

## MULTIPURPOSE SUSTAINABLE FOREST MANAGEMENT

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### Contents

1. Role of Forests
2. Sustainability
  - 2.1. World Commitment to Sustainability
  - 2.2. Criteria and Indicators of Forest Sustainability
    - 2.2.1. Detailed List of Indicators by Criteria
  - 2.3. Applying the Criteria and Indicators
3. Conservation of Biological Diversity
  - 3.1. Forest Clearing
  - 3.2. Harvesting and Forest Ecology
  - 3.3. Habitat Retention
  - 3.4. Ecosystem Diversity
4. Productive Capacity of Forest Ecosystems
  - 4.1. Factors Determining Productive Capacity
  - 4.2. Inventory of Forest Resources
  - 4.3. Predicting Future Production
  - 4.4. Production Over Many Forest Rotations
  - 4.5. Harvesting Impacts on Productive Capacity
  - 4.6. Production of Non-Wood Products
5. Forest Ecosystem Health and Vitality
  - 5.1. Loss of Health and its Consequences
  - 5.2. Diagnosing the Cause and its Impact
  - 5.3. Management of the Problem
  - 5.4. Threats to Plantation Monocultures
6. Conservation and Maintenance of Soil and Water Resources
  - 6.1. Soil Erosion
  - 6.2. Maintaining Soil Properties
    - 6.2.1. Soil Structure and Cultivation
    - 6.2.2. Nutrients
    - 6.2.3. Water Holding Capacity
  - 6.3. Water Catchment Management
7. Maintenance of Forest Contribution to Global Carbon Cycles
  - 7.1. Carbon Sequestration by Forests
  - 7.2. Effects of Increasing Atmospheric Carbon Dioxide on Forests
  - 7.3. Sequestered Carbon as a Forest Product
  - 7.4. Bioenergy Plantations
8. Socioeconomic Issues and Forest Management

## 8.1. Social Constraints to Management

## 8.2. Role of Governments

Acknowledgements

Glossary

Bibliography

Biographical Sketch

## Summary

Only over the later part of the twentieth century has the role of forests in the global environment become appreciated fully. Forests are crucial to the conservation of soil and to the provision of clean water. They are the richest reservoir of terrestrial biodiversity. They link the land and the atmosphere, and so affect global climate. They are also an important economic resource, providing food, firewood, medicines, honey, recreational activities, water catchment protection, and consumables, such as paper and building timber. This article considers how forests are managed to ensure that the things forests provide will never be lost to present or future generations. It is noted that governments have yet to make international agreements to ensure long-term sustainability of forests. However a list of criteria against which forest sustainability may be judged has been developed internationally. These include: the maintenance of biological diversity, productive capacity, health and vitality, and soil and water resources; the contribution to global carbon cycles; the socioeconomic benefits to societies; and the need for governments to provide a suitable legal, institutional, and economic framework for forest conservation and sustainable management. Each of these issues is discussed. The impact of forest management practices is considered, and practices used to minimize those impacts described. Major issues discussed include the impact of clear felling, the retention of habitat diversity for floral and faunal conservation, management of pest and disease threats, the maintenance of the long-term productivity of forests after repeated rotations, inventory requirements to assess the forest resource, and management practices to maintain the integrity of forest soils. The article concludes with discussion of the constraints to forest management imposed by social issues within rural communities, and of how these must be accommodated by managers, as well as the global political threats, which continue to constrain sustainable forest management.

### 1. Role of Forests

Over most of the two million or so years of the evolution of humankind, forests were seen as mysterious, even fearful, places. They were an impediment to movement by people, they hindered agriculture, and they harbored dangerous animals. But, they were also useful, providing food, firewood and timber. Over eons, large areas were cleared. In more densely populated areas like Western Europe, very little of the natural forest remained even millennia ago. None of the little that remains there at the start of the twenty-first century is untouched by humans.

It was only in the later part of the twentieth century that it was realized that forests are a cornerstone to the maintenance of the environment, together with soil, sea and rivers. Forests are crucial to the conservation of soil, and to the provision of clean water to

rivers. They are the richest reservoir of terrestrial biodiversity, and provide habitat and refuge to wildlife. They are an important link between the land and the atmosphere, and so affect global climate. Through their role in maintaining the environment and in providing useful products, they are an enormously important economic resource. In many developing countries, forests meet the most basic human needs, providing food, the materials for shelter, firewood, and medicines. In both developing and developed countries, they are important industrially, providing consumables such as paper and building timber, together with other products such as honey and medicines, recreational activities, and water catchment protection.

