Forest Resources Assessment
Working Paper 171

TECHNICAL MEETING ON ASSESSMENT AND MONITORING OF FOREST DEGRADATION

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Sustainably managed forests have multiple environmental and socio-economic functions which are important at the global, national and local scales, and they play a vital part in sustainable development. Reliable and up-to-date information on the state of forest resources - not only on area and area change, but also on such variables as growing stock, wood and non-wood products, carbon, protected areas, use of forests for recreation and other services, biological diversity and forests' contribution to national economies - is crucial to support decision-making for policies and programmes in forestry and sustainable development at all levels.

Under the umbrella of the Global Forest Resources Assessment 2010 (FRA 2010) and together with members of the Collaborative Partnership on Forests (CPF) and other partners, FAO has initiated a special study to identify the elements of forest degradation and the best practices for assessing them. The objectives of the initiative are to help strengthen the capacity of countries to assess, monitor and report on forest degradation by:

- Identifying specific elements and indicators of forest degradation and degraded forests;
- Classifying elements and harmonizing definitions;
- Identifying and describing existing and promising assessment methodologies;
- Developing assessment tools and guidelines

Expected outcomes and benefits of the initiative include:

- Better understanding of the concept and components of forest degradation;
- An analysis of definitions of forest degradation and associated terms;
- Guidelines and effective, cost-efficient tools and techniques to help assess and monitor forest degradation; and
- Enhanced ability to meet current and future reporting requirements on forest degradation.

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Forestry Department
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Forest Resources Assessment Working Paper

Technical Meeting on Assessment and Monitoring of Forest Degradation

FAO, Rome 8-10 September 2009

Summary Report

Forest Resources Assessment Programme

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Abbreviations and Acronyms

ADG	Assistant Director-General
CBD	Convention on Biological Diversity
COFO	Committee on Forestry
CPF	Collaborative Partnership on Forests
CIFOR	Center for International Forestry Research
CL	Conventional Logging
DRC	Democratic Republic of Congo
FAO	Food and Agriculture Organization of the United Nations
FRA	Forest Resources Assessment
FD	Forest Degradation
FOMD	Forest Assessment, Management and Conservation Division
FLR	Forest Landscape Restoration
GIS	Geographic Information Systems
GOFC-GOLD	Global Observation of Forest and Land Cover Dynamics
IFL	Intact Forest Landscapes
ITTO	International Tropical Timber Organization
IUCN	International Union for the Conservation of Nature
IUFRO	International Union of Forest Research Organizations
LADA	Land Degradation Assessment in Drylands
MA	Millennium Ecosystem Assessment
MAI	Mean Annual Increment
NDVI	Normalized Differential Vegetation Index
NFMA	National Forest Monitoring and Assessments
NTFP	Non Timber Forest Products
R&D	Research and Development
REDD	Reduced Emissions from Deforestation and Degradation
RIL	Reduced Impact Logging
SBSTTA	Subsidiary Body for Scientific and Technological Advice
SFM	Sustainable Forest Management
TOF	Trees Outside Forests
UNDP	United Nations Development Programme
UNEP-WCMC	United Nations Environment Programme – World Conservation Monitoring Centre
UNFF	United Nations Forum on Forests
UNFCCC	United Nations Framework Convention on Climate Change
WFP	Wood Forest Products
WRI	World Resources Institute

Executive summary

The Technical Meeting on "Assessment and Monitoring of Forest Degradation" took place at FAO headquarters in Rome, Italy, from 8 to 10 September 2009.

The objectives of the meeting were to present an analysis of definitions of forest degradation, present the case studies on forest degradation, review the results and recommend actions to improve measurement, assessment and reporting on forest degradation. The meeting provided an opportunity for participants to discuss technical aspects of methodologies for assessing and monitoring forest degradation.

A total of 37 specialists from 15 countries and 12 international forest-related organisations and processes participated in the meeting.

The main conclusions were as follows:

- (i) Endorsement of the generic definition of 'forest degradation' as a reduction in the capacity of a forest to provide goods and services;
- (ii) The many different aspects of forest degradation should be communicated better to Parties and relevant stakeholders of forest-related international conventions;
- (iii) Attention should be focused on harmonization of definitions and methods for monitoring five aspects of forest degradation: stocking level, biological diversity, forest health, level of use/production and forest soil;
- (iv) Methodologies do exist to monitor changes in carbon stocks and therefore to include forest degradation in terms of climate change into the proposed REDD mechanism.

There was a call for the development of tools and guidelines for measuring different aspects of forest degradation. The presentations made at the meeting can be found on the CPF site: http://www.fao.org/forestry/cpf/degradation/en/

Introduction

Background on the CPF initiative on Forest Degradation

The Challenge

Rates of deforestation and forest loss are regularly measured. Forest degradation – defined by international forest-related organizations as the reduction of the capacity of a forest to provide goods and services – is similarly important, but more difficult to measure.

Beyond this core definition, perceptions regarding forest degradation are many and varied, depending on the driver of degradation and the main point of interest (e.g., biodiversity conservation, carbon sequestration, wood production, soil conservation, recreation).

In the absence of agreed definitions and assessment methods, few countries are currently able to report on the area of degraded forests or the degree of forest degradation.

The study

Under the umbrella of the Global Forest Resources Assessment 2010 (FRA 2010), and together with members of the Collaborative Partnership on Forests (CPF) and other partners, FAO has initiated a special study to identify the elements of forest degradation and the best practices for assessing them.

The primary objective of the work is to help strengthen the capacity of countries to assess, monitor and report on forest degradation by:

- Identifying specific elements and indicators of forest degradation and degraded forest;
- Classifying elements and harmonizing definitions;
- Identifying and describing existing and promising assessment methodologies;
- Developing assessment tools and guidelines.

Expected outcomes and benefits of the initiative include:

- Better understanding of the concept and components of forest degradation;
- An analysis of definitions of forest degradation and associated terms;
- Guidelines and effective, cost-efficient tools and techniques to help assess and monitor forest degradation; and
- Enhanced ability to meet current and future reporting requirements on forest degradation.

The study has so far undertaken a survey of existing country practices to see what is being measured as well as an analytical study on definitions which provides a framework for the process. A series of case studies describing proven or promising methodologies and tools for assessing different aspects of forest degradation have been undertaken. The Technical Meeting described in this report, provided a forum where the analysis of definitions and case studies on forest degradation were presented, reviewed and discussed. The meeting provided an opportunity for participants to discuss technical aspects of methodologies for assessing and monitoring forest degradation.

Objectives and expected outcomes of this meeting

The objectives of this meeting were to:

- Review an analytical study on definitions of forest degradation
- Review case studies on assessment methodologies for forest degradation

- Discuss possible indicators of forest degradation and how to assess these

The expected outcomes were:

- A better understanding of the concept and components of forest degradation
- A set of possible indicators and promising assessment methodologies
- Recommended actions to improve measurement, assessment and reporting on forest degradation

Meeting participants

A total of 37 specialists participated in the Technical Meeting representing 15 countries and the following international and regional organizations, in addition to FAO: the Convention on Biological Diversity (CBD), Center for International Forestry Research (CIFOR), the International Tropical Timber Organization (ITTO), the International Union for Conservation of Nature (IUCN), International Union of Forest Research Organizations (IUFRO), United Nations Development Programme (UNDP), United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC), United Nations Forum on Forests (UNFF), United Nations Framework Convention on Climate Change (UNFCCC), World Resources Institute (WRI). The full list of participants is included in Annex 1.

Organization of the meeting

The Agenda of the meeting can be found in Annex 2. In the opening session, presentations were made on the background to the study and on various activities contributing to the process, the survey of existing country practices and the analytical study on definitions. This set the scene for the presentation of case studies.

Case studies describing methodologies and tools for assessing different aspects of forest degradation were presented in groups of four, relating to one of the themes of Sustainable Forest Management (SFM), followed by an opportunity for discussion. Case studies presentations can be found in Annex 3.

A half day was devoted to a working group session where 3 working groups discussed the best indicators of forest degradation in terms of the following themes:
- Forest extent, condition and health;
- Reduced capacity to provide ecosystem services;
- Reduced capacity to provide goods and economic services.

The results from the working groups were presented on the final afternoon, and can be found in Annex 4.

In preparation for the working group sessions, participants were asked to think about forest degradation in their own country. Using separate cards they then wrote down the three variables that they would measure if they had to assess and report on forest degradation in their own country. These cards were then put up on a large "blue" wall, for all to see and consider. The cards were grouped according to element of Sustainable Forest Management (SFM) to which they were most closely linked. These cards provided a starting point for the working group discussions. A list of the variables can be found in Annex 5.

Key messages and conclusions based on the discussions that had taken place following each of the sessions and the conclusions from the working group discussions were presented and discussed in the final session.

Summary of presentations and discussions by session

Opening session

The meeting was opened by José Antonio Prado, Director Forest Management Division, Forestry Department, FAO.

Opening Remarks (Jan Heino, ADG Forestry Department, FAO)
Forest degradation is a serious problem. The total area of degraded forests and forest lands in tropical countries has been estimated to be as high as 800 million hectares, or 20 % of the global forest area. Severe forest degradation can have serious negative impacts on the livelihoods of the rural poor, on biological diversity and on soil erosion and it can contribute to climate change by reducing the ability of forests to sequester carbon.

For this reason a reduction in forest degradation forms part of the first of the four global objectives on forests as agreed by the members of the United Nations Forum on Forests; it is linked to the 2010 target on Biodiversity; and it is given prominence in the discussions on climate change mitigation and adaptation.

Estimates of the rate or level of forest degradation are few and vary widely. Only a handful of countries are able to report on the area of degraded forest or the level of forest degradation – and they use different definitions and assessment methodologies to do so. Given the severity of the problem and this lack of comparable information, the CPF initiative on Forest Degradation aims to strengthen the capacities of countries and organizations to assess, monitor and report on forest degradation. The ultimate aim is to provide better information on the scale and causes of forest degradation in order to garner support at all levels to effectively address this problem.

Background (Mette Wilkie, FAO)
Countries need to know where forest degradation is taking place, what causes it and how serious the impacts are in order to prioritize the allocation of resources to the prevention of degradation and to the restoration and rehabilitation of degraded forests. For countries to report on forest degradation and demonstrate efforts to tackle the problem and meet global objectives and targets, common definitions and agreed methodologies for the assessment and monitoring of forest degradation are needed.

The CPF initiative hopes in particular to:

- Highlight the different aspects of forest degradation;
- Review assessment methodologies;
- Facilitate access to new tools, especially in developing countries;
- With the ultimate aim of leading to action to reduce current rates of forest degradation.

Process of the Study (Victoria Heymell, FAO)
This work builds on some existing processes that are already established. These include:

- Nine eco-regional processes on criteria and indicators for SFM that have been operational since 1992;
- Three past expert meetings on harmonizing forest related definitions including one in 2002 that made a recommendation for a core definition of forest degradation;
- Experiences in other sectors, both within FAO and through the CPF.

The key components of the study have included:

a. Questionnaires to National Forest Correspondents and a survey of existing country practices to establish what is being measured;
b. The preparation of an annotated bibliography and an analytical study on definitions which provides a framework for the process;
c. A series of case studies describing proven or promising methodologies and tools for assessing different aspects of forest degradation.

Other activities have included:

- An ongoing in-depth review of existing and promising new methodologies and tools to generate scientifically sound estimates of historical rates of levels of forest degradation in developing countries;
- Outreach activities, including presentations at COFO in March and at UNFCCC-SBSTA in June; development of a brochure in English, French and Spanish and a webpage dedicated to forest degradation on the CPF site.

<u>Annotated Bibliography (Evisa Abolina, Intern UNFF)</u>
During the process of the Forest Degradation study, a long list of studies had been collected through internet searches, as well as others that were provided by Guide Lund. These were collated into an annotated bibliography. The main goals in preparing the annotated bibliography were to:

- List studies on Forest Degradation under the themes of Sustainable Forest Management;
- Indicate which forest degradation assessment methodologies and indicators were used in each study;
- Identify any definitions used in assessing forest degradation in each of the studies;
- Evaluate studies to determine the most promising ones for future work;
- Determine areas that are poorly covered with few studies.

The most poorly represented elements of SFM to have been assessed were the Protective and Productive functions of forests. This might be explained by the indicators used under each element and its specifics. Regarding protective functions of forests from the point of view of forest degradation, it may be that forest degradation studies rarely look at forest areas designated for protective purposes. Regarding productive functions of forests, these are seen primarily from a commercial or market perspective. It would be useful to incorporate ecosystem services here.

Many of the studies did incorporate several elements of SFM and associated indicators. Several studies suggested that remote-sensing imagery (using indicators of biomass, forest canopy cover and density and vegetation cover) supported by ground observations (including indicators such as species composition, tree height, volume, quality of timber) are the most reliable way to estimate locations and rates of deforestation and forest degradation.

Defining Forest Degradation

Towards Defining Forest Degradation: Comparative Analysis of Existing Definitions (Markku Simula, FAO Consultant)

The paper reviews the existing international and national definitions of forest degradation, analyses their elements and parameters and identifies their commonalities and differences. The generic definition of forest degradation (*the reduction of the capacity of a forest to provide goods and services*) provides a common framework for all the international definitions however it may be difficult to operationalise. The most comprehensive international definitions have been developed by ITTO and CBD, covering change in forest structure and dynamics, forest functions, human induced causes and a reference state.

Few countries have developed a national definition of forest degradation. Typical indicators in these definitions are stocking level, productivity, biomass density and species composition. The analysis indicates that the elements of sustainable forest management may offer a suitable framework for assessing forest degradation as well as its causes and impacts.

In general, the review of existing definitions shows that many definitions are either very general or their focus is on reduction of productivity, biomass or biodiversity. There may then be a need to combine the holistic approach and specific-purpose definitions. A particular issue is the definition of thresholds between non-degraded, degraded and non-forest. For degradation definitions the temporal scale is crucial, with the need for a long term approach, while the purpose of the definition is linked with the level of assessment.

The various international definitions currently in use, leave several issues open which need to be addressed, and any operational definitions of forest degradation for specific purposes should provide: (i) identification of forest goods and services; (ii) a spatial context of assessment; (iii) a reference point; (iv) coverage of both process and state (degradation/degraded forest); (v) relevant threshold values; (vi) specification of reasons for degradation (human induced/natural) (when required by the use of definition); (vii) an agreed set of variables; and (viii) indicators to measure the change of a forest. Additional elements could be added or singled out, depending on the particular interests related to the use of definition.

It was suggested that possible core elements could be measured by 3 proxies:
- Reduction in biomass for the growing stock or the carbon stored which can be associated with the reduction of canopy cover and or number of trees per unit area;
- Reduction in the loss of biological diversity which can be associated with the occurrence of species (dominant and non-dominant) and habitats;
- Reduction in soil as indicated by soil cover, depth and fertility.

Key points raised in the discussion included the following:

- There was overall agreement that the generic definition is sufficiently broad;
- The time and scale may depend on the objectives of management;
- Degradation could be considered as both a state and a process;
- "One person's degraded forest is another person's livelihood". [There needs to be a definition and framework that can function pragmatically to ensure that the 800 million ha of degraded forests and forest lands can be incorporated into REDD. A process may be needed to measure and track degradation that meets both the aims of UNFCCC and the aims of the CBD.] Degradation cannot be measured only in terms of Carbon stocks,

as proposed by UNFCCC and SBSTA, therefore a proxy is needed at global and landscape levels that can describe the decline in capacity to provide goods and services;

- Trade-offs exist in all management decisions and tools to deal with trade-offs exist (multi-purpose forestry). Levels of tolerance, safeguards and thresholds can be used when addressing trade offs;
- If forest degradation is related to the specific objective or parameter, it may be possible to say that a forest is degraded in terms of carbon, or wood species (loss of this amount). In regard to a specific duration of degradation, it may be related to how long it might take to restore it;
- Reference data could be considered as the recovery function according to the management objective that is being set.

Potential Indicators Related to Degradation by SFM Element

SFM element	Potential indicators (examples)
Extent of forest resources	Forest cover, crown cover, growing stock, stand density, degree of fragmentation, trees outside forests (TOF).
Biological diversity	Ecosystem diversity, species composition/diversity, genetic diversity, degree of fragmentation, connectivity, naturalness, crown cover, forest structure.
Forest health and vitality	Area affected by pests, diseases, fire, storm damage, area subject to air pollution damage, area with diminished biological components.
Productive functions of forest resources	Stocking level, Mean Annual Increment (MAI), age structure, NTFP yield, wood quality.
Protective functions of forest resources	Soil erosion, water quality and runoff, managed watershed area, flood protection areas, protective plantation area
Socio-economic functions of forests	Value of forest products, recreation and tourism; cultural and community values; employment; income; area available for recreation, area available to indigenous people/social services.
Contribution to the carbon cycle/climate change by forests	Carbon stock in pools (above/below ground biomass, deadwood, litter, soil), stocking density, removals, TOF

Extent of Forest Resources

Measuring and Monitoring Forest Degradation through National Forest Assessments (Mohamed Saket, FAO)

The presentation demonstrated how the NFMA programme addresses key criteria of forest degradation linked to the thematic elements of sustainable forest management (SFM) in its methodology. Each SFM thematic element is examined in the context of the NFMA country experience and how it has facilitated delivery of data on status and extent of forest degradation. Country-level proxies and parameters are provided for each theme in order to demonstrate how the NFMA approach can enable countries to assess and monitor degradation of forest resources. In this work, remote sensing together with field level measurements and household interviews are used.

Analysis of the Normalized Differential Vegetation Index (NDVI) for the detection of Degradation of Forest Coverage in Mexico2007 – 2008 (Carmen Lourdes Meneses Tovar, Mexico)
The study described relationships between forest usage and the Normalized Differential Vegetation Index (NDVI) estimated from satellite imagery. Some of the indicators of forest usage that were related to the euclidean space of the satellite images are: type of vegetation, number of live trees, number of species, crown diameter, total height, trunk diameter, and estimates of wood volume and biomass. Other supporting variables used included precipitation, temperature, number of days of rain per year, evaporation, a digital elevation model, ecological regions of the country, as well as variables related to anthropogenic effects.

Forest Degradation in Nepal: review of data and methods (Resham Bahadur Dangi, Nepal)
In Nepal various different methods have been use to assess forest resources since the 1960s. The presentation looked at the various drivers of degradation, their level of significance and the key degradation element linked to each of those drivers. Detectability of each of those key degradation elements was rated from low to high for 3 methods of detection that included field surveys, aerial photos and satellite image analysis.

An example could be fuel wood removal as a driver of degradation. The key degradation element measured is biomass and understorey. Detectability was considered as high, medium to low for each of: field surveys, aerial photos and satellite images respectively.

Overall the work concluded that the use of satellite imagery supported by ground based inventory could provide a suitable approach for assessing forest degradation as it would combine the strengths of both methods.

Extrait de l'inventaire forestier des forêts classées autour de Bamako (Nianti Ousmane Tangara, Mali)
The case study from Mali describes a dramatic degradation process as documented by forest inventories carried out 8 years apart. The gazetted forests studied exist close to Bamako where they are used for the production of wood products. The study used forest inventory to describe the forest structure and volume of timber. Hence changes over time and forest degradation could be quantified. The study focuses particularly on wood production and provides an example of a traditional approach at the local level.

Biological Diversity

Assessing forest degradation due to fragmentation – developing biodiversity-relevant measures (Val Kapos, UNEP-WCMC)
In assessing forest degradation due to fragmentation, biodiversity-relevant measures were developed. The focus is about understanding differences in composition rather than assessing species richness. Another possibility is to investigate processes and factors known to cause biological diversity to deviate from that of undisturbed forest. These include area loss, which is known to affect the abilities of some species to survive – especially animals with large home ranges and rare species (some trees) that lose options for reproduction as areas decline. Changes in forest structure as discussed elsewhere here have implications not only for carbon, but also for the suitability of the forest as a habitat for some species. Changes in composition can themselves lead to other changes as the occurrence of predators and the availability of food species changes. Finally, it is known from many studies that forest fragmentation has implications for biological diversity that are greater than those simply relating to area loss.

Occupation des sols des forêts classes du Niger et l'analyse des dynamiques du changement (Ibro Adamou, Niger)

The case study from Niger made a comparative analysis of the situation of classified forests between 1975 and 1999. It described the forests in terms of degradation, no change or improvement. It was noted that the majority of forests were affected by advancing agricultural land use. Local communities noted changes in the structure and composition of the forests, the disappearance of some species and the general reduction in biological diversity. It is an example of what can be done in Sahelian conditions and an example of what can be done at the national level. It looks at changes in vegetation types in a sample of 20 gazetted forests covering some 230,000 hectares spread over the country from Tillabery to Diffa. Over a period of 25 years it was noted that 22.7% was degraded, 68.5% had not changed and 8.8% had improved.

Defaunation and forest degradation: how to measure the impacts of hunting? Congo Basin (Robert Nasi, CIFOR)

The work reviewed methods used for assessing defaunation, as a forest degradation component, linked to logging and logging concessions with an emphasis on mammals in the Central African Rainforests. A discussion on the usefulness and weaknesses of various methods was provided. Logging is recognized as having different types of impacts on wildlife that can be classified as direct (usually visible shortly after logging) and indirect (concerning the longer term). Direct impacts can be presence of heavy machinery and logging teams, disturbance and modification of the structure and composition of the habitat. Logging increases access to remote forests by opening roads into previously inaccessible areas. Given the limitations of the different methods discussed, a well designed survey protocol might imply the use of a combination of approaches with both measures of mammal abundance and measures of hunting and trading activities within the logging concession. Priority for the coming years should be to develop more standardized protocols that would allow comparisons among sites.

Impact of developmental projects in the humid evergreen broad-leaved forest: A case of Wasabi Pilot Project at Lamperi, Western Bhutan (Pema Wangda, Bhutan)

The case study from Bhutan describes what happened following a failed development project (a pilot Wasabi plantation project) on humid evergreen broadleaved forest. It suggests an example where following the initial removal of trees there were secondary effects of subsequent increased grazing. It appears questionable whether the forest will return to its original state, or whether the degradation has led to a permanent change in the forest composition (and structure). The measurements made were undertaken 3 years after the disturbance.

Productive Functions of Forests

Etude de cas sur la dégradation des forêts de la République Démocratique du Congo (Christophe Musampa, Democratic Republic of Congo presented by François Wencelius)

An example of what can be done at the national level, the case study looked at a comparison of changes in areas of land use classes, by comparing satellite imagery. The land use classes used were: primary forest, secondary forest, swamp forest, industrial agricultural plantations, agriculture/savannah mosaic, villages and water.

The methodology used (remote sensing + GIS):

- is operational to quantify changes in land use classes;
- is appropriate for the evaluation of DRC's large areas of forest resources;
- makes it possible to identify the main causes of deforestation and degradation.

However, most of the elements of the methodology date back to the 1990s, and considerable improvements could be achieved through updated hardware and software, and further ground truthing.

An Operational Approach to Forest Degradation - Forest Stock Measurement Chile (Carlos Bahamondez, Chile)
An operational approach to Chile's forest degradation from the productive perspective is tested by using relative density. The case study from Chile showed that a stocking chart provided a useful tool for helping to recognise degraded forest. As a tool used together with field observations there was improved identification of degraded forest. Data for building the stocking chart is provided by the National Forest Inventory data bases for one of the most common forest types in Chile, the Roble-Rauli-Coihue forest type *(Nothofagus oblique-Nothofagus alpine-Nothofagus dombeyii*). The resulting stocking chart constitutes a powerful tool for understanding and identifying degraded forest from the stock point of view. It also identified the needs for suitable data which must be provided under periodical bases, like large scale permanent forest inventories. The use of a stocking chart provides a feasible way to identify objectively the condition of forest degradation. It has become a potentially important tool for monitoring sustainable forest management practices or policies.

Measuring ecological impacts from logging in natural forests of the Eastern Amazônia as a tool to assess forest degradation (Marco Lentini, Brazil)Brazil
In Brazil reduced impact logging (RIL) was compared with conventional logging (CL) from an economic perspective. The work presents a simple method to assess forest degradation and ecological impacts caused by logging. Results showed a net income from RIL 19% higher than CL. Remote sensing techniques are able to identify coarse scale problems with logging however simple field methods are also needed to evaluate quality of forest management and use of resources.

Contribution to the Carbon Cycle

Monitoring and Reporting Forest Degradation under UNFCCC (Danilo Mollicone, FAO)
In the interests of REDD the objective is in measuring the reduction in carbon stocks.
Under UNFCCC there is no definition of forest and no definition of forest degradation, with a land based reporting approach. Carbon stock changes in the five pools, above and below ground biomass, dead wood and litter (dead organic matter), soil (mineral organic); the change in carbon being the change in carbon in any one of these pools added together. The stock difference can be the change in carbon in any one of these pools between two times.

Integrating Forest Transects and Remote Sensing data to Quantify Carbon Loss due to Forest Degradation: A case study of the Brazilian Amazon (Carlos Souza, Brazil presented by Danilo Mollicone)
Work in Brazil using remote sensing and rapid forest transect surveys showed the main sources of C emissions to be deforestation, selective logging, forest fires, forest fragmentation. Remote sensing detection of forest disturbances can range from highly detectable to almost undetectable. In this work forest degradation has been defined as a type of "land modification", which means that the original "land cover structure and composition is temporarily or permanently changed", but it is not replaced by other types of land cover. This work provided a brief review of how remote sensing has been used to detect and map forest degradation and how carbon stocks of degraded forests can be characterized using rapid forest transect surveys. Field data of forest carbon stocks can be integrated with optical remotely sensed data to regionally characterize

forest degradation. The challenges to integrating field-derived carbon estimates with remotely sensed data were also discussed.

Community Measurement of Carbon Stock Change for REDD (Eliakimu Zahabu, Tanzania)
The work presented on community measurement of carbon stock change for REDD, show that there is an interest and willingness from communities to participate in carbon trading; that communities have the capacity to undertake forest inventory and carbon inventory; that community forestry entails higher social returns than just monetary gain. One solution to forest degradation lies in sustainable forest management by local communities. While reduced degradation is to be credited and rewarded under REDD policy, it may be more important to measure and reward increases in carbon stock due to the enhanced growth, than the decreases in emissions due to reducing the degradation.

Monitoring Degradation in the scope of REDD (Thomas Baldauf, Germany)
For methodologies to observe biomass and carbon stock change in the world's forest area to be cost effective, integrated methods, utilizing terrestrial surveys and remote sensing data are widely applied. Suitable methods are available for assessing deforestation. However, for detecting degradation, which in the context of REDD applies to the partial loss of biomass, even the adaption of existing methods encounter severe constraints. The work presents a comprehensive methodology, which is intended to provide figures on both deforestation and forest degradation in the scope of REDD. As field surveys are time consuming and expensive, particularly in remote areas, they are not conducted as full tallies, but undertaken by statistical sampling approaches.

Review of work on Historical Degradation (Martin Herold, GOFC-GOLD)
Work is being undertaken to identify and promote the use of effective and cost efficient methodologies and tools to monitor forest degradation in terms of changes in forest carbon stocks and sequestration rates in "forests remaining forests" in developing countries. In this respect a group of authors are undertaking an in-depth review of existing and promising new methodologies and tools to generate scientifically sound estimates of historical rates or levels of forest degradation in developing countries. They will contribute to collating and critically reviewing case studies, articles, guidelines, manuals and other documents describing methodologies for assessing historical rates or levels of forest degradation and will compare and contrast different methodologies.

