million Ha in 2000 to 100,6 million Ha in 2003. The growth of critical land areas mostly happens outside forest areas.

¹⁵ Unsustainable forestry is rapidly eroding biodiversity, <http://www.birdlife.org/action/science/sowb/pressure/36.html>

2. Expansion of the pulp, paper and palm oil industries

The pulp and paper industry is currently expanding in tropical Asia, with several huge operational mills under construction in Indonesia and the Philippines. 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 in Indonesia has led to 65 species being moved to higher threat categories on the IUCN Red List.

3. Logging's impact on biodiversity habitat

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 under storey 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.

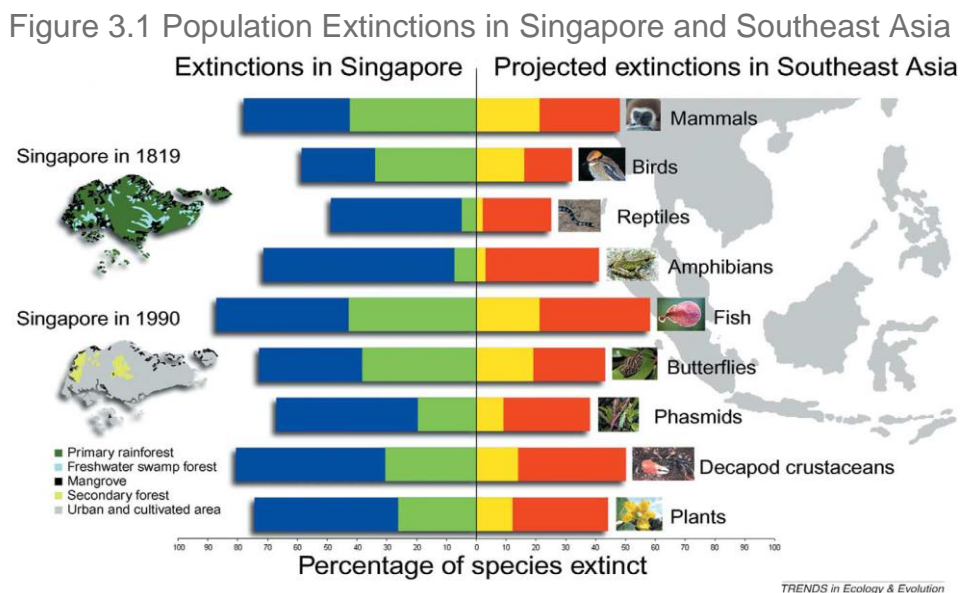
Illegal logging and associated activities

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.

UNECE Timber Committee and
FAO European Forestry Commission

The figure below showed the population extinctions in Singapore and Southeast Asia. Green and blue bars represent recorded and inferred extinctions in Singapore, respectively. Yellow and red bars represent minimum and maximum projected extinctions in Southeast Asia, respectively.



Source : "Southeast Asian biodiversity: an impending disaster,
<http://www.su.ait.ac.th/ec2008/quiz/Biodiversity%20loss%20in%20SE%20Asia.pdf>

Indonesia	Cameroon	Swedish
<p>After carrying out land clearing, the land and the remaining tree roots are usually burned by the private sector, whether domestic or foreign holders, by ordering local people to do the work. 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 have 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). The hot-spots, about 46 percent of those appearing on satellite images on September 28, 1997, were in lands granted for plantations.</p> <p>Source: "Underlying Causes Of Deforestation And Forest Degradation In Indonesia: A Case Study On Forest Fire",, Shttp://enviroscope.iges.or.jp/modules/envirolib/upload/1508/attach/1ws-7-mia.pdf</p>	<p>Forest logging has been for the specific case of the Dja Reserve, 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 and secondly in the forest sites. More than 70% 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% of medicinal plants used by the local people are composed of ligneous species, with trees (50%) having the high proportion.</p> <p>Source: "Impact Of Forest Logging In The Dja Biosphere Reserve, Cameroon" http://www.cbd.int/doc/case-studies/for/cs-ecofor-cm-01-en.pdf</p>	<p>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 trade 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.</p> <p>Estimates of the scale of the problem in Estonia point to 50%, and in Latvia 20%. These illegal 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</p> <p>Source: "Sweden: Forest Industry Giant With Big Timber Footprints In The Baltic Region, November 2005" www.taigaescue.org/v3/files/pdf/160.pdf</p>

Unsustainable forest management can cause risk that need to be anticipated. Generally, risk is 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. In forest audit the probable risks are as follows:

1. Forest Fire Risk

Forest fire risk is the risk of fire caused by human activities (such as land clearing using slashing and burning method). Forest fire risk is a combustion reaction risk that result in heat and flame in forest area that caused by human activity. Forest fire is becoming a serious problem for many countries. Natural forest fires are usually associated climactic phenomena, such as drought, forest type and ENSO occurrences. Man-made forest fires occur intentionally or through human activities. In Indonesia forests fires are often the unintended result of small scale farmers and companies using fire to clear land for agriculture.

2. Illegal Used of Land

Illegal used of land is unlawful entering (gradually and without permission) upon the (*forest estate*) land. For example, a company or group of people occupying an area of forest without a license or permission from the relevant authority. For example, a company or group of people occupying an area of forest without a license or permission from the relevant authority.

3. Disaster Risk

The risk of a natural disaster that can exhaust goods and chattels and in a specific scale are harmful to a specific community function

4. Conflict Risk

Forests are subject to the needs and interests of many different groups, including local communities, governments, NGOs, business and industry. 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 hostility of landowners against regulations which is telling them what they can or cannot do on their land.

5. Revenue Risk

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 that are still seeking to establish a practice of good governance.

6. Livelihood Lost Risk

The risk of losing livelihood is faced by the communities live surrounding the forest that are economically dependent to the forest existence around them. The following are some example of human dependence to the forest; people are exploiting wood waste inside forest and people are cropping among the forest stands to earn their living.

7. Social Risk

The risk of social changes in communities surrounding the forest especially in their lifestyle. Communities surrounding the forest would be moved out and looking for other places to keep living. In addition, social gap will exist because the local communities are removed from forest management activities.

The 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.

8. The Decrease of Carbon Storage Risk

Forest absorb the ambient carbon in the air for photosynthesis, store the carbon inside forest stands, and then release the oxygen to the ambient air as a product from photosynthesis activity. Unsustainable forest management would cause a significant decrease in trees quantity, hence it would cause the decrease of nature ability in converting carbon dioxide (CO₂) into oxygen (O₂). Furthermore , the increase of CO₂ in the air is higher than the increase of O₂ , hence it will influence the temperature on the earth surface.

9. The Destruction of Water Quality

The destruction of water quality is the forest loss of power in restraining the water, managing water, protecting land to prevent flood, controlling erosion, preventing the intrusion of the sea, and keeping the soil fertile.

10. Shortage of Industrial Supply Risk

For more details, the auditors might look the audit case study related to the risks mention above provided in Appendix 5.

The risk meant by the decrease in forestry downstream industry raw material that causing the imbalance between supply and production

F. Sustainable forest management for mediating economic, social and environmental interests

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.

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.

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 landslide.¹⁶

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 hydroelectricity and reduces the capacity and shortens the life of these costly investments.

At a local level trees can also bring environmental benefits to provide protection against wind erosion and increase the rate at which rainwater infiltrates and recharges the groundwater. Used judiciously in farming systems they help maintain the fertility of the soil as the nutrients drawn up by their roots are recycled into the top layers of the soil by leaf fall. They provide shade for animals and humans; the microclimate under trees may be several degrees cooler and more humid than out of their shade. In coastal areas, mangroves protect the land against erosion by the sea as well as providing breeding grounds for fish and shrimps.

Forests also have an increasingly important role as havens for wildlife and for the protection of 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 to relieve stress from polluted world.

¹⁶ <http://www.fao.org/docrep/T0829E/T0829E05.htm>

G. Evaluation of sustainable forest management and risks related with it

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”¹⁷ 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 prior to UNCED, by the International Tropical Timber Organization (ITTO) to demonstrate members’ commitment to achieve sustainable management of tropical forests. It has since spread world-wide.

Since 1992 several eco-regional forestry processes have been established for the development and implementation of C&I.¹⁸ Temperate and boreal forests are covered by the Pan-European and the Montreal processes. Arid zone forests are covered by the Dry 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, ITTO and the African Timber Organization (ATO). Some of the regionally based processes cover also other forest types in the region. Several countries are member of more than one process. Most of these processes meet on a regular basis to refine the concept of SFM through the development of C&I, and to follow up progress through country reporting. Table 3.4 below shows the international forest initiatives for sustainable forest management.

Table 3.4 International Forest Initiatives for Sustainable Forest Management

Process and Year Initiated	Region/Forest Types	Member Countries
African Timber Organization 1993	West and Central Africa	Angola, Cameroon, Central African Republic, Republic of Congo, Côte d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Gabon, Ghana, Liberia, Nigeria, Sao Tome et Principe, and Tanzania.
Dry Forest Asia 1999	South and Central Asia	Bangladesh, Bhutan, China, India, Mongolia, Myanmar, Nepal, Sri Lanka, and Thailand
Dry Zone Africa 1995	North, East and Southern Africa	Angola, Botswana, Burkina Faso, Cape Verde, Chad, Djibouti, Eritrea, Ethiopia, Gambia, Guinea Bissau, Kenya, Lesotho, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Senegal, Seychelles, South Africa, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe
International Tropical Timber Organization 1992	C&I initiatives cover humid tropical forests	The following ITTO member producer countries are involved in the ITTO C&I initiative: Bolivia, Brazil, Cambodia, Cameroon, Canada, Central African Republic, China, Colombia, Côte d'Ivoire, Democratic Republic of Congo, Ecuador, Egypt, Fiji, Gabon, Ghana, Guyana, Honduras, India, Indonesia, Liberia, Malaysia, Myanmar, Nepal, Panama, Papua New Guinea, Peru, Philippines, Republic of Congo, Suriname, Thailand, Togo, Trinidad

¹⁷ The full title is the Non-Legally Binding Authoritative Statement on Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forest.

¹⁸ <http://www.fao.org/docrep/004/AC135E/ac135e00.htm>

Process and Year Initiated	Region/Forest Types	Member Countries
		and Tobago, Vanuatu and Venezuela
Lepaterique Process 1997	Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama
Montreal Process 1995	Temperate and boreal forest.	Argentina, Australia, Canada, Chile, China, Japan, Mexico, New Zealand, Russian Federation, Uruguay and USA.
Pan-European Forest Process 1993	European forests	Albania, Andorra, Austria, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, European Community, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Republic of Moldova, Monaco, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and Yugoslavia.
Tarapoto Proposal 1995	Amazon Forest	Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela
Near East Process 1996	Near East	Afghanistan, Algeria, Azerbaijan, Bahrain, Cyprus, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Kyrgyzstan, Lebanon, Libya, Malta, Mauritania, Morocco, Oman, Pakistan, Qatar, Kingdom of Saudi Arabia, Somalia, Sudan, Syria, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, and Yemen

Based on all above mentioned forestry processes, sustainable forest management depends on a number of policy, governance and operational aspects. In the forest audit, attention should be paid on two points of view: governmental activities on establishing legal and institutional framework (including existence and implementation of forest policy), and actual situation and changes in forests on national level as result of management.

Here is presented the list of main principles, which can be evaluated during the forest audit. As different countries have different situation and may have different problems, therefore SAI's can focus on different issues. Set of criteria is given as example to help SAI's to pre-assess the country's forestry and to find focal-points of the audit. Also these criteria can be used in the forest audit, supplemented with other appropriate criteria and indicators described in above mentioned forestry processes or in other standards.

1. Policy and Legislation

Sustainable forest management's success depends on the support of appropriate policies and legislation at the national and regional level. Considerations in deciding a forest policy include the present proportion of land under forest; needs of protection and conservation of biological diversity; needs and aspirations of present and future generations of the population; the place of forestry in national economic planning; the various objectives of forest policy and relative importance of these; and the amount of public and private forests.

a. Forest Policy

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 at the sustainable use of all natural resources, including the establishment of a permanent forest base, is developed and adopted. |
| 1.2 | A national forest policy forming an integral part of the national land use policy, assuring a balanced use of forests, is formulated by means of a process seeking the consensus of all the actors involved: government, local population, private sector and NGO's. |
| 1.3 | An informational means have capacity 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 provides an overall policy framework for conservation and sustainable management of forests, handling all characteristics of sustainable forest management. |
| 1.5 | A legal framework governs national objectives for forestry including production, conservation protection and investment. |
| 1.6 | An economic policy framework and financial instruments 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 | 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. |
| 2.2 | 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. |
| 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. |
| 2.3 | A legal/regulatory framework maintains forest resources and prevents forest degradation. |

b. National Forest Inventory (NFI)

Sustainable forest management is a long-term process and depends critically upon the stability and security of a nation's forest estate. Therefore it is essential to have proper information about forests on national level.

