

Progress Analysis of Montreal Process Criteria and Indicators for Sustainable Forest Management in Terms of Data Availability and Applicability¹

Se-Kyung Chong^{2*}, Bong Soo Lee² and Wae Jung Kim²

持續 가능한 山林經營을 위한 몬트리올 프로세스 基準과 指標의 可用性和 適用性에 대한 分析¹

鄭世卿^{2*} · 李鳳洙² · 金畏政²

ABSTRACT

Since the development of a new paradigm of sustainable forest management, concerns have been focused on how the sustainability of forests will be assessed and measured objectively. This study examined the conceptual displacement on what is sustainability of forests, and analyzed the progress made by international and regional initiatives on criteria and indicators for sustainable forest management in terms of comparability and compatibility. Regarding data availability and applicability of criteria and indicators for sustainable forest management, the data reports gathered from Montreal Process member countries were analyzed. Within this context, Korean case were examined, using all possible existing information sources such as Forest Statistics, on 6 items of concepts of criteria and indicators, degree of difficulties, measurement units, data availabilities, problems and needs of future improvements for data gathering. The study also analyzed the applicability of criteria and indicators for sustainable forest management.

Key words : *Criteria and Indicators, Sustainable Forest Management, Montreal Process*

要 約

지속가능한 산림경영의 새로운 패러다임이 형성되면서, 어떻게 산림의 지속가능성을 객관적으로 평가하고 측정할 수 있는가의 문제가 관심의 초점이 되어 왔다. 본 연구는 산림의 지속가능성에 대한 개념적 전개과정을 정립하고, 비교성과 양립성의 견지에서 국제적, 지역적으로 개발되어 온 지속가능한 산림경영 기준과 지표의 진전상황을 분석하였다. 지속가능한 산림경영의 기준과 지표에 대한 자료의 가용성과 적용성을 살펴보기 위하여, 몬트리올프로세스 회원국이 제출한 자료를 근거로 작성된 보고서들을 분석 정리하였다. 우리나라의 경우에는 산림통계 등 기존 자료를 수집 이용하여, 기준과 지표의 개념, 난이도 정도, 측정단위, 자료의 가용성, 문제점과 개선사항 등 6개 항목에 대해 조사 분석하였고, 지속가능한 산림경영 기준과 지표의 적용성을 검토하였다.

¹ Received on August 22, 2001.

Accepted on October 19, 2001.

² Korea Forest Research Institute, Seoul 130-712, Korea 산림청 임업연구원.

* Corresponding author : skchong@foa.go.kr

INTRODUCTION

The needs to formulate internationally agreed methodologies and criteria for the management, conservation and sustainable development of all types of forests in the world were expressed in both the Forest Principles and Chapter 11 of Agenda 21. Since UNCED (United Nations Conference on Environment and Development) in 1992, in compliance with this commitment, the initiatives taken for the conservation and sustainable development of global forests such as Montreal Process (the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests), the Pan-European Process for criteria and indicators of sustainable management of European forests, and the efforts of international governmental or non-governmental organizations, for instances, the International Tropical Timber Organization (ITTO) and the Food and Agriculture Organization of the United Nations (FAO) have been intensified in a regional or global base to develop, implement and harmonize criteria and indicators for sustainable forest management. Especially, ITTO stipulated the goal in the new International Tropical Timber Agreement (ITTA, 1994) to achieve the international trade in timber products from sustainably managed forests by the year 2000, and revised the old criteria for sustainable management of tropical forests in 1998 (ITTO, 1998).

Those initiatives are part of endeavors to commit themselves to the Forest Principles 8(d) *"Sustainable forest management and use should be carried out in accordance with national development policies and priorities and on the basis of environmentally sound national guidelines. In the formulation of such guidelines, account should be taken, as appropriate and if applicable, of relevant internationally agreed methodologies and criteria"* and Chapter 11(11.22b) of Agenda 21 of the UNCED *"Formulating scientifically sound criteria and guidelines for the management, conservation and sustainable development of all types of forests"* (UNCED, 1992).

Thus, since the development of new paradigm of sustainable forest management, concerns have been focused, in the international forestry fora, on (i) how the sustainability of forests will be assessed and monitored objectively and (ii) how to make sure that the timber comes from the sustainably managed forests. With bearing it in mind, first, evolutionary process of sustainable development and sustainable forest management will be reviewed in detail. Secondly, the progress made internationally and regionally on criteria and indicators for sustainable forest management will be examined and analyzed, and especially focusing on the activities of Montreal Process.