Socio-economic functions/ Community level assessments

Forest Resources Degradation Accounting in Mongolia (Hijaba Ykhanbai, Mongolia)
A case study from Mongolia looked at the economic accounting of Forest Degradation. The case study outlined the results of forest resources degradation accounting, covering a period of 30 years (1976 – 2006), and measuring the dynamics of change of forest resources in the country. Forest Degradation accounting in that case was considered as a value of the changes of extent of forest resources and its adjustments with economic development indicators of the country. Measuring the forest as a renewable resource was dependent on annual growth and closing stock, and from stock changes due to factors of degradation.

Assessment of Forest Degradation by Local Communities – The Case Study of Ghana (Dominic Blay, Ghana)
In Ghana, the need to curb continuous degradation, led to the prioritisation of sites based on the level of degradation. Indicators for assessing degradation were developed in collaboration with the local communities. Work focussed on the state of flora resources (biodiversity), the state of

streams and rivers (protective functions) and the state of fire and soil fertility (forest health). The approach relied on skills that are locally available and indicators that are based mainly on visual assessments. It is an approach that could easily be applied at the local level elsewhere. The approach could be improved using statistical analyses.

Local Level field assessment of land degradation (Sally Bunning, FAO)LADA- FAO
Land Degradation Assessment in Drylands (LADA) looks at soil properties and soil erosion, water quality and quantity, and vegetation and land use and biodiversity. They define land degradation as "The reduction in the capacity of the land to perform ecosystem functions and services that support society and development". They use a multi-scale participatory process with an integrated analysis of human and environmental indicators.

Surveillance et Suivi de la Santé des Forêts au Maroc (Taoufiq Aadel, Morocco)
The use of permanent plots to determine and follow the state of forest health was described in a case study from Morocco. A systematic network of permanent plots (8 x 8 km) was established that uses indicators that provide a simple, rapid and reliable assessment of information on forest health. The operation was conducted in collaboration with the National Forest Inventory (NFI). The permanent plots have made it possible to report on the annual state of forest health, to monitor changes over time and to anticipate any potential phytosanitary imbalance.

Reversing Forest Degradation

Global Mapping and Monitoring of Forest Degradation: The Intact Forest Landscapes Method (Lars Laestadius, WRI)
The IFL Method uses high spatial resolution satellite images to identify and map large un-degraded areas called Intact Forest Landscapes (IFL), defined as unbroken expanses of natural ecosystems in the zone of forest growth without signs of significant human activity and at least 50,000 hectares in size. The method produces an IFL map which shows the boundary between unaltered forest landscapes (where most components, including species and site diversity, dynamics and ecological functions remain intact) and altered or fragmented forests (where some level of timber extraction, species composition change and alteration of ecosystems dynamic has taken place).

The paper presents the results of a global assessment of forest degradation and several examples of regional-level monitoring. Forest degradation was measured at the global, biome and national levels based on the distribution and proportion of IFL areas while the detailed boundary between 'intact' and 'non intact' forest landscapes was employed as a baseline for monitoring of forest degradation. The IFL method is a rapid and cost-effective practical solution for assessing forest degradation and intactness at the global and regional scales.

The method allows users essentially to define or identify the areas that can be considered not degraded, and thus eliminate them from the rest of the forest land that would potentially be included in any degradation survey.

Addressing Forest Degradation in the Context of Joint Forest Management in Udaipur, India (Michael Kleine, IUFRO)
Many rehabilitation projects define forest degradation through an indirect three-tiered approach at the local level, which covers the socio-economic situation, the reduction in goods and services from forests and the status of forest degradation through visual field inspections. Rehabilitation targets include: increased ground vegetation cover (improved grass production), reduced soil

erosion (controlled grazing; check dams), and increased tree biomass, including improved fire wood production (forest protection; planting of hedgerows).

Quantifying progress towards achieving the rehabilitation targets requires monitoring of indicators (biological, structural): data on "before and after scenarios" (on project-by project basis). Rehabilitation measures lead to higher forest biomass levels, in order to achieve improved productivity. This may or may not be in line with other goals (e.g. carbon, biodiversity).

Investments into forest rehabilitation may include field work (planting; fencing; check dam construction) and changes in the management of forests through policies and regulations, local institutions, capacities (including training of forestry staff), and employment and markets. Large portions of investments are needed to bring about a social transition to SFM. Otherwise rehabilitation results (e.g. improved production; reduced emissions) are only short-lived.

Global Partnership on Forest landscape Restoration (FLR) (Stewart Maginnis, IUCN)
Forest Landscape Restoration brings people together to identify, negotiate and implement practices that restore an agreed optimal balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses
Aims:

- Support partners in effectively restoring degraded forest landscapes
- Establish and improve relationships among different interest groups involved in forest landscape restoration
- Encourage the development and use of innovative FLR approaches and methodologies

Underlying principles:

- Multi-functional
- Situation specific
- Participation
- Scale
- Adaptive Management

FLR provides a potential remedy to degradation as currently defined, and is a useful way of framing the enhancement of carbon stocks. However flexibility is required and several learning sites indicate that countries are not bound to follow the forest transition curve.

Forest Ecosystem Resistance and Resilience and Biodiversity (Ian Thompson, CBD)
Resilience is the capacity of an ecosystem to recover after disturbance. Disturbances may move the forest to a new state or age class. The stability of a forest state is a concept related to resilience. Most primary forest ecosystems are resistant and resilient to natural disturbances. Resilience of a forest is a function of biodiversity at many scales: genes, species, and regional diversity among ecosystems. Biological diversity also underpins the ecological goods and services from the forest. Loss of biodiversity may alter the forest resilience and will result in reduced goods and services. Loss of resilience means uncertainty about future forest condition. Most often, degraded forests are unstable because they lack diversity and functionality. Degraded forests always provide fewer ecosystem services. Diseases and disturbances do not affect all species equally, more diversity means less loss to these factors.

Ecological principles for restoring degraded forests to improve stability and resistance:

- biologically diverse systems tend to be more productive, stable, and produce more goods and services than simple ecosystems (e.g., monotypic plantations);

- re-forest by using native species and by using natural forests as models;
- maintain landscape connectivity;
- manage to maintain genetic diversity (e.g., reduce selective harvest of 'best' trees) and plant several seed stocks;
- protect primary forests and species at the edges of their ranges;
- plan to reduce invasive species.

Conclusions

- Evidence supports the concept that biodiversity confers resilience within a forest ecosystem at many scales;
- Mechanisms include redundancy, resistance to disease, increased productivity, genetic capacity to adapt to change;
- Loss of biodiversity can result in an ecosystem condition that is difficult to change or that provides an uncertain future condition;
- Biodiversity also provides most ecosystem goods and services;
- Degraded forests may be stable, although more often they are not, but they will provide reduced goods and services.

Key messages/Conclusions

The generic definition of forest degradation provides an adequate umbrella for international level and a common framework to develop specific definitions for particular purposes.

The concept of degradation involves both the state of the forest and the degradation process:

- The state of degrading or degraded forest may have to be defined to differentiate it from primary and sustainably managed forest and from non-forest to ensure comprehensive coverage. This may be determined by the management objectives.
- The degradation process reduces the delivery and distorts the balance of forest goods and services.
- Equally important is to consider improvement processes (restoration, rehabilitation and natural recovery of forests).

Degradation is related to temporal and spatial scales:

- There is need to have a long-term view in assessing reduction (or improvement) in forest goods and services so that temporary changes at stand level due to regular forest management operations (e.g., thinning, selective cutting) are not considered degradation. On the other hand, short-term changes need also be monitored as they may impact livelihoods of forest-dependent people. [A priori specification of the temporal scale in the definitions of forest degradation is not recommended].
- Degradation needs to be addressed both at stand and higher levels (forest management unit, landscape, sub-national, national, regional and global) and for various forest types for various purposes. This should be considered in stand-level focused definitions.

Trade offs exist: There are trade-offs between different forest goods and services and the balance between them is determined in management objectives. The trade-offs also need to be considered in assessing forest degradation.

Management objectives: In setting management objectives there is a general trend from wood production towards more focus on a wide range of ecosystems services of forests which has implication for assessment of forest degradation. If management (or use) objectives for a specific forest area (e.g. FMU, forest stand) are available, a more target-oriented and cost-effective assessment of forest degradation can be carried out.

Information Needs: For defining, monitoring and assessing forest degradation it is necessary to define for what purpose and on what aspects information is needed, for whom and how the information is going to be used. This links back to the objectives of management, which must be clearly established.

Separation of natural and human induced causes: Both human induced and natural causes cause forest degradation. Although their separation is often difficult due to inter-linkages, for the design of policy instruments and support programmes separation of these causes may be necessary.

Reference states, thresholds and baselines: It is particularly challenging to establish appropriate reference states, thresholds and baselines for forest degradation due to limitations of data, different management objectives and issues of scale. Thresholds need to be identified and applied at a local level. Reference data could be considered as the recovery function according to the management objective that has been set.

Status and process: In assessing forest degradation there is a need to separate the status and the process of degradation, drivers and impacts (environmental, social and economic). The elements of Sustainable Forest Management (SFM) provide a useful comprehensive framework for identifying relevant aspects related to forest degradation.

Targets: In addressing forest degradation there is a need to establish specific targets for improvement measures and addressing the drivers of degradation in order to raise necessary resources through various mechanisms of financing. This calls for adequate information on the status and process of degradation as well as cost-benefit analyses and economic valuation of lost benefits due to forest degradation, for example, through forest accounting combined with use valuation of environmental services.

Country and location specific character: This calls for flexibility in defining forest degradation and indicators for its assessment. It may be more important to have consistent information on changes over time within a country than fully comparable information between countries at a given point of time. However, at the international level there is a need to have common definitions for selected key indicators.

Indicators and Methodologies:
Common indicators for monitoring and assessing forest degradation can be developed for the following key element to be used in assessing forest degradation:

- Biomass (e.g. growing stock, forest structure);
- Biodiversity (e.g. species composition and richness, habitat fragmentation);
- Forest health (e.g. fire, pest and diseases, invasive and alien species);
- Forest goods obtained (compared against sustainably managed forests);
- Soil quality (as indicated by cover, depth and fertility).

Promising methods to monitor and assess forest degradation include:

- Combination of remote sensing, GIS and field observations;
- Advanced technologies, for example aerial laser scanning;
- Community-based assessment.

There is major potential to address forest degradation by involvement of local communities (particularly for the collection of field data), but they need adequate understanding of the problem and its consequences for their livelihoods and they should have sufficient incentives to take necessary action, in addition to requiring adequate training and supervision. To achieve this they should also understand (i) forest classifications and other basic technical elements as well as (ii) compensation mechanisms to engage them fully in taking necessary improvement measures. Local communities should realize benefits, other than financial to be motivated to take action.

Monitoring of the degradation process should be systematic and continuous, involving more than two points of time. Assessment of the status or degree of degradation can be made through comparing non-degraded and degraded forests in similar ecological and socio-economic conditions. Another approach is to use periodic data on changes in area by forest categories in two points of time.

Recommended actions

International Definitions

1. Some of the existing international definitions should be improved in terms of their clarity, consistency and compatibility including clarity about their formal status, for example those of ITTO and CBD.

Climate change discussions

2. Improved understanding of assessment and monitoring of carbon emissions and fluxes from forest degradation need to take into account the inter-linkages between biomass, biological diversity and forest health, and forest carbon. In other words, in order to understand how or what to assess and monitor as regards forest degradation (as a state and process), it is also necessary to take into account the linkages with biodiversity, forest health, etc. It is not so much the means or methodologies per se.

3. In implementing actions to reduce emissions from deforestation and forest degradation in developing countries, forest carbon assessment and monitoring need to be carried out at national level to avoid leakage. A comprehensive approach (including non-degraded and degraded forest lands and non-forest lands) could avoid leakage between different land-use categories.

National level information dissemination

4. The scope of national forest inventories should be expanded to include the key elements needed to assess forest degradation.

5. Key common internationally applicable indicators should be identified for forest degradation to be applicable in FRA.

6. Supporting data sets should be developed at national level e.g. on national Red Lists of Threatened Species.

Capacity Building

7. Available methodologies and tools to address forest degradation should be further developed including guidelines for measurement and corrective action including those targeted at local communities.

8. Efforts to measure and assess forest degradation should be intensified through case studies, pilot measurements and their replication, and dissemination including ensuring policy feedback.

9. Support should be provided to capacity building in national forest inventories and education and training at different levels including local communities.

10. Support should also be provided to countries to meet international reporting requirements on forest degradation.

11. Basic research should be expanded to address forest degradation and its impacts on ecosystem services and their inter-linkages.

Annex 1. List of Participants

Technical Meeting
Assessment and Monitoring of Forest Degradation
Rome, Italy, 8-10 September 2009, Mexico Room, D211

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Annex 2. Meeting Time Table

Technical Meeting
Assessment and Monitoring of Forest Degradation

Rome, Italy, 8-10 September 2009, Mexico Room, D211

TIMETABLE

<u>Day 1 – Tuesday 8 September</u>

Morning

8:30 - 9:30	REGISTRATION
Opening Session	Chair: José Antonio Prado, Director FOMD, FAO
9:30 - 9.45	Opening Remarks (Jan Heino, ADG Forestry Department, FAO)
	Introduction of Participants Objectives and expected outcomes Adoption of the Agenda
9:45 – 10:00	Assessment and Monitoring Forest Degradation: Why, What and How? (Mette Wilkie, FAO)
10:00 – 10:15	Process – questionnaires, literature searches, case studies (Victoria Heymell, FAO)
10:15 – 10:30	Annotated Bibliography – analysis of material (Evisa Abolina, UNFF)
10:30 – 11:00	*Coffee break*
Technical session 1:	**Defining Forest Degradation (Chair: Mette Wilkie, FAO)**
11:00 – 11:30	Towards Defining Forest Degradation: Comparative Analysis of Existing Definitions (Markku Simula, Consultant FAO)
11:30 – 12:30	Facilitated discussion
12:30 – 14:00	*Lunch*
Afternoon	***Presentation of case studies linked to the themes of Sustainable Forest Management (SFM)***

Technical session 2:	**Extent of Forest Resources (Chair: Peter Csoka, UNFF)**
14:00 – 14:15	Measuring and Monitoring Forest Degradation through National Forest Assessments (Mohamed Saket, FAO)
14:15 – 14:30	Analysis of the Normalized Differential Vegetation Index (NDVI) for the detection of Degradation of Forest Coverage in Mexico 2007-2008 (Carmen Lourdes Meneses Tovar, Mexico)
14:30 – 14:45	Forest Degradation in Nepal: review of data and methods (Resham Bahadur Dangi, Nepal)
14:45 – 15:00	Extrait de l'inventaire forestier des forêts classées autour de Bamako (Nianti Ousmane Tangara, Mali)
15:00 – 15:15	Questions and Discussion
15:15 – 15:30	*Coffee break*
Technical session 3:	**Biological Diversity (Chair: Ian Thompson, CBD)**
15:30 – 15:45	Assessing forest degradation due to fragmentation – developing biodiversity-relevant measures (Val Kapos, UNEP-WCMC)
15:45 – 16:00	Occupation des sols des forêts classes du Niger et l'analyse des dynamiques du changement (Ibro Adamou, Niger)
16:00 – 16:15	Bush Meat (Robert Nasi, CIFOR)
16:15 – 16:30	Impact of developmental projects in the humid evergreen broad-leaved forest: A case of Wasabi Pilot Project at Lamperi, Western Bhutan (Pema Wangda, Bhutan)
16:30 – 17:00	Questions and Discussion
17:30 – 18:30	*Cocktail (Terrace, 8th floor)*

Day 2 – Wednesday 9 September
Morning

Technical session 4:	**Productive Functions of Forests (Chair: Jürgen Blaser, ITTO)**
9:30 – 9:45	Etude de cas sur la dégradation des forêts de la République Démocratique du Congo (Christophe Musampa, Democratic Republic of Congo presented by François Wencelius)
9:45 – 10:00	An Operational Approach to Forest Degradation - Forest Stock Measurement Chile (Carlos Bahamondez, Chile)
10:00 – 10:15	Measuring ecological impacts from logging in natural forests of the Eastern Amazônia as a tool to assess forest degradation (Marco Lentini, Brazil)
10:15 – 10:30	Discussion

Technical session 5:	**Contribution to the Carbon Cycle (Chair: Jenny Wong, UNFCCC)**
10:30 – 10:45	Monitoring and Reporting Forest Degradation under UNFCCC (Danilo Mollicone, FAO)
10:45 – 11:00	*Coffee break*
11:00 – 11:15	Integrating Forest Transects and Remote Sensing data to Quantify Carbon Loss due to Forest Degradation: A case study of the Brazilian Amazon (Carlos Souza, Brazil presented by Danilo Mollicone)
11:15 – 11:30	Community Measurement of Carbon Stock Change for REDD (Eliakimu Zahabu, Tanzania)
11:30 – 11:45	Monitoring Degradation in the scope of REDD (Thomas Baldauf, Germany)
11:45 – 12:00	Review of work on Historical Degradation (Martin Herold, GOFC-GOLD)
12:00 – 12:30	Questions and Discussion
12:30 – 14:00	*Lunch*

Afternoon

Technical session 6:	**Socio-economic functions/ Community level assessments (Chair: Robert Nasi, CIFOR)**
14:00 – 14:15	Forest Resources Degradation Accounting in Mongolia (Hijaba Ykhanbai, Mongolia)
14:15 – 14:30	Assessment of Forest Degradation by Local Communities – The Case Study of Ghana (Dominic Blay, Ghana)
14:30 – 14:45	Local Level field assessment of land degradation (Sally Bunning, FAO)
14:45 – 15:00	Surveillance et Suivi de la Santé des Forêts au Maroc (Taoufiq Aadel, Morocco)
15:00 – 15:15	Questions and Discussion
15:15 – 15:30	*Coffee break*
Technical session 7:	**Reversing Forest Degradation (Chair: Stewart Maginnis, IUCN)**
15:30 – 15:45	Global Mapping and Monitoring of Forest Degradation: The Intact Forest Landscapes Method (Lars Laestadius, WRI)
15:45 – 16:00	Addressing Forest Degradation in the Context of Joint Forest Management in Udaipur, India (Michael Kleine, IUFRO)
16:00 - 16:15	Global Partnership on Forest landscape Restoration (Carole Saint-Laurent, IUCN)

16:15 – 16:30	Forest Ecosystem Resistance and Resilience and Biodiversity (Ian Thompson, CBD)
16:30 – 16:45	Questions and Discussion
16:45 – 17:00	Briefing for Working Group Sessions

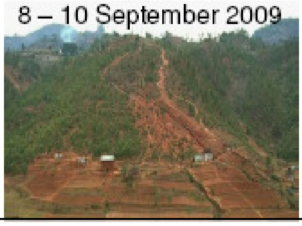
<u>Day 3 – Thursday 10 September</u>
Morning

9:00 – 12:30	Working Group Sessions Working Group 1 – Forest extent, condition and health Working Group 2 – Reduced capacity to provide ecosystem services Working Group 3 – Reduced capacity to provide goods and socio-economic services
10:30 – 10:45	*Coffee break*
12:30 – 14:00	*Lunch*
14:00 – 15:30	Chair: Mette Wilkie Presentations by working groups (20 minutes each), followed by questions and discussion
15:30 – 15:45	*Coffee break*
15:45 – 16:45	Chair: Victoria Heymell Key messages and recommended actions (Stewart Maginnis)
16:45 – 17:00	Closing Remarks

Annex 3. Presentations

Presentations are available in full on the CPF site:
http://www.fao.org/forestry/cpf/degradation/en/

Technical Meeting
Assessment and Monitoring
of Forest Degradation
Rome, Italy
8 – 10 September 2009



Objectives

1. Review analytical study on definitions
2. Review case studies
3. Discuss indicators of forest degradation and related assessment methodologies

Outcomes

1. Better understanding of forest degradation
2. List of possible indicators & assessment methodologies
3. Recommended actions to improve measurement, assessment and reporting on forest degradation

Agenda

Day 1:

Morning:

- **Opening session**
- **Defining Forest Degradation**

Afternoon:

- **Extent of Forest Resources**
- **Biological Diversity**
- **Reception**

Agenda

Day 2:

Morning:

- **Productive Functions of Forests**
- **Contribution to the Carbon Cycle**

Afternoon:

- **Socio-economic functions/ Community level assessments**
- **Reversing Forest Degradation**

Agenda

Day 3:

Morning:

- **Working Group Sessions**

Afternoon:

- **Presentations by working groups**
- **Discussions**
- **Key messages and recommended actions**
- **Wrapping up**

Assessment and Monitoring of Forest Degradation: Why? What? and How?

Mette L. Wilkie
FAO

Why?

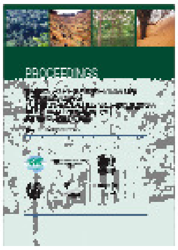
- Global problem
- Adverse impacts on:
  - provision of ecosystem goods and services
  - human wellbeing
  - the Earth
- Prioritisation of scarce human and financial resources
- Fulfill international reporting requirements

Global Goals and Targets

- UNFF Global Objective 1: Reverse the loss of forest cover ... and increase efforts to prevent forest degradation
- UNFCCC COP 13 – Reduction of Emissions from Deforestation & Forest Degradation (REDD)
- 2010 Biodiversity Target of the CBD (indicator on ecosystem fragmentation and connectivity)

The Challenge

- Many definitions
- Forest degradation is the **reduction of the capacity of a forest to provide goods and services**
- Broad definition, not operational
- Numerous perceptions



Issues

- Which functions or values?
- What time frame?
- What scale?
- Which causes?
- What reference state?
- Which indicators?
- Which assessment methodologies?

This initiative will:

- Highlight different aspects of forest degradation
- Review assessment methodologies
- Facilitate improved access to new tools, especially in developing countries
- Lead to action to reduce current rates of forest degradation

How?

- Survey of existing country practices
- Analytical study of definitions
- Case studies
- Technical discussions
- Development of guidelines and tools
- Capacity building and support to implementation

Outcomes

- A better understanding of forest degradation
- Guidelines & tools
- Increased assessment and reporting ability
- Action to reduce forest degradation

The Process

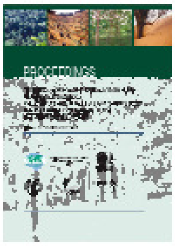
Victoria Heymell
FAO

International Partners

Countries
UN-REDD Programme
GPFLR
LADA

Established Processes

- Nine eco-regional processes on criterion and indicators for Sustainable Forest Management
- Past meetings on harmonizing forest related definitions
- Experiences in other sectors



Objectives

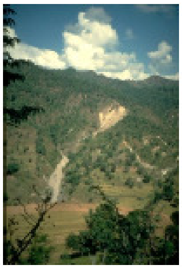
- Identify specific elements and indicators of forest degradation
- Classify elements and harmonize definitions
- Identify and describe existing and promising assessment methodologies
- Develop assessment tools and guidelines

Key Components

- Questionnaire
- Multilingual literature study
- Discussion Paper (Markku Simula)
- Annotated Bibliography (Evisa Abolina)
- Case Studies
- Review of Historical Degradation
- Outreach

Questionnaire

- Definitions
- Assessment Criteria
- Assessment Methodologies
- Framework for Analysis (SFM)
- Status of forest degradation in the country
- Case Studies



Responses

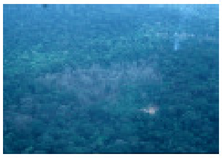
- 2/3 no definition but half had definitions for related terms
- 2/3 did not determine degradation according to different purposes of management
- 2/3 do not consider human induced temporary changes as degradation
- Most had no assessment methodology
- Majority liked themes of SFM as framework for analysis
- Less than half provided an actual or estimated figure of degradation

This suggests

- Perceptions of forest degradation vary
- Components of forest degradation that are measured vary
- Few countries able to provide information on area of degraded forest
- Parameters used vary
- Comparisons between countries not easy

Case Studies Responses

- Assessment methodologies scarce compared with information on causes, drivers and effects of forest degradation
- Some themes of SFM have been studied much more than others as regards forest degradation



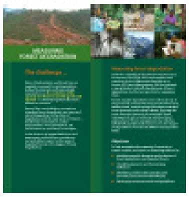
Case Studies finalized

- Abstracts 70+ received
- Papers 25
- Global spread:

Africa	7
Asia	5
Europe	1
South America	4
Inter-regional	8

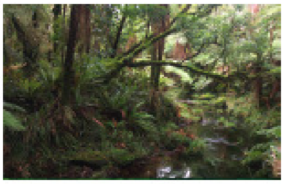
Other Activities

- Historical Degradation Review
- Outreach
- Immediate future activities:
  - This meeting, review and discussion, case studies
  - World Forestry Congress
    - Thematic Session: deforestation and forest fragmentation
    - Side Event: forest degradation
  - Sub plenary, Forest Day COP15, UNFCCC



Possible Future Steps

- Guidelines and tools
- Capacity building
- Support countries to meet current and future reporting requirements
- We are looking for your inputs and ideas



Forest Degradation:
Annotated Bibliography & Analysis of Material

Evisa Abolina
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Evisa.Abolina@gmail.com

Case Studies on Forest Degradation

- The main goals:
  - Develop annotated bibliography containing (world wide) publications and case studies on forest degradation
  - List the studies on forest degradation under SFM thematic elements/ FRA Variables/ Degradation variable
  - Determine which variables under SFM thematic elements are poorly covered
  - Identify definitions used in assessing forest degradation and main causes of degradation
  - Indicate forest degradation assessment methodologies and indicators used in each study
  - Choose and suggest the most promising studies for future work
  - Identify problem areas and give evaluation and suggestions

Table format with SFM elements & variables

SFM thematic element	FRA Variables	Degradation element/ variable	Suggested additional indicators	Assessment methodology	Potential case studies	Potential author(s)
Extent of forest resources						
	Area of forest	Forest cover and stocking				
	Area of other wooded lands	Includes function of forest and trees outside forests				
	Forest Characteristics	Extent of forest types				
		Degradation				
		Fragmentation				
		Naturalness				
		Structure				
		Crown cover %				
		Encroachment				

Studies identified and listed

- Total of 146 studies received due July 31st
- Total of 120 studies listed in bibliography
- 16 studies identified as the most appropriate and applicable and 30 studies as useful, depending on purpose
- SFM elements covered:
  - Extent of Forest resources (17)
  - Forests and climate change (28)
  - Forest health and vitality (12)
  - Biological diversity (9)
  - Productive functions of forests (9)
  - Protective functions of forests (2)
  - Socio-economic functions of forests (23)
  - Policy and Legal (20)

The most covered variables under each SFM element

- Extent of forest resources
  - Degradation (12); Forest cover and stocking (6); Extent of forest types (4); Structure (4)
- Contribution to carbon cycle
  - Carbon stock (22)
- Biodiversity:
  - Forest area designated for conservation of biodiversity (4)
- Socioeconomic functions:
  - Socioeconomic factors (market, population growth, poverty) (16)
- Policy and legal:
  - Policy aggravating or preventing forest degradation (10)
  - Measures to restore, rehabilitate, regenerate degraded forest/ number of projects (7)
  - Policies for adaptation of forests changing environment (5)

Some causes of forest degradation

- Unsustainable management practices:
  - deforestation (logging & burning)
  - land use change, forest conversion, shifting cultivations, agriculture expansion and overgrazing
  - excessive timber extraction and inappropriate harvesting techniques
- Natural occurrences:
  - Forest fires, massive die-offs (insects, diseases), biodiversity loss, damage by animals, slow natural regeneration
  - Climate change – rise of the temperature
- Social aspects:
  - Population growth, economic growth, poverty, development projects promoting monoculture production, conflicts
- Economic aspects:
  - Market forces e.g. demand for wood and non wood (medicinal plants) forest products
  - Industrial development & urbanization
- Policy incentives:
  - Changes in land use policy promoting unsustainable forest management practices

Definitions on forest degradation

- Various, mostly FAO (2002):
  "Forest degradation is the reduction of the capacity of a forest to provide goods and services"
- Forest degradation is usually understood as deforestation or loss in forest cover and not as degradation (as a whole or in some parts) of a complex eco-system
- Only few studies suggests new definitions and has more advanced perception on forest degradation

Forest degradation assessment methodologies

Several studies suggests that:
Remote-sensing imagery supported by ground observations is the most reliable way to estimate locations and rates of deforestation and forest degradation

- Methods & tools:
  - GIS/ Remote sensing/ satellite data/ spatial analysis/ aerial photography/ radar data/ maps etc. (deforestation)
    - Few advanced remote sensing methods for degradation (mostly selective logging)
  - Field inventory
  - Historic data; literature reviews; surveys; interviews
  - Monetary accounting & economic analysis
  - Modeling

Forest degradation assessment indicators

- Remote sensing:
  - Biomass (above & below ground & deadwood)
    - Forest canopy cover & density, vegetation cover etc.
- Field surveys:
  contains various indicators depending on study purpose:
  - *species composition, tree height, volume, quality of timber (e.g. level of rottenness etc.)*
  - *chemical data – forest soil quality, nutrients etc.*

  Socio-economic surveys:
  Market prices; population density; migration, income, consumption rates etc.