Principle 4 A National Forest Inventory should be carried out regularly to collect data on the current status of forest resources on national level and monitoring changes in it. 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 assures collecting and maintenance information about forest area, growing stock and description of stands |
| 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 reasoned. 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 changes are reasoned. If appropriate, forest land should be classified according to forest and vegetation type, site classes, ownership structure, origin of forest etc.
4.4	There are flexible provisions for such inventories to be broadened to include information not previously covered, if and when the need and opportunity for such additional information arises.

c. 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, 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 agricultural land and their customary use of the forest.
5.2	Total carbon storage in forest stands and in soil is increasing or stable, compared with situation certain years ago (for example 5, 10, 20 etc. years ago). The methods of measurement are understandable and acceptable on 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.

d. Protection of Biological Diversity

The conservation of ecosystem diversity can be accomplished by the establishment and management of a system of protected areas (combinations of IUCN categories I-VI, Annex XX) containing representative samples of all forest types linked as far as possible by biological corridors and/or 'stepping stones'. This can be ensured by effective land-use policies and system for choosing, establishing and maintaining the integrity of protected areas in consultation with and through the involvement of local communities. To make conservation in protected areas more effective and to contribute to forest quality, biodiversity should be protected also in production forests in appropriate way.

Although the conservation of biological diversity is best assured by preventing species from becoming endangered, it is also important to have national procedures for monitoring and protecting rare and threatened species.

The effective conservation of biological diversity also requires the maintenance of the genetic diversity of all species of flora and fauna.

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 is aware of needs to establish different types of protected areas (IUCN categories I-VI) to maintain biological diversity and ecosystem stability.

6.2	A legal/regulatory framework provides 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 the protection and monitoring of biodiversity in production forests.
6.6	Special inventories show that established network of protected areas and management of these enables to maintain or restore a favourable conservation status of natural forest habitat types and the species' habitats. If not all forest types are represented in appropriate amount on 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.

e. Soil and Water Protection

Soil and water protection has a bearing on maintaining the productivity and quality of soil and water within the forest and its related aquatic ecosystem and therefore on the health and condition of the forest. On other hand, it plays a crucial role outside the forest in maintaining downstream water quality and flow and in reducing flooding and sedimentation.

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 an institutional framework has 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 an institutional framework has capacity to conduct inventories and research on soil erosion and water quality.
7.4	Special inventories show that implemented measures in favor on soil and water protection have appropriate results. If not, a national agency or an institutional framework has an action plan to improve the situation.
7.5	If appropriate, a legal /regulatory framework sets requirements for technology used in forest management operations.

f. 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 clarifies property rights and obligations, and provides for appropriate land tenure arrangements.
8.2	A legal/regulatory framework clarifies participation opportunities of local communities and other stakeholders in forest management planning and operations.

g. National Forest Service

There must be adequate institutions and personnel to undertake sustainable forest management. These include effective implementing agencies, research institutions and appropriately trained personnel to ensure that management is in accordance with scientific and technical knowledge.

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.
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Possible Criteria :

9.1	A national agency or an institutional framework has capacity to provide guidelines for national plans or programs.
9.2	A national agency or an institutional framework has capacity to undertake and develop regular assessment of forest resources.
9.3	A national agency or an institutional framework has capacity to develop programs for enhancing the use of forest products for energy.
9.4	A national agency or an institutional framework has capacity to develop mechanisms for controlling the occurrence of serious forest damages.
9.5	A national agency or an institutional framework has capacity to analyze changes in forest area, growing stock, age structure, diameter distribution etc.
9.6	A national agency or an institutional framework has capacity to carry out integration between land-use planning and forest management.
9.7	A national agency or an institutional framework has capacity to provide assistance to customary rights holders and private forest owners to manage the forest sustainability.

2. Forest Management

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

a. Planning

Planning procedures have to be sound and effective, as the production of forest goods and services generally requires a long gestation period. It is through proper planning and control that investment in forestry activities will yield the desired returns to society. Proper planning, at national forest management unit and operational levels, reduces economic and environmental costs, and is therefore an essential component of long-term sustainable forest management.

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 enacts forest owners and managers to assemble or to order forest management plans.
10.3	All forests (despite ownership) are managed according to a management plans. If not, percentage of forest area managed according to a management plan is increasing compared with situation certain years ago (for example 5, 10, 20 etc. years).
10.4	Management objectives are set rationally for each management unit. Formulation of objective should allow the forest manager to respond flexibly 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.

1) 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 | Forest inventories are made in necessary amount, concentrating on quantities of timber of currently and potentially commercial tree species of the forest for future timber production. |
| 11.3 | If appropriate, representative series of permanent sample plots are established. |
| 11.4 | A national agency or an institutional framework has capacity to carry out supervision about existence and quality of forest inventories. |

2) 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 true progressive silvicultural system should be developed by gradually improving on these practices as better information becomes available. The harvesting intensity and the design of harvesting should be integral parts of the silvicultural concept. |

3) Yield regulation, Annual Allowable Cut (AAC)

Lack of proper yield regulation or noncompliance of Annual Allowable Cut may lead to overexploitation of timber resources, which may cause diminishing forest habitats and deplete economic benefits in future.

Principle 13 replacement (natural and/or artificial) of similar forests or forest products in a given area over the long term.

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.

Possible Criteria :

- | | |
|------|--|
| 13.1 | A legal/regulatory framework describes methods of calculating Annual Allowable Cut (AAC) |
|------|--|

	and imposes it 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 an institutional framework has capacity to carry out supervision about timber yield and to compare it with replacement.
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, past 3, 5 or 10 years).
13.5	A regular reviews of AAC are made (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

4) 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 assures that environmental issues are taken into account in management planning to maintain or re-establish biodiversity in production forests.
14.2	In order to ensure a sustained production of timber from each forest management unit, a legal/regulatory framework provides for legal instruments to appropriate regeneration of managed forests, to maintain stability of forest ecosystems.
14.3	A national agency or an institutional framework has capacity to maintain, conserve and appropriately enhance biological diversity at the ecosystem and species levels in production forests.
14.4	A national agency or an institutional framework has capacity to conduct inventories on proportion of area covered by trees significantly older than the acceptable age of exploitation currently used.
14.5	A national agency or an institutional framework has capacity to conduct inventories and/or assessments on bio-indicators.
14.6	Special inventories show that legal requirements for protection biodiversity in production forests are followed and elements important for biodiversity are maintained.

5) 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 fire management plan.

Possible Criteria :

15.1	A national agency or an institutional framework has 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.

6) Environmental Impact Assessment

Forest management operations can have important positive or negative environmental consequences, both in the forest itself and outside (transboundary effects). These consequences should be assessed in advance of operations to ensure overall sustainability

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 an institutional framework has capacity to assure implementation of EIA and to carry out appropriate supervision.

b. 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 increased increment and 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 enacts requirements for harvesting operations to ensure that all forestry operations are carried out according to high standards, to ensure economic viability and to avoid negative environmental, economical and social impacts.
17.2	A national agency or an institutional framework has capacity to control quality of harvesting operations.
17.3	Supervision and monitoring activities assure that information about harvest operations and actual cut is accurate.

1) 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 sets requirements for pre-harvest prescription.
18.2	Supervisions show that detailed prescriptions are drawn up, including measures such as climber cutting, marking of trees to be felled/retained, handling residuals to be retained and indications of extraction direction and felling directions.
18.3	If appropriate, growing stock of stand is measured before harvest, to be sure that logging companies' reports are right and to avoid timber thefts.
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 • Machine operator responsibilities (directional felling, etc) marking of trees to be retained and trees to be removed

2) 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 and 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 an institutional framework has capacity to control quality of road construction and timber extraction, and to assure compliance to laws and regulations.

3) 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 sets requirements to post-harvest forest managements.
20.2	A national agency or an institutional framework has 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.

c. Forest Protection

1) Fire

Fire is a serious threat to future productivity and environmental quality of the forest. Increased fire risk in areas being logged and even more on areas which have been logged, demands stringent safety measures.

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 to implement fire management plan.
21.2	A national agency or an institutional framework has capacity to carry out supervision about preparing and implementation of fire management plans.
21.3	A national agency or an institutional framework has capacity to fight with forest fires.

2) 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.

d. Legal Arrangements

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; 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; conditions for renewal and termination.

Concession legislation includes : (a) categories of contracts, and application and granting procedures; (b) objects of the contracts; (c) rights granted and rights withheld; (d) establishment or expansion of local wood-processing units; (e) felling, wood extraction and transport; (f) road construction and improvement of infrastructure; (g) forest management and reforestation; (h) forest taxes, stumpage and other fees; (i) control, supervision, and sanctions for disrespect of concession terms; (j) other general provisions; (k) other environmental considerations.

1) 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 an institutional framework has capacity to protect forests from activities that are incompatible with sustainable timber production.

24.3 A log-tracking systems, machinery with GPS-equipment or similar control mechanisms are established.

24.4 A national agency or an institutional framework has capacity to carry out supervision of logging permits.

e. 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 an institutional framework has 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 of 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 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.

3. Socio-Economic, Financial and Cultural Aspects

A well-managed forest is a self-renewing resource producing a host of benefits, which might include supplying high-quality timber and satisfying the basic needs of people living in and around the forest. If sustainably managed, the forest therefore has the potential to make an important contribution to the overall sustainable development of the country. Sustained 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 interest of local population.

a. Relations 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 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 consultation with local people, starting in the planning phase before road building and logging commences; for continued exercise of the customary rights; for concession agreements and other logging permits to cover the extent of assistance, employment, compensation, etc., to be provided.

b. Economics, Incentives, Taxation

Management for timber production can only be sustained in the long term if it is economically viable, taking full account in the economic value of all relevant costs and benefits from the conservation of the forest and its ecological and environmental influences.

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 intensified.
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 an institutional framework has capacity to assure that all applicable and legally prescribed fees, royalties, taxes and other charges are paid.

Based on the above descriptions on the sustainable forest management and the risks/ threats of unsustainable management, the following table portrays the risks/threat related to each aspect of sustainable forest management described above. It explains which risk/threat corresponds to each elements of sustainable forest management as follows:

Table 3.5 Risk of Forestry and Audit Topics Matrix

No	Topics/Subtopics	Risk											
		A	B	C	D	E	F	G	H	I	J	K	L
1	Policy and Legislation												
1.1	Forest Policy		X	X	X		X						
1.2	National Forest Inventory	X	X	X				X		X			
1.3	Permanent Forest Estate	X	X	X	X			X				X	
1.4	Protection of Biology Diversity	X											
1.5	Soil and Water Protection	X				X						X	
1.6	Forest Ownership	X	X	X	X		X	X					
1.7	National Forest Service				X								
2	Forest Management												
2.1	Planning	X	X	X					X	X	X		X
2.2	Harvesting	X	X	X				X	X	X	X		
2.3	Protection	X	X	X	X	X	X			X		X	X
2.4	Legal Arrangements	X	X	X	X		X	X	X	X			
2.5	Monitoring and Research	X	X	X	X	X							
3	Socio-economic, Financial, and Environmental Aspects												
3.1	Relations with Local Populations	X			X		X		X				
3.2	Economic, Incentives, and taxation		X	X	X				X				

- A : Biodiversity and ecosystem lost
- B : Forest fire risk
- C : Illegal logging risk
- D : Illegal used of land
- E : Disaster Risk
- F : Conflict Risk
- G : Revenue Risk
- H : Unemployment risk
- I : Social Risk
- J : Decrease on Carbon Storage
- K : Damage on water management
- L : Shortage Of Industrial Supply

Chapter IV

THE FOREST AUDIT

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

A. Issues in Auditing the Forest

1. 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 SAIs and encompasses all types of audit.

In this context, attention may be devoted to, for example, the disclosure of forest assets and liabilities, compliance with legislation and conventions – both national and international – as well as to assess the measures instituted by the audited entity to promote economy, efficiency and effectiveness.

2. Audit Tools and Methodology

The forest areas are too vast to allow auditors to access and cover them thoroughly in their audit. In reference to this, auditors need to be equipped with ample tools and appropriate methodology to achieve the objectives of the audit.

The following tools may be used in achieving audit objectives:

Geographical Information System (GIS)

A Geographic Information System (GIS), also known as a geographical information system, is an information system for capturing, storing, analyzing, managing and presenting data which is spatially referenced (linked to location) (*source*: Wikipedia the free encyclopedia).

In the strictest sense, it is any [information system](#) capable of integrating, storing, editing, analyzing, sharing, and displaying [geographically referenced](#) information. In a more generic sense, GIS applications are tools that allow users to create interactive queries (user created searches), analyze [spatial](#) information, edit data, maps, and present the results of all these operations (*source*: Wikipedia the free encyclopedia).

GIS can be quite useful in an audit, particularly in planning the audit and in the audit process itself. The information generated by means of a GIS can be used to identify the area of the forest for checking on the ground, locating deforestation, investigating illegal logging, and assessing forest fires and illegitimate 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](#) that transmit precise [microwave](#) signals, that enable GPS [receivers](#) to determine their current [location](#), the time, and their velocity including direction (*source*: Wikipedia the free encyclopedia).

In forest audit, the GPS functions as positioning device, to locate the area of the forest which is the subject of the audit and its findings.

