
International and National Criteria and Indicators

The Montréal Process 1995 (1999)
Canadian Council of Forest Ministers 1995
Canadian Council of Forest Ministers 2003

The Montréal Process

1995 (1999) List of Criteria and Indicators

This list was first published in 1995 in *Criteria and indicators for the conservation and sustainable management of temperate and boreal forests: The Montréal process* (http://mpci.org/rep-pub/1995/santiago_e.html).

New numbering, added in 1999, is used in this report and is shown below.

Criterion 1: Conservation of Biological Diversity

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

1.1 Ecosystem diversity

- 1.1.a Extent of area by forest type relative to total forest area
- 1.1.b Extent of area by forest type and by age class or successional stage
- 1.1.c Extent of area by forest type in protected area categories as defined by IUCN or other classification systems
- 1.1.d Extent of areas by forest type in protected areas defined by age class or successional stage
- 1.1.e Fragmentation of forest types

1.2 Species diversity

- 1.2.a The number of forest dependent species
- 1.2.b The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment

1.3 Genetic diversity

- 1.3.a Number of forest dependent species that occupy a small portion of their former range
- 1.3.b Population levels of representative species from diverse habitats monitored across their range

Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems

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

Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

- 3.a Area and percent of forest 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
- 3.b Area and percent of forest land subjected to levels of specific air pollutants (e.g., sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem
- 3.c 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 fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)

Criterion 4: Conservation and Maintenance of Soil and Water Resources

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

- 4.a Area and percent of forest land with significant soil erosion
- 4.b Area and percent of forest land managed primarily for protective functions, e.g., watersheds, flood protection, avalanche protection, riparian zones
- 4.c Percent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation
- 4.d Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties

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- 4.e Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities
 - 4.f Percent of water bodies in forest areas (e.g., stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability
 - 4.g Percent of water bodies in forest areas (e.g., stream kilometres, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity, sedimentation or temperature change)
 - 4.h Area and percent of forest land experiencing an accumulation of persistent toxic substances

Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

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

Criterion 6: Maintenance and Enhancement of Long-Term Multiple Socio-Economic Benefits to Meet the Needs of Societies

6.1 Production and consumption

- 6.1.a Value and volume of wood and wood products production, including value added through downstream processing
- 6.1.b Value and quantities of production of non-wood forest products
- 6.1.c Supply and consumption of wood and wood products, including consumption per capita
- 6.1.d Value of wood and non-wood products production as percentage of GDP
- 6.1.e Degree of recycling of forest products
- 6.1.f Supply and consumption/use of non-wood products

6.2 Recreation and tourism

- 6.2.a Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land
- 6.2.b Number and type of facilities available for general recreation and tourism, in relation to population and forest area
- 6.2.c Number of visitor days attributed to recreation and tourism, in relation to population and forest area

6.3 Investment in the forest sector

- 6.3.a Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism
- 6.3.b Level of expenditure on research and development, and education
- 6.3.c Extension and use of new and improved technologies
- 6.3.d Rates of return on investment

6.4 Cultural, social and spiritual needs and values

- 6.4.a Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values
- 6.4.b Non-consumptive use forest values

6.5 Employment and community needs

- 6.5a Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment
- 6.5.b Average wage rates and injury rates in major employment categories within the forest sector
- 6.5.c Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities
- 6.5.c Area and percent of forest land used for subsistence purposes

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

Criterion 7 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.

7.1 Extent to which the *legal framework* (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:

- 7.1.a 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
- 7.1.b Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors
- 7.1.c Provides opportunities for public participation in public policy and decision-making related to forests and public access to information

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- 7.1.d Encourages best practice codes for forest management
 - 7.1.e Provides for the management of forests to conserve special environmental, cultural, social and/or scientific values

 - 7.2 Extent to which the *institutional framework* supports the conservation and sustainable management of forests, including the capacity to:**
 - 7.2.a Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information
 - 7.2.b Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectional planning and coordination
 - 7.2.c Develop and maintain human resource skills across relevant disciplines.
 - 7.2.d Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management
 - 7.2.e Enforce laws, regulations and guidelines

 - 7.3 Extent to which the *economic framework (economic policies and measures)* supports the conservation and sustainable management of forests through:**
 - 7.3.a 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
 - 7.3.b Non-discriminatory trade policies for forest products

 - 7.4 Capacity to *measure and monitor* changes in the conservation and sustainable management of forests, including:**
 - 7.4.a Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7
 - 7.4.b Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information
 - 7.4.c Compatibility with other countries in measuring, monitoring and reporting on indicators.