Suggested types of case studies

- Studies which:
  - looks at the forests as a complex (eco)system, offering more comprehensive and sophisticated approach to evaluate and monitor changes in forest ecosystem.
  - use advanced tools and assessment methods for a certain degradation variable
  - offers approach (methodologies and indicators) to do global forest degradation assessments
- The list of chosen studies should represent assessment for all SFM elements and degradation indicators

Identified problems and suggestions

- Most part of the case studies are found in so called *"grey literature"*
- Forest as a complex ecosystem
  - *Ecosystem services*
- Degradation – suggested approach

"forest degradation should be understood as the reduction in the capacity of forests to produce ecosystem services" (K.P. Acharya)

Technical Meeting on Assessment and Monitoring of Forest Degradation
Rome, 8-10 September2009

Towards Defining Forest Degradation: Comparative Analysis of Existing Definitions

Markku Simula
FAO Consultant
markku.simula(a)ardot.fi

Objectives of the Paper

1. To review the existing international and national definitions for forest degradation and degraded forests (considering multilingual aspects),
2. To analyze their elements and parameters within a common framework, and
3. To identify their commonalities and differences as well as options for improvement of their comparability, consistency and coherence

The purpose is not to provide a comprehensive review of scientific literature on forest degradation but rather a review of the existing situation.

The approach is holistic but there is a certain focus on climate change aspects.

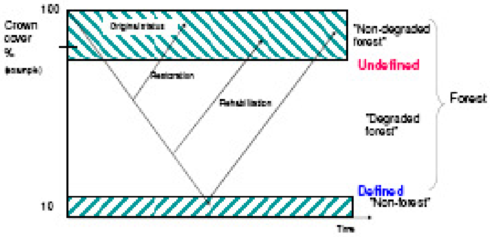
Purposes of Degradation Defintions: for What?

- Monitoring of the status and change in the degree of forest degradation (provision of associated goods and services)
- Reporting to international conventions and processes on the status and quality of forest resources
- Design and implementation of policies, programmes and forest management measures to take preventive and corrective action
- Design and implementation of payment mechanisms or other incentives schemes for forest environmental services such as carbon offsets or conservation easements.

Specific Criteria for Degradation Definitions

- Comprehensive to allow consideration of all forest products and services
- Relate to human-induced and natural changes in forests, as appropriate
- Contain clear terms which are supported by applicable variables and indicators (or their proxies if necessary) that are measurable and detectable
- Consider different time scales (temporal and long-term variation)
- Availability of technically and economically feasible options for measurement and assessment
- Provision of reference points such as time frames, thresholds and levels of absolute or relative changes as appropriate
- Allowance for different levels of resilience among forest types.

Degradation Thresholds



Do we have to define non-degraded forest?

Levels of Assessment

1. Global/regional/sub-regional (reporting, int. policy)
2. National (national policies, programmes)
3. Sub-national (programmes, projects)
4. Landscape/watershed (projects)
5. Forest management unit (operational decisions)
6. Stand/site (most definitions target at this level)

➔ Implications for (inter alia)
- Choice of indicators
- Choice of assessment methodology

Degradation and SFM Elements: Summary of Country Suggestions

- A small number of key commonly supported indicators under each SFM criterion but also a wide range of individual suggestions.
- There is a strong overlap between Extent of Forest Resources, the Productive Functions and the Carbon Cycle (carbon stocks).
- Two indicators could be applied under three Criteria: (i) growing stock and (ii) species composition
- Many indicators proposed are difficult to apply in practice.
- With few exceptions, indicators under Socio-economic Functions of Forests do not assess status of degradation but rather its consequences.
- Many respondents lacked clarity on how to classify their proposals for indicators under the individual SFM Criteria

Potential Indicators Related to Degradation by SFM Element

SFM element	Potential indicators (examples)
Extent of forest resources	Forest cover, crown cover, growing stock, stand density, degree of fragmentation, trees outside forests (TOF)
Biological diversity	Ecosystem diversity, species composition/diversity, genetic diversity, degree of fragmentation, connectivity, naturalness, crown cover, forest structure.
Forest health and vitality	Area affected by pests, diseases, fire, storm damage, area subject to air pollution damage, area with diminished biological components,
Productive functions of forest resources	Stocking level, MAI, age structure, NTFP yield, wood quality
Protective functions of forest resources	Soil erosion, water quality and runoff, managed watershed area, flood protection areas, protective plantation area
Socio-economic functions of forests	Value of forest products, recreation and tourism; cultural and community values;employment; income; area available for recreation, area available to indigenous people/social services
Contribution to the carbon cycle/climate change by forests	Carbon stock in pools (above/below ground biomass, deadwood, litter, soil), stocking density, removals, TOF

Question: Can this be validated?

General Conclusions

- Generic definitions of degradation will be difficult to operationalize
- Need to combine the holistic approach and specific-purpose definitions
- Thresholds between non-degraded/degraded/non-forest; in the climate regime wall-to-wall approach to avoid major leakage, justification for inclusion of degradation in REDD
- Temporal scale is crucial for degradation definitions: need for a long-term approach
- Purpose of definition is linked with the level of assessment; limitations of stand-level definitions ➔carbon stock reduction

Conclusions: Elements of Operational Definitions

- identification of forest goods and services
- a spatial context of assessment (land area identification)
- a reference point;
- cover both process and state (degradation/degraded forest)
- relevant threshold values
- specification of reasons for degradation (human induced/natural) when required by the use of definition
- an agreed set of variables; and
- indicators (and their proxies if necessary) to measure the change of a forest (ecosystem)

➔ As appropriate for specific purposes

Conclusions: Possible Core Elements by Three Proxies

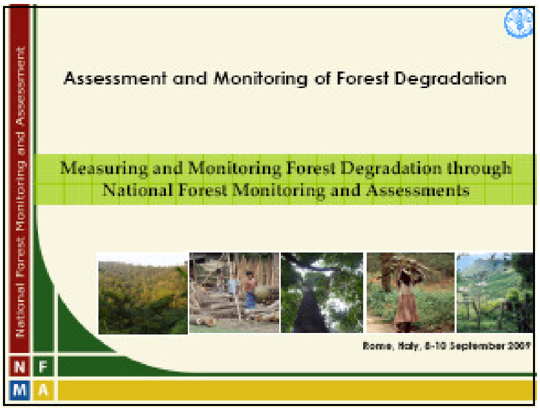
- Reduction in biomass for the growing stock or the carbon stored which can be associated with the reduction of canopy cover and/or number of trees per unit area[1]
- Reduction in loss of biological diversity which can be associated with the occurrence of species (dominant and non-dominant) and habitats
- Reduction in soil as indicated by soil cover, depth and fertility

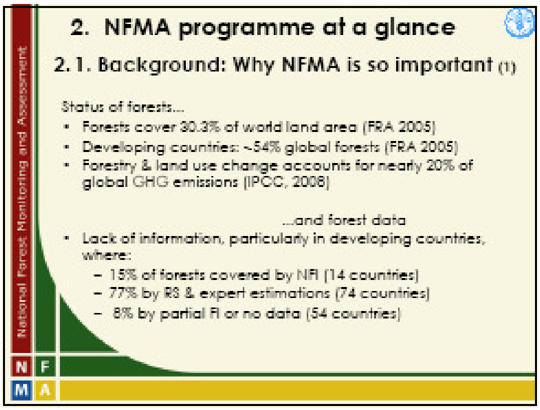
[1] Degradation does not necessarily lead to loss of biomass even if the growing stock may decrease.
Source: Lund (2009)

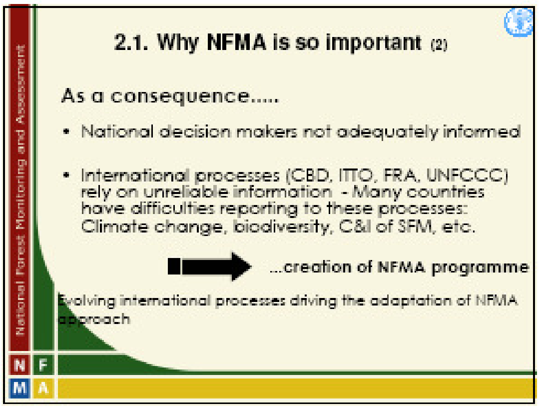
Question: Can this be validated?

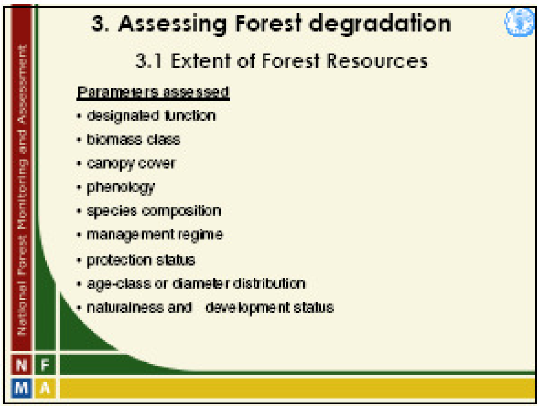
Options for Action

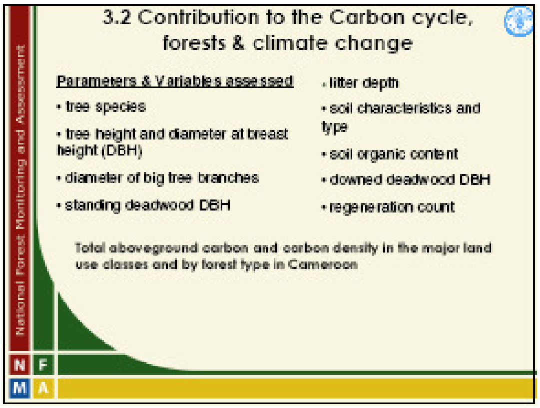
- Maintain the holistic generic definition of forest degradation to provide a common framework for definitions developed for particular purposes.
- Maintain the understanding that forest degradation can be further defined for various specific purposes and that different indicators can be used for its assessment.
- For each purpose identify what needs to be known, by whom, and for what the data should be used in order to develop appropriate indicators.
- Recognize that for international purposes forest degradation needs to be geographically assessed at a higher than stand or site level without a *priori* specification of the temporal scale in the definition.
- Allow scope for national interpretation of international definitions of forest degradation to ensure relevance and cost-efficiency and to harness synergies.
- Improve the existing definitions in view of greater clarity, consistency and compatibility with each other.
- Expand efforts to measure and assess forest degradation


National Forest Monitoring and Assessment
Assessment and Monitoring of Forest Degradation
Measuring and Monitoring Forest Degradation through
National Forest Monitoring and Assessments
Rome, Italy, 8-10 September 2009
N F
M A


National Forest Monitoring and Assessment
2. NFMA programme at a glance
2.1. Background: Why NFMA is so important (1)
Status of forests...
• Forests cover 30.3% of world land area (FRA 2005)
• Developing countries: ~54% global forests (FRA 2005)
• Forestry & land use change accounts for nearly 20% of global GHG emissions (IPCC, 2008)
...and forest data
• Lack of information, particularly in developing countries, where:
– 15% of forests covered by NFI (14 countries)
– 77% by RS & expert estimations (74 countries)
– 8% by partial FI or no data (54 countries)
N F
M A


National Forest Monitoring and Assessment
2.1. Why NFMA is so important (2)
As a consequence.....
• National decision makers not adequately informed
• International processes (CBD, ITTO, FRA, UNFCCC) rely on unreliable information - Many countries have difficulties reporting to these processes: Climate change, biodiversity, C&I of SFM, etc.
...creation of NFMA programme
Evolving international processes driving the adaptation of NFMA approach
N F
M A


National Forest Monitoring and Assessment
3. Assessing Forest degradation
3.1 Extent of Forest Resources
Parameters assessed
• designated function
• biomass class
• canopy cover
• phenology
• species composition
• management regime
• protection status
• age-class or diameter distribution
• naturalness and development status
N F
M A


National Forest Monitoring and Assessment
3.2 Contribution to the Carbon cycle, forests & climate change
Parameters & Variables assessed
• tree species
• tree height and diameter at breast height (DBH)
• diameter of big tree branches
• standing deadwood DBH
• litter depth
• soil characteristics and type
• soil organic content
• downed deadwood DBH
• regeneration count
Total aboveground carbon and carbon density in the major land use classes and by forest type in Cameroon
N F
M A


National Forest Monitoring and Assessment
3.3 Forest health and vitality
Parameters and Variables assessed
Tree level
• Invasive tree species
• Crown condition
• Overall tree condition
• Causative agents
Forest stand level
• Environmental problems
• Severity of environmental problems
• Trend of environmental problems
• Fire disturbances
• Human disturbances
• Insect, pest and invasive species categories and name
• Forest types affected by pest and disease
• Severity of invasion, pest and disease
N F
M A

3.4 Biological Diversity

Parameters & Variables assessed

- Species richness (tree composition, wildlife)
- Observations of rare & threatened species
- Forest structure
- Forest type distribution
- Forest area fragmentation
- Protected forest area

Data analysis

- Indices of diversity
- Data correlations

National Forest Monitoring and Assessment

NFMA

3.5. Productive Functions of Forests

Parameters & Variables assessed

- Tree species and derived products (fuelwood, construction material, bush meat, mushrooms, exudates, medicinal plants, soap and cosmetics, handicrafts, fibre, fertilisers, etc)
- Relative importance of tree species
- Demand and supply trends of product/service
- Reasons for changes in supply/demand
- Period and frequency of harvesting
- User groups
- User rights
- Conflicts
- Gender and child participation in harvesting

National Forest Monitoring and Assessment

NFMA

3.6. Protective Functions of Forests

Parameters assessed

- Total area for all land use/forest cover classes
- Classes of protection level that can include reserves, national parks, multiple purposes conservation, etc
- Occurrence of environmental problems such as: drought, floods, erosion, loss of soil fertility, burning, landslide, wind throw or overgrazing
- Management status (formal vs. no management, ownership, etc)

National Forest Monitoring and Assessment

NFMA

3.7. Socio-economic functions of forests

Parameters assessed

- historical background of the land use
- information on the local population
- distance of households/access to forest in sampling unit
- ownership
- protection status
- management and ecological problems within sampling unit
- local uses and importance of forest products and services
- temporal changes in land resources, biodiversity and livelihoods
- invasive and threatened species and fuelwood
- consumption of forest products and services

National Forest Monitoring and Assessment

NFMA

Further information on NFMA

http://www.fao.org/forestry/site/nfma

National Forest Monitoring and Assessment

NFMA

Analysis of the Normalized Differential Vegetation Index (NDVI) for the Detection of Forest Degradation Coverage in México

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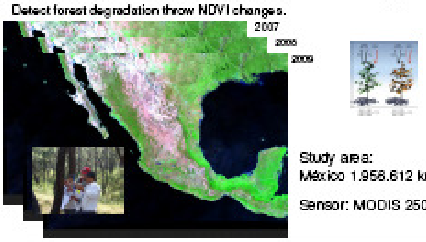
Technical Meeting of Forest Degradation. Roma
8 – 10 September 2009

GOBIERNO FEDERAL
SEMARNAT
Vivir Mejor

Objective

- Show the yearly trend of the forest coverage changes in the country
- Find relations between forest coverage features and the Normalized Differential Vegetation Index (NDVI) estimated from satellite imagery
- Detect forest degradation throw NDVI changes.



Study area:
México 1.956.612 km²

Sensor: MODIS 250 m

Goal and Vision of the project

Goal
- Generate a database annually comparable, measurable and repeatable
- The methodology must be easy, accuracy and completeness
- Generate answers to:
  - Where are changes occurring?
  - Which are the ecosystem affected?
- Generate a GIS compatible with the standards of the government (SEMARNAT, E-GOBIERNO).

Vision
- Helping the different levels of the government to take any action required.
- Helping to estimate the degradation causes and revert the process in order to benefit the communities that depend on the forest to survive.
- Guarantee the permanence of the forest resources for future generations

Definitions: Understanding the Mexican condition

"Primary vegetation" vegetation that preserves, in large part, its condition of density, coverage, and number of species, from its original, primary, ecosystem and from that represented in the cartography of Use of the Ground and Vegetation from INEGI at a scale of 1:250,000. (INEGI, 2004)

TEMPERATE FOREST
- ✓ Pine (Pino)
- ✓ Oak (Quercus)
- ✓ Sacred fir (Abies u Oyamel)
- ✓ Cupressus (Cedro)
- ✓ Douglas fir (Ayarin)
- ✓ Mixed: Pine-oak and Oak-pine
- ✓ Mesophilus

TROPICAL FOREST (JUNGLE)
- ✓ High (perennial - deciduous)
- ✓ Medium (perennial - deciduous)
- ✓ Low (perennial - deciduous)

ARID AND SEMIARID AND OTHER
- ✓ Chaparral
- ✓ Mesquite
- ✓ Shrubs
- ✓ Wetland, mangroves, palm

"Secondary vegetation" vegetation present where it has substituted totally or partially for the original (primary) vegetation as a result of some changes in the use of the ground or because of natural causes or where there is evidence of recovery of the vegetation community in some of the successional stages of vegetation ("trees", "bushes or shrubs" and "herbaceous)". (INEGI, 2004)

Concepts

Deforestation or Loss of forest: permanent change in the forest coverage to land use.
- The loss of primary vegetation (e.g. BP → ZU)
- The loss of primary vegetation with secondary trees vegetation (BP/VSA → IAPF)

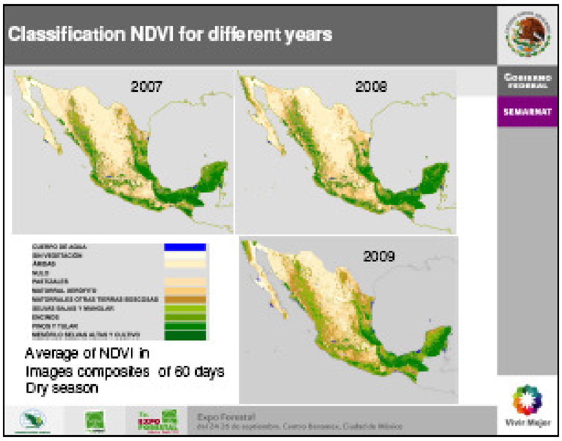
Degradation or alteration of the forest condition: indicates a change or degradation in the coverage without necessarily a loss from its original condition, but a negative change to a structure that diminishes its capacity to generate service and products and can be considered a loss of biodiversity or a decrease in biomass.
- primary vegetation that changes to secondary vegetation
- secondary vegetation that converts to inferior states for example from trees to bushes or trees to herbals

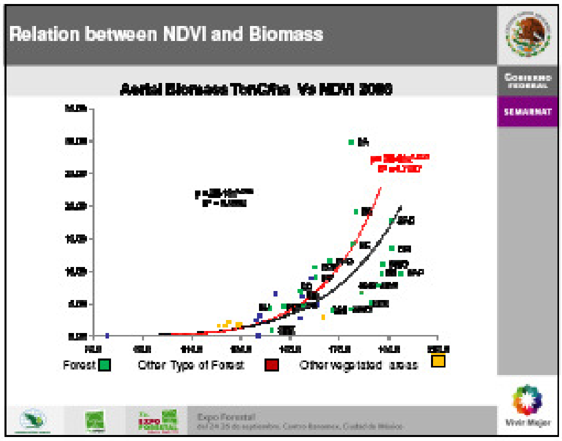
Recovery process: is the natural expansion of forest into areas where the land had been in use.

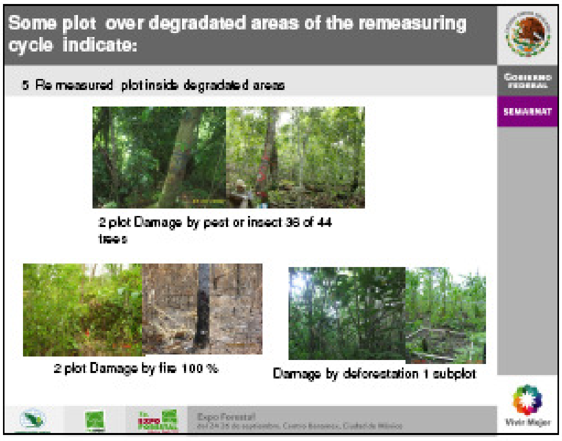
Input Data: Forest National Inventory 2004 – 2007 and updating INF 2009 - 2014

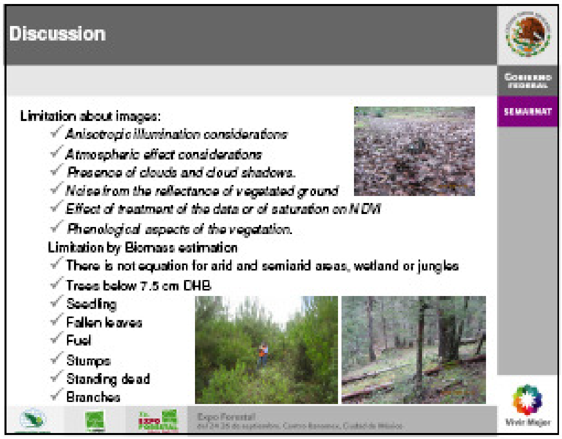
http://www.cnf.gob.mx/infys

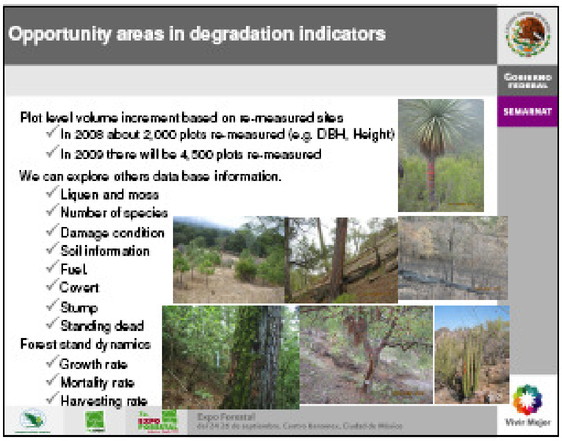
Variables:
Trees: 39
Seeding and bushes strata: 23
Herbaceous strata: 20
Soil: 10
General and ecological information: 80


Classification NDVI for different years
2007
2008
2009
Average of NDVI in
Images composites of 60 days
Dry season
SEMARNAT
Expo Forestal


Relation between NDVI and Biomass
Aerial Biomass TonC/ha Vs NDVI 2008
Forest
Other Type of Forest
Other vegetated areas
SEMARNAT
Expo Forestal


Some plot over degradated areas of the remeasuring cycle indicate:
5 Re measured plot inside degradated areas
2 plot Damage by pest or insect 36 of 44 trees
2 plot Damage by fire 100 %
Damage by deforestation 1 subplot
SEMARNAT
Expo Forestal


Discussion
Limitation about images:
Anisotropic illumination considerations
Atmospheric effect considerations
Presence of clouds and cloud shadows.
Noise from the reflectance of vegetated ground
Effect of treatment of the data or of saturation on NDVI
Phenological aspects of the vegetation.
Limitation by Biomass estimation
There is not equation for arid and semiarid areas, wetland or jungles
Trees below 7.5 cm DHB
Seedling
Fallen leaves
Fuel
Stumps
Standing dead
Branches
SEMARNAT
Expo Forestal


Opportunity areas in degradation indicators
Plot level volume increment based on re-measured sites
In 2008 about 2,000 plots re-measured (e.g. DBH, Height)
In 2009 there will be 4,500 plots re-measured
We can explore others data base information.
Liquen and moss
Number of species
Damage condition
Soil information
Fuel
Cover
Stump
Standing dead
Forest stand dynamics
Growth rate
Mortality rate
Harvesting rate
SEMARNAT
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Thanks for your attention
Published
www.cnf.gob.mx/emapas
More information
Carmen Lourdes Meneses Tovar
cmeneses@conafor.gob.mx
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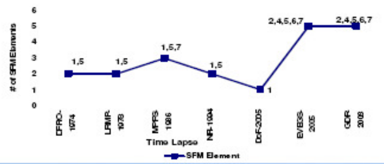
FOREST DEGRADATION IN NEPAL: REVIEW OF DATA AND METHODS

K.P Acharya, DFRS
R.B. Dangi, DoF
Presented at FAO, Rome on 8th Sept, 2009

Why assessment of forest degradation is important ?