1. Advent of Sustainable Development

The United Nations Conference on the Human Environment (UNCHE), the first this kind of gathering on environmental issues under the UN system was held in Stockholm in June of 1972 in recognition of the need to develop the common principles for the conservation of environment and the sustainable use of natural resources. It proclaimed 26 Principles called the "Stockholm Declaration", and 109 Recommendations, in which the idea of sustainable development was conceived by stressing the needs of compatibility of environment conservation with economic and social development. It also supported formulating a program under the United Nations body, the United Nations Environment Programme (UNEP), in order to stimulate, coordinate and provide global environmental actions (Environment Canada, 1972). In 1982, World Charter for Nature was adopted by the 37th UNGA, prepared by the *Ad Hoc* Group of Experts on the draft World Charter for Nature. It reaffirmed that man must acquire the knowledge to maintain and enhance his ability to use natural resources in a manner which ensures the presentation of the species and ecosystems for the benefit of present and future generations (UNGA, 1982).

Similar effort for sustainable development can be found in the activities of the Club of Rome

established in April 1968, aiming at fostering understanding of the varied but interdependent components - economic, political, natural, and social - that make up the global system. Through the report of "The Limits to Growth", it conceived the idea of sustainable development by concluding that it is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future (Meadows et al., 1975).

The phrase of sustainable development was introduced into the public arena by the World Conservation Strategy(WCS) that the International Union for the Conservation of Nature and Natural Resources (IUCN) published in 1980 in collaboration with the UNEP and World Wildlife Fund(WWF) (IUCN-UNEP-WWF, 1980). Even though the definition of sustainable development was not given in WCS, it stressed the importance of integrating conservation and development and determined the priority requirements for ecological processes, genetic diversity and sustainable utilization. UNGA adopted the Environmental Perspective to the Year 2000 and Beyond in 1987, drawn up by the Intergovernmental Inter-sessional Preparatory Committee of the UNEP. It also mentioned sustainable development and defined that "development is sustainable when it meets the needs of the present without compromising the ability of future generations to meet theirs" (UNGA, 1987).

In 1983, the World Commission on Environment and Development(WCED), known as the "Brundtland Commission" named after its chairwoman, the former Norwegian Prime Minister Gro Harlem Brundtland, was formulated as an independent body to develop 'A global agenda for change' at the aim of proposing long-term environmental strategies for achieving sustainable development by the year 2000 and beyond. This commission published "Our Common Future" in 1987, in which clearly redefined that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their

own needs". The term of sustainable development has captured greater concerns of people and instigated public debate at local, national, regional and international levels.

The above definition of sustainable development contains two key concepts : one is the concept of 'needs', in particular the essential needs of the world's poor, to which first priority should be given, and the other is the idea of limitations imposed by the state of technology and social organization on the environment's ability to absorb the effects of human activities. These concepts reflect that sustainable development requires meeting human needs both by increasing productive potential and by ensuring equitable sharings for all in a sustainable base. It implies that renewable resources like forests should be sustainably managed by determining the sustained yield of timber within the limits of growth and by minimizing the adverse impacts on the natural environment as part of a complex ecosystem in order to meet the needs of present and future generations. In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations(WCED, 1987).

2. Evolution of Sustainable Forest Management

Perception of forest resource management has been changed and newly emerged by shifting a traditional way of managing forests for primary production of timber into a forest ecosystem management, which is more focusing on the ecological stability of forest ecosystem. Social demands for forests and forestry have been also changed from economic viewpoint to encompassing all the social, cultural, spiritual and environmental functions of forests for public benefits at local, national and global levels.

The principle of traditional forest management is to create a normal forest aimed at the sustained yield

of timber which attempts keeping and maintaining forest productivity, even though specific considerations to achieve the goal may be different from by stakeholders. It implies the perpetual harvests of timber by balancing the yields which are not exceeding the growths. Sustained yield management is defined "management of a forest property for continuous production with the aim of achieving, at the earliest practicable time, an approximate balance between net growth and harvest, either by annual or some what longer periods" by the Society of American Foresters (Davis, 1966). With the advent of the importance of environmental forestry, the principle of multiple use became popularized,

of ecosystem management has been introduced into the world. The principles of sustained yield and multiple use forestry underline economic sustainability to maximize periodical returns from sales of timber and forest services subject to the maintenance of the forest resource. This idea is changing as a new concept of sustainable forest management emerges which is well known as "Ecosystem Management", introduced to the USDA Forest Service. It is based on the principle of ecological sustainability. In comparison of this concept with the old-fashioned ways, there are some differences as shown in the Table 1.