 - 7.5 Capacity to conduct and apply *research and development* aimed at improving forest management and delivery of forest goods and services, including:**
 - 7.5.a Development of scientific understanding of forest ecosystem characteristics and functions

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- 7.5.b Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems
 - 7.5.c New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies
 - 7.5.d Enhancement of ability to predict impacts of human intervention on forests
 - 7.5.e Ability to predict impacts on forests of possible climate change

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1995 List of Criteria and Indicators

Taken from *Defining Sustainable Forest Management: A Canadian approach to Criteria and Indicators* (http://www.ccfm.org/ci/framain_e.html).

Criterion 1: Conservation of Biological Diversity

The variability among living organisms from all sources and the ecological complexes of which they are part

1.1 Ecosystem diversity

- 1.1.1 Percentage and extent, in area, of forest types relative to historical condition and to total forest area
- 1.1.2 Percentage and extent of area by forest type and age class (ref. 2.2.1)
- 1.1.3 Area, percentage and representativeness of forest types in protected areas
- 1.1.4 Level of fragmentation and connectedness of forest ecosystem components

1.2 Species diversity

- 1.2.1 Number of known forest-dependent species classified as extinct, threatened, endangered, rare or vulnerable relative to total number of known forest-dependent species
- 1.2.2 Population levels and changes over time of selected species and species guilds
- 1.2.3 Number of known forest-dependent species that occupy only a small portion of their former range

1.3 Genetic diversity

- 1.3.1 Implementation of an in situ/ex situ genetic conservation strategy for commercial and endangered forest vegetation species

Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity

The health, vitality and rates of biological production in forest ecosystems

2.1 Incidence of disturbance and stress (biotic and abiotic)

- 2.1.1 Area and severity of insect attack
- 2.1.2 Area and severity of disease infestation
- 2.1.3 Area and severity of fire damage
- 2.1.4 Rates of pollutant deposition
- 2.1.5 Ozone concentrations in forested regions
- 2.1.6 Crown transparency in percentage by class

2.1.7 Area and severity of occurrence of exotic species detrimental to forest condition

2.1.8 Climate change as measured by temperature sums

2.2 Ecosystem resilience

2.2.1 Percentage and extent of area by forest type and age class (ref. 1.1.2)

2.2.2 Percentage of area successfully naturally regenerated and artificially regenerated

2.3 Extant biomass (biota)

2.3.1 Mean annual increment by forest type and age class

2.3.2 Frequency of occurrence within selected indicator species (vegetation, birds, mammals, fish).

Criterion 3: Conservation of Soil and Water Resources

The maintenance of soil and water quantity and quality

3.1 Physical environmental factors

3.1.1 Percentage of harvested area having significant soil compaction, displacement, erosion, puddling, loss of organic matter, etc.

3.1.2 Area of forest converted to non-forest land use, for example, urbanization (ref. 4.2.1)

3.1.3 Water quality as measured by water chemistry, turbidity, etc.

3.1.4 Trends and timing of events in stream flows from forest catchments

3.1.5 Changes in distribution and abundance of aquatic fauna

3.2 Policy and protection forest factors

3.2.1 Percentage of forest managed primarily for soil and water protection

3.2.2 Percentage of forest area having road construction and stream crossing guidelines in place

3.2.3 Area, percentage and representativeness of forest types in protected areas (ref. 1.1.4)

Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles

The impact of the forest and forest activities on global ecosystem functions

4.1 Contributions to global carbon budget

4.1.1 Tree biomass volumes

4.1.2 Vegetation (non-tree) biomass estimates

4.1.3 Percentage of canopy cover

4.1.4 Percentage of biomass volume by general forest type

4.1.5 Soil carbon pools

4.1.6 Soil carbon pool decay rates

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- 4.1.7 Area of forest depletion
 - 4.1.8 Forest wood product life cycles
 - 4.1.9 Forest sector CO2 emissions

 - 4.2 Forest land conversion**
 - 4.2.1 Area of forest permanently converted to non-forest land use (for example, urbanization) (ref. 3.1.2)
 - 4.2.2 Semi-permanent or temporary loss or gain of forest ecosystems (for example, grasslands, agriculture)

 - 4.3 Forest sector CO2 conservation**
 - 4.3.1 Fossil fuel emissions
 - 4.3.2 Fossil carbon products emissions
 - 4.3.3 Percentage of forest sector energy usage from renewable sources relative to total sector energy requirement

