

Examples of Mechanisms for the Development, Identification, and Implementation of Subnational Indicators of Sustainable Forest Management That Can Be Linked to National Level Indicators

Abstract

The Montréal Process is an ad hoc intergovernmental process organized to assess national progress toward the goal of sustainable forest management using a common international framework. Some countries are also developing indicators for sustainable forest management for reporting at various subnational levels. Examples of the development of subnational indicators from four Montréal Process nations (Australia, Canada, China, and the United States) illustrate the progress that some countries have made as well as some common and unique challenges in developing subnational indicators.

Although not all countries need subnational indicators, those that do base them generally on the national-level indicators, modified or supplemented as necessary. The processes used involve extensive consultation in various forms, and often local test areas. In some countries, reporting on subnational indicators has started before all indicators have been finalized, in an attempt to implement them as soon as possible.

Introduction

Sustainable development, a concept developed in *Our Common Future* (World Commission on Environment and Development 1987) and subsequent discussions, is seen increasingly as a necessary and desirable objective. Sustainable forest management is the forest sector's contribution to sustainable development. While the Montréal Process characterizes sustainable forest management for the national level, some countries need to identify and implement indicators that could be used to evaluate progress towards sustainability at the subnational level.

The Montréal Process began in 1994 and brings together 12 temperate and boreal forest nations¹ to assess progress toward sustainable forest management at a national level. To achieve this goal, the Montréal Process has developed a set of 7 criteria of sustainable forest management with 67 indicators. Some of the Montréal Process countries, however, have recognized a need for a finer level of assessment and are in various stages of developing subnational indicators and refining national criteria for subnational use. These subnational C&I are generally intended for the use of subnational administrators in assessing their progress or contribution toward sustainable forest management. Because of administrative structure or size, some countries do not need to develop subnational indicators.

Processes of developing and implementing subnational indicators are difficult and present many common and unique challenges for each country, region, or forest management unit engaged in them. This paper presents examples of mechanisms used to develop subnational indicators for sustainable forest management from four Montréal Process nations (Australia, Canada, China, and the United States). The focus here is not on the C&I themselves, but rather on the mechanisms for their identification, development, and implementation. The specific questions asked are:

- (1) How was the need for subnational C&I identified?
- (2) What mechanisms were used to develop the subnational indicators? and
- (3) How were the subnational indicators implemented?

Australia

Identifying the Need for Subnational Indicators

In 1992, Australia developed a National Forest Policy Statement, which led to the development of bilateral Regional Forest Agreements between the national and some state governments for some regions. Australia adopted the Montréal Process C&I of conservation and sustainable management of forests. Reporting on the condition of the forest resources was to be an integral component of management for the full range of forest values. The diversity of biological, social, and economic conditions across the breadth of the forested parts of the continent of Australia clearly required the

¹ Australia, Canada, Chile, China, Japan, Mexico, New Zealand, the Republic of Korea, the Russian Federation and the United States; since 1995, Argentina and Uruguay have joined the Montréal Process. These 12 nations represent nearly 60% of the world's forests. European forests are represented by the parallel pan-European Process.

development of subnational indicators.

The councils of national, state, and territory government ministers responsible for forestry and conservation made a policy decision requiring the public agencies to ensure that the systems of reporting were compatible between subnational and national levels. The subnational systems were based on the Montréal Process.

Developing the Subnational Indicators

The process of identifying the subnational indicators was to call on scientists, policy-makers, and representatives of industry, conservation groups, Indigenous people, unions, and community groups, to contribute to development of subnational indicators using the Montréal Process C&I. That exercise involved the examination of the national level Montréal Process C&I for applicability at the subnational level.

Specialist workshops were held to explore in detail some of the conceptually or pragmatically difficult indicators, for example, ecosystem health, soils, and biodiversity. At two stages in the process, input was sought from large, national, stakeholder meetings. Research priorities were identified and a phased implementation approach was developed.

The subnational framework of indicators coming out of these procedures was then sent for approval by the Ministerial Council on Forestry and the equivalent Council for Environment and Conservation. The final document, entitled *A Framework of Regional (Sub-national) Level Criteria and Indicators of Sustainable Forest Management in Australia*, was released in 1998 by the Commonwealth of Australia (ISBN 0-642-32052-7).

As a result of this process, 30 of the national level indicators unchanged for use at the subnational level were adopted, 10 were not applicable, 25 were reworded to more accurately reflect subnational issues, and 2 indicators were amalgamated with related indicators. Twelve new or interim indicators were developed for use at the subnational level. The Australian subnational indicators are compared with the Montréal Process indicators in Appendix A.

Implementing the Subnational Indicators

The process of developing the subnational set of indicators also classified each indicator according to three categories:

Category A: the indicator could be reported on immediately (that is, the information was currently available or with little effort could be made so for at least a significant proportion of forested land);

Category B: up to 5 years of research was required; or

Category C: more than 5 years of research was needed.

The implementation process is applicable to all forests in Australia on a voluntary basis. Implementation

of reporting on subnational indicators is continuing to evolve. In Tasmania, for example, all category A indicators, and any others for which information is available for that state, have been listed and reviewed by government agencies in the state and national governments, plus by the general public and industry. The National Forest Inventory will produce the first report on Category A indicators for Australia by early 2001.