Assessments and SFM linkages



Assessment Methodology

Study	Degradation criteria	Indicators	Methods
1. FSRO	•Stocking class (Crown cover <10 % as a non forest area), and •density class	•10-39 %Crown closure and •or 100-399 reproduction size tree/ha)	•Visual interpretation of aerial photographs •1:12000 to 1:60,000 aerial photographs •Dot counting •Field inventory in commercial forest •Stumps recorded with species & size
	Scrub and shrub	Lands with unmerchantable tree and shrub species growing in bush-like clumps.	
	Encroached forest	Lands 10 % or more covered by tree crown and containing commercial timbers but currently being cultivated, unlikely to remain as forests	

Assessment Methodology

Study	Degradation criteria	Indicators	Methods
2. LRMP	Stand stocking	•Crown density < 10 % as non-forest,	•Visual interpretation of aerial photographs (black and white 1: 20,000 to 1:50,000) •Ground truth •Land surveys •Topographic maps
	Soil surface erosion	• Livestock units per unit area •Few scattered trees •Low quality coarse vegetation burning	

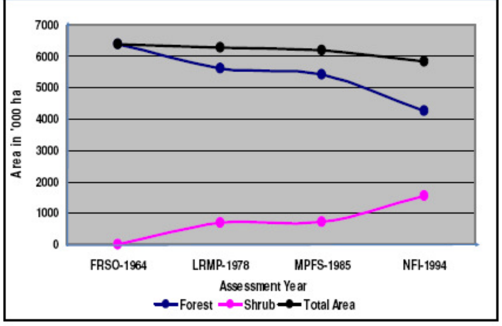
Assessment Methodology

Study	Degradation criteria	Indicators	Methods
3.MPFS	•Crown closure •Regeneration	• 10 to 40 % under stocking, • If immature containing 250 to 999 or less regeneration sized trees/ha	• Desk review • Visual interpretation of aerial photographs; and field verification
4. NFI	Crown cover-stand density	<10% crown cover or well defined stems not found	•Satellite images, GIS, topographic maps •Ground based inventory •Visual interpretation of aerial photographs of scale 1:50,000
5. DoF	Crown cover	Degraded forest means sparsely distributed trees or forest land with < 10 % crown cover including shrub	•GIS, Satellite images analysis • ground verification

Assessment Methodology

Study	Degradation criteria	Indicators	Methods
6. ESE	•Crown cover •Use value of ecosystem services	• <10 % crown cover as degraded forest or shrub land	• inventory • Questionnaires • Market price • Market price of substitutes • Benefits transfer
7. GDP	Crown cover	• <10 % crown cover and shrub as degraded forest	• Ground based forest inventory • Questionnaire • Market price • Market price of substitutes • Benefits transfer • Total net stock

Assessment Results



Assessment Results two Periods of time

Study	Year	Shrub land		degradation % per year
		Area 000 ha	%	
LRMP	1978/79	689	4.7	(1978/79 to 1994) 5.6
NFI	1994	1560	10.6	

Degradation Assessments

Method	Operation Feasibility	Accuracy	Cost	Implication
Aerial Photo	Easy and Visible to demonstrate with less technology input	High	High	No clear
Field Survey	Simple technology and capture all kinds of services, applicable for plain area	High	require long time	
Satellite Image Analysis	Easy in interpretation with high resolution, global uniformity, difficult in mountain terrain	Medium to high	Free to moderate	Combination with field survey support it in difficult terrain
Ecosystem Valuation Index	Recognize broader value of forest ecosystem, demand high technicality, Outside forest boundary	Medium to high	Low to medium	Community Participation, true valuation of forest services

Assessment methods and drivers

Drivers of degradation	Level of significance	Key degradation element	Detectability (low to high, 1 to 3)		
			Field survey	APs	Images
Fuel wood removal	High	Biomass, understory	3	2	1
Timber removal	High	Crown cover, biomass	3	2	1
Fodder, leaf litter removal	High	Biomass, understory	3	2	1
Over extraction of medicinal & other species	High	Understory, biomass, biodiversity	3	1	1
Encroachment	High	Crown cover, habitat, biomass, understory	3	2	2
Overgrazing	High	Understory, soil, habitat	3	1	1
Development activities-Road	High	Crown cover, habitat, biomass, fragmentation	3	3	2
Wild fire	Medium	Understory, biomass, soil, biodiversity	2	1	2
Settlements to landless	Medium	Crown cover, habitat, biomass	3	2	2
Invasive species	Low	Biomass, understory, habitat, biodiversity	3	1	1
Rot disease	Low	Biomass	3	1	1
Floods	Medium	Biomass, understory, biodiversity	2	1	2
Wind throw	Low	Biomass, species	3	2	2

Ways of Improvements

- Use of satellite images supported by ground based inventory. This approach will combine the strengths of both methods.
- Assessment for major forest types, physiographic regions and management regimes
- Assess BM, GS, BA, spps composition, structure and forest type.
- Regional cooperation through SAARC

REPUBLIQUE DU MALI
Ministère de l'Environnement et de l'Assainissement
Direction Nationale des Eaux et Forêts

Contribution l'Études de cas sur la dégradation des forêt
Extrait de L'Inventaire Forestier des Forêts Classées Autour Bamako

Présentation :
Niamé Ousmane Tangara
Chargé D'Aménagement
Direction Nationale des Eaux et Forêts Bamako- Mali

Contexte

L'étude a porté sur les trois forêts classées autour de Bamako.
Il s'agit de :
De la Faya,
Des Monts Mandingues,
Du Sounsan.

Elles satisfont à deux rôles essentiels:

- Rôle de Production de produits ligneux (bois énergie, bois de service, pharmacopée)
- Rôle pédagogique (forêts d'application pour les deux écoles de formation forestière du pays.

Pour une meilleure gestion de ces forêts , nous avons initié un projet
dit « Projet de mise en valeur des forêts classées de Bamako »

La philosophie du projet est basée sur une approche de cogestion .
La première phase a démarré en 1995.
Cette phase a duré quatre ans.
Des coopératives dites Structures Rurales de Gestion de bois ont été mises en place dans les villages riverains de ces massifs.
A la fin des quatre années l'évaluation finale a démontré qu'il faut consolider les acquis c'est ce qui a motivé l'exécution d'une phase de consolidation.
Avant le démarrage de cette phase de consolidation nous avons estimé faire un état des lieux de ce qui reste du potentiel de ces massifs puisque tout le monde était unanime que les forêts s'étaient dégradées après ces quatre années d'expérience de co gestion.

Notons qu'avant le démarrage de la première phase du projet un inventaire avait été réalisé afin de fixer les prélèvements annuels pour chaque village.

OBJECTIFS DE L'INVENTAIRE FORESTIER

- Actualiser les données d'inventaire des trois forêts classées;
- évaluer et caractériser le potentiel ligneux des massifs forestiers de la Faya, des Monts Mandingues et du Sounsan)

RESULTATS ATTENDUS

- les types de formations végétales sont identifiés, caractérisés et localisés,
- les prélèvements effectués au niveau des formations naturelles sont estimés
- les volumes sur pieds sont évalués par formation végétale
- les volumes par type de produits sont dégagés
- les accroissements moyens annuels sont déterminés par formation végétale
- une appréciation est faite de la tendance évolutive des principales espèces,
- les formes de dégradation existantes sont identifiées,
- une carte des formations végétales et une carte du potentiel ligneux sont produites par forêt.

Méthodologie

- **Élaboration des outils de travail**
  Fiches d'inventaire,
  Fiches de synthèse journalière
- **Le taux de sondage :**
  Formation naturelle : 0.2%
  Plantation : 0.5%
  Cela a permis de dresser le tableau suivant (Faya)

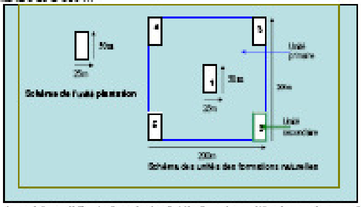
Taux de sondage utilisé pour la Faya

Détermination des taux de sondage théorique par forêt. Forêts	Types de formations	Superficies (ha)	Degré de sondage	Taux théorique de ondage (%)	Superficie de sondage (ha)	Nombre d'unités de sondage
Faya	Formations naturelles	75 500	2	1,91	1448 226	362 1810
	Plantations	4 500	1	0,55	22,25	201

Description des unités de sondage

Deux types de sondage :

- Le sondage à 1 degré ou inventaire du premier degré a été appliqué dans les plantations artificielles. Il a consisté à installer dans les plantations, de façon systématique des placettes de forme rectangulaire et de dimensions 25 m x 50 m avec une équidistance égale à 600 m.
- Le sondage à 2 degrés ou inventaire du second degré a été appliqué dans les formations naturelles. Il a consisté à installer dans les strates de formations naturelles des unités primaires de forme carrée de 200 m x 200 m à l'intérieur desquelles ont été installées des unités secondaires de forme rectangulaire de 25 m x 50 m. Les unités primaires étaient équidistantes de 2 000 m



Le schéma d' illustration de la distribution des unités de sondage en fonction des niveaux d'application.

Comptage des espèces et enregistrement des données

Cette opération a consisté à mesurer les circonférences des différents individus observés dans les unités
secondaires installées dans l'unité primaire. Ainsi pour chaque individu rencontré, les informations suivantes
ont été notées :

- *le nom de l'espèce (genre et espèce) ;*
- *la nature de l'individu (mort ou vivant) ;*
- *le diamètre à la hauteur d'homme (1,30 m du sol) ;*
- *l'état de l'individu (dépérissant ou vivace) ;*
- *la valeur de l'essence (bois de chauffe, bois non combustible) ;*
- *le type de produits exploitable*

Les critères et indicateurs utilisés

Le diamètre (minimum est de 10 cm)
les types de dégradation
les types de sols rencontrés
les caractéristique spécifique de la formation forestière
les essences rencontrées dans la placette la flore rencontrées

ceci a permis un recensement exhaustif des espèces ligneuses des unités d'échantillonnage .

- Les mesures ont été faites sur tous les arbres contenus dans les unités de sondage et pouvant fournir du bois énergie.
- Les circonférences sont appréciées à hauteur d'homme (1,5 m du sol)
- Les sujets comptabilisés dans les classes de grosseur, toutes essences confondues, avec mention "bois vert" et "bois mort" sont ceux à bois dur, utilisé ou utilisable comme bois de feu en cas de besoin.

Les critères et indicateurs utilisés

- Les arbres ont été classés par espèces et par catégories de grosseur d'amplitude égale à 10 cm de circonférence.
- la classe 1 va de 10 cm à 19 cm ;
- la classe 2 va de 20 cm à 29 cm ;
- ………… ………… ………… …………
- la classe 13 va de 130 à 139 cm ;
- la classe 14 va de 140 à cm et plus.
- Les données ainsi recueillies sur le terrain ont été dépouillées et analysées. Elles ont permis de calculer les potentialités des formations végétales.
- Le passage de l'effectif au volume cubique est obtenu après application des quotients pour chaque classe de grosseur en fonction des isohyètes.
- - Ni le nombre total d'arbres pour la catégorie de grosseur i (i allant de 1 à 14) de l'ensemble des placettes
- - Qi le quotient relatif à la classe de grosseur i
- - Vi le volume total de la classe pour l'ensemble des placettes
- - n = nombre total de placettesOn calcule facilement :
- V1 = N1 x Q1
- V2 = N2 x Q2
- ……………………
- V13 = N13 x Q13
- V14 = N14 x Q14
- Le volume total des placettes est :
- V = V1 + V2 + ……. V13 + V14
- Le volume moyen de la placette :
- Vm = V : n

Détermination du potentiel des formations naturelles

Au Mali, il existe peu de modèles mathématiques qui prennent en compte le volume total de l'arbre. Le modèle utilisé est fonction de
l'isohyète et de la classe de grosseur. Il représente l'estimation du volume moyen pour la classe.
Au niveau national, ces quotients ont été définis et testés sur quatre isohyètes :

- 300- 500 mm ;
- 500 - 800 mm ;
- 800- 1100 mm ;
- > à 1100 mm

Le volume cubique déterminé est le volume sur écorce de l'ensemble de l'arbre à la découpe minimale de 10 cm de circonférence. Le massif concerné, la Faya se situe dans l'isohyète 800 mm – 1100 mm,
Les tableaux ci-dessous résument les valeurs des quotients retenus par produits.

Valeur des quotients par classe de grosseur : bois de feu, bois non combustible et bois mort.

Isohyète	1	2	3	4	5	6	7	8	9	10	11	12	13	14
800-1100 mm	0,002	0,009	0,032	0,071	0,106	0,158	0,254	0,380	0,518	0,786	0,904	1,246	1,493	1,935

Valeur des quotients par catégorie de produits : bois d'œuvre et de service

Isohyète	Sciage	Perches	Piquets	Houpp. Sciage	Houpp. Service
800 – 1100	0,297	0,038	0,047	0,200	0,021

calcul de volumes (suite)

- Pour le calcul du volume total du bois de feu, le volume v1 est majoré du volume des houppiers des bois d'œuvre et de service. Il s'agit du volume à la découpe de 5 cm dont les produits ne peuvent avoir d'utilisations autres que le chauffage/cuisine.

Vh = nip1.qp1 + np2.qp2………+ n14p14

Le volume des houppiers est calculé de la façon suivante :

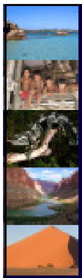
- Vh = volume de houppier,
- ni = effectif du bois de service ou d'œuvre, selon la classe de grosseur
- qi = coefficient de cubage du houppier du bois de service ou du bois d'œuvre selon la classe de grosseur.
- Le volume total d'un placeau est obtenu par simple sommation :
- **VT = Vol BV + Vol BM + Vol BS+ Vol. BO + Vol BNC**
- Vol BV = volume de bois vert ou combustible,
- VolBM = volume de bois mort,
- VolBS = volume de bois de service,
- VolBO = volume de bois d'œuvre ou de sciage,
- VolBNC = volume de bois non combustible.

Les superficies des différentes formations ont été définies à l'intérieur grâce à la cartographie par télédétection, les volumes des produits ont été ainsi extrapolés en fonction des proportions des formations à l'intérieur du massif.

L'évolution du potentiel ligneux des formations végétales et forêt classée a été déterminé grâce aux taux d'accroissement moyen annuel par formation et par forêt déterminés lors des inventaires de 1996.

Taux d'accroissement moyen annuel par formation et par forêt en m3/ha

Formations végétales	Faya
Savane galerie	1,224
Forêt claire degradée	1,374
Savane arborée	0,361
Savane arbustive	0,2
Savane arbustive et bowé	0,2

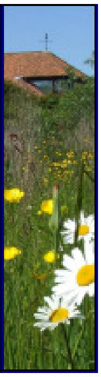


Assessing Forest Degradation Due to Fragmentation

Developing biodiversity-relevant measures

Valerie Kapos,
Raffaele Lafortezza, David Coomes,
Robert Ewers

8 September 2009



Degradation in relation to biodiversity

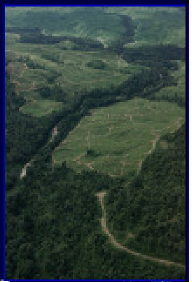
- Reduction in the ability of a forest to support biodiversity?
  - Ecosystems, species, genes
- Reduction in the ability of forest biodiversity to provide ecosystem services?
- Deviation from the biodiversity of 'undisturbed' natural forests
  - What is natural?
  - What is undisturbed?
  - How to measure it?

Measuring biodiversity

- Not about numbers of species
- Composition
  - Numbers, identity and abundance
- Processes & factors known to cause such deviation
  - Area loss
  - Structural change
  - Compositional change
  - Fragmentation

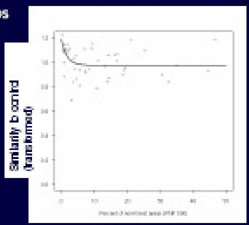
Assessing Biodiversity-relevant Forest Fragmentation

- Which measures of fragmentation are most closely related to biological changes?
- Use field data on species composition & abundance to:
  - Quantify similarity of biodiversity in areas affected by fragmentation to 'control' areas
  - Relate that similarity measure to fragmentation metrics derived from forest cover maps



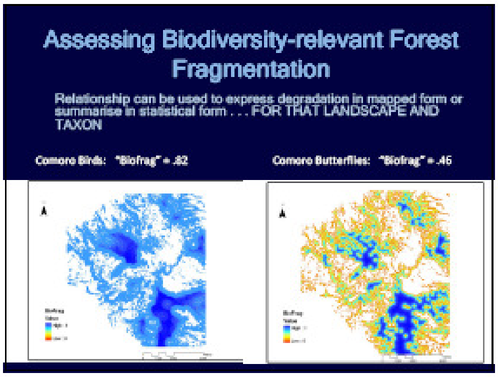
Assessing Biodiversity-relevant Forest Fragmentation

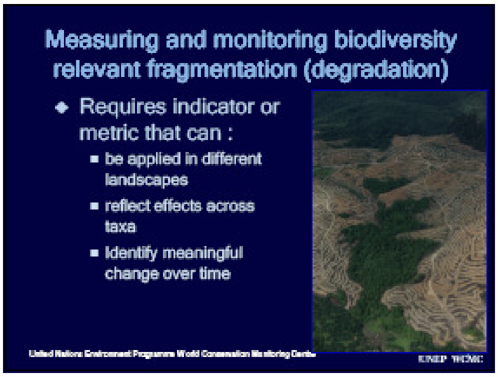
Birds in Comoros

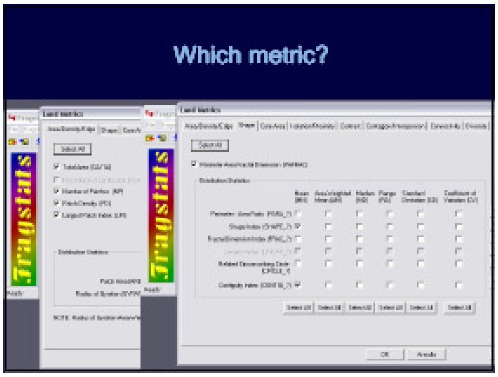


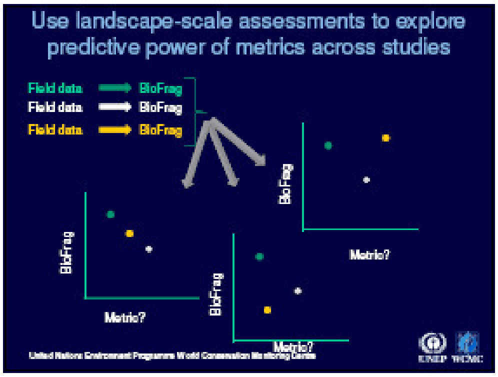
Key Fragmentation metrics and Relationships vary between landscapes and between taxa

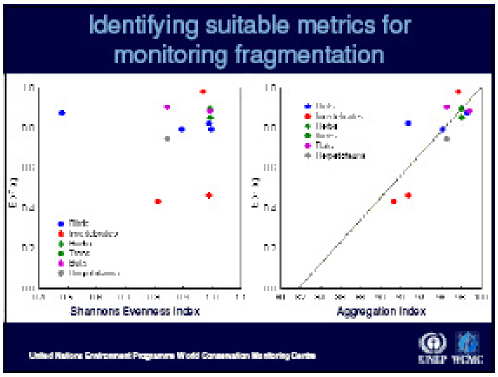
Country (region/landscape)		Taxa	Metrics (at best aggregation scale)
Comoros Islands		Birds	Proportion non-forest in 500 m radius (PNF.500)
		Butterflies	Distance from edge
United Kingdom	[illegible]	Carabids	Distance from edge
New Zealand	[illegible] district	Ground cover species	Distance from edge, PNF.1000m & Edge density in 1000 m radius (ED.1000)
		Tree & understorey spp.	Distance from edge & PNF.500
	[illegible]	Ground cover species	Patch size & ED.500
		Tree & understorey spp.	Distance from edge & Average distance to the nearest neighbouring forest patches (in 500 m radius)
	[illegible]	Carabids	Patch size
Brazil	São Paulo - [illegible]	Birds	Distance from edge
	São Paulo - Caucaia	Birds	Distance from edge & Patch size
	São Paulo - Tapiraí	Birds	Proportion non-forest in 500 m radius (PNF.500)
Mozambique		Bats	Distance from edge
		Frogs	Edge density in 500 m radius (ED.500)
Malaysia		Bats	Proportion non-forest in 1000 m radius (PNF.1000)

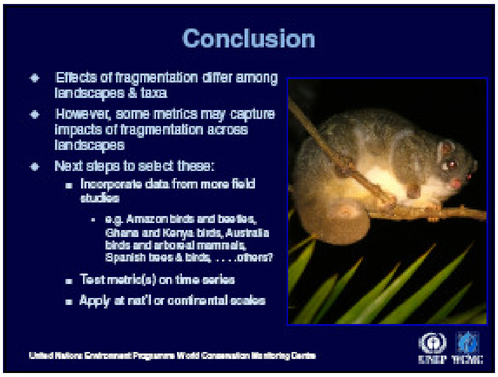

Assessing Biodiversity-relevant Forest Fragmentation
Relationship can be used to express degradation in mapped form or summarise in statistical form . . . FOR THAT LANDSCAPE AND TAXON
Comoro Birds: "Biofrag" = .82
Comoro Butterflies: "Biofrag" = .46


Measuring and monitoring biodiversity relevant fragmentation (degradation)
Requires indicator or metric that can :
be applied in different landscapes
reflect effects across taxa
Identify meaningful change over time
United Nations Environment Programme World Conservation Monitoring Centre


Which metric?
Fragstats


Use landscape-scale assessments to explore predictive power of metrics across studies
Field data → BioFrag
Field data → BioFrag
Field data → BioFrag
BioFrag
Metric?
BioFrag
Metric?
BioFrag
Metric?
United Nations Environment Programme World Conservation Monitoring Centre


Identifying suitable metrics for monitoring fragmentation
Shannons Evenness Index
Aggregation Index
United Nations Environment Programme World Conservation Monitoring Centre


Conclusion
Effects of fragmentation differ among landscapes & taxa
However, some metrics may capture impacts of fragmentation across landscapes
Next steps to select these:
Incorporate data from more field studies
e.g. Amazon birds and beetles, Ghana and Kenya birds, Australia birds and arboreal mammals, Spanish trees & birds, ...others?
Test metric(s) on time series
Apply at nat'l or continental scales
United Nations Environment Programme World Conservation Monitoring Centre

ETUDE SUR LA DEGRADATION DES FORETS: Étude de cas Niger: Occupation des sols des forêts classées du Niger et analyse des dynamiques du changement

Ibro Adamou
Directeur des Inventaires et des Aménagements Forestiers
Ministère de l'Environnement et de Lutte Contre la Désertification du Niger

Introduction

- Le domaine forestier classé du Niger constitué entre 1935 et 1977 couvre 600.000 ha.
- Les forêts classées, à part certains droits d'usage reconnus aux populations riveraines, sont officiellement affranchies de toute activité pouvant nuire au développement des espèces animale et végétale à l'intérieur des périmètres classés.
- Ces forêts classées sont soumises à une dynamique de dégradation dont les manifestations les plus évidentes sont la transformation desdites forêts en terrains de cultures et le changement des structures des peuplements dans certains cas.
- Dans ce contexte, et afin de définir une stratégie nationale de préservation, de gestion et de suivi de ces forêts classées, le Ministère de l'Environnement et de la Lutte Contre la Désertification s'est proposé de mettre en place un Système d'Information sur les Forêts Classées

Matériels

- Cartes topographiques nationales;
- Cartes d'occupation des sols 1975 ;
- Images Landsat 7 ;
- Images Spot 1996 ;
- Global Positionning System (GPS).

Méthodologie

- **Recherche bibliographique**
  - la recherche des documents juridiques et des documents relatifs aux études réalisées;
  - L'inventaire exhaustif des cartes topographiques (échelles 1/200 000 et 1/50 000)
- **Mission vérités terrain**
  - vérification de limites de 84 forêts classées.
  - Caractérisation des forêts (structure).
- **Structuration et analyse des données.**
  - Les données collectées ont été contrôlées, vérifiées et structurées;
  - Les données géographiques ont été numérisées
  - mise à jour de la carte des forêts classées;
  - comparaison des polygones des nouvelles limites avec celles indiquées dans les actes de classement et les images satellitales ; ceci a permis d'affiner la précision des cartes finales;

Résultats et discussions

- **Tableau 1: Nombre et des superficies des Forêts Classées par région en 1999**

Région	Superficies (ha)	Nombre de forêts
Agadez	826.3	1
Diffa	72819.5	10
Dosso	15539.5	4
Maradi	96379.2	17
Tahoua	10343.5	9
Tillabery	258195.9	6
Zinder	29257.5	24
TOTAL	**483. 361.4**	**71**

Évolution du nombre et des superficies des Forêts Classées par région de 1975-1999 (suite)

- Le nombre et conséquemment les superficies des forêts classées ont régressé de 1975 à 1999.
- sur 84 forêts classées répertoriées à partir des actes de classement (pour une superficie totale de 600 000 ha), seules 71 totalisant une superficie de 483361.4 ha ont pu être identifiées sur le terrain en 1999.

Évolution des différentes classes d'occupation des sols au niveau des 71 forêts classées

- En 1999
  - la classe des savanes arbustives était la plus dominante (45.68%);
    Probablement, une partie de la steppe arbustive aurait évolué en savane arbustives.
- Par région
  - les Régions de Zinder et Tahoua sont les plus touchées par l'occupation agricole (pression foncière, population sans cesse croissante, pauvreté des sols) et des conditions environnementales difficiles.
  - La région de Dosso jouissant du régime pluviométrique moyen le plus élevé du pays et de la plus faible pression agricole présente le plus faible taux de dégradation des forêts classées.

Dynamiques des changements sur un échantillon de 25 forêts(1975 – 1999)

- 25 forêts classées reparties comme suit : Diffa 2, Dosso 4, Maradi 6, Tahoua 3, Tillabery 6 et Zinder 4.
- L'occupation des sols des forêts classées a été structurée en deux couches d'information en format PC-ArcInfo, l'une de 1975 et l'autre de 1999.
- Trois classes principales ont été retenues :
  - « ***dégradation*** » : *(1)* Conversion des superficies des classes d'occupation de sols à végétation dense en des classes de faible densité; (2) conversion de l'espace forestier en terrain de cultures; (3) perte de la biodiversité ;
  - « ***pas de changement*** » ;
  - « ***amélioration*** » : C'est quand il y a passage d'une classe de faible densité à une classe de forte densité.

Dynamiques des changements (1975 – 1999) (suite)

Région	Dégradation	Pas de changement	Amélioration	Total
Diffa	2991	6397	6152	15540
Dosso	8697	55325	3373	67395
Maradi	3571	6365	408	10344
Tahoua	19475	11192	1512	32179
Tillabery	6842	14671	7441	28954
Zinder	10103	61899	1121	73123
Total	**51679**	**155849**	**20007**	**227535**

- ***Au niveau national, 51.679 hectares se sont dégradés soit (22,7%) ; 155.849 hectares n'ont pas subi des variations soit (68,5%) et 20.007 hectares ont été améliorés (soit seulement 8,8%).***

Analyse de la méthodologie utilisée

- L'analyse de la démarche méthodologique suscite les commentaires suivants :
  - La méthodologie utilisée dans le cadre de l'étude est onéreuse et exige la mobilisation d'importantes ressources humaines (experts).
  - L'échelle temporelle (de 1975 à 1999) semble trop longue.
  - Toutefois, la base des données numérisées sur les forêts mise en place constitue un outil précieux à la disposition de chaque intéressé à la gestion des forêts classées.