Example :

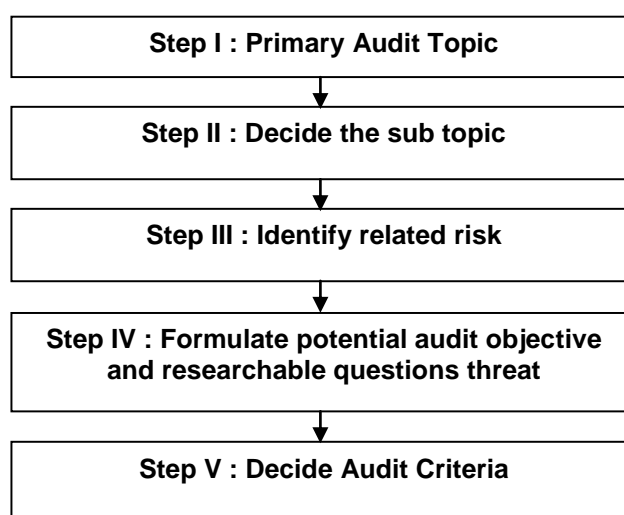
Indonesia has conducted a performance audit on forest planning and management. The objective of the audit is to assess the effectiveness of the government's planning and management of forests. In this audit, BPK uses GIS as a tool to achieve the audit's objective.

In addition to the above devices, forest audits uses widely accepted examination methods such as interviews, ground checking, sampling, analysis and observation.

B. Design matrix

This matrix is designed to be used as a tool to make it easier for auditor in designing audit program. In designing an audit program, auditor may follow these steps:

Figure 4.1 Steps on Design Matrix



1. Choose the primary audit topic

This is most important step in the audit process, requiring the full attention of those commissioning the audit and senior SAI auditors. The key forest issue of prime importance for the recipients of the report is required to be identified by the SAI. 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 III.

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 Chapter III.

3. Identify related risk

After deciding on the topic and sub-topics, the risk that have the potential to influence the direction and aims of both the audit and each of the units working on the sub-topics are started to be identified by the SAI can begin to identify the risks. 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 III. We can use Environmental Impact Assessment as an information resource to identify forest risks.

4. Formulate potential audit objective and researchable questions

By identifying the risks, the SAI develops a clearer picture of the audit's direction and possible findings. This helps the SAI 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 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.

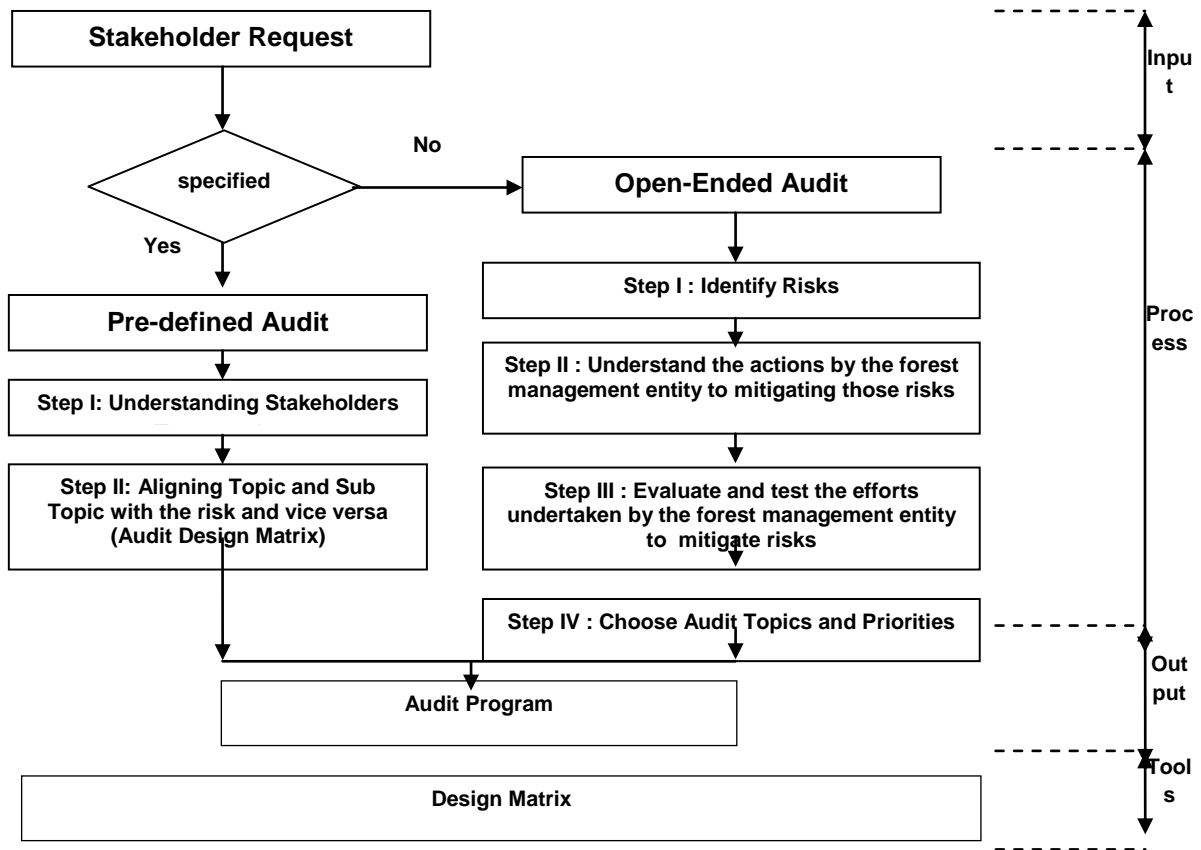
Each of the preceding steps is presented in Audit Design Matrix in Appendix 3

The previous steps explained above are basically only tools for auditor and they might be applied based on the situation and the needs of auditors. This matrix could be used to determine audit objectives, scope, and criteria. Although these steps are presented linearly, in fact, those steps are related to each other.

C. Choosing and Designing Audits of Forest (Risk based Audit Approach)

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 the capacity of the government units in charge. Two approaches for developing a forest management audit are open-ended audit assignment and pre-defined audit assignment.

Figure 4.2 Flow Chart of Risk Based Audit Approach



1. Open-ended audit assignment

When priority topics or sub topics are not specified, the SAI should consider the existing risks, the capacity of the management in mitigating those risks, and the priority of topics and sub topics to be audited.

The steps of Open-ended audit assignment are as follows:

Step 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.

Threats/Risks	Characteristic to consider	Key players
<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 	<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 	<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

How: Risks related to forest management are difficult to assess and complex, and sometimes there is no comprehensive data available, either in the government or audited entities. SAIs may use external sources available to identify risks, such as academic papers, studies done by NGOs, results of interview with relevant officials and representatives, information from the media, and other sources. In addition, SAI may use the above risk table as a reference to risk identification.

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

What	How
<ul style="list-style-type: none"> • Risk of Biodiversity and ecosystem lost • Forest fire Risk • Risk of Illegal logging • Illegal used of land • Disaster Risk • Conflict Risk • Revenue Risk • Unemployment risk • Social Risk • Decrease on Carbon Storage • Destruction on water management • Shortage Of Industrial Supply 	<ul style="list-style-type: none"> • Establish policies • Enact legislation • Forest biodiversity inventory • Designate areas for Permanent forest • Establish National Forest Service • Designate annual allowable cut (chapter III: Forest Policy)

At this stage, it is possible that the forest management entity is doing various efforts to resolve the issues and problems preventing it from achieving its objectives. With this in mind, the SAI should understand 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.

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

At this point the SAI assesses the effectiveness of the management entity's efforts to mitigate risks. This step is connected closely to Step II. The SAI's capacity in identifying risks and assessing the government's effort in mitigating those risks is essential when determining appropriate audit priorities.

How: Step III involves interviewing relevant staff and senior officials of the forest management entity. During interview, entity's various controls systems and procedures may be discussed to get better understating. Additionally, sample-testing could also be undertaken to check whether the systems and procedures are sufficiently effective and reliable.

Step IV: Choose audit topics and priorities

This is the most important and crucial stage. From the step undertaken in Step 3, the SAI has 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. At this stage, the SAI must consider a number of aspects other than the entity's control systems and the level of risk. These include 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.

Step V: This step is conducted using the above Audit Design Matrix.

At this stage, the SAI is advised to refer to the stages in the design matrix above. (Appendix 3)

2. Pre-defined audit assignment

Where the government 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 steps of pre-defined audit assignment are as follows:

Step I: Understanding Stakeholders Expectation

In this step, SAI should formulate stakeholder's request into topic and sub topic, including determining specific risk related to the topics and sub topics identified. Sometimes, stakeholder's requests are not the form of key area of interest but rather than in risk area of interest.

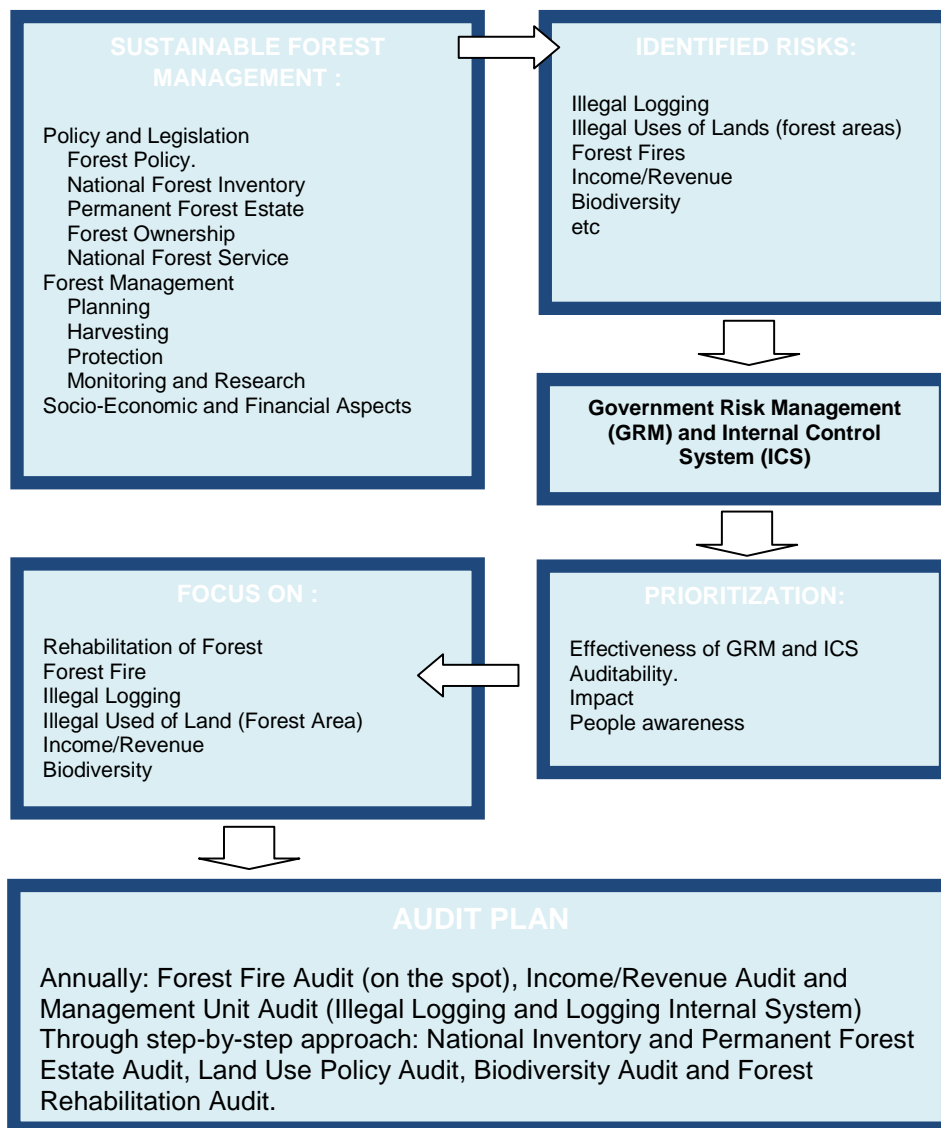
Step II: Aligning Topic and Sub Topic with the risk and vice versa

After determining topic and sub topic or determining risks that will be examined, SAI can apply Appendix 3 (design audit procedures) to establish audit procedures.

Case Study

Table 4.1- 4.3 shows the samples of the implementation on design matrix steps which are related one to another. Using a sample of case is forest destruction caused by tin mining activity in region of Bangka Belitung Island. Tin mining is one of open mining activity, in this case the activity is conducted by the corporate and society by ignoring the forest sustainability.

Figure 4.3 Risk Based Audit Strategy to Audit Management of Forest – A Case Study of SAI Indonesia



At this stage, the SAI is advised to refer to the stages in the design matrix above provided in Appendix 3

Table 4.1. How To Choose The Primary Audit Topics and Subtopics

Sample for Case of Pre-Defined Audit Assignment

House of representatives asks SAI to conduct audit related to forest destruction caused by tin mining. The house of representatives ask SAI to consider forest policy. Considering this sub topic, SAI could refer to Appendix 3 (audit design matrix) to establish procedures that will be applied when conducting the audit. The same thing could be applied when stakeholders ask SAI to conduct audit on illegal used of land related to tin mining in forest. Considering those risks, SAI could directly refer to topic and sub topic related to illegal used of land then sets audit procedures by referring Appendix 3 (audit design matrix). The next step is to develop Audit Program or Audit Plan Memorandum.