Table 1. Changes of management principles and their concepts.

Management Goals	Concepts	Principles	Objectives	Constraints
Normal Forest	Sustained yield of timber	Economic sustainability (output-oriented)	Profit maximization by sales of forest products and services	Maintenance of forest resources
Multiple Use Forestry	Sustainable yield of forest products and services			
Ecosystem Management	Sustainability of forest ecosystem	Ecological sustainability (state of ecosystem)	Ecological stability of forest ecosystem	Production of minimum quantities of products and services

* Source : this table is adapted from an article prepared by Peter Glück(1994)

According to the "Forest Principles", it states that forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual human needs of present and future generations. It also stressed that decisions taken on the sustainable management of forests should benefit from a comprehensive assessment of economic and non-economic values of forest goods and services, and integrate environmental costs and benefits into market forces and mechanisms. Program area D of Chapter 11 Agenda 21, which is assessment and systematic observations of forests indicates, at 11.31(d), that the values of forest goods and services should be incorporated especially in 1960's and 70's, and now the concept

into national systems of accounts and planning.

ITTO in the "Criteria for the Measurement of Sustainable Tropical Forest Management" published in 1992 defined sustainable forest management as the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment. And in the revised version of criteria and indicators published in 1998, it is stated the same as the previous definition, except for the change of replacing the word "permanent forest land" with

"forest", with which conceiving more universal concept of forest rather than specifying on some type of forests. In 1993, the Helsinki ministerial conference resolution H1 also defines that sustainable management is the stewardship and use of forests and forest lands in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality, as well as their potential to fulfill, now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems (Ministry of Agriculture and Forestry of the Finland, 1993).

Thus far, concept of the sustainable forest management has not been arrived at the generally agreed format, but assumes encompassing all the ecological, social and economic benefits with non-declining potential of forests, satisfying a variety of demands which need for the present and future generations. However, the reality exists different from the ideology because the common denominator under the diagram of the ecological, social and economic aspects is not being sufficient to go along but small enough provoking competitions among the dimensions, rather than independent or complementary relationships.

MATERIALS and METHODS

In order to analyze the current status and trends of development on criteria and indicators for sustainable forest management, 10 initiatives (Montreal Process, Helsinki Process, Tarapoto Proposal, Central America Process of Lepaterique, Dry-Zone Africa Process, African Timber Organization, Near East Process, Dry Forests in Asia, International Tropical Timber Organization, Food and Agriculture Organization of the United Nations) related to the subject at the global and regional levels were reviewed and compared in terms of clarity, flexibility, feasibility and applicability.

Regarding overall data availability and reporting, data reports from the Montreal Process Secretariat

were gathered and analyzed for the member countries. For the analysis of the Korean situation, 6 items on criteria and indicators' concepts, degree of difficulties, measurement units of indicators, data availabilities, problems and needs of future improvements for data gathering were considered and analyzed to investigate the data availability. The applicability of criteria and indicators for sustainable forest management in Korea were also reviewed by gathering and formulating all the possible forest information sources currently available.

RESULTS and DISCUSSION

1. Comparability and Compatibility among the Initiatives

In terms of overall framework of the criteria and indicators, all the processes are incorporating most of common elements of the criteria, regarding forest resource base, biological diversity, forest health and vitality, productive capacity, protective functions, socio-economic benefits, and instrumental and institutional framework. This suggests a general agreement on the components of criteria and indicators for sustainable forest management. At the same time there are some distinctions between the processes which differentiate structure and content in terms of wording, arrays and practicability by region. This is to be expected, given the diversity of the data that is required or available to support different criteria under different geographic, ecological, economic, social and cultural conditions. Another major distinction is the scale. All of the processes concentrate on providing data at least at the national level, while some encompass forest management unit level as well.

As shown in Table 2 below, even though there are still many countries that have not been involved in the processes developing criteria and indicators for sustainable forest management, regional initiatives are covering almost all types of forests and forest zones in the world. Initial concerns at the development stage were placed on assessing the

Table 2. Summary of the Processes on criteria and indicators for sustainable forest management.