Example: New South Wales – The need for subnational indicators in New South Wales was identified as a major requirement of the implementation of sustainable forest management² in the forests being reviewed under the national Regional Forest Agreement process.

A mechanism for implementing C&I was developed by a group (comprised of representatives of state and national government agencies, the timber industry, trade unions, conservation groups, and indigenous peoples) convened to address requirements of sustainable forest management. A comprehensive project specification was developed by the group based on the framework of subnational C&I developed for all Australia. This was endorsed by state and Commonwealth governments and included the following steps:

1. *A review of each of the subnational indicators* was done to determine applicability to each of four regions within New South Wales. Regions varied in size from about 800 000 ha to 10 000 000 ha. Data availability, reliability, and access were used to determine sets of indicators that could be reported on immediately;
2. *A consultancy report by an expert group of independent scientists* was commissioned by the group to draw together resource material on current and international trends, and the state of information on the use of C&I; advice was provided on the development of indicators requiring further research before being implemented;
3. *Stakeholder workshops were held* to inform local stakeholders and experts of the process, and to receive their feedback on regional issues affecting the development of indicators;
4. *Specialist expert workshops were held* to provide scientific and technical advice on regional indicator sets and to further develop and refine specific indicators;
5. *Indicators were developed for each region* by the group using the input from the various workshops, meetings, the expert report, and the advice provided by specialist workshops;
6. *Reports were prepared* on “Criteria, Indicators, Targets and Monitoring Processes of Ecologically Sustainable Management” for specific regions to provide a basis for monitoring and reporting by responsible state agencies on the environmental, social, and economic

² Australia has historically used the phrase “ecologically sustainable forest management” where other countries have used “sustainable forest management”. The meaning and uses are the same for both phrases.

performance of forest management in each region. (available at <
<http://www.rfa.gov.au/rfa/nsw/eden/esfm.html> >).

Implementation in New South Wales is an ongoing process in which reports and five-year reviews assist stakeholder groups in implementing the C&I.

Canada

Identifying the Need for Subnational Indicators

Forests in Canada are 94% under federal, provincial or territorial ownership. In 1995, the Canadian Council of Forest Ministers (CCFM), which includes federal, provincial, and territorial ministers responsible for forests, agreed to a set of national C&I for sustainable forest management. These national C&I were developed in consultation with governments, academics, industry, Aboriginals, and other interest groups, at the same time as the Montréal Process C&I. The two sets of national C&I are very similar and are viewed as complementary.

At the various meetings involved in developing the national C&I, it became clear that no single set of C&I could satisfy the needs of all regions and all scales. Local and provincial managers, increasingly interested in C&I for their potential application to certification, began to seek mechanisms for developing subnational indicators.

Developing the Subnational Indicators

One of the major mechanisms for developing subnational indicators in Canada has been Canada's 11 model forests, established in representative forest regions of the country for developing sustainable forest management practices. Each model forest represents a partnership consisting of a broad range of interests which may include educational institutions, industry, Aboriginal groups, governments at all levels, community and public interest groups, environmental organizations, recreation associations, and others. One of the model forests is specifically designed to explore the effectiveness of a framework where Aboriginals have the leadership role and are not just another partner. To assess their progress toward sustainable forest management, each model forest board is testing and developing indicators for use within its region.

In keeping with the participatory concept of the model forests, a series of stakeholder meetings was held in each model forest to develop local sets of subnational indicators. The Model Forest Network, which links all the sites, regularly exchanged notes and experiences in order that each model forest might benefit from the progress made in the others. In most cases, the national indicators were used as a starting point and adjusted to suit local needs and conditions. Although this has led to indicator sets that are well-tailored to the needs of each region and are linked to the national set, this decentralized process has also meant that the resulting subnational indicator sets differ from each other in several respects.

At another subnational level, several of Canada's provinces have also engaged in defining C&I, generally starting with the national C&I. Quebec, Ontario, Saskatchewan, and Newfoundland are in various stages of developing provincial indicators; in some cases, reporting on these indicators is

expected to be required by law.

As an example of the mechanism used, in the province of Quebec, a workgroup in the provincial government was established to develop subnational indicators for the province. This group started with the national indicators, largely because many of the group members had been part of the team that developed the CCFM C&I. The national criteria were adopted, and individual indicators were adapted, replaced, and added as needed to reflect provincial requirements. This process involves extensive consultation with partners in industry, academia, Aboriginal groups, and other interested parties. A draft document was widely circulated to stakeholders for comment, appropriate revisions made, and the new draft circulated again. This process is ongoing.

Implementing the Subnational Indicators

Within the model forests, reporting on the various local-level indicators has started with those for which data are most readily available. Because the model forests have strong research components, the capacity to report on most indicators is not expected to require a great deal of additional research, and much of the reporting is being done in the form of scientific or technical publications in the normal course of research activities. The model forest indicators are being used outside the model forests themselves. For example, the government of Newfoundland and Labrador, a partner in the Western Newfoundland Model Forest, has worked closely with that model forest in developing indicators (Appendix B) and a guide to C&I used by the province in all its forest management offices (“Sustainable Forest Management: A Practical Guide to Using Criteria and Indicators” is available at <<http://www.wnmf.com/guidetoc.htm> >).