Sample for Case of Open-Ended Audit Assignment

House of Representatives asks SAI to conduct audit related to forest management in certain area. When accepting the assignment, BPK-RI should determine audit topic related to that issue. In this step, auditor would discuss with the House of Representatives and other related parties to that issue. In order to design Audit Program, the SAI will follow the following steps:

Step I : Identify Risk

After Receiving the request from the House of Representative (HR), SAI can formulate the risk(s) related to Forest Management by conducting interview, analyzing the previous report, and researching public opinion or others opinion. The SAI also can use the risk table in Chapter III to identify risk related to Forest Management. The risks related to Forest Management are follows:

- a. Biodiversity and Ecosystem Lost
- b. Forest Fire Risk
- c. Illegal Logging Risk
- d. Illegal Used of Land
- e. Disaster Risk
- f. Conflict Risk
- g. Revenue Risk
- h. Unemployment Risk
- i. Social Risk
- j. Decrease on Carbon Storage
- k. Damage on Water Management
- l. Shortage of Industrial Supply

The output of this step is the list of risk related to Forest Management.

Step II : Understanding the Forest Management Entity's Efforts to Mitigate Risks

The SAI has already has all of identified risks related to forest management. Those risks related to many sub topics in the forest management. In order to choose the subtopic(s), SAI need to understand the entity's effort to mitigate each risk. SAI can review legal regulation, standard operation procedures, policies and instruments set out by the entity and interview key player.

Step III : Evaluate and Test The Capacity of Management Entity Effort to Mitigate Risk

In this step, SAI will test and review the effort in order to know the effectiveness of the Effort (system) to mitigate the respective risk (Government Risk Management (GRM) and Internal Control System (ICS). For example, in this case, the risk related to illegal logging and illegal used of land are the highest priority or the risks that have weak effort or management control system.

The output of this step is the list of risk (from the highest priority to the lowest)

Step IV : Choose Audit Topics and Priorities

After choose illegal logging and illegal used of land as the highest priority risks, SAI can go to the audit design matrix to choose the subtopics that have those risks. In the matrix, SAI will find the following:

- a. The sub topics that relate to illegal logging are: planning, harvesting, forest protection, legal arrangement and monitoring and research.
- b. The sub topics relate to illegal used of land are: forest protection, legal arrangement and monitoring research.

The next step, SAI can formulate the audit objective and research questions related to respective risk and sub topics and make the Audit Program or Audit Plan Memorandum.

Table 4.2 How to Formulate Potential Audit Objective and Researchable Questions

After the identification of risks, the auditor then should formulate audit objective and researchable questions based on topics, sub topics and risk which are the focus of the audit. The Design Audit Matrix in Appendix 3 is provided to assist auditor. For example, for topic of forest policy and legislation with sub topic of forest policy related with forest destruction caused by tin management, the audit objective is to determine:

Does the government have forest policy to ensure the development in the forest sector related to tin mining activity effective and sustainable?

To achieve the audit objective, the possible research question is:

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

Table 4.3 How to Decide Audit Criteria

In the case of forest destruction caused by tin mining activity, the auditor should determine the audit criteria to be used in comparison between practices which have been implemented and the regulated standard. In Indonesia, the used criteria are Act No. 41 of 1999 on forestry 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. A national land use policy aiming at the sustainable use of all natural resources, including the establishment of a permanent forest base.
 - b. 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?
 - a. 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.
 - b. 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.
 - c. 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?
 - a. Provision of adequate funds for research and monitoring to allow updating of policies.
 - b. 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.

Finally, SAI might develop audit program based on the needs of forestry audit in each country.

Chapter V

CONCLUSION

The importance of forests to human life is undebatable. They provide some basic human needs and a wide range of environmental services. Also, they are sources of livelihood for local and national economies.

To support the sustainability of forests, SAI could assist government, who has responsibility to conserve the forest, by auditing not only the performance and the compliance of government activities but also the soundness of the government accountability systems and practices. Furthermore, SAI could also assist strengthening the quality of the government's forest management internal controls.

As this paper illustrates, in auditing the government's forest management, SAIs are advised to follow a risk-based approach. This approach commences with identifying risks, understanding actions taken by the forest management to mitigate those risks, evaluating the adequacy of actions undertaken, and then developing the Audit Design Matrix.

In addition, this paper proposed the use of Geo-Spatial Technologies, such as GIS and GPS to improve the effectiveness of auditing the forest management

The Distribution Map of 26 Types of Forests in the World

Temperate and Boreal Forest Types

1.	Evergreen needleleaf forest	Natural forest with > 30% canopy cover, in which the canopy is predominantly (> 75%) needleleaf and evergreen.
2.	Deciduous needleleaf forest	Natural forests with > 30% canopy cover, in which the canopy is predominantly (> 75%) needleleaf and deciduous.
3.	Mixed broadleaf/needleleaf forest	Natural forest with > 30% canopy cover, in which the canopy is composed of a more or less even mixture of needleleaf and broadleaf crowns (between 50:50% and 25:75%).
4.	Broadleaf evergreen forest	Natural forests with > 30% canopy cover, the canopy being > 75% evergreen and broadleaf.
5.	Deciduous broadleaf forest	Natural forests with > 30% canopy cover, in which > 75% of the canopy is deciduous and broadleaves predominate (> 75% of canopy cover).
6.	Freshwater swamp forest	Natural forests with > 30% canopy cover, composed of trees with any mixture of leaf type and seasonality, but in which the predominant environmental characteristic is a waterlogged soil.
7.	Sclerophyllous dry forest	Natural forest with > 30% canopy cover, in which the canopy is mainly composed of sclerophyllous broadleaves and is > 75% evergreen.
8.	Disturbed natural forest	Any forest type above that has in its interior significant areas of disturbance by people, including clearing, felling for wood extraction, anthropogenic fires, road construction, etc.
9.	Sparse trees and parkland	Natural forests in which the tree canopy cover is between 10-30%, such as in the steppe regions of the world. Trees of any type (e.g., needleleaf, broadleaf, palms).
10.	Exotic species plantation	Intensively managed forests with > 30% canopy cover, which have been planted by people with species not naturally occurring in that country.
11.	Native species plantation	Intensively managed forests with > 30% canopy cover, which have been planted by people with species that occur naturally in that country

Tropical Forest Types

12.	Lowland evergreen broadleaf rain forest	Natural forests with > 30% canopy cover, below 1200m altitude that display little or no seasonality, the canopy being >75% evergreen broadleaf.
13.	Lower montane forest	Natural forests with > 30% canopy cover, between 1200-1800m altitude, with any seasonality regime and leaf type mixture.
14.	Upper montane forest	Natural forests with > 30% canopy cover, above 1800m altitude, with any seasonality regime and leaf type mixture.
15.	Freshwater swamp forest	Natural forests with > 30% canopy cover, below 1200m altitude, composed of trees with any mixture of leaf type and seasonality, but in which the predominant environmental characteristic is a waterlogged soil.

16.	Semi-evergreen moist broadleaf forest	Natural forests with > 30% canopy cover, below 1200m altitude in which between 50-75% of the canopy is evergreen, > 75% are broadleaves, and the trees display seasonality of flowering and fruiting.
17.	Mixed broadleaf/needleleaf forest	Natural forests with > 30% canopy cover, below 1200m altitude, in which the canopy is composed of a more or less even mixture of needleleaf and broadleaf crowns (between 50:50% and 25:75%).
18.	Needleleaf forest	Natural forest with > 30% canopy cover, below 1200m altitude, in which the canopy is predominantly (> 75%) needleleaf.
19.	Mangroves	Natural forests with > 30% canopy cover, composed of species of mangrove tree, generally along coasts in or near brackish or salt water.
20.	Disturbed natural forest	Any forest type above that has in its interior significant areas of disturbance by people, including clearing, felling for wood extraction, anthropogenic fires, road construction, etc.
21.	Deciduous/semi-deciduous broadleaf forest	Natural forests with > 30% canopy cover, below 1200m altitude in which between 50-100% of the canopy is deciduous and broadleaves predominate (> 75% of canopy cover).
22.	Sclerophyllous dry forest	Natural forests with > 30% canopy cover, below 1200m altitude, in which the canopy is mainly composed of sclerophyllous broadleaves and is > 75% evergreen.
23.	Thorn forest	Natural forests with > 30% canopy cover, below 1200m altitude, in which the canopy is mainly composed of deciduous trees with thorns and succulent phanerophytes with thorns may be frequent.
24.	Sparse trees and parkland	Natural forests in which the tree canopy cover is between 10-30%, such as in the savannah regions of the world. Trees of any type (e.g., needleleaf, broadleaf, palms).
25.	Exotic species plantation	Intensively managed forests with > 30% canopy cover, which have been planted by people with species not naturally occurring in that country.
26.	Native species plantation	Intensively managed forests with > 30% canopy cover, which have been planted by people with species that occur naturally in that country.

Different Types of Forests per Region

Continental South and South East Asia

Pakistan has very sparse forest cover. A fair amount of deciduous forest occurs in central India and these are mixed with other forest types in the Western Ghats. Much of the Himalayan region shows forest cover but in Nepal in particular these are disturbed forests. Forests in Thailand are concentrated mostly in the north, but there are some large patches in the south east which lie within protected areas. In comparison to Laos and Cambodia, Vietnam appears much less forested, particularly in the south. Peninsular Malaysia supports much forest inland, and there is a large swamp forest near Pekan on the east coast.

Europe

There were five main types of forest, the most abundant being the evergreen needleleaf forest and the deciduous broadleaf forest, with the mixed broadleaf/needleleaf forests being abundant in the Iberian Peninsula and Greece. In much of Europe the most forested areas are the mountains. The Carpathians support both deciduous broadleaf forest and evergreen needleleaf forest, the latter in the higher zones. The Alps have evergreen needleleaf mainly, but the forests in Switzerland have been mainly classified as mixed. Italy's Apennines support mainly deciduous broadleaf forest, as does the Massif Central of France. The Pyrenees support all three: mixed, deciduous broadleaf and evergreen needleleaf. The higher areas of the Iberian Meseta support all forest types on the map except the deciduous needleleaf.

Russia

The central belt of Russia had vast areas of forest, mainly evergreen needleleaf in the west and deciduous needleleaf in the east, with sparse trees and parkland and deciduous forests interspersed. The areas above the arctic circle were generally without forest, except in Russian Lappland and south of the Khatanga river. In general deciduous broadleaf forests were more frequent towards the south of the region, particularly in the Kamchatka Oblast in the east, the southern part of the Ural mountains and near Krasnodar at the Russian east coast of the Black Sea.

Insular South East Asia

The south west of Papua New Guinea and the south eastern parts of Irian Jaya had less forest than other parts of this island: this area is swampy and not as conducive to forest growth. The most widespread by far was the lowland very moist zone, which was predominant except in the north of the Philippines and in the more easterly of the Lesser Sunda Islands, Sumba and Timor. Some montane zones were found in the larger islands: down the west side of Sumatra, and in the more central regions of Java, Borneo, Sulawesi and New Guinea, and in Mindanao and Luzon of the Philippines.

Africa

The main areas of forest in Africa are the moist equatorial forests of the Congo basin and coastal West Africa, the Miombo woodlands to the south of the Congo basin, the dry forest band stretching from southern Sudan to Guinea Bissau, the mountain formations of the Ethiopian Plateau and in Kenya, the thorn forests of Somalia and eastern Ethiopia, and the Mediterranean forests of Morocco, Algeria and Tunisia. Most of the forest around the Mediterranean region is mixed needleleaf/broadleaf forest and sclerophyllous forest. The Sahara desert appears as a vast area devoid of trees from Mauritania and Western Sahara in the west to Egypt and northern Sudan in the east. Namibia and western South Africa largely show a lack of forest cover, but in South Africa some of this is due to insufficient data for the forests around the southern tip. Madagascar shows moist forest in a stretch along the eastern side, dry forests in the west.

North America

Hawaii has a tropical forest type. The Great Plains of the U.S. and up into Saskatchewan was mainly not forested. The Appalachians appeared quite forested, and taking into account that the eastern states are the more populated ones, there was a considerable amount of forest still remaining in these states. Between the Rocky Mountains and the coastal ranges of California was less forested than in the mountains, and where it was forested the forest types were dry. Towards the very south and the north of the continent the land was less forested, as in Texas and Florida, and northern Alaska, the Northwest Territories and northern Quebec. In Canada the datasets showed the sparser forest types where boreal forest blends into tundra.

South America

The semi-evergreen moist broadleaf forest in Brazil are probably not that different from the adjacent lowland evergreen broadleaf rain forest, but had a more seasonal quality that would have been lost had they been lumped with the latter. Uruguay has very little forest cover. The high mountainous areas of the Andes do not support forest in many places, and the very dry areas of northern Chile and coastal Peru are not generally forested. The lowland wet and lowland very moist ecological zones support much of the Amazonian rainforests.

Central America

There are two types of non-tropical forest in Mexico, and the rest of the forest types are tropical. Much of the tropical forest in Mexico is montane, except the forests on the Yucatán peninsula. Due to the different origins of the datasets for each country, forest types do not always match on both sides of a national border. Quite a bit of disturbed natural forest is shown for Guatemala but not in its neighbouring countries: this is due to the absence of a "disturbed" category in the classifications used in the source datasets from those countries. The needleleaf forests of Honduras are distinctly shown, and the freshwater swamp forests of Nicaragua. The Pacific side of the countries south of Mexico is much less forested than the Atlantic side, and the opposite is true for Mexico itself, except in the very south. There are also more dry forest categories along the Pacific coast than the Atlantic.