 - 4.4 Forest sector policy factors**
 - 4.4.1 Recycling rate of forest wood products manufactured and used in Canada
 - 4.4.2 Participation in the climate change conventions
 - 4.4.3 Economic incentives for bioenergy use
 - 4.4.4 Existence of forest inventories
 - 4.4.5 Existence of laws and regulations on forest land management

 - 4.5 Contributions to hydrological cycles**
 - 4.5.1 Surface area of water within forested areas

Criterion 5: Multiple Benefits to Society

Sustaining the flow of benefits from the forest for current and future generations

- 5.1 Productive capacity**
 - 5.1.1 Annual removal of forest products relative to the volume of removals determined to be sustainable
 - 5.1.2 Distribution of, and changes in, the land base available for timber production
 - 5.1.3 Animal population trends for selected species of economic importance
 - 5.1.4 Management and development expenditures
 - 5.1.5 Availability of habitat for selected wildlife species of economic importance

- 5.2 Competitiveness of resource industries (timber/non-timber related)**
 - 5.2.1 Net profitability

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- 5.2.2 Trends in global market share
 - 5.2.3 Trends in research and development expenditures in forest products and processing technologies

5.3 Contribution to the national economy (timber/non-timber sectors)

- 5.3.1 Contribution to gross domestic product (GDP) of timber and non-timber sectors of the forest economy
- 5.3.2 Total employment in all forest-related sectors
- 5.3.3 Utilization of forests for non-market goods and services, including forest land use for subsistence purposes
- 5.3.4 Economic value of non-market goods and services

5.4 Non-timber values (including option values)

- 5.4.1 Availability and use of recreational opportunities
- 5.4.2 Total expenditures by individuals on activities related to non-timber use
- 5.4.3 Membership and expenditures in forest recreation-oriented organizations and clubs
- 5.4.4 5.4.4 Area and percentage of protected forest by degree of protection

Criterion 6: Accepting Society's Responsibility for Sustainable Development

Fair, equitable, and effective resource management choices

6.1 Aboriginal and treaty rights

- 6.1.1 Extent to which forest planning and management processes consider and meet legal obligations with respect to duly established Aboriginal and treaty rights

6.2 Participation by Aboriginal communities in sustainable forest management

- 6.2.1 Extent of Aboriginal participation in forest-based economic opportunities
- 6.2.2 Extent to which forest management planning takes into account the protection of unique or significant Aboriginal social, cultural or spiritual sites
- 6.2.3 Number of Aboriginal communities with a significant forestry component in the economic base and the diversity of forest use at the community level
- 6.2.4 Area of forest land available for subsistence purposes
- 6.2.5 Area of Indian reserve forest lands under integrated management plans

6.3 Sustainability of forest communities

- 6.3.1 Number of communities with a significant forestry component in the economic base
- 6.3.2 Index of the diversity of the local industrial base
- 6.3.3 Diversity of forest use at the community level
- 6.3.4 Number of communities with stewardship or co-management responsibilities

6.4 Fair and effective decision-making

- 6.4.1 Degree of public participation in the design of decision-making processes
- 6.4.2 Degree of public participation in decision-making processes
- 6.4.3 Degree of public participation in implementation of decisions and monitoring of progress toward sustainable forest management

6.5 Informed decision-making

- 6.5.1 Percentage of area covered by multi-attribute resource inventories
- 6.5.2 Investments in forest-based research and development and information
- 6.5.3 Total effective expenditure on public forestry education
- 6.5.4 Percentage of forest area under completed management plans/programs/guidelines which have included public participation
- 6.5.5 Expenditure on international forestry
- 6.5.6 Mutual learning mechanisms and processes

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2003 List of Criteria and Indicators

Taken from *Defining Sustainable Forest Management in Canada: Criteria and Indicators 2003* (found at http://www.ccfm.org/3_e.html#publications).

Criterion 1: Biological Diversity

The variability among living organisms and the ecosystems of which they are part

1.1 Ecosystem diversity

- 1.1.1 Area of forest, by type and age class, and wetlands in each ecozone. (Core Indicator)
- 1.1.2 Area of forest, by type and age class, wetlands, soil types and geomorphological feature types in protected areas in each ecozone. (Core Indicator)

1.2 Species diversity

- 1.2.1 The status of forest-associated species at risk. (Core Indicator)
- 1.2.2 Population levels of selected forest-associated species. (Core Indicator)
- 1.2.3 Distribution of selected forest-associated species. (Supporting Indicator)
- 1.2.4 Number of invasive, exotic forest-associated species. (Supporting Indicator)