Conclusion Générale et Recommandations

- Importantes informations obtenues sur les changements qui ont touché le domaine classé.
- Mise en exergue des zones les plus affectées parla dégradation.
- Le défrichement constitue la principale menace pour les forêts classées.
- l'analyse statistique générale de l'occupation des sols a permis d'estimer l'intensité du processus de dégradation des forêts classées en terme de conversion des superficies d'une classe d'occupation de sols en une autre.
- En effet, en 25 ans (de 1975 à 1999), sur un échantillon de **25** forêts classées représentant une superficie de **227 535** ha, il ressort qu'au niveau national :
  - **51 679 ha** se sont dégradés soit **(22,7%)** ;
  - **155 849 ha** n'ont pas subit des variations soit **(68,5%)** ;
  - Et **20 007** ha ont été améliorés soit seulement **8,8%.**

Conclusion Générale et Recommandations (suite)

- La mesure de classement, bien acceptée et respectée par les populations peut constituer une bonne alternative pour la restauration des espaces forestiers dégradés.
- La conservation des forêts pourrait passer aussi par une meilleure intégration de la gestion sylvicole et des activités agricoles, notamment au moyen des contrats de cultures.
- La mise à jour de l'étude pourrait aussi permettre d'actualiser les informations et prendre en compte les principaux enjeux suivants :
  - la dimension « décentralisation » intervenue après l'étude;
  - le besoin d'améliorer la méthodologie et la rendre moins onéreuse.

Defaunation and forest degradation: how to measure the impacts of hunting?

Robert Nasi, Nathalie Vanvliet

FAO, Rome, 08/09/2009

THINKING beyond the canopy CIFOR

Selective logging in Congo Basin

- Major land use in humid forests
  - Logging concessions: 51M ha
  - Protected areas: 23M ha
- Major economic activity
  - Major income earner for countries
  - Main rural employer
- As all other extractive activities, induces damage to the ecosystem

THINKING beyond the canopy CIFOR

Typology of logging impacts

Impacts	Directs	Derived
Unavoidable	• Damage to residual stand • Disturbances (noise, light) • Fragmentation • Changes in C stocks	• **Increased human presence** (both temporary and permanent) • **Increased access to remote forests**
Avoidable	• Soil erosion • Water course pollution • Reduced regeneration • …	• Increased deforestation • Increased fire risks • Favor invasive species • **Increased hunting**

THINKING beyond the canopy CIFOR

Bushmeat hunting in Congo Basin

- Estimates of the value of the bushmeat trade range from US$42 to US$205 million per year in West-Central Africa.
- Current harvest in Central Africa alone may well be in excess of 2 million tons annually, equivalent of over 1.3 billion chickens or 2.5 million cows!
- 30 t0 80% of the protein intake of many rural populations

THINKING beyond the canopy CIFOR

Consequences of hunting

- Direct
  - Depletion of hunted populations
  - Animal-man transmissions
  - …
- Indirect
  - Changes in vegetation structure and regeneration patterns
  - Increase in unhunted species
  - Change in predation and herbivory patterns
  - Food crisis
  - …

THINKING beyond the canopy CIFOR

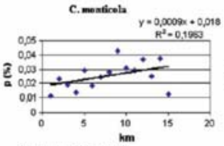
Indicators of defaunation

- Direct:
  - Hunted populations
  - Large mammals (e.g. duikers)

- Indirect:
  - Road network
  - Hunter surveys
    - ✓Hunting profiles
    - ✓Hunting effort
  - Household surveys
    - ✓Meals with meat
    - ✓Sales/consumption
  - Market surveys
    - ✓Fresh/smoked
    - ✓Quantities

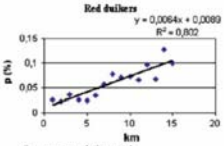
THINKING beyond the canopy CIFOR

Effect of roads...



Spearman correlation matrix

Variables	dist road	C. monticola	p= 0.065
dist road	1	0.489	
C. monticola	0.489	1	



Spearman correlation matrix

Variables	dist road	red duikers	p < 0.0001
dist road	1	0.875	
red duikers	0.875	1	

THINKING beyond the canopy CIFOR

Surveys of mammal populations

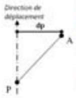
- Direct observations
  - Line transects, RECCE
    - Direct sightings (day/night)
    - Dung counts or trails
  - Capture/recapture
  - Net hunts
- Indirect observations
  - Line transects
    - Hunting signs
  - Market, household, hunter surveys

THINKING beyond the canopy CIFOR

Classic methods

Line transect with measure of perpendicular distances

❑ **Direct observations during the day or night**



Recent innovations

•*Call method* (van Vliet et al., in press)

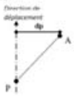
THINKING beyond the canopy CIFOR

Classic methods

Line transect with the measure of perpendicular distance

❑ Direct observations during the day or night

❑ **Dung counts**



Recent innovations

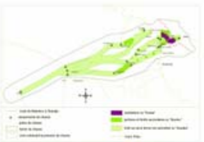
•*Call method* (van Vliet et al., in press)

•Capture recapture methods with non invasive genetic methods

•Capture recapture using camera traps

Surveys of indirect indicators

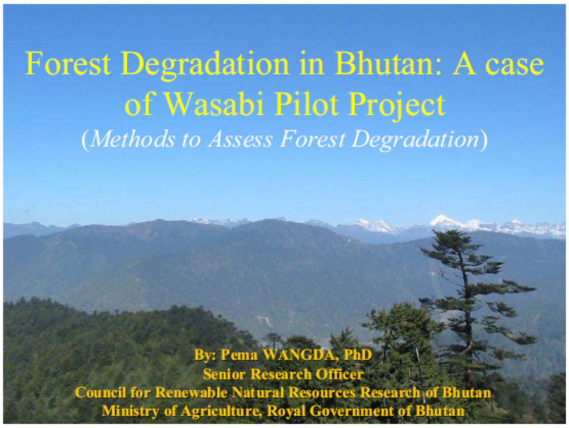
- Resource mapping
- Sharing hunters' life
- Understanding household economies
- ....



In guise of conclusion

- Lack of basic knowledge of natural ecosystem processes
- No ideal method is available
- Trends matter!
- Comparability matters too! (almost impossible to compare between studies)
- Basic research is still needed
- A good survey must combine several methods (direct, indirect) and approaches (synchronic, diachronic)
- Intelligent use of modelling
- Design and use survey comparable across sites

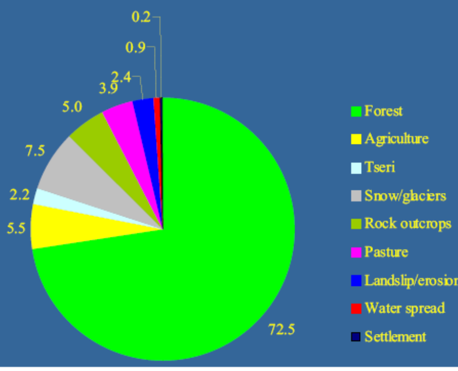
THINKING beyond the canopy CIFOR

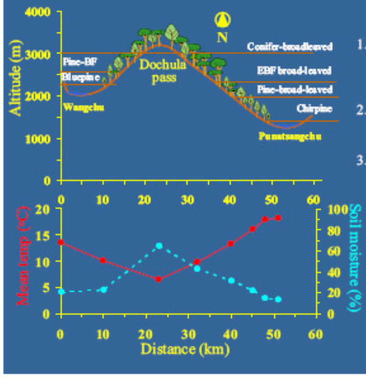


Chronology of Forest Degradation

Period (Year)	Forest for what (concept)	Forest institutions/ infrastructure	Forest degradation process
Before 1950	Forest for basic needs of people.	Forest uses administered by the community (*maang, reesups, meesups*)	Extensive forest fire damage (shifting cultivation)
1950-1960	Forest as potential resource for revenue generation	Civil Administration and Forest Department established (1952).	Accessible forests at the foothills degraded.
1960-1970	Forest for sustainable production	Nationalization of Forest through Bhutan Forest Act 1969.	Forests near roads degraded.
1970-1980	Forest for timber. Scientific management plan (silviculture).	Preparation of scientific management plan bringing experiences of American, European and Indian foresters.	Forest Management Units (FMU) established.
1980-1990	Forest for wood (wood based industry development)	Wood based industries (Plywood, particle board) established. Forest Research Division established (1988)	Fast growing tree species for industrial purposes introduced.
1990-2000	Forest for nature conservation and people	A network of Protected Areas established. Forest and Nature Conservation Act 1995.	Forests near settlements and critical watersheds degraded.
2000-to date	Forest for integrated natural resources and environment services	Social Forestry Division in DoF and participatory forestry field programs implemented.	Quality of forest in FMU, plantations and community forests decreasing.

Major land use types of Bhutan

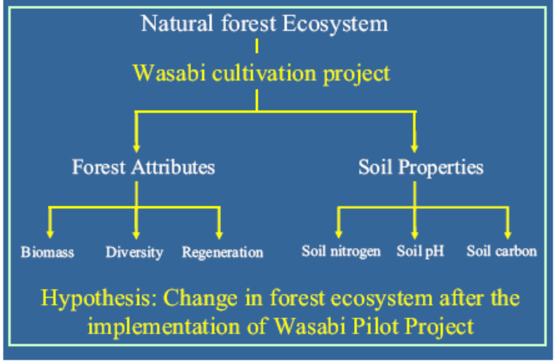




1. Generally dry valley vegetation starts from dry valley bottom to humid ridge top
2. Similar dry valley patterns are found throughout the inner valleys of Bhutan
3. Deeper valley harbor diverse forest types.

1. Climatic factors determines dry valley vegetation in the Himalayas
2. High temperature and low humidity at the dry valley bottoms in contrast to low temperature and high humidity at the ridge top

Study Framework



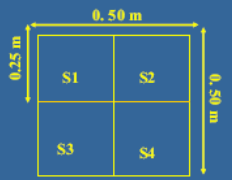
Method I: Soil and Climate measurement

A. Litter and soil

1. L layer (4 replicates)
2. F-H layer (4 replicates)
3. Surface soil (4 replicates)

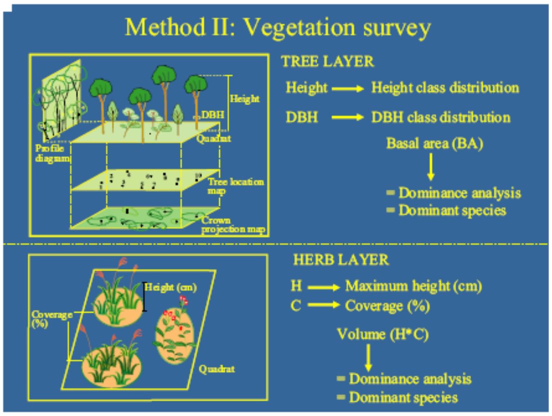
Nutrients analysis

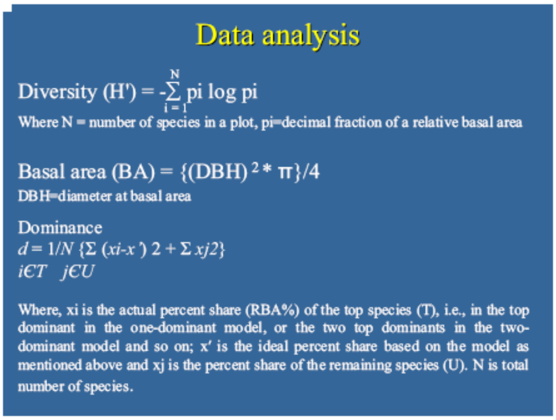
pH, C, N, Ca, Mg, P

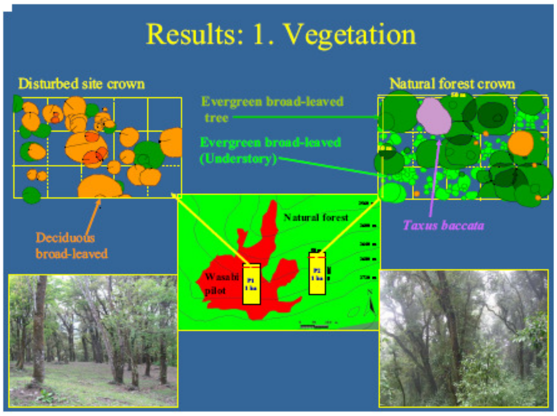


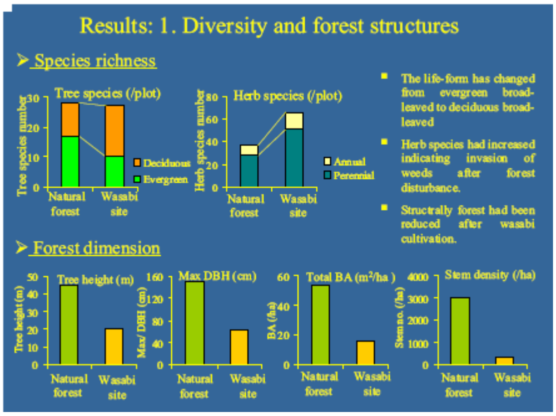
B: Meteorological data measurement

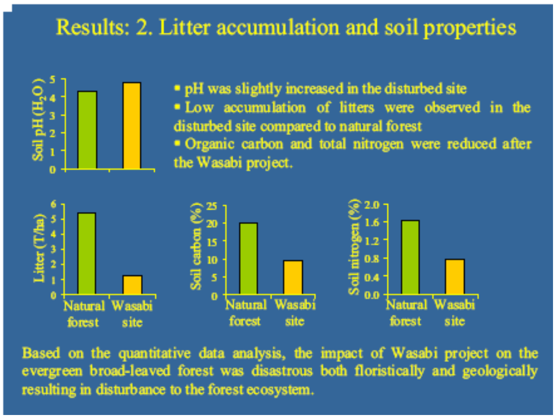
1. Temperature & relative humidity (HOBO Onset data logger)
2. Soil moisture content measured by Hydro-sense

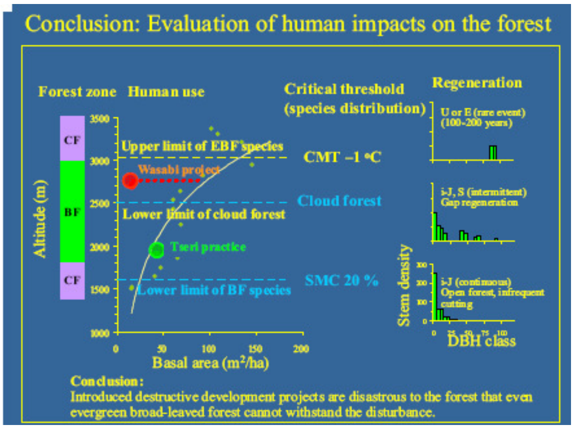

Method II: Vegetation survey
TREE LAYER
Height → Height class distribution
DBH → DBH class distribution
Basal area (BA)
= Dominance analysis
= Dominant species
Profile diagram
Height
DBH
Quadrat
Tree location map
Crown projection map
HERB LAYER
H → Maximum height (cm)
C → Coverage (%)
Volume (H*C)
= Dominance analysis
= Dominant species
Height (cm)
Coverage (%)
Quadrat


Data analysis
Diversity (H') = -Σ pi log pi (i = 1 to N)
Where N = number of species in a plot, pi=decimal fraction of a relative basal area
Basal area (BA) = {(DBH)² * π}/4
DBH=diameter at basal area
Dominance
d = 1/N {Σ (xi-x')2 + Σ xj2}
i∈T j∈U
Where, xi is the actual percent share (RBA%) of the top species (T), i.e., in the top dominant in the one-dominant model, or the two top dominants in the two-dominant model and so on; x' is the ideal percent share based on the model as mentioned above and xj is the percent share of the remaining species (U). N is total number of species.


Results: 1. Vegetation
Disturbed site crown
Natural forest crown
Evergreen broad-leaved tree
Evergreen broad-leaved (Understory)
Taxus baccata
Deciduous broad-leaved
Natural forest
Wasabi pilot


Results: 1. Diversity and forest structures
Species richness
Tree species (/plot)
Herb species (/plot)
Deciduous
Evergreen
Annual
Perennial
Natural forest
Wasabi site
The life-form has changed from evergreen broad-leaved to deciduous broad-leaved
Herb species had increased indicating invasion of weeds after forest disturbance.
Structrally forest had been reduced after wasabi cultivation.
Forest dimension
Tree height (m)
Max DBH (cm)
Total BA (m²/ha)
Stem density (/ha)


Results: 2. Litter accumulation and soil properties
Soil pH (H₂O)
• pH was slightly increased in the disturbed site
• Low accumulation of litters were observed in the disturbed site compared to natural forest
• Organic carbon and total nitrogen were reduced after the Wasabi project.
Litter (T/ha)
Soil carbon (%)
Soil nitrogen (%)
Natural forest
Wasabi site
Based on the quantitative data analysis, the impact of Wasabi project on the evergreen broad-leaved forest was disastrous both floristically and geologically resulting in disturbance to the forest ecosystem.


Conclusion: Evaluation of human impacts on the forest
Forest zone
Human use
Critical threshold (species distribution)
Regeneration
CF
BF
CF
Altitude (m)
Upper limit of EBF species
Wasabi project
Lower limit of cloud forest
Tseri practice
Lower limit of BF species
CMT -1 °C
Cloud forest
SMC 20 %
Basal area (m²/ha)
U or E (rare event) (100-200 years)
i-J, S (intermittent) Gap regeneration
i-J (continuous) Open forest, infrequent cutting
Stem density
DBH class
Conclusion:
Introduced destructive development projects are disastrous to the forest that even evergreen broad-leaved forest cannot withstand the disturbance.

EVALUATION ET SUIVI DE LA DEGRADATION DES FORETS
REUNION TECHNIQUE DU 08 AU 10 SEPTEMBRE 2009
SIEGE DE LA FAO/ ROME- ITALIE

ETUDE DE CAS DE LA DEGRADATION DES FORETS EN REPUBLIQUE DEMOCRATIQUE DU CONGO

Par Christophe MUSAMPA KAMUNGANDU
Chef de Division Géomatique
Direction Inventaire et Aménagement Forestiers (DIAF)
Ministère de l'Environnement, Conservation de la Nature et Tourisme
République Démocratique du Congo

L'APPROCHE METHODOLOGIQUE

1. **Définition des concepts thématiques**

1.1. **Forêt**

Elle est définie comme étant un espace occupé par des écosystèmes, où la densité minimale du couvert d'arbres est de 10 %, avec une hauteur de plus de 3 mètres, généralement associés à une flore et une faune sauvage, sur des sols à l'état naturel.

1.2. **Dégradation forestière**

Elle est définie par les changements qui influent négativement sur le peuplement forestier, en réduisant en particulier la capacité de production (quantité, qualité et le volume) ; par conséquent, la dégradation forestière n'est pas à confondre dans les estimations de la déforestation.

1.3. **Déforestation**

La déforestation correspond à une nette conversion des terres forestières, qui passent à d'autres usages avec réduction du couvert forestier à une densité inférieure à 10 %.

Classification d'occupation du sol

CLASSES D'INTERPRETATION	SYMBOLE
Forêt Primaire	FP
Forêt Secondaire	FS
Forêt Marécageuse	FM
Régénération Culture Abandonnée	RCA
Savane	SA
Plantation agro-industrielle	PL
Eau	EA
Localité	LO
Nuage et ombre de nuage	NU
Feu	FE

METHODOLOGIE (Marche à suivre)

1. Disposer de deux images satellitaires Landsat TM géoréferencées et orthoréctifiées sous format Tiff d'une même scène, avec un écart de plusieurs années entre l'image historique (1990) et récente (2000)

METHODOLOGIE (Marche à suivre)

2. Disposer d'un équipement informatique muni des logiciels de traitement des images Erdas Imagine et du système d'information géographique (SIG) ArcView 3.3 ou ArcGIS 9.1 ou 9.2.
3. Analyser par l'interprétation des images satellitaires du site.
   Sur base de la classification d'occupation du sol.

3.1. Interprétation par numérisation de l'image récente (2000)
3.2. Superposer le shapefile de l'image récente sur l'image historique (1990).
3.3. Création et interprétation du shapefile de l'occupation du sol à partir de l'image historique (année 2000).
3.4. Création du shapefile des changements de l'occupation du sol, à partir de la superposition de deux shapefiles de 2000 et 1990, suivie par l'identification et la numérisation des zones ayant connues des changements entre les deux périodes.
3.5. Aggrégation pour le regroupement des classes d'occupation du sol, pour le calcul de leurs superficies et pourcentages respectifs.

Niveau de la dégradation

Par rapport aux trois sites étudiés, le niveau de la dégradation n'est pas le même à cause de plusieurs paramètres dont;

- l'étendue du site,
- la croissance démographique,
- l'accessibilité aux ressources forestières,
- La densité des réseaux de transport,
- L'occupation du sol par la progression des activités agricoles,
- L'exploitation forestière industrielle,
- Proximité des zones urbaines et des marchés de consommation.

D'où le tableau suivant:

Site	Superficie total	Superficie perdue	Taux %	Écart
Gemena	2.414.484,28	7.854,050 ha	0,0174	14 ans
Bumba	452.147	1.165,45 ha	0,82	10 ans
Isangi	344.383	954,96 ha	0,549	15 ans

Niveau de la dégradation (suite)

1. **Le site de Gemena**

Site entièrement occupé uniquement par les intenses activités agricoles des populations locales, dont la production fait de ce site un des principaux greniers du pays.
Toute la dégradation forestière constatée entre 1986 et 2000 qui est de l'ordre de 7.854,050 hectares, est causée essentiellement par les activités agricoles en plus de ravitaillement en énergie bois pour ces populations.

2. **Le site de Bumba**

Ce site présente une particularité du fait que pendant la période séparant les deux prises de vue (1990 et 2000), en dehors des activités habituelles des populations locales sur les forêts, il a été soumis à l'exploitation forestière industrielle, d'où les traces des routes constatées en forêt sur l'image récente de 2000.

Le niveau de la dégradation (suite)

Dans ce site, la dégradation des forêts est de deux origines:

- Superficies occupées par les populations locales est de 1.133,63 hectares soit 97,27 % de l'ensemble du site,
- Superficies dégradées par l'exploitation forestière industrielle est de l'ordre de 31,82 hectares, soit 2,73% du total du site, essentiellement autour des chantiers d'exploitation, aux parcs à grumes et dans les environs des camps des travailleurs pour leur ravitaillement en produits agricoles.
- **Le site d'Isangi**

Bien que ce site soit actuellement attribué à l'exploitation forestière industrielle, les deux images satellitaires analysées ont été prises avant le début de l'exploitation. La dégradation forestière constatée est d'origine principalement agricole pratiquée par las populations locales, elle a été évaluée à 954,96 hectares pendant la période de 15 ans (1986 et 2001).

Forme de la dégradation des forêts

Quand un espace forestier subit une dégradation de son couvert, il s'en suit une perturbation au niveau des écosystèmes de sa faune et de sa flore.

- Disparition ou diminution de certaines espèces floristiques les plus recherchées et caractéristiques d'une zone écologique donnée.
- Disparition de la faune sauvage après la destruction ou la forte pression sur leurs habitats.
- Réduction chaque année des superficies autrefois occupées par les forêts denses.
- Les zones occupées par l'agriculture continuent leur progression de plus en plus et remplacent les forêts.
- Réduction et même la disparition de certains produits forestiers non ligneux.
- La dégradation forestière est aussi à la base de la pauvreté des sols, dans le premier site il y a apparition de savanes au stade final de la déforestation.

Les communautés locales sont affectées par la dégradation des forêts

Les populations locales subissent effectivement les effets de la dégradation forestière et en sont les premières victimes:

1) Après la destruction de leur habitat, le gibier arrive à manquer pour l'alimentation en protéines animales, et pour compenser ce manque, les populations locales commencent à s'intéresser au petit élevage des poules, canard, chèvre et porc.
2) Elles recourent aussi à la culture maraîchère, par les achats des poissons fumés ou salés auprès des commerçants.
3) Les conditions de vie deviennent de plus en plus difficiles, surtout par l'éloignement des lieux de culture par rapport aux villages, le transport des produits agricoles devient un problème pour ces communautés qui ne savent pas comment évacuer leur production jusqu'à la route.
4) La dégradation des forêts aggrave davantage le niveau de la pauvreté des communautés locales.

Conclusion

Cette approche méthodologique que nous avons utilisée pour la réalisation de cette étude de cas, est une combinaison des techniques de la télédétection et du système d'information géographique, que nous avons testé sur quelques sites de la République Démocratique du Congo, nous a permis d'obtenir des résultats indispensables pour la mise en place, d'un dispositif pour l'évaluation des changements du couvert forestier de la RDC notre pays.

Étant donné l'immensité de ce pays et qui dispose d'énormes ressources forestières, cette approche est appropriée et devrait être recommandée dans le cadre de la connaissance de ce capital forestier, qui doit être géré d'une manière tout à fait durable, en vue de le préserver pour satisfaire aux besoins des générations présentes et à venir.

Conclusion (suite)

Les résultats obtenus à l'issue de cette étude, ont permis de mieux appréhender la dynamique sur l'évolution du couvert forestier, face aux pressions de plus en plus grandes exercées par les différentes exploitations agricoles, forestières industrielles et artisanales et pour des besoins énergétiques.

Les causes directes et adjacentes de la dégradation des forêts peuvent être déterminées, et les solutions alternatives peuvent aussi être préconisées.

Ces études peuvent constituer les outils d'aide à la prise de décisions, dans le cadre d'un zonage forestier et aussi dans l'élaboration d'un plan d'aménagement forestier durable, et dans la préservation de la diversité biologique.