Although Quebec’s provincial C&I are not all finalized, implementation has begun. As the Quebec government already holds large computerized databases, collected for other purposes, several indicators can already be reported on. The intent is that any data relevant to reporting on provincial C&I will eventually be accessible through the Internet, as a tool set for evaluation of progress toward sustainable forest management in Quebec.

China

Identifying the Need for Subnational Indicators

The national *Framework of Criteria and Indicators for Sustainable Forest Management in China* was drafted by the Sustainable Forestry Research Centre of the Chinese Academy of Forestry, based on the Montréal Process C&I. Comments were supplied by various divisions of the State Forestry Administration and the final document was then approved by the State Forestry Administration of China.

Among the main challenges facing sustainable forest management in China are the shortage of forest resources, population pressure, economic pressure, and lack of public awareness. Subnational indicators in China are required to increase public awareness of sustainable forest management, to use indicators as the basis for forestry planning, to monitor and produce forest inventory, and to provide a framework for decision-making by local government.

Developing the Subnational Indicators

The process of developing subnational indicators in China has involved several activities coordinated by the Sustainable Forestry Research Centre of the Chinese Academy of Forestry, for example, the assessment of the national level Montréal Process indicators for their immediate relevance to China. Some indicators were added, while others were deleted to reflect national issues. The resulting list, showing all changes is included in the Year 2000 Progress Report and can be seen on the Montréal Process web site (www.mpci.org).

Subnational indicators have been under development and testing since 1997 in three representative forest zones supported by the United Nations Development Program (UNDP). The subnational C&I were developed partly through consultation and partly through the establishment of eight sustainable forest management experiment and demonstration areas in selected areas across the ecozones of China. Further testing of the indicators is planned through model forests developed in cooperation with the Canadian Forest Service. The subnational indicators are based on the national C&I with appropriate deletions or additions to reflect the local or regional situation.

The national indicators were presented to several local workshops to determine what was useful, where data could be found, and who would find it useful. Comments on the subnational set were sought from national and international consultants. The subnational set was then presented to a national workshop, attended by experts and forest officials from different regions of China and from the Chinese Academy of Forestry. Another workshop was organized at which Chinese representatives came from the eight Demonstration Experimental Areas, as well as from Provincial Forestry Institutes. This workshop included experts from the Center for International Forestry Research (CIFOR) and Australia invited to assist in the evaluation. The subnational indicators are being tested in the field at four sites (Fenyi, Zhangye, and two at Yichun). These tests are expected to be completed by the end of 2000.

In the Fenyi region of Southeast China, 60 indicators have been developed (Appendix C), with several indicators designed specifically to take into account issues regarding forest ownership, timber plantations, and “cash plantations”³. In the Zhangye region of Northeast China, 68 indicators have been developed with an emphasis on environmental and social issues, including water resource conservation, shelterbelts, and cash plantations. In the Yichun region of the Northeast, 77 indicators were developed, several of which emphasize maintaining forest productivity.

Implementing the Subnational Indicators

China is currently identifying which of the subnational indicators require more research or data and which can be reported on with existing information, with a view to completion by the end of 2000. A feasibility study for a selected set of indicators has been carried out at the forest management unit level. Testing the local capacity to report on subnational indicators is currently under way for the Zhangye, Yichun and Fenyi regions.

United States of America

³ “Cash plantations” in China are plantations that are established to produce an economic and social outcome in the short term (3-5 years), thus providing an early income for local farmers without the need to cut the trees. Examples of cash plantations are fruit and nut trees.

There are currently many activities under way developing C&I in the United States. These are linked in a variety of ways and degrees to the Montréal Process C&I. Examples of these activities follow.

Identifying the Need for Subnational Indicators

In the United States, forested areas are overlain by diverse, and largely decentralized, jurisdictional, ownership, and organizational patterns. The need for subnational indicators is driven by the management requirements of the various agencies and organizations responsible for different aspects of land and resource management. For example, the six million private landowners who own and manage 58% of US commercial forest lands must meet state environmental standards designed to safeguard the environment. Within the private sector, certification initiatives such as the Green Tag Program sponsored by the National Woodland Owners Association, an association of nonindustrial woodland owners, feature certain C&I. The National Woodland Owners Association participates in national interagency efforts to implement the Montréal Process C&I nationwide.

The timber industry, which owns and manages 14% of US commercial forest lands, is also required to meet state regulations and is also interested in demonstrating sustainable management practices to satisfy public demand for products from lands that are properly managed. The American Forest & Products Association has a sustainable forest initiative with C&I to improve and demonstrate sustainable forest management activities on industrial lands. Concurrent with their development of subnational C&I for sustainable forest management, they participated in international efforts to identify the Montréal Process C&I.

Similarly, on US Forest Service lands, by law the agency must complete Forest Plans that entail collaborative assessment, planning, and decision-making processes. Forest Plans lay out the constraints, probable impacts, goals and objectives, desired future condition, and land-based performance measures to gauge progress. Thus, information needed for planning and decision-making processes, the need to demonstrate that environmental laws and regulations are being met, and public demand for responsible management all drive the need to collect specific C&I measurements at both subnational and national scales.