Processes	Countries involved	Scale concerned	Number of Criteria	Number of Indicators	Forest Area (1000ha)	Forest type
Montreal	12	National	7	67	1 500 000	Temperate Boreal
Pan-European	38	National	6	27	904 577	Temperate Boreal Mediterranean
Tarapoto	8	Global/ National/ FMU	7/4/1	47/22/7	540 000	Amazon Tropical
Central America	7	Regional/ National/ FMU	4/8/5	40/52/50	19 631	All types
Dry-Zone Africa	28	Regional	7	47	278 021	Sub-Saharan Dry-zone
Near East	30	Regional	7	65	69 895	Dry-zone
ITTO	25	National FMU	7/7	106/80	1 305 046	Tropical

* Source : adapted from State of the World's Forests(FAO, 1997) and Background Document 1 of the 2nd Session of IFF(1998)

* FMU : Forest Management Unit Level

* The figures in slash correspond to the scale concerned

* Some overlapping figures due to the dual membership. Forest area of Russia appears both in Montreal and Pan-European processes

sustainability at the national level except for Tarapoto, Central America and ITTO. Since the implementation stages were begun, most of initiatives are becoming more interests in linking the national level criteria and indicators to sub-national and operational levels.

In terms of promoting data availability, comparability and compatibility, some consideration was given by most of the processes to relate the indicators with the data requirement of the Global Forest Resources Assessment, which has been undertaken by FAO at about 10-year intervals since 1947.

The indicators at the national level would be desirable to have the following characteristics (FAO and ITTO, 1995); ① Clarity : they should be precisely defined, scientifically sound, and easy to understand at political, technical and public levels; ② Flexibility : they should be applicable to all types of forests, including those existing in countries

not presently involved in the ongoing initiatives; ③ Feasibility : preferably, they should be based on readily available data and/or they should be easily measurable by available techniques; ④ Applicability : they should be practical to measure, not require excessive administrative workloads and be cost-effective.

It is generally agreed that the key concepts and terms used in the criteria and indicators should be further clarified and defined to promote a better understanding among the initiatives and nations even though they are varied by eco-regional differences. Currently there are some terminology used in the processes, incomparable with one another. Definition of forest types, classification of forest lands, forest dependent species and forest ecosystems, and forest land use systems may be all different from nation by nation or region by region. Flexibility is another issue. For instance, ITTO recommends using only

the IUCN categories of defining protected forests, however many countries currently do not follow this procedure. Feasibility and applicability should also be facilitated by providing a practical manual regarding how information on the indicators can be obtained and analyzed because collecting data and reporting are another key to success.

Regarding implementing the criteria and indicators, some practical aspects should be resolved before hand such as trained foresters to apply the essence of the criteria and indicators in the field practices and easy-to-use convention to data collection, storage, analysis and reporting.

In terms of the interpretation of the measurement, indicators are told to show the direction of change or trends in the state of forests toward or away from sustainable forest management. What if some of indicators are showing toward sustainability and others are against among so many indicators? The most important thing is that how we can judge and assess whether the forests are sustainably managed or not at the national or forest management unit level by interpreting the results in a comprehensive and holistic way, considering all the indicators involved together. Of course, the indicators satisfying all the social, environmental and economic aspects of forestry which implies the ideal of sustainable forest management may not be feasible. Then what are the next options to be considered progressing toward sustainability?

Regarding public perception on sustainable forest management, another issue raised by the public is that criteria and indicators for sustainable forestry ignore public visual perception and aesthetics. This argument supports the idea of equating forest ecosystem health with visual quality of forests at the forest management unit level. Most of the processes involved in developing criteria and indicators of sustainable forest management ensure incorporating the indicators regarding cultural, social and spiritual needs and values including non-consumptive use of forest values, and public participation in decision making for forest management and practices

at national or forest management unit level. However, there can be found some weaknesses in the most of initiatives dealing with the criteria and indicators, which are not giving a high emphasis on visual perception of public on forests. Aesthetic values of forest landscape may be further recognized in developing the criteria and indicators for sustainable forest management.

The overall success for sustainable forest management may depend largely on the political commitment of a nation which influences decision-making on policy, legislation, and social, environmental and economic instruments. The World Commission on Forests and Sustainable Development also indicates that lack of political will to implement sound policies is the most important barrier to sustainable development of forests and people. Such frameworks as legal, economic and institutional capacities, which are incorporated in most of processes as a qualitative or descriptive measure, will take a great role in succeeding sustainable forest management at both national and forest management unit levels.