Conclusion (suite)

Ces résultats constituent une bonne base pour d'une part procéder à évaluation de la quantification du stock de carbone séquestré par la forêt, et d'autre part pour orienter les efforts à fournir dans le cadre de la lutte pour la réduction des émissions des gaz à effets de serres dues à la déforestation et à la dégradation forestière (REDD)

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ETUDE DE CAS DE LA DEGRADATION DES FORETS EN REPUBLIQUE DEMOCRATIQUE DU CONGO

(Summary in English)

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DRC: Quick Overview

- Forests: 145 M ha or 60% of dense humid forests in CA and 10% worldwide
- Forest inventories: 21 M ha (16 M ha are mapped) and 5 M ha with FMP
- Few studies on deforestation (FRA 1990) ➔ WWF study in 2006 ➔ This case study on forest degradation in 2009

Definitions

- Forest: standard (FC>10%, H>3m)
- Forest degradation: the result of changes which negatively impact on the forest stand, in particular by reducing its production capacity
- Deforestation: conversion of forest land into other uses, with a reduction of FC below 10%

Methodology

- Changes in areas of land use classes, by comparing satellite imagery (LANDSAT TM / late 1980s - early 2000s)
- 6 sites (2/ agriculture expansion zones, 2/logging concessions, 2/protected areas)
- Land use classes:
  - Primary forest
  - Secondary forest
  - Swamp forest
  - Industrial agriculture plantations
  - Agriculture/savannah mosaic
  - Village
  - Water

Results / Deforestation (2006)

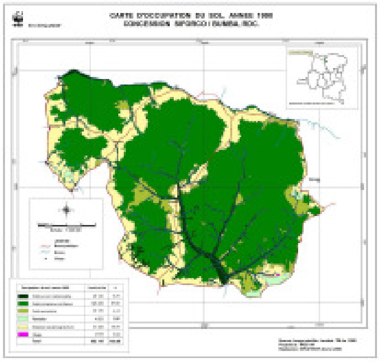
- Negligible / Swamp forests
- Deforestation / Primary & secondary forests varies from 0.6% to 1.6% / YR
- Main causes are demographic growth ➔ small-scale agriculture & fuelwood collection (pockets)
- Other limited causes are logging & industrial agriculture plantations

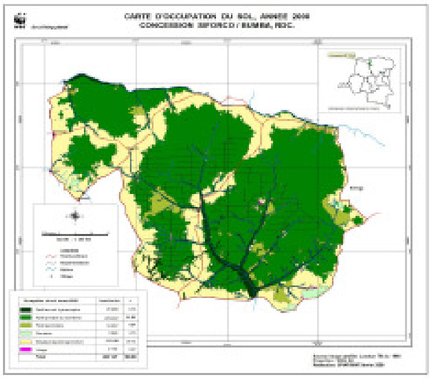
Results / Degradation (2009)

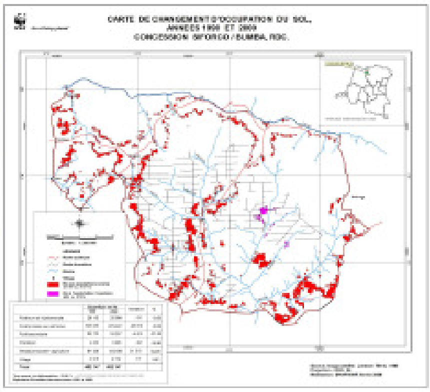
- Case study / 3 sites
  - GEMENA: high intensity agriculture zone
  - BUMBA: medium agriculture pressure + logging activities
  - ISANGI: medium agriculture pressure
- Degradation = Changes in area of primary forests into secondary forests

% / YR	DEF (PF&SF)	DEG (PF→SF)
GEMENA (1986 - 2000)	1.58	0.08
BUMBA (1990 - 2000)	0.93	0.04
ISANGI (1986 - 2001)	0.60	0.03

- Process: DEG → DEF over 3 to 5 years
- Causes
  - GEMENA: agriculture activities mainly, and fuelwood collection to a lesser extent
  - BUMBA: agriculture (97%) and logging (3%)
  - ISANGI: agriculture only







Conclusions

- The methodology (remote sensing + GIS):
  - is operational to quantify changes in land use classes
  - is appropriate for the evaluation of DRC's huge forest resources
  - makes it possible to identify the main causes of DEF and DEG

- However, most of the elements of the methodology dates back to the 1990s

- Considerable improvements could be achieved, if support is provided to DRC in terms of (i) recent hardware and software, and (ii) ground truthing

AN OPERATIONAL APPROACH TO FOREST DEGRADATION

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Meeting on Forest Degradation
FAO Rome
September 8-10, 2009

Why the interest on Forest degradation?

- Is defined as "changes within the forest which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services" FAO-FRA 2005.
- Or "forest degradation is a long-term reduction of tree crown cover towards but not exceeding the minimum accepted 'forest' threshold.". IPCC.
- Notice the definition itself is an issue.
- Forest degradation:
- Is related to REDD+ in Climate Change.
- Is related to Deforestation, because is actually a precursor of Deforestation.
- We may be very effective in avoiding deforestation, but, we may not realize the leakage our actions are producing, i.e., degradation.
- Degradation and deforestation are strongly related and should be treated together.
- Example of this in Chile we have no deforestation, but we have degradation (leakage effect?, which is the reference we are using to arrive to such a conclusion, ancient information may answer this 1944 vs 2000.)

How to face forest degradation measurement?

- One option: giving up
- Or, searching for good scientific solutions like:
  - Taking advantage of "system thinking" to organize the scope of analysis.
  - i.e., Considering the forest ecosystem from a hierachical point of view (Hierarchical theory, Prigogine I.1990) (Allen T. F. H. and T. Hoekstra. 1992. *Toward a unified ecology*).

- Given this approach, forest degradation may be observed at different levels from the:
- Landscape level (genetic implications, fragmentation, reproductive capacity of forest, conectivity, among others)
  - to even,
- chemical reactions level (organism cells, soil minerals)
  - Given our limitations we face with data and resources, we always use to have at most information related to the interval of *landscape level* to *stand development level*.

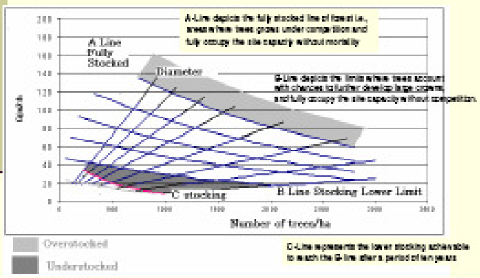
The Chile´s study case

- **Level of analysis:** Stand development
- **Objective:** test an operational approach to identify areas of forest degradation based on stock definition.
- **Measurement tool:** Densitiy, approached by the stocking chart (Gingrich S.F., 1967)
- **The forest:** one the most important forest type in southern forest in Chile: Roble-Rauli-Coihue forest types (MM ha 1,4.)
- **The data:** 290 permanent sampling plots from National Forest Inventory (systhematically located in a grid of 5 km by 7 km., since 2000)

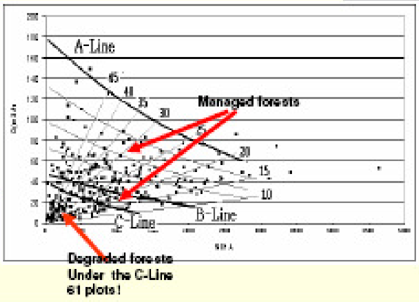
The Stocking chart

- Stock is defined as the "Volume of all living trees more than 'X' cm in diameter at breast height (or above buttress if these are higher) measured over bark from ground or stump height to a top stem diameter of 'Y' cm, excluding or including branches to a minimum diameter of 'Z' cm. Excludes: smaller branches, twigs, foliage, flowers, seeds, stump and roots" (FRA 2005).
- Forest stock is a common term used by forest managers for describing the optimal combination of tree size, growth, and numbers of trees in relation to a particular management objective.
- The stock is closely related to stand density which implies how the growing space is occupied by trees in the forests.
- Forest stocking varies according to company or owner management goals.
- However stocking is flexible enough to include even small trees, (national forest inventory in Chile include from 4 cm DBH trees)

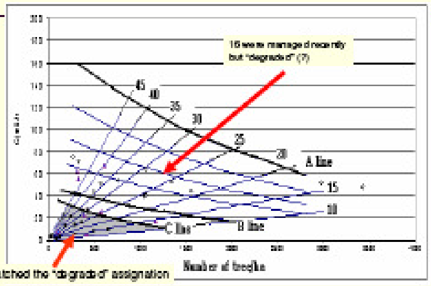
The stocking chart represents the state of the forest by relating, Numbers of trees/ha, Basal Area/ha and, Site space occupation (%)



How does this work for identifying degraded forest? The case of Roble-Rauli-Coihue forest type



Testing against reality
37 sample plots were reported as "degraded" by field brigades



Confusing results?

- The stocking chart is not able to say about 'quality of management', but field observation does.
- Field observations are not able to see stock of forest directly (trees does not let us see the forest)
- Let's recall the 61 sample plots located under the C-Line, field observation only detected 21 of those, 40 were missed !!.

Conclusion & recommendations

- The stocking chart is an useful tool for aiding recognizing degraded forests.
- The stocking chart assume good management practices.
- The field observations and stocking chart acting together improve the identification of degraded forest.
- It is necessary and required the presence of a national forest inventory under permanent bases.
- The stocking chart allows for objetive comparison in time, i.e., monitoring.
- This practice is Tier 3.
- The degradation involves more than stocking, as such hierarchical theory help us to devise suitable tools for measure it.

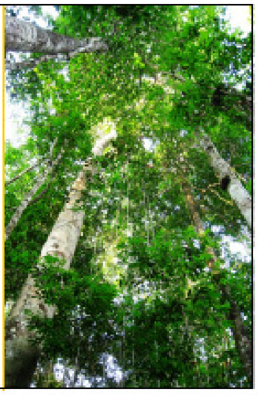
- Capacitation & training is a key issue in recognizing forest degradation from field.
- Operationalizing imply a practical method for checking degradation from the productive perspective.
- We are trying now a quick method for defining in field the degradation status, by using Variable sampling plots (Bitterlich) and Prodan samples.
- We are also trying approaches for the other hierarchical levels of observations, moving toward Landscape level (remote sensing material, spatial analysis-fragmentation).

Instituto Floresta Tropical
Fundação Floresta Tropical

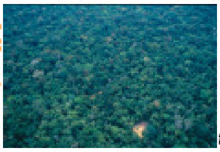
Measuring ecological impacts from logging in natural forests of Eastern Amazônia as a tool to assess forest degradation

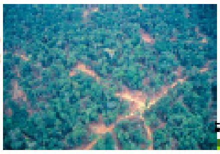
Marco W. Lentini
Johan C. Zweede
Thomas P. Holmes

IFT´s institutional support



Forest management and reduced impact logging (RIL)





- ✓ In 1996, an experiment in Paragominas compared costs and benefits of CL and RIL (Holmes *et al.* 2002).
- ✓ Showed a net income from RIL 19% higher than CL
  - > productivity in skidding and log deck operations (39%)
  - < fixed and variable costs (12%)
  - < timber wasted after logging (78%)
- ✓ Main constraints for adopting sound FM are not related to costs.

2

Objectives

- ✓ To present a method to assess ecological impacts provoked by logging, based on a study conducted in 1996 at a forest site in Paragominas, Eastern *Amazônia*
- ✓ This method has being intensively replicated in the last 14 years in IFT´s field activities
  - Damage to future crop trees
  - Ground damage
  - Timber waste

Photos: IFT

3

Methods

- ✓ The experiment was conducted in three 100 ha forest blocks (1 RIL, 1 CL and 1 unlogged)
- ✓ Before harvesting, IFT conducted censuses of all commercial and potentially commercial trees (> 35 cm D.B.H.) and established permanent plots (1% of the area)
- ✓ In the forest block harvested with RIL, harvesting was planned
  - Liana cutting, planning maps for felling and skidding of logs based on the census, directional felling techniques, skidder with winch and grapple, planning of roads and skid trails as part of the permanent infrastructure.
- ✓ The CL operation was conducted by a logger
  - Harvesting crew with on-the-job-training
  - Sawyers were paid on a piece rate
  - Skidding crews were not provided with precise information from felling crews
  - No census or planning is executed

4

Damage to future crop trees

Severi-ty class	Crown damage	Bole damage	Cause of damage	Health class
0	No damage, complete crown	No damage	-	No damage
1	Minor damage, i.e. < 1/3 of crown damaged	Minor damage to < 1,500 cm² of bark	Felling	Clear signs of recovery
2	Moderate damage, i.e. > 1/3, but less than 2/3 of crown destroyed	Minor damage to > 1,500 cm² of bark	Skidding	No sign of recovery or death/decay
3	Severe damage, i.e. crown smashed	Moderate damage, i.e. deeper than bark, but < 1,500 cm² in area	Road building	Clear signs of death or decay (e.g. insect of fungal attack)
4	N/A	Severe damage to area > 1,500 cm², e.g. a major tear or broken branch	Log deck construction	N/A
5	N/A	Irreversible damage (clearly dead or dying), e.g. smashed bole	Natural causes (unrelated to harvest activities)	N/A

-Adapted version of the method proposed by Johns et al. (1996)

- Only commercial and potentially commercial tree species with good form and DBH > 35 cm

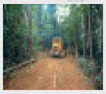
- Survey was conducted about 20 months after harvest.

5

Ground area disturbed by logging

- ✓ It measures the total impact of heavy machinery on the forest floor
- ✓ Assessment is made by measuring in the field the total area of roads, log decks and skid trails established for harvesting
  - A technician used a 50-m tape to measure the length and width of every road, skid trail and log deck in both harvest areas.
  - The direction of every infra-structure measured was recorded with a compass to permit mapping these features in the office.
  - Surface of these features were calculated.
- ✓ Although compaction was not measured, disturbance severity was estimated.
  - Every 30 meters along all skid trails, it was evaluated whether mineral soil was exposed.
  - Sampling unit was a single line across the width of the skid trail.

Photos: IFT



6

Volume of merchantable timber wasted

- ✓ The volume of timber wasted is the difference between the volume under "ideal" logging and the actual volume recovered
- ✓ Causes of timber wasted
  - timber felled and not found by skidding crew or left in the forest because poor felling caused logs to split and lose merchantability
  - timber left on the log deck
  - timber wasted because cutting stumps were too high or due to poor bucking of felled logs
  - poor felling techniques
- ✓ Volume was measured by a crew of IFT technicians by measuring the area and the length of timber portions which could be harvested but were left in the forest

Photos: IFT



7

Results: Damage to future crop trees

Health class	Conventional Logging		Reduced Impact Logging	
	Felling Damage	Damage from other activities	Felling Damage	Damage from other activities
Recovering	0.14 (54)	0.11 (43)	0.24 (80)	0.17 (57)
No sign of change	0.16 (63)	0.05 (21)	0.18 (58)	0.05 (17)
Dying	**0.34 (136)**	**0.04 (16)**	**0.16 (52)**	**0.01 (2)**
Total Impacted	**0.64 (253)**	**0.20 (80)**	**0.58 (190)**	**0.23 (76)**

-Felling was revealed as the most important driver of damages to residual trees (> 95% of human-induced damages)

- Damages which provoked the death of residual trees were > 2 x higher in CL than in RIL

8

Results: Ground area disturbed by logging

Activity	Conventional logging		Reduced-impact logging	
	m³ / tree harvested	ha / 100 ha block	m³ / tree harvested	ha / 100 ha block
Secondary roads	34	1.35	20	0.65
Log decks	26	1.05	19	0.63
Skid trails	193	7.66	120	3.90
Total	**253**	**10.05**	**159**	**5.18**

In addition, the experiment showed that 100% of the CL skid trails were cleared to mineral soil, whereas less than 10% of the RIL skid trails had mineral soil exposed.

Cumulative disturbance over time in CL tend to intensify, since forest infrastructure tend to be permanent in RIL.

9

Results: Wasted merchantable timber

Source	CL waste (m³/ha)	RIL waste (vol./ha)
High stumps	0.28	0.10
Split logs	0.87	0.31
Bucking waste	1.97	0.85
Logs lost	0.96	0.06
Total forest	**4.08**	**1.32**
Log deck	1.97	0.60
Total	**6.05**	**1.92**

Timber wasted in the CL block was almost ¼ (23.9%) of the standard harvest volume. RIL provoked a total wasted of 7.6% of merchantable timber.

10

Discussion

- ✓ The main purpose was to present a simple method to assess forest degradation and ecological impacts provoked by logging.
- ✓ Despite current development of remote sensing techniques able to identify in a coarse scale the overall occurrence of sound FM indicators, field based methods are still necessary to evaluate the quality of forest operations and their ecological impacts over the forest.
- ✓ It is still necessary to replicate the method in other regions in *Amazônia*, taking into account the diversity of conditions.

Photos: IFT



11

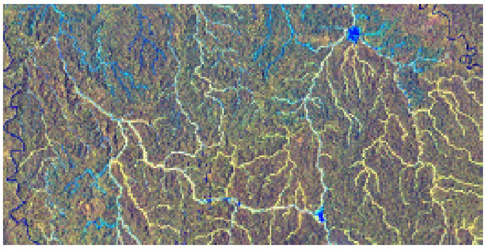
Conclusions

- ✓ The method used to evaluate forest degradation and ecological impacts from logging presented in this paper has a large potential to be disseminated to other regions in *Amazônia* and surrounding countries.
  - As main advantages, we can cite is simplicity and viability to be used in different contexts.
  - Measurement of roads, log decks and skid trails can be improved in large scale enterprises using recent GPS technology
  - Methodology still requires validation in other forest types and technological alternatives, mainly considering CFM operations.
- ✓ The method should be disseminated to other FM centers, training centers, universities and forestry foment organizations and agencies.

12

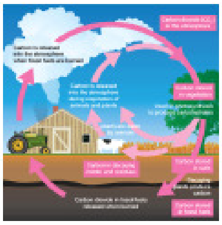
Reporting forest degradation under UNFCCC

Danilo Mollicone, FAO



CONTEXT

- Under UNFCCC: no forest definition and no forest degradation definition with a land based reporting approach

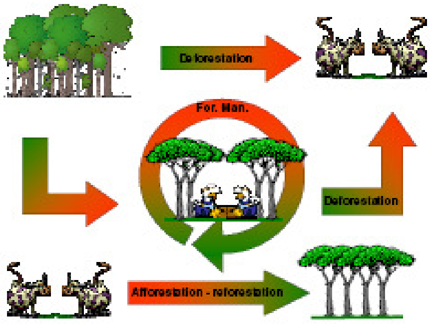


CONTEXT

- Under the Kyoto Protocol: a framework forest definition and no forest degradation definition with an activity based approach
- Under the expected REDD mechanism: forest definition ? and forest degradation definition ? with an activity based approach
- In the context of UNFCCC there are no definitions that explain changes occurring within a land use category

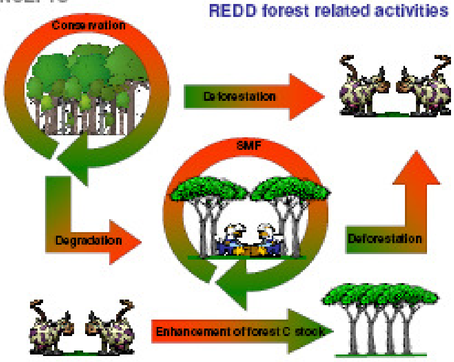
CONCEPTS

KP forest related activities



CONCEPTS

REDD forest related activities



IPCC methodology

KP and REDD activities	=	Forest sector (AFOLU / IPCC)
Deforestation	=	Forest land converted to other land
Forest management Degradation SMF Conservation	=	Forest land remaining forest land
Reforestation Afforestation Enhancement F C S	=	Other land converted to forest land

IPCC methodology

Carbon stock changes: five pools

- Above-ground biomass } biomass
- Below-ground biomass
- Deadwood } dead organic matter
- Litter
- Soil { mineral, organic

$$\Delta C = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{DW} + \Delta C_{LI} + \Delta C_{SO}$$

IPCC methodology

„Stock Difference" method

$$\Delta C = C_2 - C_1$$

ΔC = change of carbon stock

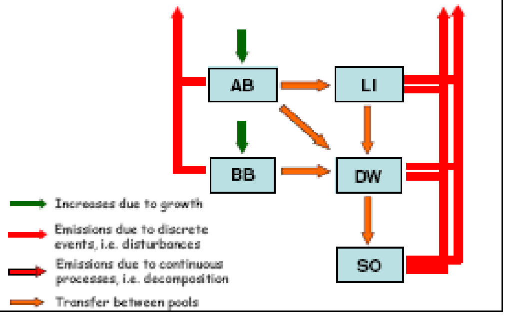
C_2 = carbon stock at **time 2**

C_1 = carbon stock at **time 1**

for one year: $\Delta C = (C_2 - C_1)/(t_2 - t_1)$

IPCC methodology

Changes = Gains – Losses (by pool)



Gain-Loss (default) method for Biomass

$$\Delta C_B = \Delta C_G - \Delta C_L$$

ΔC = change of carbon stocks in biomass

ΔC_G = increase due to biomass **growth**

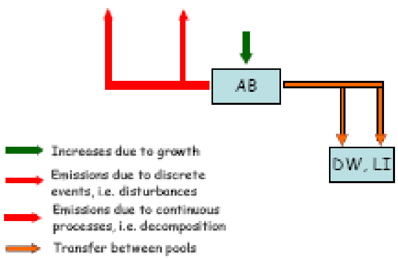
ΔC_L = decrease due to biomass **loss**

Gain-Loss, or default method: consider all processes

$$\Delta C_G = G_{growth}$$

$$\Delta C_L = L_{wood\text{-}removals} + L_{fuelwood} + L_{disturbances}$$

IPCC 2006GL



Integrating Forest Transects and Remote Sensing data to Quantify Carbon Loss due to Forest Degradation: a case study of the Brazilian Amazon

Technical meeting on Forest Degradation
FAO FOIM
8-10 September 2009
Rome, Italy

Carlos M. de Souza Jr.[1*], Mark A. Cochrane[2], Marcio H. Sales[1], André L. Monteiro[1], Danilo Mollicone[3]
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South Dakota State University
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Remote Sensing Detection of Forest Disturbances

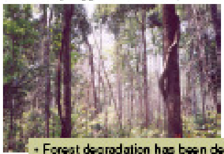
Highly Detectable	Marginally Detectable	Almost Undetectable
Deforestation Forest fragmentation Recent slash-and-burn agriculture Major canopy fires Major roads Conversion to tree monocultures Hydroelectric dams and other forms of flood disturbances Large-scale mining	Selective logging Forest surface fires A range of edge-effects Old-slash-and-burn agriculture Small scale gold-mining Unpaved secondary roads (6-20-m wide) Selective thinning of canopy trees Blowdowns	Hunting and exploitation of animal products Harvesting of most non-timber plants products Old-mechanized selective logging Narrow sub-canopy roads (<6-m wide) Understorey thinning and and clear cutting Invasion of exotic species Spread of pathogens Changes in net primary productivity Community wide shifts in plant species composition Other cryptic effects of climate changes Most higher-order effects

Main Sources of C emissions:
- Deforestation
- Selective Logging
- Forest fires
- Forest fragmentation

Peres et al., (2006), TREE

Deforestation vs. Forest Degradation

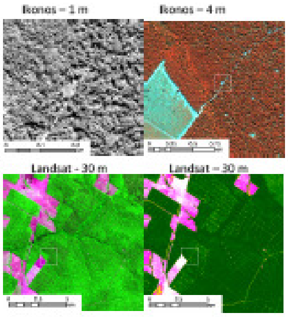
Selectively logged forest, Sinop-MT



Deforested area for plantation, Sinop-MT

- Forest degradation has been defined as a type of land modification, which means that the original land cover structure and composition is temporarily or permanently changed, but it is not replaced by other type of land cover type (Lambin, 1999).
- For the purpose of REDD, we are interested in monitoring reduction of C stocks.

Monitoring Forest Degradation



- More challenge than monitoring deforestation.
- There are several methods to detect and monitor forest degradation (GOFC-GOLD REDD Sourcebook).
- Methods:
  - Visual interpretation can easily detect canopy damage areas in very high spatial resolution imagery.
  - Spectral enhancement is required at lager pixel sizes.

Souza Jr. (2007)

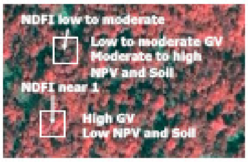
Objetives

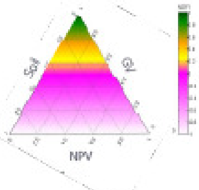
- Present a brief review of how remote sensing has been used to detect and map forest degradation.
- Show how carbon stocks of degraded forests can be characterized using rapid forest transect surveys.
- Demonstrate how field data of forest carbon stocks can be integrated with optical remotely sensed data to regionally characterize forest degradation.
- Discuss the challenges to integrating field-derived carbon estimates with remotely sensed data.

Normalized Difference Fraction Index - NDFI

$$NDFI = \frac{GV_{Shade} - (NPV + Soil)}{GV_{Shade} + NPV + Soil}$$

$$GV_{Shade} = \frac{GV}{100 - Shade} \qquad -1 \leq NDFI \leq 1$$

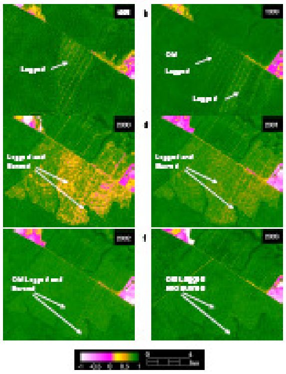




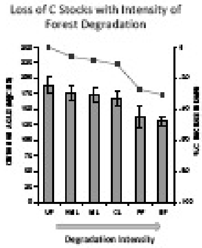
Souza Jr. et al. (2005)

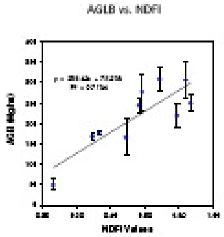
Dynamic of Forest Degradation

- Degrataion signal changes fast.
- There is a synergism of forest degradation processes that can reduces more C stocks of degraded forests.
- Reccurrent forest degratation is expected and creates even more loss of C stocks.
- Annual monitoring is required to keep track of forest degrataion process.



C Stocks Change vs NDFI





Challenges to Monitor Forest Degradation and C Stock Changes

- Monitoring forest degradation requires well-documenting forest disturbance history, specifically recurrent degradation events and time since last disturbance.
- High spatial variability of forest biomass requires site-specific calibration of RS and AGLB.
- Monitoring degradation requires annual acquisition of satellite images because the rapid changes in degraded forests inhibit detection and mask out the intensity of the degradation after one year

Challenges to Monitor Forest Degradation and C Stock Changes

- Optical remote sensing techniques presented in this study cannot be applied in regions with intense cloudy conditions.
- Correlation of NDFI and AGLB of intact forest and forest degradation classes collapses after one year after the degradation event because the NDFI degradation signal disappear fast.

Community Measurement of Carbon Stock Changes for REDD

By
Dr. Eliakimu Zahabu

Kyoto: Think Global Act Local Research Project
Tanzania

www.communitycarbonforestry.org

Introduction

- Kyoto: Think Global, Act Local (K:TGAL) is:
  - a research and capacity building program,
  - investigates possibilities and potential for CFM of existing natural forest to be included as an eligible carbon mitigation activity.
- Research teams in four regions:
  - East Africa (Tanzania),
  - West Africa (Senegal, Mali and Guinea Bissau),
  - PNG and,
  - the Himalayas (Nepal and India).
- Measuring :
  - sequestration in existing forests and reduced emissions of carbon by avoiding degradation

TZ Forest extent

- Tanzania:94.5 million ha
- Forestland of 35 million ha:
  - 16 million are reserved forests,
  - 2 million hectares are forests in national parks and
  - 17 million hectares (49% of all forestland) are unprotected forests in general lands.
- Deforestation & Degradation: 412,000 ha per yr in the general land forests.