Developing the Subnational Indicators

Example, US Forest Service – As a first step in the development of subnational indicators, the Federal US Forest Service hosted a CIFOR-North American test in Boise Idaho. Many subnational indicators developed by a variety of organizations were examined, and a report on the initial selection and testing of appropriate measures of sustainability was produced (available at <http://www.fs.fed.us/institute/lucid/>). The federal US Forest Service has adopted the Montréal Process criteria as a framework. To strengthen the linkages between subnational indicators and the national Montréal Process C&I framework, the Forest Service is undertaking the Local Unit Criteria and Indicators Development project, or LUCID. This project will further refine the C&I selected during the CIFOR-North American Boise test, reconfiguring the indicators under the seven Montréal Process criteria. Organizing the CIFOR-North American indicators (Appendix D) under the Montréal Process C&I framework suggests a strong relationship between indicators. The LUCID project will strengthen these linkages. It has established six test forest areas to identify the areas that are

necessary to sustain ecological, economic, and social systems and the C&I necessary to assess how forest management is influencing sustainability.

Implementing the Subnational Indicators

Currently hundreds of millions of dollars of measurements of various indicators are collected annually by the plethora of forest management entities. Current initiatives adapting existing Forest Stewardship Council C&I will identify key C&I and help focus scarce resources on collecting measurements most useful in gauging sustainable forest management. Certification efforts by the forest industry are gaining momentum. In some sectors, increasing public demand for products generated from sustainable forest management is fueling certification efforts in the private sector. The National Association of State Foresters has endorsed the Montréal Process C&I, and several multiple state initiatives are under way using the Montréal Process C&I to assess sustainable forest management. The LUCID project is still under development. Thus efforts to implement C&I for sustainable forest management at both the national and subnational scales within government, industrial, and private sectors are ongoing and increasing in momentum.

Conclusions

- The Montréal Process C&I have provided a good basis for developing a subnational monitoring system of indicators to evaluate or assess subnational contributions to a country's progress toward sustainable forest management.
- In some countries, the implementation of the Montréal Process C&I has highlighted the need to develop subnational indicators. National circumstances, such as the size of the country, political infrastructure, and ecological diversity, strongly influence the requirement for subnational indicators. Consequently, some countries are developing subnational indicators based on the Montréal Process framework (or closely related sets of C&I), whereas other countries do not perceive a need for such indicators.
- The processes used to develop subnational indicators vary. Extensive consultation, frequently through a workshop with a diverse range of stakeholders, has been an integral part of the process. There is, however, no single mechanism for developing subnational indicators.
- Some countries have developed demonstration areas and test sites to assess subnational indicators. While these areas may fulfil multiple goals, they are proving useful for the development and evaluation of subnational indicators.
- Implementation of subnational indicators need not wait for the entire indicator set to be defined or for data to be available for all indicators.

References

World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press, Oxford. 400 p.

Appendix A. Comparison between Montréal Process (MP) indicators and the Australian (Au) sub-national indicators. Significant differences are highlighted with bold type.

MP #	Montreal Process text	Au #	Australian text
1.1.a	Extent of area by forest type relative to total forest area	1.1.a	Extent of area by forest type and tenure
1.1.b	Extent of area by forest type and by age class or successional stage	1.1.b	Area of forest by type and growth stage and distribution by tenure
1.1.c	Extent of forest type in protected area categories as defined by IUCN or other classification systems		See 1.1.a
1.1.d	Extent of areas by forest type in protected areas defined by age class or successional stage		See 1.1.b
1.1.e	Fragmentation of forest types	1.1.c	Same
1.2.a	The number of forest dependent species	1.2.a	Same
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	1.2.b	Same
1.3.a	Number of forest dependent species that occupy a small portion of their former range	1.3.a	Amount of genetic variation within and between populations of representative forest dwelling species
1.3.b	Population levels of representative species from diverse habitats monitored across their range	1.2.c	Same
		1.3.c	Extent of native forest and plantations of indigenous species which have genetic resource conservation plans prepared and implemented
2.a	Area of forest land and net area of forest land available for timber production	2.a	Same
2.b	Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production	2.b	Total growing stock of both merchantable and non-merchantable tree species on native forest land available for timber production
2.c	The area and growing stock of plantations of native and exotic species	2.c	The area, age class and future yields of plantations of native and exotic species
2.d	Annual removal of wood products compared to the volume determined to be sustainable	2.d	Same
2.e	Annual removal of non-timber forest products (e.g., fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable	2.e	Same
		2.f	Area and per cent of plantation established meeting effective stocking one year after planting
		2.g	Area and per cent of harvested area of native forest effectively regenerated
		2.h	Extent of exotic plantations managed according to documented procedures or management plans to maintain genetic resources
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,	3.a	Area and percent of forest affected by processes or agents that may change ecosystem health and vitality