2. Progress of the Montreal Process Criteria and Indicators and their Data availability and reporting

The Seminar of Experts on Sustainable Development of Boreal and Temperate Forests was held in Montreal, Canada in September 1993 under the auspices of the Conference on Security and Cooperation in Europe(CSCE), now renamed as the Organization on Security and Cooperation in Europe (OSCE). It provided an initial step to develop criteria and indicators for sustainable forest management (Natural Resources Canada, 1993). The Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests, known as Montreal Process was established as a follow-up to the CSCE seminar. It held the first meeting officially in June 1994 in Geneva and consecutive meetings of six times(New Deli India July, 1994; Olympia USA

September, 1994; Ottawa Canada October, 1994; Tokyo Japan November, 1994) until the Santiago meeting in Chile in February 1995 where the Santiago Declaration was endorsed by the original 10 member countries (Australia, Canada, Chile, China, Japan, Mexico, New Zealand, Republic of Korea, Russian Federation and United States of America), together with a set of 7 criteria and 67 indicators, including 20 qualitative indicators in the Criterion 7 for monitoring sustainability at the national level. Argentina and Uruguay each has joined and endorsed the Montreal Process criteria and indicators in July and October 1995.

The 47 quantitative indicators of criteria 1 to 6 describe ecological and socio-economic aspects of sustainable forest management, and the 20 qualitative indicators of criterion 7 define the basic conditions which enable the member countries to implement the criteria 1-6. The Montreal Process criteria and indicators are tools for assessing national trends in forest conditions and management and provide a common framework for describing, monitoring and evaluating progress towards sustainability at the country level (Progress Report, 1997).

Since the Santiago Declaration, the Working Group meetings, hosted by New Zealand (Auckland, November 1995), Australia (Canberra, June 1996), Korea (Seoul, July 1997), Russian Federation (Moscow, October 1998), USA (Charleston SC, November 1999) and China (Beijing, November 2000), have been continued to encourage and promote implementation of the agreed criteria and indicators. Canada takes a major role by hosting the Liaison Office since its establishment in the 6th Working Group meeting in Santiago, Chile in 1995.

The working group of the Montreal Process gathered the first time in New Zealand in October 1995 since the Santiago Declaration. It was the seventh meeting, aimed at the future actions to be followed up to implement the "Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests" agreed upon by the member countries. The possibility of applying

the criteria and indicators at the national level was briefly reported by countries which had some experiences on gathering and analyzing data. The meeting promised to further look into approaches to data requirements and reporting on indicators, even though the exact action plan for them was not proposed at that time. The Montreal Process countries exchanged views on the relationship between criteria and indicators and certification and reaffirmed that the criteria and indicators have a sole purpose of assessing sustainable forest management at the national level, and not being intended to be used for certification at the management unit level.

The eighth meeting of the Montreal Process was held in Canberra, Australia in June 1996. Prior to the meeting, the Liaison Office surveyed the data availability and reporting capacity of the member countries and prepared a report of "Status of Data and Ability to Report on the Montreal Process Criteria and Indicators". It showed that data of more than 50% of the 67 indicators was available even though there were significant variations among the member countries and the seven criteria. Data were least available for the Criterion 3 (forest ecosystem health and vitality) and the Criterion 4 (soil and water resources), while most available were for the Criterion 2 (productive capacity) and Criterion 7 (legal, institutional and economic frameworks) and some of data were available for the indicators of Criterion 1 (biological diversity) and Criterion 6 (socio-economic benefits). Many of the indicators can be readily measurable, but others need to be further studied for methodologies (Table 3).

The reporting capacity on indicators also varied from country to country and showed similar pattern with the data availability. It was decided to establish an *ad hoc* Technical Advisory Committee (TAC) to cover technical and scientific issues related to implementing the criteria and indicators such as term definitions and methods for data collection and reporting in order to build the capacity of member countries to report. The working group also decided to prepare a progress report by

Table 3. Data availability and reporting of Montreal Process criteria & indicators.