It is now agreed generally throughout the world that sustaining forests is an important part of sustaining nature in general, and humankind in particular. This article is concerned with how modern forests are managed, and how they are affected by that management. Most importantly, it considers what needs to be done to ensure that the things forests provide will never be lost to present or future generations of humankind.

## **2. Sustainability**

### **2.1. World Commitment to Sustainability**

Particularly since the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, the international community has been considering the sustainable use and development of the forests of the world. Perhaps significantly, it could not be agreed in Rio that there should be a legally binding, international agreement on the management, conservation and sustainable development of forests, or indeed on the environment and development in general. Instead, the Conference simply declared the principle that “States have...the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States...”

This means that the world is not yet ready to commit itself formally to ensuring sustainability of the global environment. So dependent are the populations of many countries for direct subsistence on natural resources such as forests, that their governments fear that international restrictions on the use of those resources will damage the welfare of their state. No doubt, this lack of international commitment will ensure that environmental activism will continue to increase throughout the world until it, or a global environmental catastrophe, obliges the international community to address the issue formally.

### **2.2. Criteria and Indicators of Forest Sustainability**

Despite the lack of international commitment to sustainability, many individual countries have become interested in ensuring the sustainable development of their forests. Numerous international meetings have followed the Rio conference to consider the specific issues pertaining to forests. Through these meetings a set of seven criteria has been established within which performance in achieving sustainability might be

judged. These criteria cover the wide range of biological, economic and social issues, which it is believed together make up forest sustainability. They are:

- Conservation of biological diversity.
- Maintenance of productive capacity of forest ecosystems.
- Maintenance of forest ecosystem health and vitality.
- Conservation and maintenance of soil and water resources.
- Maintenance of forest contribution to global carbon cycles.
- Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies.
- Provision of a legal, institutional and economic framework for forest conservation and sustainable management.

Under each of these criteria, a set of “indicators” has been established against which performance against the criteria might be judged. Indicators are generally used by measuring them at a specific time to give a “baseline.” Some years later, they are measured again, and compared with the baseline results to see if performance has improved or not. The set of indicators developed for forestry under each of the seven criteria for sustainability are reproduced in detail below in Section 2.2.1. These indicators were developed particularly for temperate and northern coniferous (boreal) forests. However, they are useful for all forest types and give a good idea of the breadth of issues, which need to be considered in dealing with the sustainability of forest ecosystems. Indeed, the list of criteria provided the basis for the specific issues of sustainability discussed in this article.

### **2.2.1. Detailed List of Indicators by Criteria**

The criteria and indicators listed in the subsections below derive from meetings of the Montreal Process Working Group, and are part of their Santiago Declaration of 1995. They apply to the conservation and sustainable management of temperate and boreal forests.

#### **Criterion 1: Conservation of Biological Diversity**

Biological diversity includes the elements of the diversity of ecosystems, the diversity of species, and genetic diversity in species.

#### **Indicators for Criterion 1 by Category:**

- Ecosystem diversity:
  - Extent of area by forest type relative to total forest area.
  - Extent of area by forest type and by age class or successional stage.
  - Extent of area by forest type in protected area categories as defined by IUCN or other classification systems.
  - Extent of areas by forest type in protected areas defined by age class or successional stage.
  - Fragmentation of forest types.
- Species diversity:
  - The number of forest dependent species.

- The status (rare, threatened, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment.
- Genetic diversity:
  - Number of forest dependent species that occupy a small portion of their former range.
  - Population levels of representative species from diverse habitats monitored across their range.

## **Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems**

### **Indicators for Criterion 2:**

- Area of forest land and net area of forest land available for timber production.
- Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production.
- The area and growing stock of plantations of native and exotic species.
- Annual removal of wood products compared with the volume determined to be sustainable.
- Annual removal of non-timber (also termed non-wood) forest products (e.g., fur bearers, berries, mushrooms, game), compared with the level determined to be sustainable.

## **Criterion 3: Maintenance of Forest Ecosystem Health and Vitality**

### **Indicators for Criterion 3:**

- Area and percent and area of forest type affected by processes or agents beyond the range of historic variation, e.g., by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals.
- Area of forest subjected to levels of specific air pollutants (e.g., sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem.
- Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g., soil, nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as nematodes, arboreal epiphytes, beetles, fungi, wasps, etc.).

## **Criterion 4: Conservation and Maintenance of Soil and Water Resources**

This criterion encompasses the conservation of soil and water resources and the productive function of forests.

### **Indicators for Criterion 4:**

- Area and percent of forest land with significant soil erosion.