	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 - that may cause negative impacts on the forest ecosystem	3.b	Same
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.)	3.c	Area and percent of forest land with diminished or improved biological, physical and chemical components indicative of changes in fundamental ecological processes
4.a	Area and percent of forest land with significant soil erosion	4.a	Same; Interim indicator: Area and per cent of forest land systematically assessed for soil erosion hazard, and for which site-varying scientifically-based measures to protect soil and water are implemented
4.b	Area and percent of forest land managed primarily for protective functions, e.g., watersheds, flood protection, avalanche protection, riparian zones	4.b	Same
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.c	Same
4.d	Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties	4.d	Same; Interim indicator: The total quantity of organic carbon in the forest floor (<25 mm diameter components) and the surface 30 cm of soil
4.e	Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities	4.e	Same; Interim indicator: Proportion of harvested forest area with significant change in bulk density of any soil horizon of the surface (0-30 cm) soil
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.f	Same
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.g	Same
4.h	Area and percent of forest land experiencing an accumulation of persistent toxic substances	4.h	Same
5.a	Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages	5.a	Same
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.b	Same
5.c	Contribution of forest products to the global carbon budget	5.c	Same
6.1.a	Value and volume of wood and wood products production, including value added through downstream	6.1.a	Same

	processing		
6.1.b	Value and quantities of production of non-wood forest products	6.1.b	Same
6.1.c	Supply and consumption of wood and wood products, including consumption per capita	6.1.c	<i>Deemed not to be useful at a sub-national level</i>
6.1.d	Value of wood and non-wood products production as percentage of GDP	6.1.d	Value of wood and non-wood products production as percentage of regional value of production
6.1.e	Degree of recycling of forest products	6.1.e	<i>Deemed not to be useful at a sub-national level</i>
6.1.f	Supply and consumption/use of non-wood products	6.1.f	Same
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.a	Area and percent of forest land available for general recreation and tourism
6.2.b	Number and type of facilities available for general recreation and tourism, in relation to population and forest area	6.2.b	Number, range and use of recreation/tourism activities available in a given region
6.2.c	Number of visitor days attributed to recreation and tourism, in relation to population and forest area	6.2.c	Number of visits per annum
		6.2.d	Proportion of forest sites available for recreation and tourism which are impacted unacceptably by visitors
6.3.a	Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism	6.3.a	Same
6.3.b	Level of expenditure on research and development, and education-(b);	6.3.b	<i>Deemed not to be useful at a sub-national level</i>
6.3.c	Extension and use of new and improved technologies	6.3.c	Same
6.3.d	Rates of return on investment	6.3.d	Same
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.a.i	Area and per cent of forest land in defined tenures, management regimes and zonings which are formally managed in a matter which protects Indigenous peoples' cultural, social, religious and spiritual values, including non-consumptive appreciation of country
		6.4.a.ii	Proportion of places of non-Indigenous cultural value in forests formally managed to protect those values
6.4.b	Non-consumptive use forest values	6.4.b	Same
6.5.a	Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment	6.5.a	Same
6.5.b	Average wage rates and injury rates in major employment categories within the forest sector	6.5.b	Same
6.5.c	Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities	6.5.c	Same (not specifically including Indigenous communities)
6.5.d	Area and percent of forest land used for subsistence purposes	6.5.d	Area of land available and accessible for Indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs
		6.6.a	Extent to which the management framework

			maintains and enhances Indigenous values including customary, traditional and native title use by Indigenous peoples and for Indigenous participation in forest management
7.1.a	Extent to which the legal framework 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.a	Extent to which the legal framework provides mechanisms to clarify property rights and establish appropriate land tenure arrangements that recognize traditional management practices and self-management as well as the existence of native title and the customary and traditional rights of indigenous peoples
7.1.b	Extent to which the legal framework provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors	7.1.b	Same
7.1.c	Extent to which the legal framework provides opportunities for public participation in public policy and decision-making related to forests and public access to information	7.1.c	Same
7.1.d	Extent to which the legal framework encourages best practices codes for forest management	7.1.d	Extent to which the legal framework encourages the development and application of best practices codes for forest management
7.1.e	Extent to which the legal framework provides for the management of forests to conserve special environmental, cultural, social and/or scientific values	7.1.e	Extent to which the legal framework provides for the management of environmental, cultural, social and/or scientific values in forests and ensures the participation of Indigenous peoples in all aspects of forest planning and management processes
7.2.a	Extent to which the institutional framework supports the capacity to provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information	7.2.a	Same
7.2.b	Extent to which the institutional framework supports the capacity to undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and coordination	7.2.b	Same
7.2.c	Extent to which the institutional framework supports the capacity to develop and maintain human resource skills across relevant disciplines	7.2.c	Same
7.2.d	Extent to which the institutional framework supports the capacity to develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management	7.2.d	<i>Deemed not to be useful at a sub-national level</i>
7.2.e	Extent to which the institutional framework supports the capacity to enforce laws, regulations and guidelines	7.2.e	Same
7.3.a	Extent to which the economic framework supports investment and taxation policies and a regulatory environment which recognizes the long-term nature of investments and permits 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	7.3.a	<i>Deemed not to be useful at a sub-national level</i>