Far East

In the continental areas of the region the most abundant types are non-tropical mixed broadleaf/needleleaf forest, evergreen needleleaf forest and sparse trees and parkland, with deciduous forests becoming more common in the south east. In Japan the forests are mainly plantations of exotic species with some deciduous broadleaf forest and evergreen needleleaf forest in the north.

Middle East

Of all the regions the Middle East is the most sparsely forested. The forests of Turkey are concentrated in the areas near the coasts of the Black Sea and the Mediterranean Sea and are of the sclerophyllous dry type. Those of Iran are of the same type and are concentrated in the highlands south of the Caspian Sea. Afghanistan's forests are concentrated along the eastern border, near Pakistan, around the Khyber Pass. These forests are different than those in Iran and Turkey. Elsewhere forest cover is very sparse, the only other small concentration being in north eastern Kazakhstan.

Caribbean

Needleleaf forests were only recorded in Dominican Republic and Cuba. Thorn forest was only recorded in Cuba and Jamaica, although the related deciduous/semi-deciduous forests were recorded from seven countries. Mangroves covered the greatest area of any forest type. The deciduous/semi-deciduous broadleaf forests had the second greatest cover figure. The upper montane type was present in four countries, Cuba, Guadeloupe, Jamaica and Saint Lucia. The mixed needleleaf/broadleaf forest was only recorded from the Dominican Republic. Freshwater swamp forests is the most of this forest type occurred in Cuba.

Source:

"Forest Types of the World" <http://forestry.about.com/library/tree/blwrlidx.htm>

"Statistical Analysis of Global Forest Conservation" <http://www.unep-wcmc.org/forest/data/cdrom2/stat1.htm>

AUDIT DESIGN MATRIX

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria	
Policy and Legislation	Forest Policy	Forest fire risk. Illegal logging risk. Illegal used of land. Conflict risk.	Does the government have forest policy that can ensure the development in the forest sector 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 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. 	
				Does an agreed forest policy (supported by appropriate legislation) be in harmony with laws concerning related sectors.	<ul style="list-style-type: none"> 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. 	
					Does a mechanism for regular revision of policy in the light of new circumstances and/or availability of new information exist?	<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.
	National Forest Inventory	<ul style="list-style-type: none"> Biodiversity and ecosystem Lost. Forest fire risk. Illegal logging risk. 	Does the government conduct comprehensive, regular and flexible national forest	Is a National Forest Inventory carried out regularly to collect data on the current status of forest resources on national	<ul style="list-style-type: none"> A legal/regulatory framework assures collecting and maintenance information about forest area, growing stock and description of stands. Area of country's forest and other wooded land during certain period (for example 5, 10, 20 etc. years) is stable or 	

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
		<ul style="list-style-type: none"> Revenue risk. Social risk 	inventory?	level and monitoring changes in it.	<p>changes in area are reasoned. If appropriate, area should be classified according to forest and vegetation type, ownership structure, age structure, origin of forest etc.</p> <ul style="list-style-type: none"> 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 changes are reasoned. If appropriate, forest land should be classified according to forest and vegetation type, site classes, ownership structure, origin of forest etc. There are flexible provisions for such inventories to be broadened to include information not previously covered, if and when the need and opportunity for such additional information arises.
	Permanent Forest Estate	Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Illegal used of land. Revenue risk. Damage on water management.	Are the 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 based on 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, 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 agricultural land and their customary use of the forest. Total carbon storage in forest stands and in soil is increasing or stable, compared with situation certain years ago (for example 5, 10, 20 etc. years ago). The methods of measurement are understandable and acceptable on international level.
				Are the land destined for	Land destined for conversion to other uses (agriculture, mines,

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
				conversion to other uses handled properly?	etc.) and any land for which the final use is uncertain, should be kept under managed forest until the need for clearing arises.
	Protection of Biological Diversity	Biodiversity and ecosystem lost	Does the government establish and manage a system of protected area to conserve ecosystem biodiversity?	Does forest management conserve biological diversity, unique and fragile ecosystem 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 is aware of needs to establish different types of protected areas (IUCN categories I-VI) to maintain biological diversity and ecosystem stability. • A legal/regulatory framework provides 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 the protection and monitoring of biodiversity in production forests. • Special inventories show that established network of protected areas and management of these enables to maintain or restore a favourable conservation status of natural forest habitat types and the species' habitats. If not all forest types are represented in appropriate amount on 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.
	Soil and water protection	Biodiversity and ecosystem lost.	Does forest management damage	Does forest management damage soils and water	<ul style="list-style-type: none"> • A legal/regulatory framework provides for legal instruments to regulate or limit forest management practices in areas

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
		Disaster risk. Damage on water management.	soils and water resources?	resources?	with vulnerable soils and in favor of water conservation or protection of water resources. <ul style="list-style-type: none"> • A national agency or an institutional framework has capacity to strengthen institutional instruments to regulate or limit forest management practice in favor on soil and water protection and to supervision on it. • A national agency or an institutional framework has capacity to conduct inventories and research on soil erosion and water quality. • Special inventories show that implemented measures in favor on soil and water protection have appropriate results. If not, a national agency or an institutional framework has an action plan to improve the situation. • If appropriate, a legal /regulatory framework sets requirements for technology used in forest management operations.
	Forest Ownership	Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Illegal used of land. Conflict risk. Revenue risk.	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 clarifies property rights and obligations, and provides for appropriate land tenure arrangements. • A legal/regulatory framework clarifies participation opportunities of local communities and other stakeholders in forest management planning and operations.
	National Forest Service	Illegal used of land	Is sustainable forest management undertaken by adequate institutions and personnel?	Is there any national agency or an institutional framework capable of managing the government forest estate and assisting in the management of private and customarily	<ul style="list-style-type: none"> • A national agency or an institutional framework has capacity to provide guidelines for national plans or programs. • A national agency or an institutional framework has capacity to undertake and develop regular assessment of forest resources. • A national agency or an institutional framework has

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
				held forests, according to the objectives laid in the national forest policy?	<p>capacity to develop programs for enhancing the use of forest products for energy.</p> <ul style="list-style-type: none"> • A national agency or an institutional framework has capacity to develop mechanisms for controlling the occurrence of serious forest damages. • A national agency or an institutional framework has capacity to analyze changes in forest area, growing stock, age structure, diameter distribution etc. • A national agency or an institutional framework has capacity to carry out integration between land-use planning and forest management. • A national agency or an institutional framework has capacity to provide assistance to customary rights holders and private forest owners to manage the forest sustainability.
Forest Management	Planning	<p>Biodiversity and ecosystem risk.</p> <p>Forest fire risk.</p> <p>Illegal logging risk.</p> <p>Unemployment risk.</p> <p>Social risk.</p> <p>Decrease on carbon storage.</p> <p>Shortage of industrial supply.</p>	Has the planning procedures been sound and effective?	Does a management plan have 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 enacts forest owners and managers to assemble or to order forest management plans. • All forests (despite ownership) are managed according to a management plans. If not, percentage of forest area managed according to a management plan is increasing compared with situation certain years ago (for example 5, 10, 20 etc. years). • Management objectives are set rationally for each management unit. Formulation of objective should allow the forest manager to respond flexibly to present and future variations in physical, biological and socio-economic circumstances, keeping in mind the overall objectives of

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					sustainability. <ul style="list-style-type: none"> 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.) A legal/regulatory framework regulates public participation in forest management planning, decision-making, data collection, monitoring and assessment.
			Is the forest inventory conducted in the planning?	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. Forest inventories are made in necessary amount, concentrating on quantities of timber of currently and potentially commercial tree species of the forest for future timber production. If appropriate, representative series of permanent sample plots are established. A national agency or an institutional framework has capacity to carry out supervision about 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 true progressive silvicultural system should be developed by gradually improving on these practices as better

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					information becomes available. The harvesting intensity and the design of harvesting should be integral parts of the silvicultural concept.
				Does the Yield regulation exist?	<ul style="list-style-type: none"> • A legal/regulatory framework describes methods of calculating Annual Allowable Cut (AAC) and imposes it 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 an institutional framework has capacity to carry out supervision about timber yield and to compare it with replacement. • 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, past 3, 5 or 10 years). • A regular reviews of AAC are made (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
			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 assures that environmental issues are taken into account in management planning to maintain or re-establish biodiversity in production forests. • A legal/regulatory framework provides for legal instruments to appropriate regeneration of managed forests, to maintain stability of forest ecosystems. • A national agency or an institutional framework has

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					<p>capacity to maintain, conserve and appropriately enhance biological diversity at the ecosystem and species levels in production forests.</p> <ul style="list-style-type: none"> • A national agency or an institutional framework has capacity to conduct inventories on proportion of area covered by trees significantly older than the acceptable age of exploitation currently used. • A national agency or an institutional framework has capacity to conduct inventories and/or assessments on bio-indicators. • Special inventories show that legal requirements for protection biodiversity in production forests are followed and elements important for biodiversity are maintained.
			Does working plan exist in field operation?	Does the working plan guarantee the respect of environmental standards in field operations?	<ul style="list-style-type: none"> • A national agency or an institutional framework has 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.
			Does the environmental impact assessment exist?	Does the environmental impact assessment complete and adequately integrate into management system?	<ul style="list-style-type: none"> • 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. • A legal/regulatory framework provides for legal instruments for Environmental Impact Assessment (EIA).

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					<ul style="list-style-type: none"> A national agency or an institutional framework has capacity to assure implementation of EIA and to carry out appropriate supervision.
	<p>Harvesting</p>	<p>Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Revenue risk. Unemployment risk. Social risk. Decrease on carbon storage.</p>	<p>Does harvesting consider sustainable practice?</p>	<p>Does Harvesting operations fit into the silvicultural concept, and may, if they are well planned and executed, help to provide conditions for increased increment and for successful regeneration?</p>	<ul style="list-style-type: none"> Harvesting operations should fit into the silvicultural concept, and may, if they are well planned and executed, help to provide conditions for increased increment and 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. A legal/regulatory framework enacts requirements for harvesting operations to ensure that all forestry operations are carried out according to high standards, to ensure economic viability and to avoid negative environmental, economical and social impacts. A national agency or an institutional framework has capacity to control quality of harvesting operations. Supervision and monitoring activities assure that information about harvest operations and actual cut is accurate.
			<p>Does pre-harvest prescription exist?</p>	<p>Does per-harvest prescription sustain the forest after harvesting?</p>	<ul style="list-style-type: none"> 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. A legal/regulatory framework sets requirements for pre-harvest prescription. Supervisions show that detailed prescriptions are drawn up, including measures such as climber cutting, marking of

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					<p>trees to be felled/retained, handling residuals to be retained and indications of extraction direction and felling directions.</p> <ul style="list-style-type: none"> • If appropriate, growing stock of stand is measured before harvest, to be sure that logging companies' reports are right and to avoid timber thefts. • 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 ○ Machine operator responsibilities (directional felling, etc) marking of trees to be retained and trees to be removed.
			<p>Does road and timber extraction consider environmental damage?</p>	<p>Is planning, location, design, and construction of roads, bridges, causeways and fords done so as to minimize environmental damage.</p>	<ul style="list-style-type: none"> • 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 precautions must be taken to avoid damage to roads, forests, soils and water. • A legal/regulatory framework specifies limits to road dimensions and grades, drainage requirements and 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 an institutional framework has

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					capacity to control quality of road construction and timber extraction, and to assure compliance to laws and regulations.
			Does post-harvest stand management?	Does post-harvest stand management secure the sustainability of forest?	<ul style="list-style-type: none"> • A legal/regulatory framework sets requirements to post-harvest forest managements. • A national agency or an institutional framework has 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.
	Forest Protection	Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Illegal used of land. Disaster risk. Conflict risk. Social risk. Damage on water management. Shortage of industrial supply.	Does forest have forest protection from fire and chemical?	Is forest protected from forest disaster?	<ul style="list-style-type: none"> • 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. • A legal/regulatory framework sets requirements to avoid forest fires, and if appropriate, to prepare and to implement fire management plan. • A national agency or an institutional framework has capacity to carry out supervision about preparing and implementation of fire management plans. • A national agency or an institutional framework has capacity to fight with forest fires.
				Is forest protected from chemical in order to secure personnel safety and avoid environment	Instructions for handling and storage of chemicals and waste oils are provided and enforced. Special restrictions are applied near watercourses and other sensitive areas.

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
				pollution?	
	Legal Arrangements	Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Illegal used of land. Conflict risk. Revenue risk. Unemployment risk. Social risk.	Does legal arrangement exist in the forest management?	Is the concession agreement secure the sustainable forest management?	<ul style="list-style-type: none"> • 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; government should receive sufficient revenue to continue its forest management operations. • 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; conditions for renewal and termination. • Concession legislation includes : (a) categories of contracts, and application and granting procedures; (b) objects of the contracts; (c) rights granted and rights withheld; (d) establishment or expansion of local wood-processing units; (e) felling, wood extraction and transport; (f) road construction and improvement of infrastructure; (g) forest management and reforestation; (h) forest taxes, stumpage and other fees; (i) control, supervision, and sanctions for disrespect of concession terms; (j) other general provisions; (k) other environmental considerations.
			Is forest protected from activities that are incompatible with sustainable timber production?	Is forest protected from activities that are 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 an institutional framework has capacity to protect forests from activities that are incompatible with sustainable timber production. • A log-tracking systems, machinery with GPS-equipment or similar control mechanisms are established. • A national agency or an institutional framework has capacity to carry out supervision of logging permits.