- Area and percent of forest land managed primarily for protective functions, e.g., watersheds, flood protection, avalanche protection, riparian zones.
- Percent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation.
- Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties.
- Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities.
- Percent of water bodies in forest areas (e.g., stream kilometers, lake hectares) with significant variance of biological diversity from the historic range of variability.
- Percent of water bodies in forest areas (eg. stream kilometers, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change.
- Area and percent of forest land experiencing an accumulation of persistent toxic substances.

### **Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles**

#### **Indicators for Criterion 5:**

- Total forest ecosystem weight and carbon pool, and, if appropriate, by forest type, age class and successional stage.
- Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing weight, coarse woody debris, peat and soil carbon).
- Contribution of forest products to the global carbon budget.

### **Criterion 6: Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies**

#### **Indicators for Criterion 6 by Category:**

- Production and consumption:
  - Value and volume of wood and wood products production including value added through downstream processing.
  - Value and quantities of production of non-wood forest products.
  - Supply and consumption of wood and wood products, including consumption per capita.
  - Value of wood and non-wood products production as percentage of GDP.
  - Degree of recycling of forest products.
  - Supply and consumption/use of non-wood products.
- Recreation and tourism:
  - Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land.
  - Number of facilities available for general recreation and tourism, in relation to population and forest area.

- Number of visitor days attributed to recreation and tourism, in relation to population and forest area.
- Investment in the forest sector:
  - Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism.
  - Level of expenditure on research and development, and education.
  - Extension and use of new and improved technology.
  - Rates of return on investment.
- Cultural, social and spiritual needs and values:
  - Area and percent of forest land managed in relation to the total area of forest to protect the range of cultural, social and spiritual needs and values.
  - Non-consumptive-use forest values.
- Employment and community needs:
  - Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment.
  - Average wage rates and injury rates in major employment categories within the forest sector.
  - Viability, and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities.
  - Area and percent of forest land used for subsistence purposes.

### **Criterion 7: Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management**

This criterion and associated indicators relate to the overall policy framework of a country that can facilitate the conservation and sustainable management of forests. Included are the broader societal conditions and processes often external to the forest itself, but which may support efforts to conserve, maintain or enhance one or more of the conditions, attributes, functions and benefits captured in criteria 1–6. No priority or order is implied in the listing of the indicators.

#### **Indicators for Criterion 7 by Category:**

- Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:
  - Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process.
  - Provides for periodic forest-related planning, assessment and policy review that recognizes the range of forest values, including coordination with relevant sectors.
  - Provides opportunities for public participation in public policy and decision-making related to forests and public access to information.
  - Encourages best practices codes for forest management.
  - Provides for the management of forests to conserve special environmental, cultural social and/or scientific values.
- Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:

- Provide for public involvement activities and public education, awareness and extension programs, and make available forest related information.
- Undertake and implement forest-related planning, assessment and policy review, including cross-sectoral planning and coordination.
- Develop and maintain human resource skills across relevant disciplines.
- Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management.
- Enforce laws, regulations and guidelines.
- Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:
  - Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments, and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions, in order to meet long term demands for forest products and services.
  - Non-discriminatory trade policies for forest products. Capacity to measure and monitor changes in the conservation and sustainable management of forests.
- Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:
  - Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1–7.
  - Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information.
  - Compatibility with other countries in measuring, monitoring and reporting on indicators.
- Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:
  - Development of scientific understanding of ecosystem characteristics and functions.
  - Development of methodologies to measure and integrate environmental and social costs and benefits into market and public policies, and to reflect forest related resource depletion or replenishment in national accounting systems.
  - New technologies and the capacity to assess the socioeconomic consequences associated with the introduction of new technologies.
  - Enhancement of ability to predict impacts of human intervention on forests.
  - Ability to predict impacts on forests of possible climate change.

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## Biographical Sketch

**Phil West** is a graduate in forestry of the Australian National University and has a Ph.D. in forestry from the same University. In the early part of his professional career he worked as a research forester for the State Forest Service of South Australia in their radiata pine plantations. The bulk of his career has been as a scientist with CSIRO, working in their Tasmanian laboratory. His research specialty is the growth behavior of trees in forests, and the mathematical modeling of growth for the prediction of wood yield in managed forests. He has worked across a wide range of forest types, from plantation forests to tropical rainforests. In his later years with CSIRO, he was the Director of a major research center considering sustainable management practices in the Australian tropical savannas, which occupy the northern third of the continent. He left CSIRO in 1997, and now works as a consultant in forestry, specializing in yield prediction and management practices in plantation forests. He is also an Adjunct Professor of Southern Cross University in northern New South Wales, and teaches units in forestry in their forestry school.