	and services		
7.3.b	Extent to which the economic framework supports non-discriminatory trade policies for forest products.	7.3.b	<i>Deemed not to be useful at a sub-national level</i>
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.a	Same
7.4.b	Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information	7.4.b	Same
7.4.c	Compatibility with other countries in measuring, monitoring and reporting on indicators.	7.4.c	<i>Deemed not to be useful at a sub-national level</i>
7.5.a	Capacity for research and development, including development of scientific understanding of forest ecosystem characteristics and functions	7.5.a	Same
7.5.b	Capacity for research and development, including 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.b	<i>Deemed not to be useful at a sub-national level</i>
7.5.c	Capacity for research and development, including new technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies	7.5.c	<i>Deemed not to be useful at a sub-national level</i>
7.5.d	Capacity for research and development, including enhancement of ability to predict impacts of human intervention on forests	7.5.d	Same
7.5.e	Capacity for research and development, including ability to predict impacts on forests of possible climate change	7.5.e	<i>Deemed not to be useful at a sub-national level</i>
		7.5.f	Per cent of native forests and plantations that are formally supported by silvicultural and utilization research support

Appendix B. Sub-national indicators from Canada's Western Newfoundland Model Forest organized under Values (in italics) which are in turn organized under Criteria (in bold); an indication of geographic scale of applicability is given in parentheses after each indicator.

Conservation of Biological Diversity

Representative Landscapes

- Proportion of each eco-region that is in a protected status (District/Provincial)
- Proportion of each eco-region that is barren, bog, forest and water (District/Provincial)
- Proportion of each protected area that is barren, bog, forest and water (District/Provincial)

Special Places

- Proportion of unique features identified in the Natural Areas System Plan that are protected or subject to special management provisions (Provincial)

Wildlife Habitat

- Area of each forest type by age class (District/Provincial)
- Area of suitable habitat for selected species (District/Provincial)

Native and Valued Species

- Known forest-dependent species classified as extinct, extirpated, endangered, threatened and vulnerable on national, provincial and local lists, including change in risk status of species and change in numbers of individuals for each species at risk (District/Provincial)
- Change in population level or ranges of selected species (District/Provincial)
- Genetic information about selected species (Provincial)
- Reproductive success or fecundity of selected species (Provincial)

Healthy Forests

Natural Processes

- Area and severity of insect, fire and disease disturbance, and succession pattern afterwards (District/Provincial)
- Area and severity of human-caused disturbances and succession pattern afterwards (District/Provincial)
- Frequency, abundance and distribution of selected indicator species relative to natural cycles (District/Provincial)

Natural Productive Capacity

- Mean annual increment (District/Provincial)
- Reproductive success or fecundity of selected species (Provincial)
- Land use changes, changes to total area of forest cover (District/Provincial)

Long-term Ecosystem Health

- Information about provincial strategies to respond to the management challenges posed by global climate change (Provincial)

Soil and Water

Water

- Percentage of forest managed primarily for water protection (District/Provincial)
- Hydrometric data compared with stream-specific historical values in selected watercourses (Stand/District)
- Number and severity of extraordinary flood events (Stand/District)
- Reported cases of giardia (“beaver fever”) (Local/Provincial)
- Changes to streams (positive and negative) that affect salmonid habitat (Stand/District)

Soil

- Percentage of harvested area having significant soil compaction, displacement, erosion, puddling, loss of organic matter, etc. (District/Provincial)
- Information about nutrient cycling, such as nutrient availability, nutrient uptake, and evidence of nutrient loss (Stand/District)

Good Forest Policy Enforcement

- Percentage of the forest lands that are part of a current Five-Year Management Plan that has been registered under Environmental Assessment and released (District/Provincial)
- Number of forest-related infractions (District/Provincial)

Global Impacts

Stable Climate

- Percentage of wood harvested that is used for energy, paper and lumber (District/Provincial)
- Logging utilization rate (District/Provincial)
- Information about forest wood product life cycles (Provincial)
- Percentage of recycled fibre used in newsprint manufacturing (Provincial)
- Forest sector CO₂ emissions (Provincial)
- Surface area of fresh water (District/Provincial)

Forests as Carbon Sinks

- Tree biomass volumes (District/Provincial)
- Vegetation (non-tree) biomass estimates (District/Provincial)
- Percentage of canopy cover (District/Provincial)
- Percentage of biomass volume by general forest type (District/Provincial)
- Soil carbon pools (District/Provincial)
- Soil carbon pool decay rates (District/Provincial)
- Area of permanent forest depletion (District/Provincial)
- Area of forest lands that are not sufficiently restocked (District/Provincial)

Benefits to Society

Commercial Timber

- Volume or mean annual increment (District/Provincial)

Area treated to encourage the growth of timber for sawlog production (District/Provincial)
 Area and percentage of the forested land base available for commercial timber production (District/Provincial)
 Volume of merchantable wood left on site after harvest (District)
 Percentage of Annual Allowable Cut used for lumber District/Provincial)
 Volume of wood exchanged between pulp mills and sawmills (Provincial)
 Volume of lesser-used species used in forest product manufacturing (District/Provincial)
 Total value of value-added forest product manufacturing (District/Provincial)

Employment

Number of people employed in forest-based activities, broken down by category (Local/District/Provincial)
 Number of people employed, in full-time equivalents, by category (Local/District/Provincial)
 Average annual income, by category (Provincial)
 Workers' Compensation costs, by category (Provincial)
 Forest-related employment (in person-hours) per unit (Provincial)
 Investment in training to promote best practices related to sustainable forest management (Provincial)