Criteria	Data Availability and Reporting
Criterion 1. Conservation of biological diversity	MA : Area by forest type, protected area LA : Area by age class or successional stage, Species diversity(forest dependent species) FS : Forest fragmentation, Genetic diversity, Classification of forest types, Assigning age to uneven-aged stand, Microflora and microfauna
Criterion 2. Maintenance of productive capacity of forest ecosystems	MA : Area and growing stock for timber production and for plantations, Annual removal of wood products LA : Annual removal of non-timber products, Data on private forest lands FS : Sustainable levels of timber and non-timber production, Stratifying forests by eco-zones, Standardized inventory program, Ecological interaction between species and ecosystem
Criterion 3. Maintenance of forest ecosystem vitality and health	MA : Extent of forest damages LA : Air pollutants, Diminished biological components, Historic variation FS : Monitoring system for forest damages, air pollution and ecological changes, Clarification of terms of diminished biological components and vitality
Criterion 4. Conservation and maintenance of soil and water resources	MA : Forest land managed for protective functions LA : Toxic substances, Soil physical and chemical properties, Variation of water bodies FS : Monitoring system for soil and water variations, Needs for historical records
Criterion 5. Maintenance of forest contribution to global carbon cycles	MA : Forest ecosystem biomass, Contribution of forest ecosystem to global carbon budget LA : Contribution of forest products to global carbon budget FS : Methodologies for estimating carbon budget and monitoring system
Criterion 6. Maintenance and enhancement of long-term multiple socio-economic benefits	MA : Value and volume of wood production, Supply and consumption of wood products Direct employment, Average wage rates in forest sector LA : Recreation and tourism(facility and usage), Forest for cultural, social and spiritual needs Indirect employment and community needs FS : Lack of data for non-wood products and wood recycling, Recreation and tourism on private land, Investment data, Research and development expenditures by the private sector, Non-consumptive forest values, Forest dependent community, Subsistence purpose land
Criterion 7. Legal, institutional and economic framework	MA : Data on legal, institutional and economic framework LA : Data on measure and monitor change, Research and development FS : Measuring environmental and social costs-and benefits, Impacts of human intervention and climate change on sustainable forest management

* MA : Most available LA : Less available FS : Further studied

the early 1997 to distribute at the fourth session of the IPF(Intergovernmental Panel on Forests) and another report by the late 1997 which was known as the First Approximation Report (FAR) of the Montreal Process. The progress report contained identical analysis for the data availability and reporting ability of the member countries as the initial survey report in 1996.

The ninth meeting of Montreal Process was hosted by the Korean Government in Seoul in July

1997. The main focuses of the talks were to review the future work of the TAC and to finalize preparations of the First Approximation Report which was published in August 1997 and presented to the Eleventh World Forestry Congress in Antalya, Turkey in October 1997. Reporting rate of the First Approximation Report (1997) was higher than the previous survey report, averaging at 87% (refer to Figure 1). However, more detailed explanation using tables, charts and figures, in addition to texts, for indi-

icators was provided at the much lower level of 39%, especially lower in Criterion 4 (soil and water) and Criterion 3 (forest ecosystem health) as 14% and 33%, respectively, while Criterion 2 (productive capacity) and Criterion 5 (global carbon cycle) each showed higher response rates of 51% and 59%. The rate of detail provided for Criterion 7 is not accounted because it is a descriptive criterion and does not allow quantitative measure.

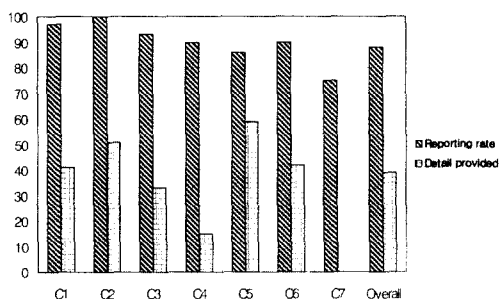


Figure 1. Indicator reporting rate (%) by criterion (adapted from FAR).

There are wide differences between 'Reporting rate' and 'Detail provided' shown in Chart 1. It suggests that there exists short of data reliability or inconsistency in aggregating scattered local data into national level data. Most countries extended their analyses to identifying areas where information gaps might be occurred if more complete reporting on indicators should be provided. The identification of gaps such as knowledge, database and monitoring gaps was enormous, exceeding 50% for six of the seven criteria except for Criterion 7. This high figure implies an inability to report fully because of lack of scientific understanding or data gathering to fill the gaps in assessing criteria and indicators for sustainable forest management. Criterion 7 was lowest at 25%. Most countries simply described the appropriate legal, institutional and economic circumstances of the country without attempt to evaluate them in terms of need, adequacy,

implementation, or domestic and international pressures. Most of countries have also embodied, to one degree or another, the principles of sustainable forest management in their forest management legislation and established legal frameworks for the management of forest lands, although there are some differences in their application between private and public forest lands (FAR, 1997).

FAR was more intensively undertaken to see the data availability and reporting ability of member countries since the initial survey in 1996. It identified common problems and technical and scientific issues requiring further studies in implementing the Montreal Process criteria and indicators. It also emphasized the role of TAC to be played in solving the technical problems raised in FAR. The major issues addressed to TAC were to further define the terms and concepts such as subsistence and forest dependent communities and develop a multi-lingual glossary used in various Montreal Process languages. It was also proposed that explanatory notes on criteria and indicators should be more developed to give better understanding of how the indicators are related and appropriate to measure sustainable forest management. TAC was recommended to conduct long-term, standardized approaches to the monitoring of indicators and develop methods of collecting data for criteria and indicators for private forests and the areas managed primarily for conservation. In this respect, TAC produced Technical Notes in 2000, regarding concepts, rationale and approaches to measurement. However, the report of FAR points out that it is not clear on how indicator trends can be interpreted within the context of the criteria to which they prefer and how they relate to the overall assessment of sustainability.

