

DEVELOPMENT OF EFFECTIVE INFORMATION SYSTEMS SUPPORTING MONITORING AND CERTIFICATION PROCESS OF PRODUCTION FOREST IN INDONESIA: CONCEPT AND PROGRESS

M. A. Sharifi, And Y. Hussin

International Institute For Geo-Information And Earth Observation
P.O. Box 6,7500 Aa Enschede, The Netherlands

Alisharifi@Itc.Nl

Working Group VII/3: Integrated Monitoring Systems for Resource Management

KEYWORDS: Monitoring, Forest Certification, Remote Sensing, GIS, illegal logging

ABSTRACT

To improve the assessment of sustainability situation of production forest management a research project has been designed and being implemented jointly by the International Institute for Geo-Information Science and Earth Observation "ITC, TROPENBOS International foundation, and the Indonesian Watershed Management Technology Center, in collaboration with Indonesian Eco-Labeling Institute and the Ministry of Forestry in Indonesia. The project is aiming at "Design and development of an effective monitoring and certification system to support sustainable management of production forest in Indonesia. This article reports on some of the findings of this research program. In this context special attention will be given to the potential role of GIS, Remote Sensing and Decision Science.

1. INTRODUCTION

Rapid decline of forest cover and forest degradation especially in the tropical rain forest is now acknowledged as a "global problem" with social, economical and environmental implications. To assist in coping with the problem and to promote sustainable forest management, one of the policy instrument which is formulated by the international communities is "Forest Certification" that would allow export of forestry products only from so-called "sustainable managed forests". In this line, the Indonesian Ministry of Forestry has decided to extend the concession rights of only those concessionaries that are practicing Sustainable Forest Management* "mandatory certification". What is Sustainable Forest Management? How can it be achieved and assessed, especially considering the decentralization process that has taken place in Indonesia? What should be the criteria and indicators of achievement? How should they be measured, estimated and generalized; how should they be aggregated to a decision reflecting sustainability? how can it be handled in large areas ranging from a few hundreds to hundred thousands of hectares of forest, many of which not easily accessible.

Currently, many scientists are involved in the development of models, procedures, standards to conceptualise, operationalize and evaluate Sustainable Forestry Management "SFM" at the international, national or forest management unit (FMU) level. As a result, many management models for SFM and guidelines with large sets of sustainability Criteria, Indicators and Verifiers have been developed and recommended. However the developed management models and their related indicator system so

far experiences problem in terms of feasibility, efficiency and effectiveness. This is especially true in Indonesia where new policies for decentralization and partnership with local communities have been adopted. The certification model for the Indonesian production forest had been developed based on a forest management model, which assumes the full authorities for the concessionaire and the central government. Such assumption is not valid and the situation has completely changed. The current criteria and indicators have little connection with the actual forest management practices, and are yet intended to assess the quality of management (LEI, 2000). The current attempts to measure and verify so many criteria, indicators, and verifiers (over 200) require excessively large sets of information from the concessions (Figure 1). Proper acquisition, management and processing of such information are a massive and complex process. In some cases, non-existence, in others non-availability, accessibility and questionable reliability of the data and information, data capture, collection and processing, the time and cost that involved, has made the proper implementation of 'certification' in accordance with these excessive numbers of hierarchically structured indicators very difficult, especially when sufficient reliability is expected.

To improve the situation this research has been developed and supported by a number of international and national Institutions in Holland as well as in Indonesia. The main contributors from Holland are ITC, and TROPENBOS International, and in Indonesia Watershed Management Technology Centre, Indonesian Eco-labelling Institute, CIFOR, and the relevant departments within the Indonesian Ministry of Forestry. The research which is planned for 2003-2007, includes the following main components:

- Selection/adaptation of a collaborative management model for SFM of production forest
- Design and development of an information model to support sustainable management of production forest. Such system internally will be used to support the management of the concession as well as certification process.
- Design and development of a spatial decision support system to support monitoring and certification of sustainable forest management based on the above information model.

This paper will elaborate on the existing problems of certification process in Indonesia, and further describes the objectives, concept, components and some of the achievements of the project.