Non-timber Forest Products and Services

Number of lodges and businesses (District/Provincial)
 Number of out-of-province licenses issued (District/Provincial)
 Total revenue generated by the outfitting industry (Provincial)
 Number of licensed trappers (District/Provincial)
 Total revenue from fur sales (Provincial)
 Volume of berries shipped (District/Provincial)
 Total revenue from commercial berry sales (Provincial)

Recreation

Number of domestic hunting and fishing licenses (District/Provincial)
 Membership in forest-based recreation clubs (Local/District/Provincial)
 Participation rate in forest-based recreation activities (Local/District/Provincial)
 Resource base available for selected recreation activities (District/Provincial)
 Satisfaction levels (Local/District/Provincial)

Forest Products for Personal Use

Estimated volume of harvest for personal use (Local/District/Provincial)
 Equivalent dollar value (Local/District/Provincial)

Heritage

Number of sites, trails or facilities that provide public interpretation of some aspect of or information about forests (Local/District)
 Proportion of each ecoregion in a protected area (District/Provincial)
 Historic or archaeological sites that have been inventoried, and percentage that have adequate protection (District/Provincial)

Spiritual Values

“Litter index” based on ground surveys (Local/District)

Percentage of each watershed or valued viewscape that has been cut in the previous 10 years (District/Provincial)

Public Involvement and Commitment*Forest Contribution to Community Sustainability*

Percentage of households that have some forest-based employment (Local/Provincial)

Number of households that supplement their income through the collection or sale of forest products, and approximate value as a percentage of total household income (Local/Provincial)

Value of forest-based goods and services, in dollars or dollar equivalents and as a percent of Gross Domestic Product (Provincial)

Fair Decision Making

Number and variety of different stakeholders represented on forest management planning or monitoring committees (District)

Degree of consensus on the part of all stakeholders who have been involved in the planning process (District)

Informed and Responsible Decision Making

Investments in forest-related communications and awareness-raising (Local/District/Provincial)

Investments in forest-related education and training (Local/Provincial)

Investments in forest-related research and technology transfer (Provincial)

Violations or infractions (District/Provincial)

Aboriginal Perspectives and Involvement

Number of Aboriginal groups/communities involved in the forest management planning process (District/Provincial)

Area of Aboriginal forest lands under integrated management plans (District/Provincial)

Appendix C. Sub-national indicators developed for the Fenyi Region of China, compared to China's National indicators. Major differences are marked in bold type.

National indicator	Regional indicator	Regional	FMU
1.1.1	Ecosystem diversity	Yes	Yes
1.1.2	Species diversity	Yes	Yes
1.1.3	Genetic diversity	Yes	?
2.1	Area and net area forest land available for timber production	Yes	Part
2.2	Area and total growing stock	Yes	Yes
2.3	Ratio of different productivity classes/types of forest land	Yes	Yes
2.4	Total growing stock of forests for timber	Yes	Yes
2.5	Area and growing stock of plantation	Yes	Yes
2.6	Distribution of area and stock of forest for wood by age-class	Yes	Yes
2.7	Annual cutting of forests for timber should not exceed	Yes	Yes
2.8	Annual removal of non-timber forest products	Yes	Yes
3	Maintenance of forest ecosystem health and vitality		
3.1	Area and percent of forest affected by processes or agents beyond the range of historic variation	Yes	Yes
3.2	Area and percent of air polluted	Yes	Yes
3.3	Area and percent of land with diminished biological components	Yes	Yes
4.1	Area and percent of land with serious soil erosion	Yes	Yes
4.2	Area and percent of cultivated land on slope over 25 degrees which has been turned back into forest land	Yes	Yes
4.3	Area and percent of forest for soil and water conservation	Yes	Yes
4.4	Percent of stream km in forested catchments	Yes	Yes
4.5	Range of changes in physical and chemical properties	Yes	Yes
4.6	Controlled area and control percentage of areas with soil and water losses – middle (rehabilitation)	Yes	Yes
4.7	<i>Controlled area and control percentage of areas with soil and water losses – light (rehabilitation)</i>	<i>Combine with 4.6</i>	
4.8	<i>Area and percent of cultivated (agricultural) land on slope on which maintenance and conservation</i>	<i>Yes</i>	<i>Yes</i>
4.9	Area and percent of man-made forest which has a serious degrading index	Yes	Yes
4.10	<i>Area and percent of broad leaved forest in man-made forest</i>	<i>Yes</i>	<i>Yes</i>
4.11	<i>Area and percent of different tree species</i>	<i>Yes</i>	<i>Yes</i>
4.12	<i>Area and percent of replanted man-made forest</i>	<i>Yes</i>	<i>Yes</i>
4.13	Area and percent of land on slope on which maintenance and conservation of soil and water	Yes	Yes
4.14	Intensity, area and percent of protection of forest ground vegetation	Yes	Yes
5.1	Area of forests	Yes	Yes
5.2	Total forest ecosystem biomass	No	No
5.3	<i>Area and consumption of forests for energy resources and its contribution</i>	<i>Yes</i>	<i>No</i>