During the 12th meeting in China, Montreal Process member countries agreed to publish the First Montreal Process Forest Report in 2003 against indicators which will be due to submit by April 2002.

3. Data availability and Applicability of Montreal Process Criteria and Indicators in Korea

To examine the applicability of Montreal Process criteria and indicators developed to date, the availability of the existing data and the needs to further survey were identified. Among 6 criteria and 47 quantitative indicators, the data for 15 indicators are immediately available, 16 of them needs complementary survey and 16 of them needs to be initiated for the new survey. Total 32 survey for gathering forest data should be carried out fully or in part for measuring indicators, and research development in the areas of forest monitoring system, forest management modelling, ultra-violet damage measurement techniques and forest carbon budget model should be further collaborated among international initiatives or institutional organizations to facilitate the data collection and analysis process.

In detail, the data for many indicators for the conservation of biological diversity(Criterion 1) have been widely collected and stored during the recent years. However, some indicators such as vegetation composition, fragmentation of forest types, the status of forest-dependent species and genetic diversity of forest ecosystems have short of information available.

Data for the maintenance of productive capacity of forest ecosystems(Criterion 2) are relatively well available, except for the needs of developing forest management models for determining the sustainable utilization levels of wood and non-timber forest products.

Like the other Montreal Process member countries, data for Criteria 3 and 4 are least available. Regarding the maintenance of forest ecosystem health and vitality(Criterion 3), data on forest area affected by insects, diseases, forest fires and air pollutants have been extensively collected through local governments. However, data on forest area with diminished biological components and the degree of ecological continuity would require much efforts to collect and analyze. Data for conservation

and maintenance of soil and water resources (Criterion 4) are less available. Even though some data on forest land with soil erosion and/or primarily managed for protective functions are gathered. Information on biological, chemical and physical changes of forest soils and water bodies in forest areas should be further accumulated.

For the maintenance of forest contribution to global carbon cycles(Criterion 5), forest ecosystem biomass and carbon pool for the woody and non-woody plants is estimated. Information on contribution of forest ecosystems including soil component and forest products to the global carbon budget should be further studied.

In terms of the maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies(Criterion 6), regarding production and consumption(6.1), value and volume of wood and non-wood forest products, supply and consumption of wood products and contribution of wood and non-wood products production to GDP are mostly available. The degree of recycling of forest products and supply and demand of non-wood products should be further examined. Regarding recreation and tourism(6.2), data on forest area and visitors purposed for recreation and tourism are relatively available, however, the number and type of facilities for that purpose should be further surveyed. Regarding investment in the forest sector (6.3), data are less available. The total investment value related to forest sectors, level of expenditure on research and development and rates of return on forest sector's investment needs to be further surveyed. Regarding cultural, social and spiritual needs and values(6.4), data are well gathered through lawfully designated forest areas and quantitative study on public welfare functions of forests. Regarding employment and community needs(6.5), data are required to be further examined, especially on direct and indirect employment and injury rates in the forest sector.

In relation to the legal, institutional and economic framework for forest conservation and sustainable

management(Criterion 7), the contents are relatively well reflected in the forest-related laws, regulations and guidelines. However, integrating forest environmental and social benefits and costs into market system or public policies is the most difficult challenge.

CONCLUSIONS

Since the Rio Summit, pursuit of sustainable development in the global scale has been a main agenda. For the forests as a renewable resource, the concept of sustainability has emerged in a different way from the traditional sustained yield of timber and pushed forestry issues up in the air. The answer to how the sustainably managed forests can be achieved is a real challenging one to foresters and interested parties who have sought some measures to the criteria and indicators for sustainable forest management.

The development and implementation of criteria and indicators for sustainable forest management have encouraged many countries to change national forest policies and legislation which stipulate and monitor the essential elements (criteria) of sustainable forest management in order to reflect the concept of sustainable forest management. Main focus has been given to the national level criteria and indicators which attempt to assess overall conditions of forests towards or against sustainability. Concerns on operational level criteria and indicators have been also raised from NGOs, local authorities and forest industries in practical terms. The efforts of narrowing gaps between upper and lower levels are made to clarify links among, and promote compatibility of, criteria and indicators scaled at the regional, national and forest management unit/operational levels because they are strongly inter-linked.