CFM in Tanzania

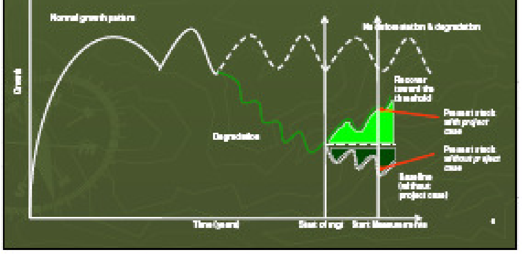
- Started in 1990's
- Low speed: To date 17 million ha unprotected
- This is where most deforestation & degradation happen
- CFM retard deforestation in unreserved forestland.
- They transform unsustainable management of existing natural forests, to sustainable management
- However, only 11% of the country's forests are under CFM due to lack of funds and capacity.
- Accessing carbon finances could potentially provide incentives for more CFM establishment.
- Challenge: Limited forest inventory data due to lack of human & financial resources

Components of REDD

- REDD credit = Country improvements Vs baseline scenario
- Deforestation baselines
  - loss of forest area, that is, complete land use change: use historical trends of forest area changes, RS
- Degradation baselines
  - loss of biomass stock within a forest: No historical data available
- Enhancement baselines
  - Incremental change in biomass stock within a forest: No historical data available

Individual projects e.g. CFM

- Should determine and monitor carbon stocks
  - With project case: to determine the rate of recovery
  - Without project case: to determine the rate of degradation



Material & methods

- Carbon Assessment & Monitoring
  - Stock changes in managed CFM and unmanaged forests in proximity
  - Done by local communities themselves after training
  - Use IPCC GPG 2003

The equipment

Consists of:

- A handheld computer with ArcPad^{TM} 6.0 software and connected to GPS
- It is easy to use
- Is used to locate:
  - forestry boundaries
  - sample plots and
  - recording measurement data
- With a step-by-step guide to the procedures, local communities were trained in a short time and were able to use the system effectively

Steps in Carbon Assessment

i. Forest mapping/stratification

ii. Pilot survey to estimate variance and number of sample plots

iii. Locate the sample plots on the ground

iv. Measure the dbh of all trees

v. Set out the sub-plots for the grasses, herb and litter data

vi. Take soil samples randomly within the plot

Data analysis

The following trees stand parameters were computed:

- Density i.e. the number of stems per ha (N)
- Basal area per hectare (Dominance)(G)
- Volume per ha (V) and
- Dry biomass / carbon (tones per ha)

➢ Trees volume and biomass were computed using tested local existing allometric functions for the areas.

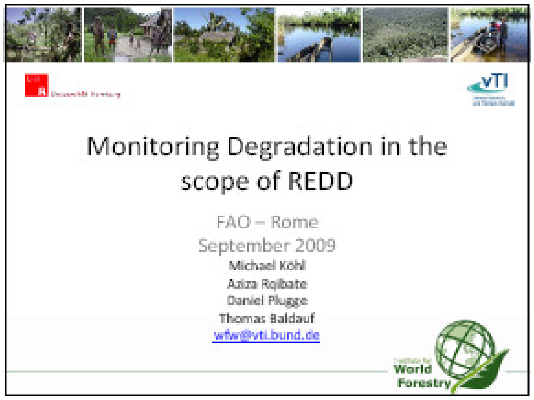
➢ Computation were fitted on Ms Access database

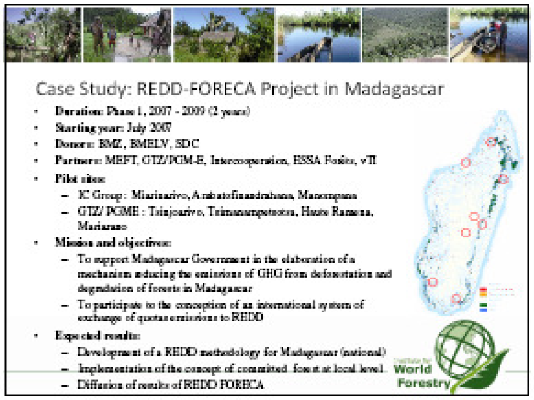
Results

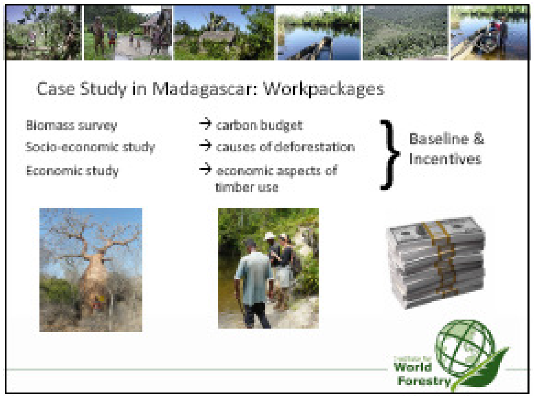
With Project Case					
Vegetation type	Location	Average annual increment (t/ha/yr)	CO2 sequestration (tCO_2/ha/yr)	Forest Area (ha)	Total sequestration (tCO_2/ha/yr)
Woodlands	Kitulangalo	2.8	5.3	600	3,180
	Ayasanda	1.7	3.2	550	1,760
Lowland	Ludewa	4.4	8.3	28.5	237
Montane	Mgambo	5.2	9.8	158	1,760
Without Project case					
Vegetation type	Location	Average biomass loss (t/ha/yr)	Average CO_2 Emissions (t/ha/yr)	Forest Area (ha)	Total CO_2 Emissions (tCO2/ha/yr)
Woodland	Kitulangalo	1	1.8	600	1014
Montane	Mgambo	3.5	6.5	158	1080

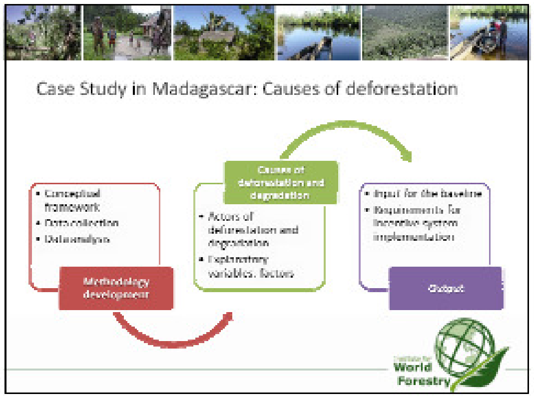
Conclusions & Recommendations

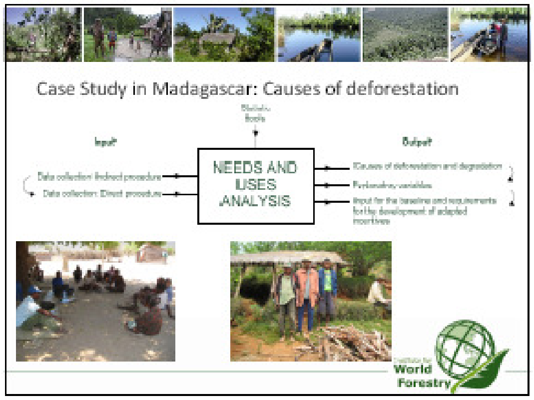
- **Since forests under CFM are efficient in carbon storage and sequestration:**
  - governments are argued to consider CFM as part of their approach under climate mitigation policy
- **Since there are no data on carbon stocks**
  - Studies on forest inventories using methodologies such as that developed in this study are recommended

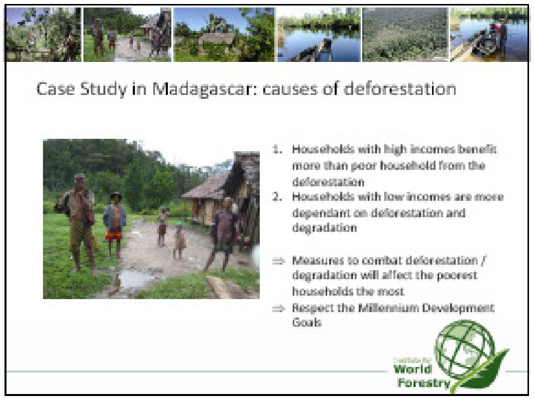

Monitoring Degradation in the scope of REDD
FAO – Rome
September 2009
Michael Köhl
Aziza Rqibate
Daniel Plugge
Thomas Baldauf
wfw@vti.bund.de
World Forestry

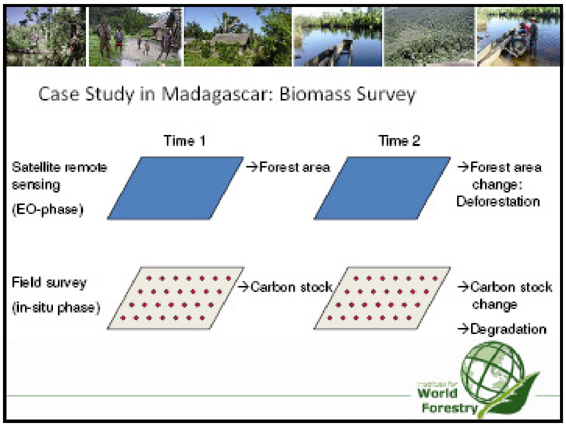

Case Study: REDD-FORECA Project in Madagascar
Duration: Phase 1, 2007 - 2009 (2 years)
Starting year: July 2007
Donors: BMZ, BMELV, SDC
Partners: MEFT, GTZ/PGM-E, Intercooperation, ESSA Forêts, vTI
Pilot sites:
IC Group: Miarinarivo, Ambatofinandrahana, Manompana
GTZ/ PGME : Tsinjoarivo, Tsimanampetsotsa, Haute Ramena, Mariarano
Mission and objectives:
To support Madagascar Government in the elaboration of a mechanism reducing the emissions of GHG from deforestation and degradation of forests in Madagascar
To participate to the conception of an international system of exchange of quotas emissions to REDD
Expected results:
Development of a REDD methodology for Madagascar (national)
Implementation of the concept of committed forest at local level
Diffusion of results of REDD FORECA
World Forestry

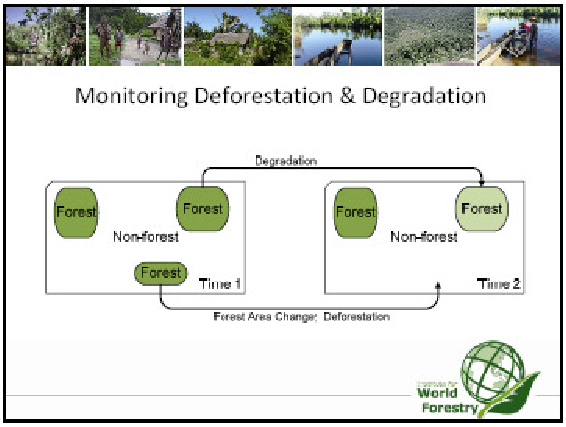

Case Study in Madagascar: Workpackages
Biomass survey
Socio-economic study
Economic study
→ carbon budget
→ causes of deforestation
→ economic aspects of timber use
Baseline & Incentives
World Forestry

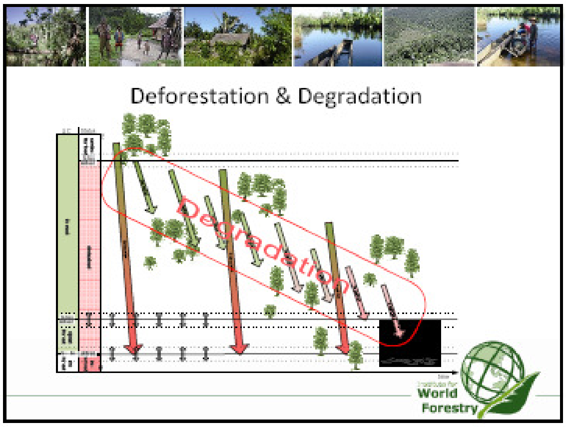

Case Study in Madagascar: Causes of deforestation
Conceptual framework
Data collection
Data analysis
Methodology development
Causes of deforestation and degradation
Actors of deforestation and degradation
Explanatory variables, factors
Input for the baseline
Requirements for incentive system implementation
Output
World Forestry

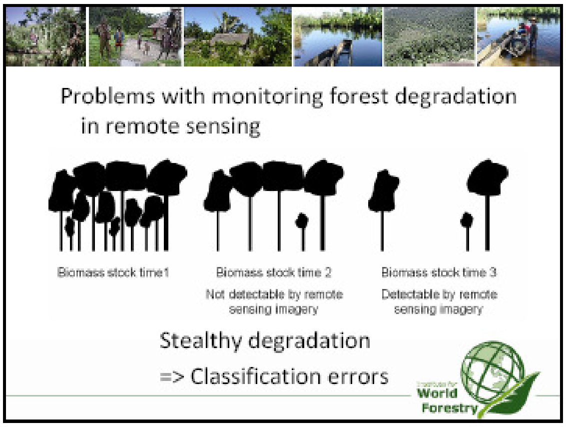

Case Study in Madagascar: Causes of deforestation
Input
Output
NEEDS AND USES ANALYSIS
World Forestry

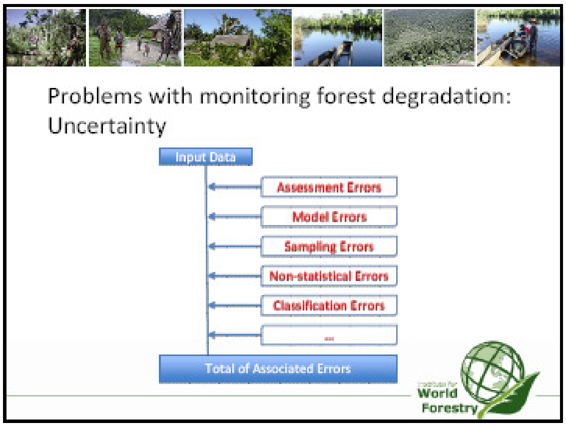

Case Study in Madagascar: causes of deforestation
1. Households with high incomes benefit more than poor household from the deforestation
2. Households with low incomes are more dependant on deforestation and degradation
⇒ Measures to combat deforestation / degradation will affect the poorest households the most
⇒ Respect the Millennium Development Goals
World Forestry

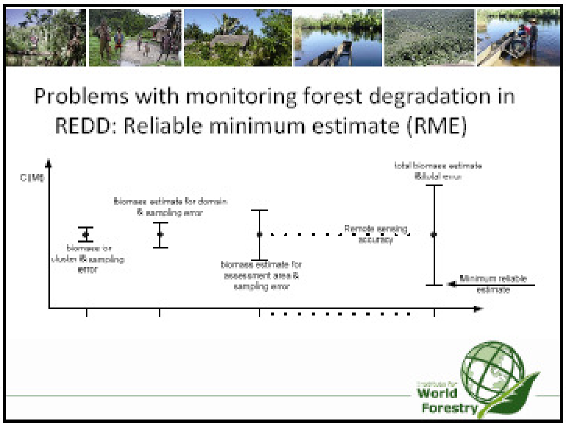

Case Study in Madagascar: Biomass Survey
Time 1
Time 2
Satellite remote sensing
(EO-phase)
→Forest area
→Forest area change: Deforestation
Field survey
(in-situ phase)
→Carbon stock
→Carbon stock change
→Degradation
Institute for World Forestry

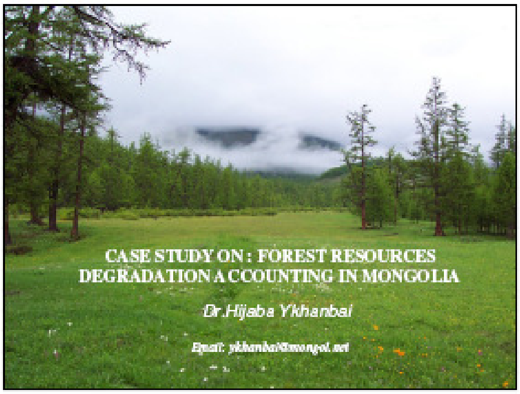

Monitoring Deforestation & Degradation
Degradation
Forest
Forest
Non-forest
Forest
Time 1
Forest
Forest
Non-forest
Time 2
Forest Area Change: Deforestation
Institute for World Forestry


Deforestation & Degradation
Degradation
Institute for World Forestry


Problems with monitoring forest degradation in remote sensing
Biomass stock time1
Biomass stock time 2
Not detectable by remote sensing imagery
Biomass stock time 3
Detectable by remote sensing imagery
Stealthy degradation
=> Classification errors
Institute for World Forestry


Problems with monitoring forest degradation: Uncertainty
Input Data
Assessment Errors
Model Errors
Sampling Errors
Non-statistical Errors
Classification Errors
...
Total of Associated Errors
Institute for World Forestry


Problems with monitoring forest degradation in REDD: Reliable minimum estimate (RME)
biomass estimate for domain & sampling error
biomass estimate for assessment area & sampling error
Remote sensing accuracy
Minimum reliable estimate
Institute for World Forestry



Introduction

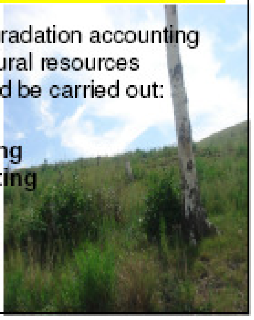
- Mongolia is a traditional agriculture country , dominated by pastural herdsman and is also a forest deficit nation
- The forest area of Mongolia is 12,7 million ha and total growing stock is 1.27 billion cubic meters and the volume of commercial forest about 301,9 million cubic meters (2006)
- Forest degradation accounting considered, as value of the changes of extent of forest resources and its adjustments with economic development indicators of the country
- Traditional calculation of GDP in National accounting system in Mongolia underestimates the true value of natural resources and essentially ignores the value of natural resources and forests

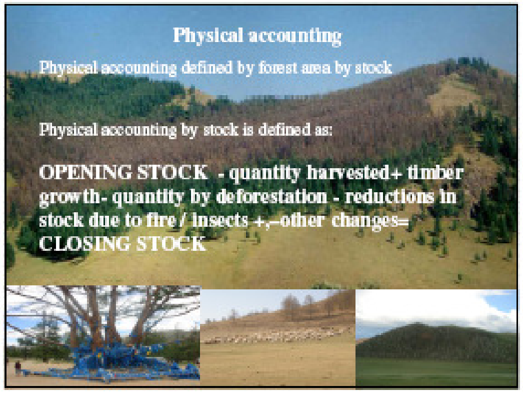
Almost 70% of community members surveyed in Batsumber sum, Tuv aimak, in July 2009, says that forest degradation is higher than other NR, and 63% of respondents answered that it also highly impacting to the local community livelihood.

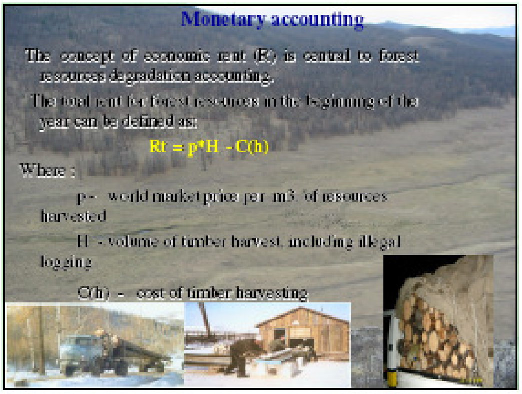
Methodology

Forest resources degradation accounting is similar to other natural resources accounts and it should be carried out:

i. **Physical accounting**
ii. **Monetary accounting**







Methodology

Value of the resources at the beginning of the accounting period (Vso) are defined as:

$$Vso = \Sigma \frac{Rt}{(1+r)t}$$

Intermediate cost of resources:

$$VSi = Vso + \Sigma \frac{Rt}{(1+r)t} * g - \Sigma \frac{Rt}{(1+r)t} * H +/- \Sigma \frac{Rt}{(1+r)t} * L - \Sigma \frac{Rt}{(1+r)t} * D$$

Forest resources degradation value:

FDV = VSi - VSo

Forest land use value by non-timber benefits can be defined as: [illegible]

Where: g - annual growth of forests,
D - De forestation (deforestation, forest insects and fire),
L - [illegible]

[illegible]

Macroeconomic adjustment

Environmentally adjusted green Net National Product (gNNP) :

$gNNP = GNP - Dc - FDV$

Where:

GNP – Gross National Product

NNP – Net National Product

Dc – Depreciation of man-made capital or fixed assets

FDV – Degradation of Forest resources

GS = NS - FDV

Where:

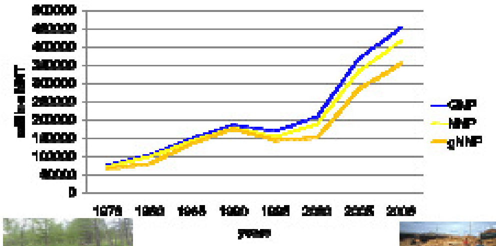
GS - Genuine Saving

GS = NS - FDV

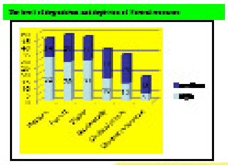
Where:

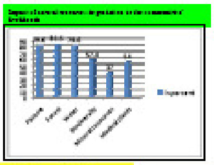
GS - Genuine Saving

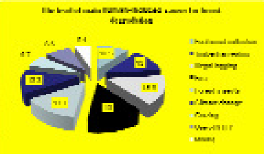
Results

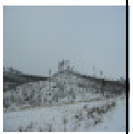


Community opinion: the level and impact of Forest degradation



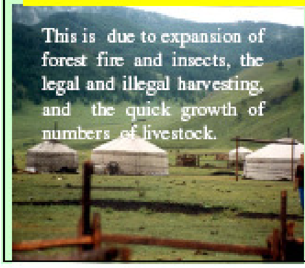






Results

The results of this study shows that degradation and depletion of forest resources have increased from year to year during the entire study period.



This is due to expansion of forest fire and insects, the legal and illegal harvesting, and the quick growth of numbers of livestock.

The ratio of gNNP to NNP was 84.9 % in 2006. This means that the annual NNP of Mongolia will be reduced to 15.1 % in 2006 only by its forest resources degradation.

Discussion

The existing scheme of rent capture is comparatively lower it equal to only 3-5 % of the actual rent. Most rent income is earned by private companies and illegal loggers. Therefore, a forest taxation & monitoring should be improved.

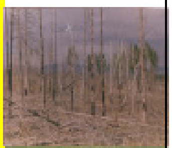
The lower level of interest rate (5%) is more comparable with discounted income value of forest growth.

The weakness of this study is it's inability to capture all the environmental benefits of the forest, including carbon statistics.

In the future also possible to compare Forest resources degradation in the framework of Environmental Accounting in the country, and address it for Sustainable Development approaches.

Conclusions

- **This study is the first effort to apply forest resources accounting in Mongolia. Therefore need improvement and institutionalization for its official use**
- **The ratio of forest resources degradation is comparatively high, so it requests for more SFM approaches**
- **Economic incentives and instruments for SFM are recommended, particularly for CBFRM , to reduce illegal logging and losses from forest and steppe fire**
- **There need for specific case studies of Forest resources degradation accounting at local level**



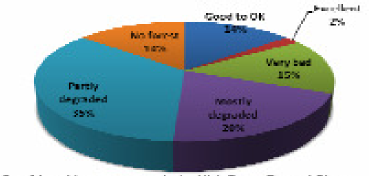
ASSESSMENT OF FOREST DEGRADATION BY LOCAL COMMUNITIES: THE CASE STUDY OF GHANA

Dominic Blay
Francis K. Dwomoh
Lawrence Damnyag

FORESTRY RESEARCH INSTITUTE OF GHANA

INTRODUCTION

- Degradation of forests in Ghana is alarming
- Forest land declined from 8.1 million ha to 2.1 million ha within the last century
- Remaining forested areas are in poor condition



Condition of forest reserves in the High Forest Zone of Ghana

- Degradation impact negatively on human livelihood and the environment
- Therefore urgent measures needed to curb continuous degradation
- Hence an ITTO-funded project implemented by the Forestry Research Institute of Ghana (FORIG) to rehabilitate some degraded forests with collaboration of local communities
- However, due to limited resources proposed project sites had to be prioritized based on the level of degradation
- To ensure active local participation & transparency, indicators for assessing degradation were developed in collaboration with the local communities

Development of indicators

- PRA and workshops were used
- Questions focused on:
  - present state of forests as compared to about 20 years ago,
  - products obtained from the forest some years back and which are no more available,
  - fertility of the land at present as compared to some 20 years ago, and
  - present state of streams and rivers in the forests compared to some years ago
- Answers compiled and list of final indicators agreed upon through four separate workshops with local communities

Indicators used for assessment of degradation

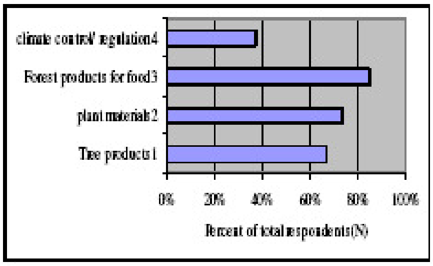
- State of flora resources: timber and NTFPs that communities depend on (Biodiversity)
- State of streams/rivers in the forest (Protective functions)
- State of fire incidence and soil fertility (Health of the forest)

Method for assessment

- Vegetation survey for the assessment biodiversity
- Habitat assessment method for assessment of protective function
- History of fire incidence for state of health of the forest

RESULTS AND DISCUSSION

Percent of local respondents indicating resources obtained from the forest in the past but which are no more available (total respondents (N) = 441)



Indicators of degradation provided by local communities

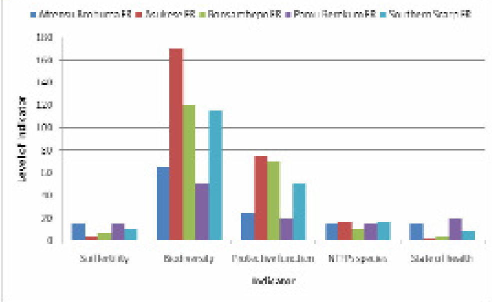
- Fire: presence of burnt areas and fire adapted grasses,
- soil erosion due to burning of grasses;
- Fire related suspended particulate matter;
- Reduction in soil fertility
- Reduced water supply and quality;
- Reduction in forest food, medicines and herbs;
- Decrease in game, wild animals and birds;
- Reduction in materials for shelter and households;
- Reduction in income from NWFPs
- Reduction in rainfall amount and pattern;
- Destruction of plantations;
- Reduction in provision of services (e.g. shade and wind breaks);
- Vegetative cover destruction;

Summary list of final indicators of degradation

No	*Indicator*
1	Number of plant species in the forest
2	Level of soil fertility as indicated by the presence of indicator plants
3	State of riparian vegetation
4	Number of plant species used as Non-Timber Forest Products
5	State of fire attack in the forest

Field inventory were based on these indicators

Summarized results on levels of degradation



CONCLUSION

- The approach relies on skills that are locally available in many communities and indicators based mainly on visual assessments
- Case study demonstrates high potential for active involvement of local communities in the assessment of degradation
- This assessment could be replicated in other areas upon improvement in local capacity
- However, the only constraint against such replication and capacity building are financial resources

RECOMMENDATION

- Need to build capacity of local communities
- Tailor-made manual for local communities be produced
- Guidelines for the development of indicators for assessment need to be made
- Approach could be improved using statistical analyses and additional indicators/data including participatory mapping

LADA

Land Degradation Assessment in Drylands

Land Degradation Assessment in Drylands (LADA): A focus on the local level assessment

by

Sally Bunning FAO, Land and Water Division, Natural Resources and Environment Department

for the Technical Meeting on A&M of Forest Degradation 8-11 September 2009

WHAT ARE WE ASSESSING ?

Land degradation (LADA definition):

"The reduction in the capacity of the land to perform ecosystem functions and services that support society and development"

Status and Trends of degradation (& improvement):

- Soil properties and soil erosion
- Water quality and quantity
- Vegetation/land use and biodiversity

Causes & Drivers: focus on human induced degradation (SLM)

- land use management practices
- capacity (knowledge, equipment, access to services...)
- policies and legislation (tenure, market, PES...)