5.4	Production and consumption of forest products and its contribution	No	No
5.5	<i>Area of forest cutting and its contribution</i>	No	No
5.6	Absorption of carbon by forest	No	No
5.7	Carbon emission by soil	No	No
5.8	Release of CO ₂ and CH ₄ by peat	No	No
6.1	Demand and supply of forest products	Yes	No
6.2	Investment in forestry	Yes	Yes
6.3	Forest recreation and tourism	Yes	Part
6.4	Demands and assessment of culture	Yes	Yes
6.5	Employment and social community requirements	Yes	Yes
7.1	Legislation		
7.1.1	Forest resource ownership in China	No	No
7.1.2	Institution for management of forest resources in China	Yes	No
7.1.3	Forest management system should be established	Yes	No
7.1.4	Adopt data management system for managing forest resources	Yes	Yes
7.1.5	Strengthen administrative regulation in forest, management (forest management act)	No	No
7.2	Policy		
7.2.1	Policy for social participation in forestry	Yes	No
7.2.2	Policy for training of forestry human resources	Yes	No
7.2.3	Policy for adjusting the structure of forestry industry	Yes	No
7.2.4	Policy for construction of forestry infrastructure	Yes	No
7.3	Investment policy		
7.3.1	Favourable policy on forestry	Yes	No
7.3.2	Adopt policy collecting silviculture expenditure (tax)	No	No
7.3.3	Establish forest ecology compensation system	Yes	No
7.3.4	Strengthen institution of forestry funds	Yes	Yes
7.3.5	Expand fund channel for forestry construction	Yes	Yes
7.3.6	<i>Absorb and exploit overseas funds to speed up major project construction in forestry</i>	Dropped	
7.3.7	Speed up construction of institution for modern forestry enterprise	Yes	Yes
7.3.8	Establish fair trading of forest products	Yes	No
8.1	Measuring and monitoring		
8.1.1	<i>The scope and rationale for choice of criteria on relevant data</i>	Dropped	
8.1.2	The scope within which data in different monitoring network are available	Yes	Yes
8.1.3	Selection of common internationally used measurement methods and the..	No	No
8.2	Research and development		
8.2.1	Classified characteristics	Yes	No
8.2.2	The accounting system and techniques	No	No
8.2.3	Evaluation of the contribution of science and technology	No	No
8.2.4	<i>Evaluation of effects of anthropogenic disturbance to forests</i>	Yes	Yes
8.2.5	Evaluation of possible effects of climate on forests	Yes	No

Forest Management Unit Types in SE China

Avg. size

State owned forest farm	2000
Township	200
a) Collective forest farm	
b) village	
Contracted forest	2
Other (National reserve & forest park)	1000

Appendix D. Relationship between national Montréal Process and sub-national CIFOR-NA Boise test

Montreal Process National C&I	CIFOR-NA sub-national C&I
1. Conservation of biological diversity <i>1.1 Ecosystem diversity</i> <i>1.2 Species diversity</i> <i>1.3 Genetic diversity</i>	1. Ecological integrity is maintained <i>1.2 Landscape patterns support native populations</i> <i>1.1 Ecosystem function is maintained</i> <i>1.4 Ecosystem diversity is maintained</i> <i>1.3 Native species diversity is maintained</i> <i>1.6 Genetic diversity is maintained</i>
2. Maintenance of productive capacity of forest ecosystems	<i>2.2 Forest management provides for sustainability of goods and services</i>
3. Maintenance of forest ecosystem health and vitality	<i>1.5 Incidence of disturbance and stress</i>
4. Conservation and maintenance of soil and water resources	<i>1.7 Physical environmental factors</i>
5. Maintenance of forest contribution to global carbon cycles	
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies <i>6.1 Production and consumption</i> <i>6.2 Recreation and tourism</i> <i>6.3 Investment in the forest sector</i> <i>6.4 Cultural, social and spiritual needs and values</i> <i>6.5 Employment and community needs</i>	2. Yield and quality of forest goods and services are sustainable <i>2.4 Forest management is socially efficient</i> <i>3.1 Forest management provides ongoing access to the resource</i> <i>3.5 There is equitable access to and distribution of economic rents</i>

Montreal Process National C&I	CIFOR-NA sub-national C&I
	<p>3. Society accepts responsibility for sustainability</p> <p>3.2 <i>Concerned stakeholders have a right to participate in open and meaningful public participation processes in order to influence management</i></p> <p>3.3 <i>Forest-based human health issues</i></p> <p>3.4 <i>Recognition and respect for Aboriginal roles in sustainable forest management</i></p>
<p>7. Legal, institutional and economic framework for forest conservation and sustainable management</p> <p>7.1 <i>Legal framework</i></p> <p>7.2 <i>Institutional framework</i></p> <p>7.3 <i>Economic framework</i></p> <p>7.4 <i>Capacity to measure and monitor changes in the conservation and sustainable management of forests</i></p> <p>7.5 <i>Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services</i></p>	<p>2.3 <i>The management plan is implemented and effective in moving towards stated goals</i></p> <p>4.0 <i>Enabling Conditions</i></p> <p>4.1 <i>Policy, planning and institutional frameworks are conducive to sustainable forest management</i></p>