Discussions for criteria and indicators for sustainable forest management were also done in the past IPF meetings, and have been continued in the process of IFF(Intergovernmental Forum on Forests),

taking into account the conclusions and proposals for action recommended by Forest Principles and Agenda 21 of the UNCED for the management, conservation and sustainable development of all types of forests. Currently criteria and indicators for sustainable forest management have been recognized as a useful tool to assess, monitor and report the sustainability of forests at the national level.

LITERATURE CITED

1. Amazon Cooperation Treaty. 1995. Proposal of Criteria and Indicators for Sustainability of the Amazon Forest. Results of the Regional Workshop. 149pp.
2. Davis, K. P. 1966. Forest Management : regulation and valuation. Second edition. McGraw-Hill Book Company.
3. Environment Canada. 1972. Conference on the Human Environment-A report on Canada's preparations for and participation in the United Nations Conference on the Human Environment, Stockholm, Sweden, June 1972.
4. FAO. 1997. Expert Meeting on Criteria and Indicators for Sustainable Forest Management in Central America-Report. Tegucigalpa, Honduras.
5. FAO. 1997. State of the world's forests. FAO, Rome.
6. FAO and ITTO. 1995. Report on the FAO/ITTO Expert Consultation on the Harmonization of Criteria and Indicators for Sustainable Forest Management. 20pp.
7. FAO and UNEP. 1998. FAO/UNEP Meeting for National Coordinators on Criteria and Indicators for Sustainable Forest Management in the Near East Countries. Damascus, Syria.
8. Glück, P. 1994. Criteria of sustainable forest development. *EFI News* 2(1) : 3
9. ITTO. 1998. Criteria and Indicators for Sustainable Management of Natural Tropical Forests. ITTO Policy Development Series No. 7.
10. IUCN-UNEP-WWF. 1980. World Conservation

Strategy.

11. Meadows, D. H., L. M. Dennis, R. Jorgen and W. B. William. 1975. *The Limits to Growth A Report for the Club of Rome's Project on the Predicament of Mankind. A Potomac Associates Book. Second Edition(Revised).* 207pp.
12. Ministry of Agriculture and Forestry of the Finland. 1993. *Report on the Follow-up of the Strasbourg Resolutions.* 203pp.
13. Ministry of Agriculture, Rural Development and Fisheries of the Portugal. 1996. *Ministerial Conference on the Protection of Forests in Europe. Progress Report.* 62pp.
14. Montreal Process. 1999. *Criteria and indicators for the conservation and sustainable management of temperate and boreal forests-the Montreal Process. Second Edition.* 19pp.
15. Montreal Process Liaison Office. 1996. *Status of data and ability to report on the Montreal Process criteria and indicators.*
16. Montreal Process Liaison Office. 1997. *First Approximation Report of the Montreal Process.* 47pp.
17. Natural Resources Canada. 1993. *Seminar of experts on sustainable development of boreal and temperate forests. Technical Report.* 66pp.
18. Natural Resources Canada. 1993. *Seminar of experts on sustainable development of boreal and temperate forests. Technical Report-Annex I.* 145pp.
19. United Nations. 1994. *International Tropical Timber Agreement, 1994.* UNCTAD, TD/Timber. 2/16.
20. UNCED. 1992. *The Forest Principles.*
21. UNCED. 1992. *Agenda 21, Chapter 11-13.*
22. UNEP and FAO. 1995. *UNEP/FAO Expert Meeting on Criteria and Indicators for Sustainable Forest Management in the dry-zone Africa-Report.* Nairobi, Kenya.
23. UNEP and FAO. 1996. *FAO/UNEP Expert Meeting on Criteria and Indicators for Sustainable Forest Management in the Near East.* Cairo, Egypt.
24. UNEP and FAO. 1997. *UNEP/FAO Workshop on Criteria and Indicators for Sustainable Forest Management in the dry-zone Africa-Report.* Nairobi, Kenya.
25. United Nations Economic and Social Council. 1998. *Report of the Intergovernmental Forum on Forests on its second session.* E/CN.17/IFF/1998/14.
26. UNGA. 1982. *World Charter for Nature.* A/RES/37/7.
27. UNGA. 1987. *Environmental Perspective to the Year 2000 and Beyond.* A/RES/42/186.
28. World Commission on Environment and Development. 1987. *Our Common Future.* Oxford University Press. 400pp.