2. PROJECT DESCRIPTION

To promote sustainable forest management and improve the monitoring and certification process, this research will aim at

* For the license extension purpose, certification process is compulsory/mandatory, while for forest product trading certification is voluntary such as what LEI developed.

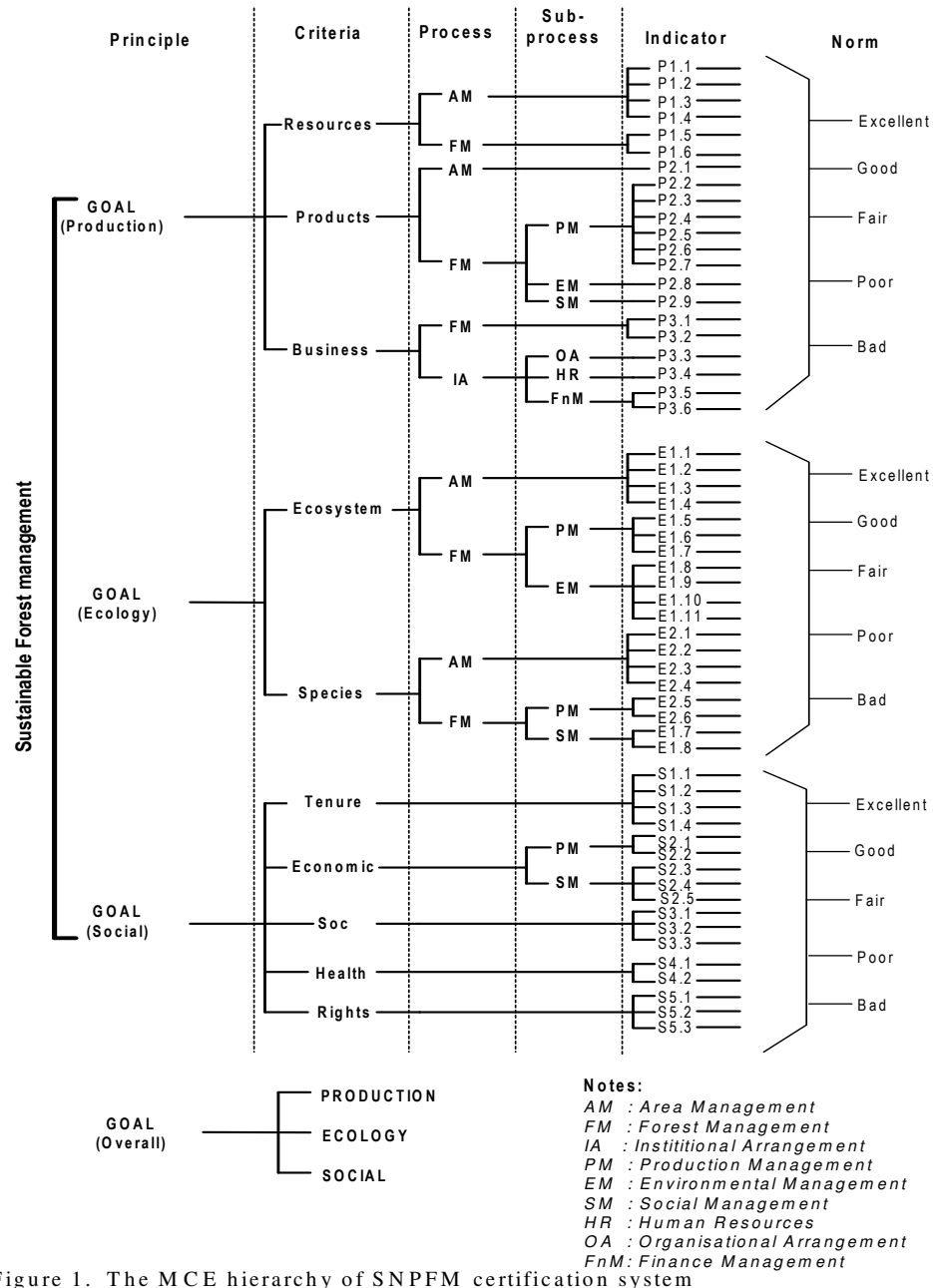


Figure 1. The MCE hierarchy of SNPFM certification system

selecting/adapting a collaborative management model, and its required information systems for monitoring SFM at concession level.. It further supports certification of the concession management. In the latter effort will be made to simplify the current certification process while ensuring its social and political acceptance, and retaining its necessary scientific rigor, and proposes a practical, effective and efficient forest certification and monitoring system. To this end, the research is aimed at the following:

- Bench-marking of the state of the art issues in SFM and certification for production forest at local level, mainly in Indonesia,
- Selection/adaptation of an Integrated model [i.e. including community values / indigenous knowledge] supporting

sustainable forest management at concession level for production forest concessions in Indonesian,

- Improve the existing forest certification model that is suitable for the Indonesian production forest, which is scientifically acceptable by the international communities, and technically and economically feasible to be implement in Indonesia,
- Explore the role of geo-information technology (GIS, Remote Sensing, and Decision Support Systems) in the process of reaching the above disciplinary objectives;
- Institutional and Civil Society strengthening/building through knowledge generation, transfer and application in close collaboration with the local institutions.

The project has started on year 2001 and shall be completed by 2007.

2.1 Conceptual design of the research

Conceptually, the research includes three main components as presented in Figure 2. In the following each elements are briefly explained.

Development of sustainable forest management mode:

For the last thirty years, forest administration in Indonesia had been highly centralized, with the Ministry of Forestry in Jakarta making the strategic and operational decisions about how the nation's forest estate would be managed. This top-down approach has been ineffective in securing sustainable forest management. 'Sustainability' has remained a paper exercise. With Indonesia's ongoing processes of decentralization and regional autonomy, significant degrees of authority over forest administration have been and are being transferred to the provincial and district governments. In some areas, this shift has intensified pressures on forests, while in other areas it has made local government decision-making more responsive to communities whose livelihoods depend on forest resources. On this basis, to be realistic before any information system designs a revisit and redesign of the management process is necessary. In this context, the concepts of ACM as developed and applied in CIFOR, the concept of joint forest management, together with the concepts "Model Forest" developed and applied in the International Forest Network will be employed to build the collaborative sustainable forest management model. The adopted should respond to socio-economic and institutional issues and the demand by local communities to improve their well-being and livelihood through forest management.

Development of Monitoring and evaluation systems: To support management of the concession as well as acting as a source of information for all the externals, such as the government agencies, Ngo's and mandatory and voluntary certification systems a monitoring and evaluation system will be designed and implemented. In this context, the concepts and methods of Structured System Development Methodology, participatory mapping and data collection, participatory GIS and analysis of remotely sensed data will be applied.

Development of forest certification system: Based on the structure and flow of information in accordance with the developed management model and its related monitoring and evaluation system, a Decision Support System for Certification will be developed and evaluated. This system will support Mandatory and Voluntary certification process as required by the Indonesian authorities and the international communities. The system shall allow selection of appropriate sets of indicators, identify the methods of assessment, and allow multi-criteria judgment to be integrated to support a final decision or assessment of SFM and sustainable products. In this process, the potential application of GIS and remote sensing techniques, especially the potential of new data collection platforms (satellite systems) together with decision support systems theory will be explored in order to improve the assessment of sustainability in the Tropical Rain Forest. In the process of building spatial decision support system for certification, the related theories and applications of multiple criteria decision making process, especially the application of fuzzy set theory to model and apply the linguistic variables, together with the related methods of rule-based and knowledge based systems will be explored and applied. This shall allow formative (process) evaluation for management im-

provement and progress monitoring, as well as summative (product) evaluation for certification

The related, models, techniques, and methodology will be developed and evaluated in a typical forest production concession. For this purpose, two potential sites are suggested, the Labanan forest concession, which is managed by PT. Inhutani I (a government owned concession company), and the TROPENBOS research site in East Kalimantan, Indonesia. Depending on the results of further study and discussions, the research can be carried in one of the two or both sites. The Labanan forest concession has been used as a pilot area by BFMP for improving the local forest management as of 1996, and possess rich amounts of historical data sets. The Labanan concession is located in a lowland dipterocarp, and consists of around 100,000 ha of production forest, which has been managed for production forestry since 1974 and has shows considerable re-growth. Forest growth has been scientifically monitored.