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
	Monitoring and research	Biodiversity and ecosystem risk. Forest fire risk. Illegal logging risk. Illegal used of land. Disaster risk.	Does monitoring and research exist?	Does monitoring and research conduct appropriate and effective?	<ul style="list-style-type: none"> 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. A national agency or an institutional framework has 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 of 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.
Socio-economic, Financial and cultural aspects	Relation with local population	Biodiversity and ecosystem risk. Illegal used of land. Conflict risk. Unemployment risk.	Does forest management consider relation with local population?	Does forest management consider relation with indigenous people?	<ul style="list-style-type: none"> The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected. A legal/regulatory framework 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	<ul style="list-style-type: none"> Forest management operations shall maintain or enhance

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
				consider the long term social and economic well-being of forest workers and local communities?	<p>the long-term social and economic well-being of forest workers and local communities.</p> <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 consultation with local people, starting in the planning phase before road building and logging commences; for continued exercise of the customary rights; for concession agreements and other logging permits to cover the extent of assistance, employment, compensation, etc., to be provided.
	Economics, incentives, taxation	<p>Forest fire risk. Illegal logging risk. Illegal used of land. Unemployment risk.</p>	Does the timber management of timber production consider economic aspect?	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"> • 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. • 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 intensified. • 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. • 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

Topic	Sub Topic	Risk	Researchable Question	Sub Researchable Question	Criteria
					<p>parties involved.</p> <ul style="list-style-type: none"> • A national agency or an institutional framework has capacity to assure that all applicable and legally prescribed fees, royalties, taxes and other charges are paid.

MANUAL ON USING GIS AND GPS IN FORESTRY AUDIT

Outline Manual on Using GIS and GPS in Forestry Audit

The manual consist of several topics as follow:

- A. Introduction to Geographical Data
- B. Introduction to GIS
- C. How to use GIS in conducting forestry audit
- D. Limitation in Using GIS
- E. Conclusion

A. Introduction to Geographical Data

Geographical data is the data or information that identifies the geographic location of features and boundaries on earth, usually stored as coordinate and topology and 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?) (gisdevelopment.net)

In fact, we can use this geographical data for a lot of application, such as :

- *Different streams of planning*
urban planning, housing, transportation planning, architectural conservation, urban design, landscape.
- *Street Network Based Application*
it is an addressed matched application, vehicle routing and scheduling: location and site selection and disaster planning.
- *Natural Resource Based Application*
Management and environmental impact analysis of wild and scenic recreational resources, flood plain, wetlands, aquifers, forests, and wildlife.
- *View Shed Analysis*
Hazardous or toxic factories sitting and ground water modeling. Wild life habitat study and migration route planning.
- *Land Parcel Based*
zoning, sub-division plans review, land acquisition, environment impact analysis, nature quality management and maintenance etc.
- *Facilities Management*
can locate underground pipes and cables for maintenance, planning, tracking energy use.

In this manual, we will focus on natural resource based application, especially in forestry. We need geographical data on forestry because the forest has a wide area, so we must choose the appropriate level of interest. And to choose that level of interest we need Geographical Information System (GIS)

B. Introduction to GIS

This chapter describe shortly the definition of GIS, the use of GIS in the audit, especially in forestry audit, and some cases in some country that use GIS in forestry.

The chapter is structured as follow:

a. 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. (www.esri.com)

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. (www.geografiana.com)

b. Why using GIS?

The forest is very vast and sometimes hardly accessible. Imagine if an auditor has to audit a forest with several thousand hectares using conventional methods, how long it will take for he/her to finish the audit? For such wide area, the use of GIS is very helpful. Using GIS we can get many information related to the forest to be audited easily, such as land coverage, the boundary of LICENSED FOREST COMPANY (LFC) , forest boundary, whether plantation or mining activities in has license or not, and many other information.

c. Country cases

There are many examples the use of GIS 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/Final_Projects/1997/KKane/Project.html

C. How to use GIS in conducting forestry audit

The chapter will briefly explain the use of GIS, in what phase of audit GIS will be used, and the know-how of GIS

The chapter will be structured as follow:

a. Who can use GIS?

The users of GIS usually are those who need spatial information. Each user has individual need on how to utilize GIS. In a forestry audit, GIS is used during analysis to determine audit sample.

b. When can we use GIS?

There are several phases in forestry audit, i.e. planning, execution, and reporting. GIS could be used in planning phase while GPS could be used in execution phase as supporting tool.

In the forestry audit planning, GIS could be used to select samples to be audited. With GIS, we could select from various objects that relevant to the audit objective/s. For example, we could use GIS to determine which LICENSED FOREST COMPANY (LFC) that has the highest hot spot, or forest area that has highest level of deforestation, complemented with information where is the location (additional advantage of GIS).

During execution phase of an audit, GPS helps in providing evidence on results of planning from GIS analysis. We can directly go to the point where there is a problem with GPS.

c. How to use GIS? :

How to utilize GIS in forestry audit effectively depend on the research question we are going to answer from the audit. For example:

1. Research question:

Have fire prevention activities performed by UPT PHKA, local forest agency, and holder of LICENSED FOREST COMPANY (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 occur (time series data)
- Spatial data on the administrative boundary of a district
- Spatial data regarding forest zone.
- Spatial data regarding the LICENSED FOREST COMPANY (LFC) boundary

Data processing:

- If hotspot data is still in excel, first, it should be transformed to spatial data. Uses add XY tool provided in GIS. This tool will transform X and Y data (hotspot coordinates) in excel into map coordinates to be used for further analysis.
- Then, intersect hotspot spatial data with district administrative spatial data, forest zone spatial data, and LICENSED FOREST COMPANY (LFC) spatial data. From this intersection will provide new spatial data explaining in which district the hotspot occur, in which forest zone, and in which company.
- Classify the hotspots based on the number for each district in certain zone. Use summarize tool in GIS software. The output is a data in database format (.dbf)
- Then, we present this database in a table of hotspots for each district and each forest area. The example of the result is shown in Figure 1.

Figure 1. Data Requirement for Analysis

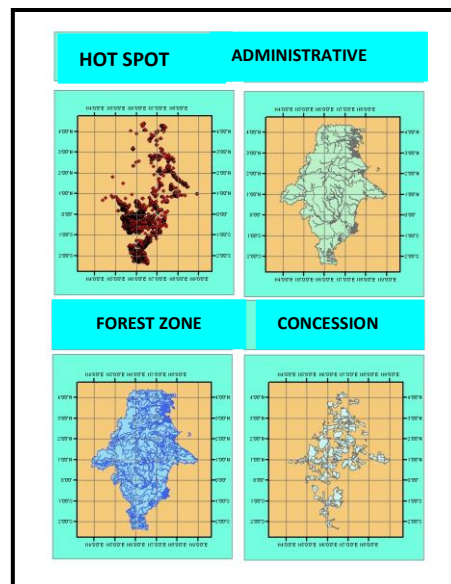


Table 1. Hotspots 2006

DISTRICT	HOT SPOT	Non Forest Zone	Wildlife Conserv	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

Table 2. Hotspot 2007

DISTRICT	HOT SPOT	Non Forest Zone	Wildlife Conserv	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

Table 3. Hotspot change 2006-2007

DISTRICT	HOT SPOT	Non Forest Zone	Wildlife Conserv	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 is BB district as it has additional hotspots as many as 109. However, the largest contribution 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 arrived at the destination, prepare the observation report.

2. Research question:

Did the company cut the tree/timber outside allowed areas?

Minimum data required:

- LICENSED FOREST COMPANY (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 LICENSED FOREST COMPANY (LFC) cut trees outside its ANNUAL CUTTING block from many LICENSED FOREST COMPANY (LFC), we do analysis on deforestation per LICENSED FOREST COMPANY (LFC).
- Intersect time series data on land coverage to obtain the land coverage condition for the beginning of the year and at the end of the year.
- Then, this spatial data is filtered according to data attribute. Since we would like to have deforestation data, identify land coverage data in the form of primary forest in the beginning of the year and in the form of underbrush at the end of the year. As such, we would get spatial data indicating the deforestation.
- We intersect this data with spatial data regarding LICENSED FOREST COMPANY (LFC) to get information in which LICENSED FOREST COMPANY (LFC) the deforestation occurred.
- The next step is to calculate the area of deforestation for each LICENSED FOREST COMPANY (LFC), so that we could list which LICENSED FOREST COMPANY (LFC) to be sampled. After deciding which LICENSED FOREST COMPANY (LFC) has the largest deforestation area, then we do next analysis to identify the fell outside block ANNUAL CUTTING.
- If block map of company ANNUAL CUTTING in JPEG format, this file needs to be processed first, this is called georeferencing. This process would provide coordinate data for every pixel in the JPEG file.
- The output of georeferencing is JPEG file with coordinate. This new data could be overlaid with deforestation spatial data.
- Overlay deforestation spatial data with georeferenced JPEG ANNUAL CUTTING.
- Determine whether deforestation area is inside or outside the ANNUAL CUTTING block. Select area with deforestation outside the ANNUAL CUTTING block
- The following is example of the output:

Figure 2. Deforestation Outside Allowed Area

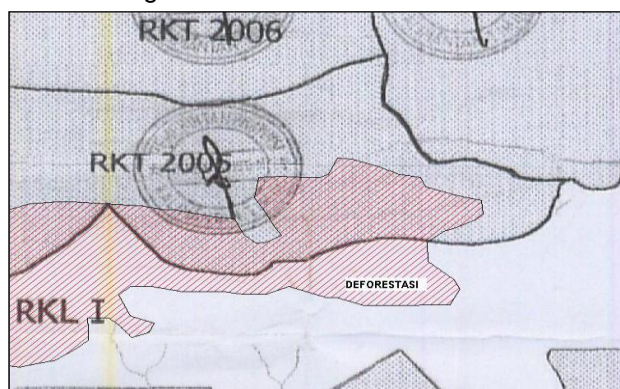
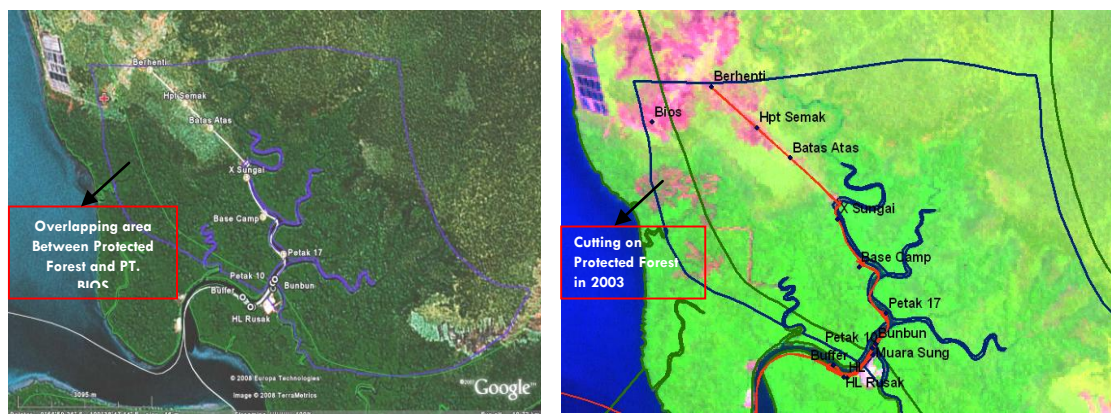


Figure 2. Deforestation Outside Allowed Area



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.
-

3. Research question:

Whether 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 in the beginning of the year with those of in the end of the year to obtain new spatial data regarding the condition of area coverage in the beginning and in the end of the year.
- From this spatial data, do selection based on certain attribute. Select data which has attribute of primary forest in the beginning of the year and underbrush in the end of the year.
- This selection results in spatial data indicating deforestation.
- Intersect this spatial data of deforestation 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 deforestation data with spatial data of district boundary. This intersection provides new data of in which forest zone and in which district deforestation occurred.
- Then, calculate the wide of the area. To calculate the wide, change the projection mode first to Projected Coordinate System appropriate for such area.
- After calculating the wide, summarize the data to obtain a table describing the wide of deforestation for each forest zone and in which district that deforestation occurred.
- Example for the result is as follow:

Table 4. Location of Deforestation

District	Deforestation area (Acre)						
	Non Forest Zone	Protected Forest	Productive Forest	Limited Productive Forest	Wildlife Conserv.	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: number in pink color indicating highest numbers

- From the GIS output, we could see that Protected Forest should be the object as it has the highest deforestation.
- It also could be seen that there is deforestation as wide as 58,50 acres in National Park. As such, select one location in deforestation area (area in green circle).
- After obtaining deforestation area in green circle, we do observation to the area by showing it in Google earth.
- Zoom those detected deforestation area.
- It could be seen that area is not primary forest anymore