1.3 Genetic diversity

- 1.3.1 Genetic diversity of reforestation seed-lots. (Core Indicator)
- 1.3.2 Status of *in situ* and *ex situ* conservation efforts for native tree species within each ecozone. (Core Indicator)

Criterion 2: Ecosystem Condition and Productivity

The stability, resilience and rates of biological production in forest ecosystems

- 2.1 Total growing stock of both merchantable and non-merchantable tree species on forest land. (Core Indicator)
- 2.2 Additions and deletions of forest area, by cause. (Core Indicator)
- 2.3 Area of forest disturbed by fire, insects, disease and timber harvest. (Core Indicator)
- 2.4 Area of forest with impaired function due to ozone and acid rain. (Core Indicator)
- 2.5 Proportion of timber harvest area successfully regenerated. (Core Indicator)

Criterion 3: Soil and Water

The quantity and quality of soil and water

- 3.1 Rate of compliance with locally applicable soil disturbance standards. (Core Indicator)
- 3.2 Rate of compliance with locally applicable road construction, stream crossing and riparian zone management standards. (Core Indicator)
- 3.3 Proportion of watersheds with substantial stand-replacing disturbance in the last 20 years. (Supporting Indicator)

Criterion 4: Role in Global Ecological Cycles

The impact of the forest and forest activities on global ecosystem functions

4.1 Carbon cycle

- 4.1.1 Net change in forest ecosystem carbon. (Core Indicator)
- 4.1.2 Forest ecosystem carbon storage by forest type and age class. (Supporting Indicator)
- 4.1.3 Net change in forest products carbon. (Core Indicator)
- 4.1.4 Forest sector carbon emissions. (Core Indicator)

Criterion 5: Economic and Social Benefits

Sustaining the flow of benefits from forests for current and future generations

5.1 Economic benefits

- 5.1.1 Contribution of timber products to the gross domestic product. (Core Indicator)
- 5.1.2 Value of secondary manufacturing of timber products per volume harvested. (Supporting Indicator)
- 5.1.3 Production, consumption, imports and exports of timber products. (Supporting Indicator)
- 5.1.4 Contribution of non-timber forest products and forest-based services to the gross domestic product. (Core Indicator)
- 5.1.5 Value of unmarketed non-timber forest products and forest-based services. (Supporting Indicator)

5.2 Distribution of benefits

- 5.2.1 Forest area by timber tenure. (Core Indicator)
- 5.2.2 Distribution of financial benefits from the timber products industry. (Core Indicator)

5.3 Sustainability of benefits

- 5.3.1 Annual harvest of timber relative to the level of harvest deemed to be sustainable. (Core Indicator)

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- 5.3.2 Annual harvest of non-timber forest products relative to the levels of harvest deemed to be sustainable. (Supporting Indicator)
 - 5.3.3 Return on capital employed. (Core Indicator)
 - 5.3.4 Productivity index. (Supporting Indicator)
 - 5.3.5 Direct, indirect and induced employment. (Core Indicator)
 - 5.3.6 Average income in major employment categories. (Supporting Indicator)

Criterion 6: Society's Responsibility

Fair and effective resource management choices

6.1 Aboriginal and treaty rights

- 6.1.1 Extent of consultation with Aboriginals in forest management planning and in the development of policies and legislation related to forest management. (Core Indicator)
- 6.1.2 Area of forest land owned by Aboriginal peoples. (Core Indicator)

6.2 Aboriginal traditional land use and forest-based ecological knowledge

- 6.2.1 Area of forested Crown land with traditional land use studies. (Core Indicator)

6.3 Forest community well-being and resilience

- 6.3.1 Economic diversity index of forest-based communities. (Core Indicator)
- 6.3.2 Education attainment levels in forest-based communities. (Core Indicator)
- 6.3.3 Employment rate in forest-based communities. (Core Indicator)
- 6.3.4 Incidence of low income in forest-based communities. (Core Indicator)

6.4 Fair and effective decision-making

- 6.4.1 Proportion of participants who are satisfied with public involvement processes in forest management in Canada. (Core Indicator)
- 6.4.2 Rate of compliance with sustainable forest management laws and regulations. (Core Indicator)

6.5 Informed decision-making

- 6.5.1 Coverage, attributes, frequency and statistical reliability of forest inventories. (Core Indicator)
- 6.5.2 Availability of forest inventory information to the public. (Core Indicator)
- 6.5.3 Investment in forest research, timber products industry research and development, and education. (Core Indicator)
- 6.5.4 Status of new or updated forest management guidelines and standards related to ecological issues. (Core Indicator).