3. PROGRESS

So far sixteen MSc students have completed their research in the framework of this project. They have mainly focused on various aspects of certification model that has been developed and implemented by Indonesian Ecolabelling Institute (LEI, a none government organization) for natural production forest (SNPFM). As a result of the research activities, the main issues related to certification and the ways that Geo-information and decision-science can support the process are explored. In the following some of the issues related to various elements of forest certification, mainly, decision-making process, operational aspects and potential role of remote sensing and GIS application in certification process are presented.

3.1 Decision-making process

The issue related to decision-making process could be classified in three groups. The first issue is multicriteria evaluation (MCE) criteria structure (Figure 1) that has been determined according to an assumed sustainable forest management model. The second issue is the need to making sure those decision-makers and adequately understanding both issues of forest management aspect and decision-making procedures. The third issue is the need to analyse whether the compensatory decision strategy is appropriate for such decision problem where there is a feedback from bad performance of certain indicator, which can be compensated by the good one, to the achievement of the objective of higher elements in MCE hierarchy.

Decision strategies can be categorised by how they approach conflicts, use or process information, or deal with other issues in decision-making such as complexity and uncertainty (Rosenberger, 2001). Employing AHP model in SNPFM decision-making process to obtain the best choice of alternatives compared, which are the acceptable or passing grade performance with the actual performance, means allowing compensation of bad performance indicators by good indicators because AHP designed as compensatory model. That SNPFM decision model also can be regarded as a linear dimension model, which Hogart, (1987) in Rosenberger, (2001) assumes that each dimension can be measured on a scale and given a weight reflecting its relative importance. The evaluation of each alternative is then the sum of the weighted values on all dimensions.

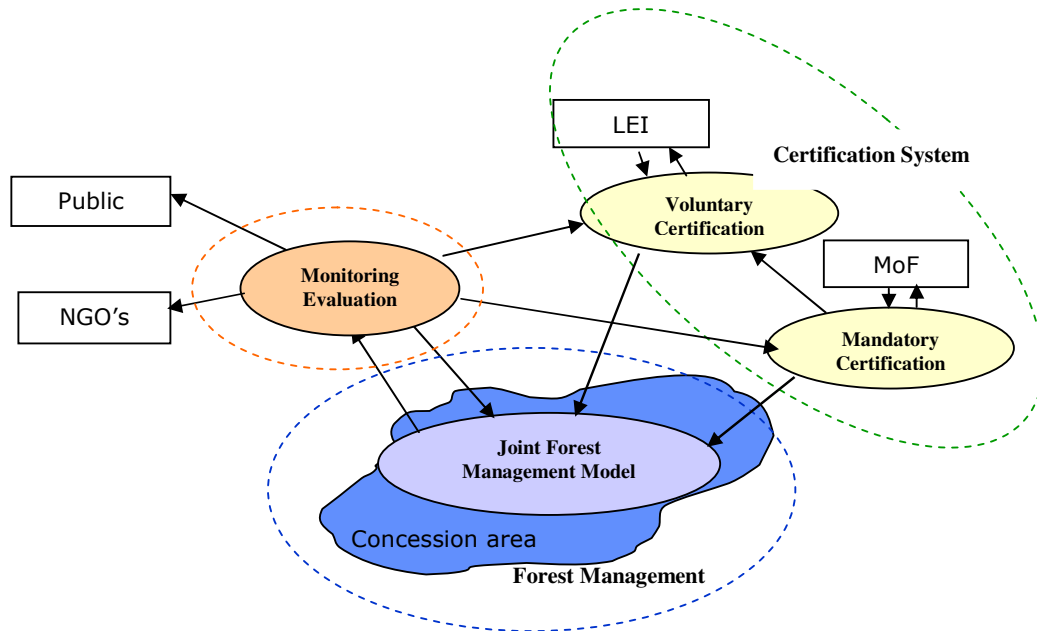


Figure 1. Conceptual presentation of different elements of the research

Applying compensatory model in sustainable forest management evaluation needs careful examination. Allowing complete compensation of bad performance, how bad it is, of certain indicator by the good performance one, may be not true. Certain indicators could be fundamental to achieve the sustainability of forest management such as forest area certainty, biodiversity conservation and assurance of local community and employee's right, while the others are not. Therefore they must be achieved at certain level of performance or threshold and cannot be compensated by any other indicators. However in another part compensation may be acceptable as a fair way in evaluation, it is most unlikely to be good in every aspects of evaluation.