Figure 3. Deforestation on National Park

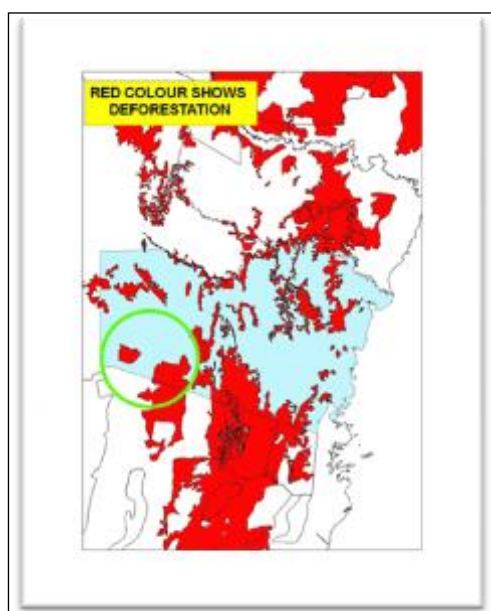
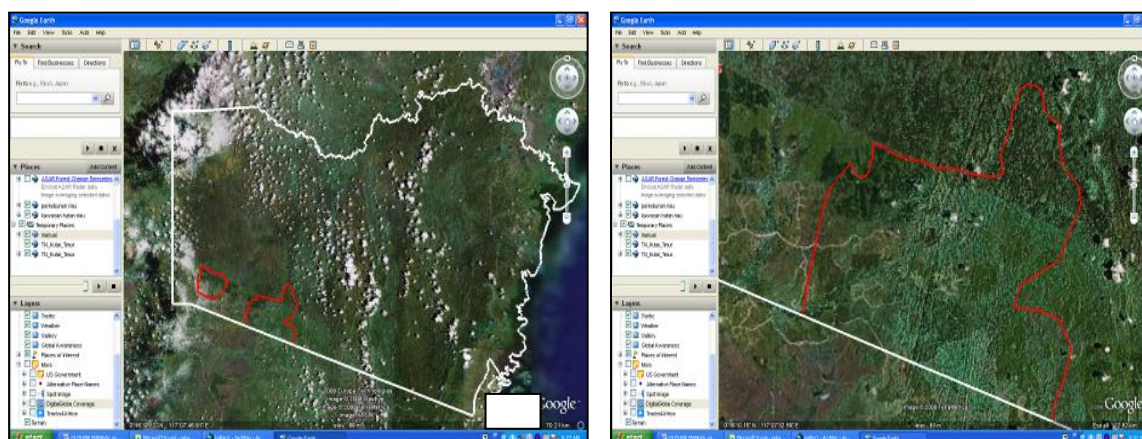


Figure 4. Deforestation on National Park by Google Earth



- Use GPS to navigate us to the determined area.
- After arriving at the area, prepare the report.

4. Research question:

Whether there is land overlapping and inappropriate land utilization?

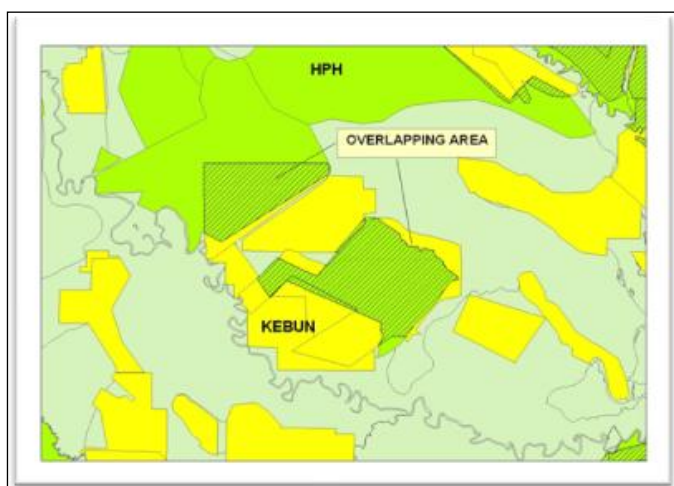
Minimum data required:

- Spatial data of forest zone
- Spatial data of LICENSED FOREST COMPANY (LFC)
- Spatial data of farm
- Spatial data of mine

Data analysis:

- Intersect gradually the above data to obtain new spatial data indicating land overlapping.
- For example, intersecting spatial data of farm with spatial data of LICENSED FOREST COMPANY (LFC) results in new spatial data indicating area of farm that is LICENSED FOREST COMPANY (LFC) also.
- Select area where there is overlapping and in which forest that overlapping occurred. The result can be seen in the following figure.

Figure 5. Overlapping of Land Utilization



From the figure, it can be seen that there overlapping between farm area and LICENSED FOREST COMPANY (LFC) and, after referring to the database, the overlapping 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 :

Whether there is plantation in forest zone?

Minimum data required:

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

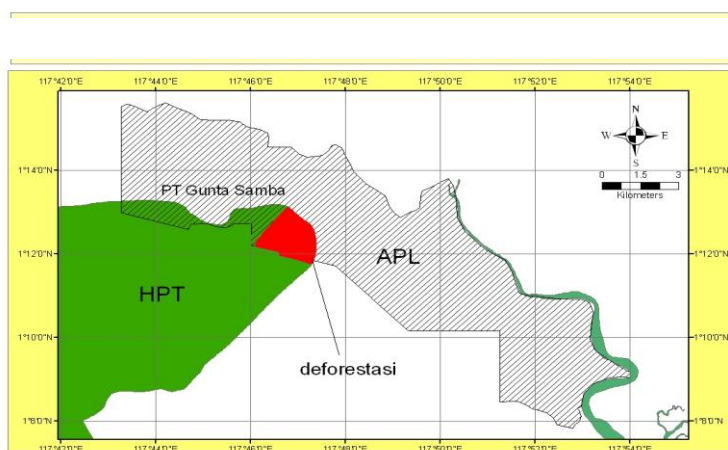
Data analysis:

- Intersect spatial data of area coverage in the beginning of the year with those of in the end of the year to obtain new spatial data regarding the condition of area coverage in the beginning and in the end of the year.
- From this spatial data, do selection based on certain attribute. Select data which has 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 to obtain plantation data complemented with in which area of primary forest that plantation occurred.
- To identify which plantation industry that is 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 6. Plantation on Forest Zone



D. Limitation in Using GIS

The chapter will explained the limitation of the GIS that should be aware of by the auditors

There are some limitations in using GIS. Referring to 5 components of GIS, the limitations are:

a. Data

Remote sensing data used as database in GIS is limited and expensive (especially for updated version). Because of this limitation, BPK attempt to get already available data.

For example:

- 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) (not available for current position)
- Google Earth.

b. Hardware :

To build a complete GIS laboratory needs much fund.

BPK RI started using GIS with Laptop having 2GB DDRAM only.

c. Software :

Cost for license is expensive. Yet, there is also open-source GIS software.

For the software, BPK opted to use one single user licensed software, and rely on open-source software for the rest.

d. People :

The use of GIS requires specific skills and not all auditors can use it

BPK has 5 auditors who have capabilities of using GIS, one auditor is GIS Manager, one auditor is GIS Analyst, and the rest are GIS Operator.

e. Method :

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.

E. Conclusion

This chapter will conclude what was explained in the previous chapters and explain the lessons learned

The use of GIS in audit of forestry rely on auditors readiness and willingness to utilize resource as minimum as possible. Creativity is necessary to process limited data available. Using simple analysis of intersect data, we can get many beneficial information.

CASE STUDY OF FORESTRY AUDIT

The main objective of this chapter is to provide Supreme Audit Institutions (SAIs) information about audits on forestry practices from around the world. Whenever possible, the examples include information on the audit objectives, scope, findings, and recommendations.

The chapter is divided into the following 9 (nine) sections which cover the main forestry topics below:

1. Illegal Used of Land
2. Biodiversity and Ecosystem Lost
3. Forest Fire Risk
4. Deforestation and Forest Degradation
5. Climate Change
6. Revenue Risk
7. Social risk
8. Shortage of Industry Supply Risk
9. Water Management

Each section contains a general audit approach that includes:

- A short background
- Audit criteria from international conventions, legislation, policies, and programs
- Case study from SAIs

A. Illegal Used of Land

Title : REPORT ON PROTECTION OF FORESTS, By TURKISH COURT OF ACCOUNTS

Audit objectives

Objective of this audit is to ensure;

1. identification of legal and administrative regulations preventing effective and efficient conduct of forest protection activities together with risky factors in implementation and taking necessary measures,
2. that the General Directorate of Forestry carry out its activities in line with realistic and clear aims and objectives,
3. conduct of productive activities for more effective protection of our forest assets

Audit Scope

Implementation of safeguard activities in a more effective and efficient manner by way of identifying the risks threatening forests, mainly the activities of General Directorate of Forestry

Audit Criteria

1. Conduct of forest surveying activities within the scope of a plan with attainable annual objectives and in line with priorities,
2. Ensure land registry of the completed surveying activities,
3. Ensure timely and complete access of survey committees to the information they need during the course of their activities,
4. Practice exclusion of lands from forest areas based on scientific principles and procedures.

Findings

1. In Milas Forest Management Directorate, 109.747 of the overall 154.767 hectares of forest area were surveyed and no survey was done in 6 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 register office. Number of cases still processed only with the cadastral court was found to be 145.
2. It was observed within the purview of Marmaris Forest Management Directorate that the cadastral procedures had been completed, 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 and that approximately 182 of the 243 hectares of land excluded from the forest area within sub-provincial boundaries.

B. Biodiversity and Ecosystem Lost

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 Sneznik and Kocevko Kolpa and in Risnjak National Park.

Audit objectives.

To assess the appropriateness of the institutional framework for the conservation protection of biodiversity and the efficiency of establishment of management of the protected area

Audit Scope

1. The establishment of management of the protected areas
2. The implementation of the measures for the protection of the large carnivores that exist in the forest

Audit Criteria

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

Findings

1. The cooperation between the two countries exist on the area of research and individual projects but there is less cooperation on the institutional level that would contribute to defining the policy of the sustainable development
2. The cooperation between countries exists also on the area of the management of large carnivores though mainly referred to scientific and research activities namely by implementing projects. Currently they cooperate in a project of monitoring the populations of lynx in both countries
3. The area of conservation and protection of forest the cooperation of the two countries is not institutionalized.

C. Forest Fire

Title : Italian Court of Auditors

Case study of an environmental audit regarding forecasting, preventing and actively combating forest fires

Audit objectives

To measure adopted and the related results achieved in terms of environmental education on all the aspects provided by Italian legislation; procedures for procuring firefighting aircraft, bearing in mind the initiative taken by the European Commission against the Administration regarding helicopter procurement; supervising and reusing central government budgetary allocations to assignees remaining unspent; 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 demand a coherent and organic 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.

D. Deforestation and Forest Degradation

Title : Planning of logging in State Forest Management Centre

Österreichischer Rechnungshof (Austrian Court of Audit)

Report; Bericht des Rechnungshofes Reihe Bund 2008/11; published in November 2008

Audit objectives

to assess whether the value of state forest is to be retained and whether the planned cutting volumes ensure the sustainable management of state forest.

Audit Scope

RMK's activities in planning the logging during the period of 2003–2006

Audit Criteria

Forest Act

Findings

1. RMK's accounting of cuttings in state forest is not accurate.
2. State forest management is planned on a short-term basis. In planning the logging in state forest, RMK does not meet several requirements of forest management planning and employs data, which shows larger area of standing crop than is actually available.
3. Planning of logging in RMK is not transparent and the exchange of information between different administrative levels is distracted.
4. Centre of Forest Protection and Silviculture (hereinafter CFPS) has not fulfilled its purposes in establishing state forest management plans.
5. The annual volumes maximally permitted to cut from the state forest, as proposed to the Government of the Republic for its approval, are not based on data of sufficient reliability.
6. In all seven forest districts included in the audit sample, the audit identified cases of forest stands, where RMK had planned cuttings, which violated the requirements of forestry law.

E. Climate Change

Title : EMISSION TRADING SYSTEM

Österreichischer Rechnungshof (Austrian Court of Audit)

Report; Bericht des Rechnungshofes Reihe Bund 2008/11; published in November 2008

Audit objectives

To investigate whether the specifications and targets of the emission trading system were realistic. The contribution of the emission trading system to reaching the Kyoto targets by allocating certificates was to be evaluated.

Audit Scope

1. Allocation of emission allowances covering the periods 2005 to 2007 and 2008 to 2012
2. Actual use of emission allowances during the first period
3. Administration, costs and benefits of the system

Findings

1. The European Emission Allowance Trading Directive (October 2003) is the statutory framework concerning emission allowances, plants and gases to be included, the allocation and the registration of emission allowances, emission monitoring and sanctions.
2. In the first period 197 plants were included in the Austrian emission trading system. From 33 million emission allowances annually distributed 38 % were allocated to plants of the energy sector and 62 % to plants of the industry sector. Generally speaking the allocated emission allowances corresponded to the CO₂ emissions. The relative amount of CO₂ emissions of the specific plants differed significantly. In 2006 the biggest plant emitted approx. 13 % of the total emissions, while all plants with emissions of less than 10000 t CO₂ per year (about one third of all plants included) emitted less than 1 % thereof. In Austria the emission trading system covered about 42 % of the total CO₂ emissions. To extend the effect of the system, the inclusion of other relevant emitters such as air traffic or chemical industry as well as the inclusion of other gases beside CO₂(e.g. N₂O) was recommended.