The current certification system for assessing sustainability of forest management has problems in input and in processing. In the input part the major problems are that a) the verifiers are of diverse nature and vaguely defined, b) experts assess the verifiers using verbal judgement but these judgements are considered as crisp number so judgement uncertainty is not considered and c) moreover on the ground verifiers are interrelated, but in the current system they are put under different hierarchical levels and hence their ground interaction reality is restricted. In the processing part a) Crisp numbers leads to under estimation or over-estimation, b) these numbers are processed using mathematical aggregation based on AHP (Saaty, 1995) and hence uncontrolled degree of compensation that leads to irrational interactions and information loss and c) interpretation of finally derived crisp number. These problems are systematically researched and analysed in the research to choose a proper approach and necessary procedures, which can lead to decisive assessment of SFM (Purbawiyatna, 2002).

Jeganathan (2003) and Retno (2004) use AHP, Fuzzy-AHP; Fuzzy Reasoning approaches, to explore the alternative method of assessing the sustainability of the forest management. They found that fuzzy reasoning based approaches gives more flexibility, transparency and full control on the processes involved in achieving the rational sustainability assessment. For a complex problem of decision making, such as assessment of the sustainable forest management, the result usually need to be obtained through reasoning by rules. This study has found that

rule base assessment in fuzzy reasoning model allows better linking of the human knowledge with the existing indicators.

3.2 Potential role of remote sensing and GIS application

Potential role of application of RS/GIS in certification process were identified as determination of forest management typology, land-cover change determination and analysis of the status of biodiversity (Aguma, 2002; Dahal, 2002; Wardhana, 2002). Fauzi (2001) researched detection of forest structure change using image classification and found remote sensing application practical, since it deal with huge and often inaccessible area.. Cui (2003) and Santosh (2003) found that Landsat-7 ETM+ can play a partial, but also crucial role for supporting forest certification process in Indonesia. They demonstrated that the following six indicators can be positively assessed with reasonable accuracy using remotely sensed data i.e. Landsat ETM+:

- P1.1-“It must be guaranteed that land will remain as a forest area”
- P1.3-“The level of change in land cover due to encroachment and conversion of forest, fire, and other factors”
- P2.5-“Condition of remaining stands”
- P2.7-“Infrastructure of the forest management unit in the harvesting of forest products”
- P2.8-“Implementation of reduced impact logging”
- E1.3-“The intensity of damage in protected areas which includes the danger of forest fires”

Among these 6 indicators, P1.3 and E1.3 can be assessed quantitatively, while others can only be assessed qualitatively. He also showed that object-oriented image analysis, which is implemented by eCognition software, is the suitable image processing method for the information extraction to support forest certification process, although it is not very easy to use. Many functions provided by it are not available yet in other pixel-based techniques, and some of these functions are useful for assessing forest management.

Considering the large amount of indicators and the difficulty of getting relatively cloud free images, Landsat-7 ETM+ data can only partially be used to support certification process in Indonesia. Meanwhile, considering the importance of indicators and regulations that can be assessed, this partial support is also very crucial to the whole certification process. It can help to get pre-

cious and timely information at low cost, and this information are not easy, if not impossible to get by other means.

Virigina (2004) and Anita (2004), explored the role of Landsat-7 ETM+ data in exploring single tree illegal logging. They combined the classification of satellite data with the expert knowledge to successfully locate the newly illegally lodged single tree in the project area. Yohanes (2004), explored the application of remote sensing and GIS to High Conservation Valued Forest with respect to Soil erosion and water conservation.

4. Concluding Remarks

Monitoring and Certification systems are important instruments to monitor and promote sustainable forest management. However, effective monitoring and credible certification systems require large set of information, which cannot be collected only for monitoring and certification purposes. The quality of the data which is collected for this purpose is acceptable/reliable and their collection make sense if they are systematically collected and used in the process of routine management activities (planning, control and evaluation) of the concession. The foundation of the sustainable management is the concession management model, supported by proper monitoring and certification system. In these processes, the concepts of Adaptive Collaborative Management, which guarantees the right and responsibility of all stakeholders, especially the local communities are an important factor. In these processes, the remote sensing technology, geographic information science, and decision science can play an important supporting role.

REFERENCES:

- Aguma, R. C. (2002). Determination of Tropical Forest Status Using Selected Ecological Criteria and Indicators: A case study of Labanan cessioniont, East Kalimantan – Indonesia.ia. MSc Thesis, International Institute For Geo-information Science and Earth Observation ITC). Enschede, The Netherlands.
- Anita Zaituna, (2004). *"Monitoring and Modeling Illegal Logging in Tropical Forest Using Remote Sensing and GIS"*. MSc. Thesis. Enschede, ITC
- Baharudin, H. J. a. S., M. (1994). Certification Schemes for All Timber and Timber Products. Report for The International Tropical Timber Organisation. Yokohama, Japan: ITTO.
- Cui, Y. (2003). Remote Sensing and GIS for Supporting Sustainable Forest Management Certification in the Tropics: a case study in Labanan concession, East Kalimantan, Indonesia. Unpublished MSc., ITC, Enschede.
- Dahal, P.P. (2002). Determination of Forest Status Using Selected Criteria and Indicators of Sustainable Forest Management: A case study of Labanan cessioniont, East Kalimantan – Indonesia. MSc Thesis, International Institute For Geo-information Science and Earth Observation ITC). Enschede, The Netherlands.
- Fauzi, A. (2001). Remote Sensing for Detecting Tropical Logged Over Forest: A case study in Labanan Concession, East Kalimantan, Indonesia. Unpublished MSc Thesis, International Institute for Aerospace Survey and Earth Science (ITC), Enschede, The Netherlands.
- Jeganathan, C. (2003). Development of Fuzzy Logic Architecture to Assess the Sustainability of the Forest Management. MSc. Thesis. Enschede, ITC: 126.
- Lammerts van Bueren, E. M., & Blom, E. M. (1997). Hierarchical framework for the formulation of sustainable forest management standards. Wageningen, Netherlands: Stichting Tropenbos.
- LEI. (2000). LEI Guideline 99 Series: Sustainable Production Forest Management (SPFM) Certification System. Bogor, Indonesia: Lembaga Ekolabel Indonesia (The Indonesian Ecolabelling Institute).
- Purbawiyatna, A. (2002). Forest Certification as an Evaluation Process: The case study of Labanan forest management unit, East Kalimantan – Indonesia. MSc Thesis, International Institute For Geo-information Science and Earth Observation ITC). Enschede, The Netherlands.
- Retno, K. (2004). Assessment of Different Methods for measuring the sustainability of Forest Management, MSc. Thesis. Enschede, ITC: 116.
- Rosenberger, R.S. (2001). Rationality, Decision Theories, and Threshold: Implication for Environmental Valuation. Morgantown, West Virginia: Regional Research Institute and Division of Resource Management, West Virginia University.
- Saaty, T. L. (1995). Decision Making for Leaders. Pittsburgh: RWS Publications.
- Santosh. P.B. (2003). Detecting and Characterizing Selective logging in Tropical Forest. MSc. Thesis. Enschede, ITC
- Talento, M.F. (2002). Green Accounting: Improving the Business Criteria for Sustainable Forest management (A case study of Labanan management unit, East Kalimantan – Indonesia). MSc Thesis, International Institute For Geo-information Science and Earth Observation ITC). Enschede, The Netherlands.
- Virginia P. Atmopawiro (2004). "Detection of Illegal and Legal Logging in the Tropical Forest using Optical Satellite Data and Different Image Classification Techniques" MSc. Thesis. Enschede, ITC
- Wardhana, W. (2002). An Integrated Information System for Supporting the Process of determination of the Typology of the Forest management Unit: An Improvement Process for the Indonesian Sustainable Production management Certification Process. MSc Thesis, International Institute For Geo-information Science and Earth Observation ITC). Enschede, The Netherlands.
- Yohanes Budi Sulistioadi. (2004) *"Identification of High Conservation Value Forest (HCVF) related to Soil and Water Conservation to support Forest Certification Process in Indonesia"* MSc. Thesis. Enschede, ITC