F. Revenue Risk

Title : NAO of Estonia, AUDIT REPORT

Planning of logging in State Forest Management Centre
Estonia National Audit Office

Background

Forest covers half of Estonia, while just over a third of it belongs to the State. In the state forest administered by the Ministry of the Environment, reforestation, tending, use and protection of forest 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 with 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 observing that current cutting volumes would not damage the environment and decrease prospects of future logging.

Audit Objectives:

1. To assess how the planning of logging in the state forest administered by the Ministry of the Environment affects the value of state forest,
2. To answer the question of whether the State Forest Management Centre manages the state forest in a way in which the retention of forest's value is ensured.

Audit Scope

1. The Ministry of the Environment and the State Forest Management Centre as its subordinate agency. In the course of the audit, data was also collected from the
2. Centre of Forest Protection and silviculture, the Environmental Inspectorate and County Environmental
3. The period audited was from 2003 to 2006

Audit Criteria

1. Forest Act 2006
2. Forest Register – a national register for accounting of forest resource, which is established by the
3. Resolution no. 294 of the Government of the Republic on 7 October 1999.

Findings

1. RMK's accounting of cuttings in state forest is not accurate
2. State forest management is planned on a short-term basis
3. In planning the logging in state forest, RMK does not meet several requirements of forest management planning and employs data, which shows larger area of standing crop than is actually available
4. Planning of logging in RMK is not transparent and the exchange of information between different administrative levels is distracted
5. Centre of Forest Protection and Silviculture (hereinafter CFPS) has not fulfilled its purposes in establishing state forest management plans

6. The annual volumes maximally permitted to cut from the state forest, as proposed to the Government of the Republic for its approval, are not based on data of sufficient
7. Reliability
8. In all seven forest districts included in the audit sample, the audit identified cases of forest stands, where RMK had planned cuttings, which violated the requirements of forestry law

Recommendations

1. To organize the management of RMK in a way in which its internal control system would ensure reliable and correct accounting of the areas and volumes of cuttings
2. To analyze and, if necessary, to rearrange the organization of state forest inventory, preparation of forest management plans and forest management in a way in which the possible conflict of interests would be eliminated.
3. To recommence forest management planning in the state forest managed by RMK
4. To ensure that CFPS fulfills the duties assigned to it and requests RMK for formal forest
5. management plans
6. To improve the performance of County Environmental Departments and the Environmental Inspectorate in the field of state forest in order to prevent violations of the Forest Act.
7. To assess consistently the effect of state forest management on the value of state forest as state's biological assets.

G. Social Risk

Title : Performance and Governance Series

Environment Audit Report, June 2002

The Impact of Eucalyptus Plantations on The Environment Under The Social Forestry Project Makaland-Dir. Director General Audit N-W.F.P, Auditor General of Pakistan, Islamabad

Audit Objectives

1. To inspect of a watercourse in the Malakand hills
2. To assess the sustainability aspect and the likely impacts of all project activities and programs on the environment

Scope

plantations of *Eucalyptus camaldulensis* in Malakand-Dir region on an area of 22071.285 ha (54,497 acres) 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 survey
Field visits to project area were made to record interviews, take photographs of plantations and prepare video-clips for future CD ROM Development.

Criteria

The long-term objectives of the project:

1. Restore suitable vegetation to the denuded hillsides and marginal farmlands to create an ecologically and economically improved living environment on a sustainable basis.
2. Further develop an extension approach for these field activities.
3. Stimulate institutionalization of this extension approach at local level and within the N-W.F.P Forest Department.
4. In addition to the above objectives the project also emphasized institutional developmental, community organization, range land 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 the social forestry in the Forest Department.

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* plantations that have been carried out on a very large scale over the past 13 years resulting in an approximate 14.723 million *Eucalyptus* trees. *Eucalyptus camaldulensis* is a tree capable of surviving 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 creating a drain on the water resources.
2. Loss of Nutrients
It was observed that the tree is a fast producer of biomass merely because of the large amount of water and nutrient intake as 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 of *Eucalyptus* trees.
3. Allelopathy
The tree has visible and scientifically established allelopathic effects on agricultural crops and other plants due to soil poisoning and toxicity. It is generally believed that oil-rich *Eucalyptus* leaf litter makes the soil toxic for seed germination and plant growth and thereby reduces the yield potential of most agricultural crops, certain grasses and even young *Eucalyptus* saplings.
4. Ecological and Social Hazard
The tree exhibits a number of ecological and social hazards. It has been established as a big fire hazard due to its inflammable leaf litter. In Australia, the USA and India, fires have devastated huge plantations. The roots system of *E. camaldulensis* has tampered with the under ground utility services in the Hayatabad Township, Peshawar where *Eucalyptus camaldulensis* trees were cut on a large scale since they had choked and broken the under ground water supply, sewer and drainage pipes. Roadside plantations of *E. camaldulensis* posed a threat to road travelers and traffic since the tree was liable to breakage during strong winds. The trees have protruded into the drinking wells in the project area contaminating 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 and it has therefore 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 since it has twisted and knotted fibre of short length, highly susceptible to breakage in stress conditions. The locals contend that as compared to other trees, it has little sale price in the market. They do not prefer to use *Eucalyptus* as fire wood, since they claim, it emits smoke, it has a disagreeable odour of eucalyptus oil and it burns to ash and has thus low heat value.
7. Soil Erosion
The tree is found to contribute to soil erosion since the leaves do not decompose soon 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.
8. Pests and Disease
It has been known from many *Eucalyptus* growing countries and from experiments in research institutions in Pakistan that *Eucalyptus* has susceptibility to termite attacks. Other diseases might crop-up in the new ecological settings of Malakand-Dir region.
9. Climate
Monoculture i.e. singletree plantations have definitely cast an adverse effect on the environment by creating an imbalance in the biodiversity cycle. The plantations have an effect on the microclimate of the locality because of greater evapotranspiration, change 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 Achievement
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 stake holders including community members on research findings and experiences regarding the characteristics of 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 as sample population revealed that the majority respondents were of the opinion that

Eucalyptus plantations had lowered both fertility and the water table. The majority of the respondents believed that *Eucalyptus* had allelopathic effects on the environment and 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 may therefore be planted in rain fed areas with over 700 mm of annual rainfall after proper planning and assessment.
2. A 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 in consonance with water/nutrient availability. This will be like appropriating the water/nutrient budget in the locality to each consumer to avoid imbalance. The nature and quantity of the ground water resources need also be determined.
3. Adequate thinning should be done in the monoculture plantations to reduce the number of trees and also to widen the gaps between trees. 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 and as a matter of policy monoculture should be disallowed. Fruit orchards and economic olive need be proliferated profit. Orchard trees certain shrubs like *Dodonaea viscosa* (Ghwarraskay or Sanatha) need be planted and properly managed to attain economic uplift of the people and fulfill fire wood requirement.
4. Soil nutrient balance should be critically examined and tree leaves and barks should not be removed from the forests floor so as to prevent further depletion. 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 maintaining the balance of soil organic matters and Nitrogen.
5. *Eucalyptus* being a high consumer of water and soil nutrients, may therefore be planted and replicated in rain fed areas that has over 700 mm of annual rainfall after proper planning and assessment.
6. Forest policy need be strengthened to make environmental impact assessment studies mandatory for project appraisal and approval.
7. Sustainability issues need be linked to feasibility studies and should be made compulsory.
8. Rehabilitation of the damaged ecosystem be ensured through mitigative measures so as to arrest further decline of resources.
9. Problematic, waterlogged and saline areas should be reclaimed by planting *Eucalyptus* trees at scientifically planned proper intervals.
10. *Eucalyptus* plantations for shelterbelts and windbreaks need also be made in a planned manner.
11. Forest policy 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.
12. The restoration and rehabilitation of the damaged ecosystem be ensured through mitigative measures through community participation since recovery in the normal course cannot be envisaged even over a long period of time.
13. Rotation and diversification of crops may also serve to replenish depleted soils.
14. The overall impact on the environment at the national level by the tremendous number of eucalyptus trees growing in the country need be critically examined and a policy framed to regulate their numbers keeping in view the water nutrient budget and other matters associated with the tree.

H. Shortage of Industry Supply Risk

**Title : Performance Audit Inbrief
Sustaining Native Forest Operations-Forest NSW
April 2009-05-18 The Audit Office of New South Wales**

Audit Objectives

To assess whether Forests NSW manages the supply of hardwood to meet wood supply commitments and sustain our native forests.

Scope

The management and maintenance of state forest and timber supply of Forest NSW

Criteria

1. Does Forests NSW know how much native forest and plantation hardwood is available for harvesting, presently and in the future?
2. Has Forests NSW promised to sell more native forests and plantation hardwood than it can sustainably supply?

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 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 re-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 challenge for Forests NSW to manage.
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 which 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 property.
9. 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

Recommendations

1. To improve its knowledge of timber availability, we recommend that Forests NSW review its yield estimates for southern region and its hardwood plantations and compare actual harvest results with yield estimates.
2. To address business risks, we recommend that Forests NSW simplify and improve timber pricing and develop better way of meeting its private property targets.
3. To recommend the Minister responsible for native forest operations include yield review requirements that allow for a non-compensable reduction in allocation, in all future wood supply agreements.

I. Water Management

Title : Water Quality Risk
Idaho Department of Health and Welfare
Division of Environmental Quality
1410 North Hilton Street
Boise, Idaho 83706, February 1997
(Forest Practices, Water Quality Audit, 1996)

Background :

The *Rules and Regulations Pertaining to the Idaho Forest Practices Act* (Idaho Department of Lands 1992) are identified in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (Idaho Department of Health and Welfare 1996) as the approved best management practices for water quality protection from silvicultural activities. The forest practices audit is one step that is needed to determine if silvicultural management practices are being implemented and maintained on the ground, and if they are being effective in controlling water pollutants.

Audit Objectives

To address a number of other issues having an impact on water quality that do not directly pertain to the Idaho forest practices rules

Audit Scope

The 1996 audit was not intended to be statistically robust or to evaluate the cumulative effects of forest practices within a specific drainage. We based our conclusions and recommendations on the rule-by-rule evaluation as well.

Audit Criteria

1. The Forest Practices Water Quality Management Plan (Bauer et al. 1988)
2. Memorandum of Understanding Implementing the Nonpoint Source Water Quality Program in the State of Idaho (Idaho Department of Health and Welfare et al. 1993)
3. The Rules and Regulations Pertaining to the Idaho Forest Practices Act (Idaho Department of Lands 1992)
4. Water Quality Standards and Wastewater Treatment Requirements (Idaho Department of Health and Welfare 1996)

Findings

1. Grazing and mining impact
Sediment delivery to stream channels and stream bank trampling were the primary impacts observed by the audit team. The forest practices rules are not intended to deal with grazing and mining water quality issues
2. Pre FPA logging
Sediment delivery is the primary water quality impact from the pre-FPA logging. Reduced large woody debris and shading were observed as secondary impacts.
3. Road closure breaching
Three of the five sales were observed to be delivering sediment to streams.
4. Water quality and fire management conflicts
Conflicts between water quality and fire management were observed on one federal, one state and one industrial timber sale. The conflict was the placement or size of fire lines in stream protection zones which resulted in sediment delivery or reduced stability of stream channels.
5. Fill compaction
Improperly compacted fills may take years to become evident or to fail, but when they do, they generally trigger major sediment delivery directly to streams.

Audit Recommendations

1. We recommend that public and endowment land managers implement and evaluate grazing and mining practices consistent with forest practices and to a greater extent than currently done.
2. We recommend the cumulative watershed effects process (IDL 1995) or other watershed analysis and monitoring process should be used to identify areas impacted by pre-FPA logging.
3. We recommend that land managers increase their efforts to explain why road closures are needed on a site-specific basis
4. We recommend that fire managers be made more aware of water quality issues. We suggest that the Idaho fire hazard reduction rules be modified to require consideration of water quality in the placement and magnitude of fire management practices.
5. We recommend Idaho Department of Land and the Forest Service assess road fill stability in their internal audits

GLOSSARY

Audit	:	Action of examining or verifying accounts
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	:	Preventing extinction or reduction in range
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
Criteria	:	Standard, rule, or principle for evaluating or testing something
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	:	maintain companies, communities and families that are economically dependent on forests
Ecosystem	:	A natural unit consisting of all plants, animals and micro organism in an area functioning together with all of the non living physical factors of the environment
Erosion	:	Removal of solids (sediment, soil, rocks and other particles) in the natural environment
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 resulted from forest like 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)
Global Positioning System	:	Global Navigation Satellite System (GNSS) developed by the United States Department of Defense
Government	:	The body within an organization that has authority and function to make and the power to enforce laws, regulations, and rules

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	: An instrument for measuring and recording something
Key player	: Individual or parties involved such as national/federal government, provincial government, local government, private sector, NGO, and communities in or near forest
Mitigation	: An effort to make less in intensity
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 that is 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	: Providing independent assurance on the risk management and producing an opinion on the extent to which soundness what have been implemented and maintained to mitigate the significant risks
Sedimentation	: The motion of molecules or particles in response to an external force
Silviculture	: Controlling establishment, growth, composition, health, and quality of forest to meet diverse needs and values of the many landowners, societies and cultures over the parts of the globe that are covered by dry land
Social sustainability	: Related to the forest's role in maintaining the human community that depends upon the forest
Sustainable forest management	: 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
Woodlands	: An area covered in trees, usually at low density, forming an open habitat, allowing sunlight to penetrate between the trees, and limiting shade