Impacts on

- Ecosystem services: Environmental, Productive & Socioeconomic
- Livelihoods: Natural, Physical, Human, Social & Financial assets

Assessment Process, Methods and Tools

Participatory Process

Multi-scale

- Global level
- National level
- Local Level

Integrated (human and environmental)

- Socioeconomic (livelihoods and vulnerability analysis)
- Biophysical : soil, water, vegetation/biodiversity ; on-site and off-site (wider watershed/ landscape level)
- DPSIR and Ecosystems analysis

OBJECTIVES & OUTCOMES OF LOCAL LEVEL LADA

OBJECTIVES

1. to establish a baseline of LD information at local scale
2. to provide basis for a (future) LD monitoring (geo-referenced system)
3. to validate the LD Hot Spots (GLADA-NDVI) and national LD assessment
4. to enable causal analysis of land degradation and human/socio economic factors (Drivers - Pressures - State - Impacts - Responses)
5. to identify remedial action for sustainable land management (SLM).

OUTCOMES

- Methods and Tools
- LADA-Local manual (parts 1 and II)
- Local Study Areas assessed
- Documentation of SLM measures (using WOCAT tools, incl. costs and benefits)
- Curriculum for training (in LADA countries and by UNCCD member states)

Degradation types : National (LADA/WOCAT) and local

W: Soil erosion by water
- Wt - loss of topsoil by water
- Wg - gully erosion
- Wm - mass movements
- Wr - riverbank erosion
- Wc - coastal erosion
- Wo - offsite effects (sediments, flooding...

E: Wind erosion
- Et - loss of topsoil by wind
- Ed - deflation and deposition
- Eo - offsite effects of wind erosion

C: Soil chemical deterioration
- Cn - fertility decline and reduced OM content not by erosion e.g. by leaching, fertility mining, oxidation and volatisation (N)
- Ca - acidification (lowering of soil pH)
- Cp - soil pollution with toxic materials
- Cs - salinisation/alkalinisation of topsoil leading to a productivity decline

P: Soil biophysical deterioration
- Pc - compaction: by trampling or machinery-weight/ frequent use
- Pk - sealing of pores and creation of impervious layer at soil surface obstructing infiltration of rainwater
- Pw - waterlogging, human induced hydromorphism (excl. paddy fields)
- Ps - subsidence of organic soils, settling of soil
- Pu - loss of bio-productive function due to construction, mining etc.

V: Vegetation and biodiversity degradation
- Vr - reduction of vegetation cover
- Vs - quality & species composition decline (above and below ground)
- Vq - reduced biomass/production due to clear felling, forest fire, etc

H: Water degradation
- Ha - aridification/soil moisture problem
- Hp - water quality decline (pollution)
- Hq - water quantity decline (groundwater, surface water)

Rapid assessment of vegetation + land use

1. Obtain an overview of vegetation and land use patterns
2. Make a rapid assessment of vegetation in each LUT
   1. plant and litter cover
   2. structure and composition
   3. habitat and species diversity
   4. plant health/vigour
   5. productivity
3. Develop initial ideas on relationships between vegetation and LD/SLM practices:
   - effects of vegetation degradation on erosion, soil quality, the water cycle, biomass/ productivity; and livelihoods (food, other products, vulnerability)
   - effects of SLM practices on vegetation resources and productivity

→ to help select detailed assessment sites

4. Conduct Detailed assessment of status and trends
   - scoring of pasture quality/condition
   - forest/woodland status and trends
   - natural vegetation in croplands

Focus group discussion on vegetation resources

1. Identify plant indicators - change in pasture quality (3) + soil quality (3).

2. Information on the grazing regime and stocking rate

3. Information on fires, drought risk/resilience and coping strategies

4. Information on laws and regulations that affect vegetation quality

5. Describe the reasons for current vegetation status (and change dynamics)
back up from household interviews, technical specialists, secondary information

Analysis of Effects on Ecosystem Services LADA (N+L)

P Productive services
- P1 - production (quantity + quality) incl. effects on biomass; and assoc. risks
- P2 – water (quantity + quality) for human consumption, animals and vegetation
- P3 – land availability

E Ecological services (regulating + supporting)
- E1 – water cycle (hydrological regime)
- E2 – organic carbon content (soil/vegetation)
- E3 – soil cover (vegetation, mulch)
- E4 – condition of soil surface (e.g. crusting)
- E5 - nutrient cycling
- E6 - soil formation
- E7 - biodiversity
- E8 – effects on greenhouse gas emissions

S- Socio-economic services + human well being
- S1 - spiritual, aesthetic, cultural landscape, heritage value, recreation, tourism
- S2 - education and knowledge (e.g. indigenous)
- S3 - conflicts
- S4 – food security, health and poverty
- S5 - infrastructure private and public (buildings, roads, dams, etc)

Need to develop a scoring system for LADA- L for assessing ecosystem services

CHALLENGES AND CONCEPTS

As with forest degradation assessment

Degradation is a process so we need to assess
- type and severity of land degradation (observation)
- land condition (quality and quantity of soil, water and biological resources) (measurement and observation)
- change /trend over recent past e.g. 10 years (information from land users, technical sectors, policy makers (take into account varying perceptions and also look at historical context to understand land users behaviour and policy decisions) backed up by LUCC analysis at national level
- Impacts (human; environmental) and thereby determine remedial measures

Problem of Baseline : so comparison is important in the field to compare degraded and well managed land (e.g. between fields, farms, catchments)

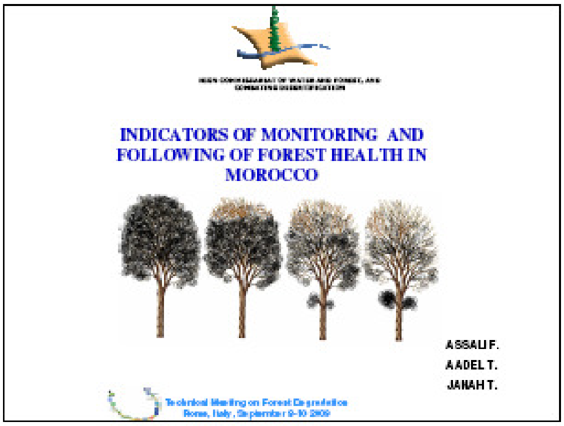
- Aim : not the assessment itself but the capacity to use results to inform decision making (by land users, technical sectors, policy makers) and action to improve land resources and ecosystem management (Prevent ; Mitigate ; Restore/rehabilitate)

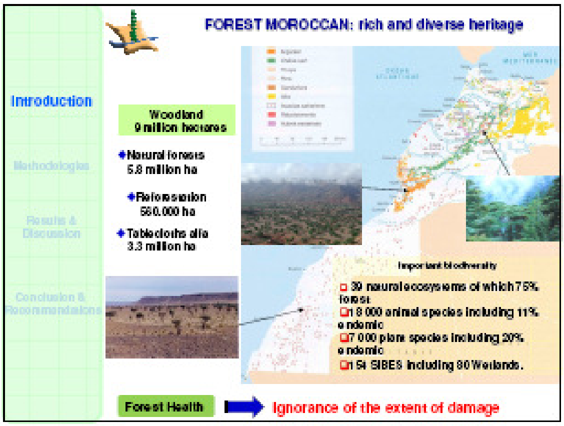
Closing remarks

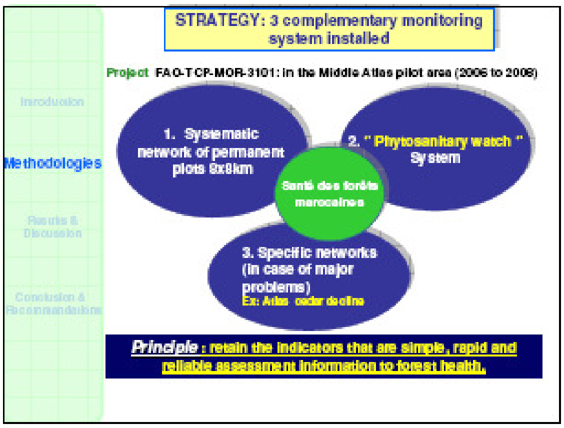
- LADA local is being adapted and validated in range of situations
- Manual available
- Requests for scaling up (How can we collaborate with FO)
- Technical collaboration between LADA and FO forest degradation process
- Suggestion to prepare a forest degradation module for LADA

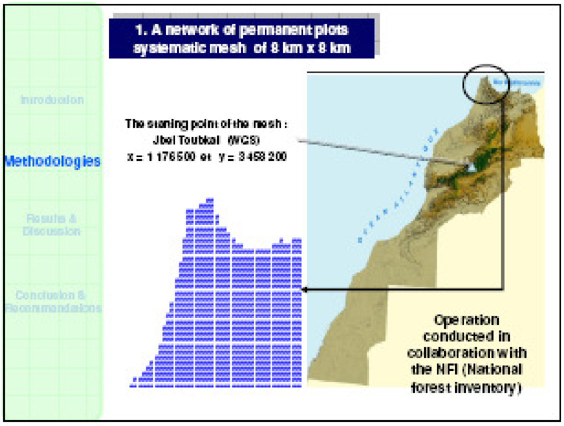
Details on local, national and global level assessment process on website
www.fao.org/nr/lada

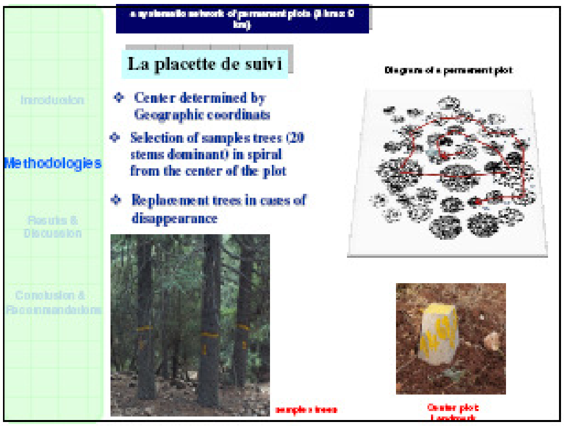
Please see also the LADA fliers

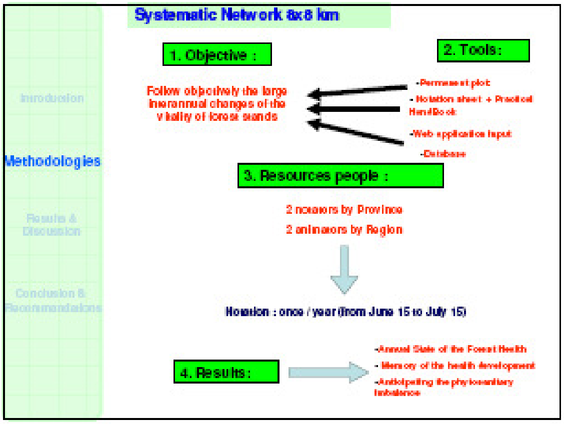

INDICATORS OF MONITORING AND FOLLOWING OF FOREST HEALTH IN MOROCCO
ASSALI F.
AADEL T.
JANAH T.

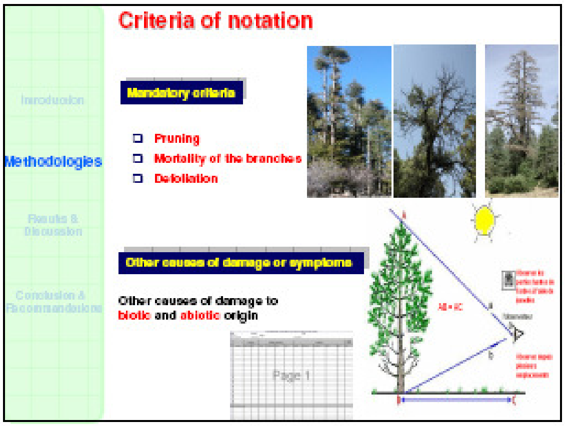

FOREST MOROCCAN: rich and diverse heritage
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Woodland
9 million hectares
Natural forests
5.8 million ha
Reforestation
560.000 ha
Tablecloths alfa
3.3 million ha
Important biodiversity
39 natural ecosystems of which 75% forest
18 000 animal species including 11% endemic
7 000 plant species including 20% endemic
154 SIBES including 80 Wetlands.
Forest Health
Ignorance of the extent of damage

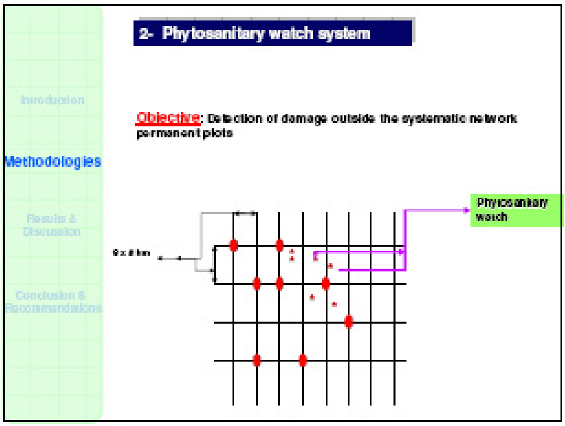

STRATEGY: 3 complementary monitoring system installed
Project FAO-TCP-MOR-3101: in the Middle Atlas pilot area (2006 to 2008)
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
1. Systematic network of permanent plots 8x8km
2. " Phytosanitary watch " System
Santé des forêts marocaines
3. Specific networks (in case of major problems)
Ex: Atlas cedar decline
Principle : retain the indicators that are simple, rapid and reliable assessment information to forest health.

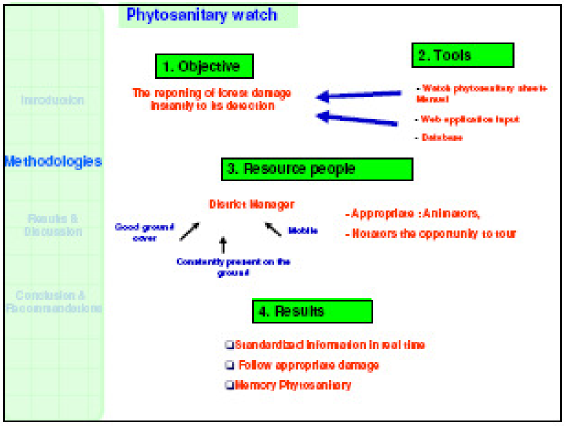

1. A network of permanent plots systematic mesh of 8 km x 8 km
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
The starting point of the mesh :
Jbel Toubkal (WGS)
x = 1 176500 et y = 3 458 200
Operation conducted in collaboration with the NFI (National forest inventory)

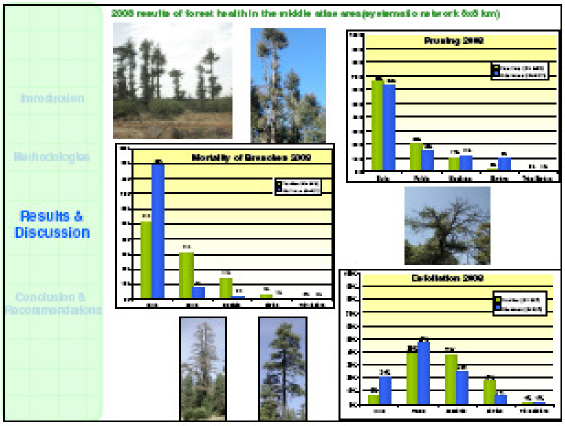

La placette de suivi
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Center determined by Geographic coordinats
Selection of samples trees (20 stems dominant) in spiral from the center of the plot
Replacement trees in cases of disappearance
Diagram of a permanent plot
samples trees
Center plot Landmark

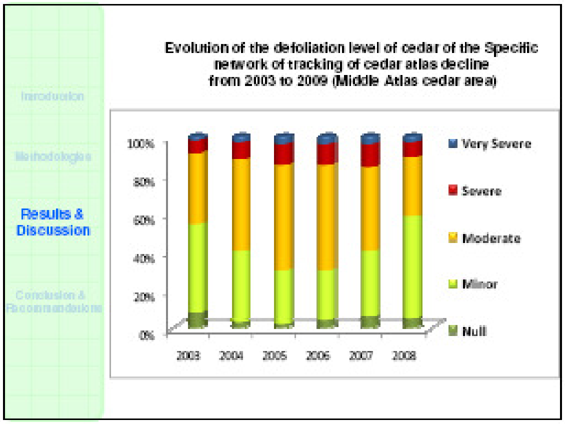

Systematic Network 8x8 km
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
1. Objective :
Follow objectively the large interannual changes of the vitality of forest stands
2. Tools:
-Permanent plot
- Notation sheet + Practical HandBook
-Web application input
-Database
3. Resources people :
2 notators by Province
2 animators by Region
Notation : once / year (from June 15 to July 15)
4. Results :
-Annual State of the Forest Health
- Memory of the health development
-Anticipating the phytosanitary imbalance

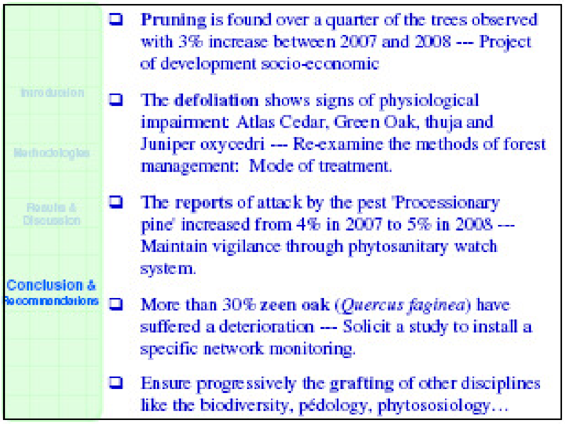

Criteria of notation
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Mandatory criteria
Pruning
Mortality of the branches
Defoliation
Other causes of damage or symptoms
Other causes of damage to biotic and abiotic origin
Page 1


2- Phytosanitary watch system
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Objective: Detection of damage outside the systematic network permanent plots
Phytosanitary watch
8 x 8 km


Phytosanitary watch
Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
1. Objective
The reporting of forest damage instantly to its detection
2. Tools
- Watch phytosanitary sheets Manual
- Web application input
- Database
3. Resource people
District Manager
Good ground cover
Mobile
Constantly present on the ground
- Appropriate : Animators,
- Notators the opportunity to tour
4. Results
Standardized information in real time
Follow appropriate damage
Memory Phytosanitary


Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Pruning 2008
Mortality of Branches 2008
Defoliation 2008


Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Evolution of the defoliation level of cedar of the Specific network of tracking of cedar atlas decline from 2003 to 2009 (Middle Atlas cedar area)
100%
80%
60%
40%
20%
0%
2003
2004
2005
2006
2007
2008
Very Severe
Severe
Moderate
Minor
Null


Introduction
Methodologies
Results & Discussion
Conclusion & Recommendations
Pruning is found over a quarter of the trees observed with 3% increase between 2007 and 2008 --- Project of development socio-economic
The defoliation shows signs of physiological impairment: Atlas Cedar, Green Oak, thuja and Juniper oxycedri --- Re-examine the methods of forest management: Mode of treatment.
The reports of attack by the pest 'Processionary pine' increased from 4% in 2007 to 5% in 2008 --- Maintain vigilance through phytosanitary watch system.
More than 30% zeen oak (Quercus faginea) have suffered a deterioration --- Solicit a study to install a specific network monitoring.
Ensure progressively the grafting of other disciplines like the biodiversity, pédology, phytososiology…

Addressing Forest Degradation in the Context of Joint Forest Management in Udaipur, India

Presented by:
Michael Kleine
International Union of Forest Research Organizations (IUFRO)
IUFRO's Special Programme for Developing Countries

Source used:
Promode Kant, Preet Pal Singh, Ghazala Shahabuddin and Rajeshwar Singh Jasrotia, 2008. India: Bringing a third of the land under forest cover. In: Don Koo Lee (Editor), 2008. Keep Asia Green, Volume III "South Asia". IUFRO World Series Volume 20-III.

FES, Foundation for Ecological Security, India: Project Location Site: Udaipur, Rajasthan:

Recent IUFRO-led Scientific Publication Initiatives on Rehabilitation of Degraded Forests in Africa and Asia

1. Rehabilitation of Degraded Lands in Sub-Saharan Africa

Lessons Learned from Selected Case Studies
Presents success and failure of forest rehabilitation in various eco-regions of Africa

2. "Keep Asia Green"

Analyses past and ongoing forest rehabilitation and restoration efforts in the Asia Pacific region.

http://www.iufro.org/science/special/spdc/actpro/keep/

State of Knowledge – Information Gaps – Research Needs – Policy Recommendations

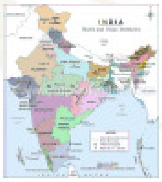
---

Addressing Forest Degradation in the Context of Joint Forest Management in Udaipur, India

Community Development Project

FES
Foundation for Ecological Security

Tropical dry forests and grasslands (semi-arid eco-zone) in Udaipur District of the north-western state of Rajasthan, India.



Three villages (1500 inhabitants in 350 tribal households)

Foothills and valleys of the Aravalli Hill Range
- Forest land 201 ha
- Pasture 167 ha
- Un-irrigated agric. Land 13 ha

Typical situation in many dryland areas in economically disadvantaged countries

---

Status of Forest Degradation

FES

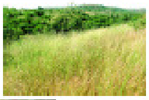
Assessment of Forest Degradation

- **Step 1: Socio-economic situation**
  - Growing population with insufficient income
  - Sustenance through government programs and migration
- **Step 2: Reduction/loss of vital goods and services**
  - Insufficient water for human consumption and irrigation
  - Low productivity of agriculture crops and livestock
  - 20% drop of income from forests (fuelwood, grass)
- **Step 3: Status of forest degradation**
  - Low stocking density and loss of tree species
  - Degradation of pasture land (i.e. low grass production, loss of grass cover)

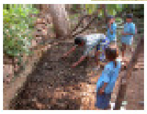
FES

Forest Rehabilitation Projects

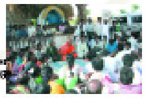
Project on natural resource management and dairying
- 40% of total fodder intake of animals from forest lands;
- Bring commons land under active village governance;
- Provide legal rights on the usufructs from commons lands.



Poverty alleviation through social mobilisation around natural resources management
- Reduce migration to cities for unskilled labour;
- Creation of local employment opportunities.



Development of models of local self-governance at village and inter village level for natural resources management.
Strengthen decentralisation of governance over natural resources;
Continued protection of forests and commons lands through village institutions.



FES

Results of Forest Rehabilitation Efforts

Results of Forest Rehabilitation Efforts

Conclusions „Assessment of Forest Degradation“

- Defining forest degradation through a indirect three-tiered approach at the local level
  - Socio-economic situation
  - Reduction of goods and services from forests
  - Status of forest degradation (visual field inspection)

Many rehabilitation projects are based on this type of indirect assessment

Provides the basis/motivation for implementing a forest rehabilitation project;

Conclusions „Forest Rehabilitation“

- Rehabilitation targets include
  - Increased ground vegetation cover – improved grass production – reduced soil erosion (controlled grazing; check dams etc.)
  - Increased tree biomass – improved fire wood production (forest protection; planting of hedgerows etc.)

Quantifying progress towards achieving the rehabilitation targets requires monitoring of indicators (biological, structural etc.): data on „before – after scenarios“ (on project-by project basis)

Rehabilitation measures lead to higher forest biomass levels, in order to achieve improved productivity. This may or may not be in line with other goals (e.g. carbon, biodiversity etc.)

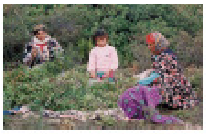
Conclusions „Investment Strategy“

- Investments into forest rehabilitation
  - Field work (planting; fencing; check dam construction; etc.)
  - Changes in the management of forests through
    - Adequate policies and regulations;
    - Local institutions;
    - Capacities (including retraining of forestry staff); and
    - Employment/markets etc.

Large portions of investments are needed to bring about a social transition to SFM. Otherwise rehabilitation results (e.g. improved production; reduced emissions) are only short-lived.

Thank you for your attention

ASSESSING AND REVERSING FOREST DEGRADATION THROUGH GLOBAL PARTNERSHIP



Stewart Maginnis

Director, Environment and Development Group

International Union for Conservation of Nature

Introduction to FLR and GPFLR

Forest Landscape Restoration brings people together to identify, negotiate and implement practices that restore an agreed optimal balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses

Underlying principles :
- Multi-functional:
- Situation specific:
- Participation:
- Scale:
- Adaptative Management

International Union for Conservation of Nature

Global Partnership on Forest Landscape Restoration

Aims
- Support partners in effectively restoring degraded forest landscapes
- Establish and improve relationships among different interest groups involved in forest landscape restoration
- Encourage the development and use of innovative FLR approaches and methodologies

GPFLR Learning Network GPFLR
- Research phase (Jan-March 09), Scoping phase with learning sites (April- Sept 09), Operational phase (October 2009 onwards
- See www.ideastransformlandscapes.org

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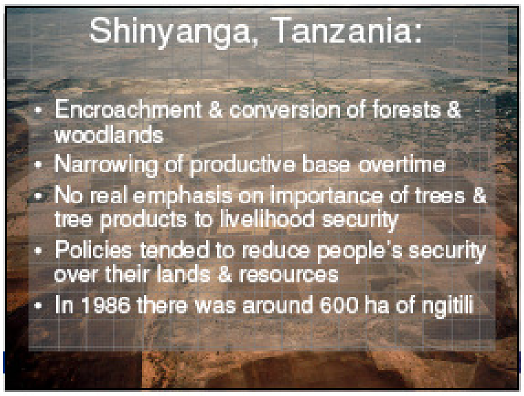

POSTIVE LANDSCAPE LEVEL CHANGE BUT BENEFITS NOT SPREAD EQUALLY

- *Shinyanga, Tanzania*

  The *"Desert of Tanzania"* now benefits from:
  - USD 1200/household/yr in economic assets
  - 500,000 ha of new assets
  - Contributes x1.6 compared to regional average income
  - Benefits extend to 2.5 million people but still issues of underlying disparity

International Union for Conservation of Nature

Shinyanga - Preliminary outcomes

Issue	Outcome
Economic value of restored Ngitili in $ per person per month	[illegible] (which is higher than the national average rural consumption of [illegible] per month per person)
Costs of wildlife damage as a result of the restored forest	Approximately $[illegible] per family per year
Average value of 15 natural resource products used per annum	Per household $1,200 per annum Per village $700,000 per annum Per district $89,600,000 per annum
Species of tree, shrub and climbers found in restored Ngitili	152
Other flora found (dry season only)	Up to 30 different families of grass and herbs
Bird species recorded (dry season only) and mammals	145 bird species and 13 mammals
Reduction in time for collecting various natural resources	Reduced collection time by ... Fuelwood 2 to 6 hours Pole 1 to 5 hours Thatch 1 to 5 hours Water 1-2 hours Fodder 3-6 hours
Percentages of households using Ngitili products for various reasons in the 7 districts	Education 36% (10% to 61%) Diversify nutrition 22% (7%-65%) Fodder and forage 21% (10%-37%) Medicinals (over 130 spp) 14% (5%-39%) Fuelwood 61% (54% to 69%)

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South Platte Watershed

Buffalo Creek Fire - 1996

- 11 miles burnt in half hour
- 11,900 acres burned
- Multiple flooding events
- Loss of life and homes
- Total costs USD 25 million

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STARTING POINT

- Dense uniform forest
- Susceptible to pest attack
- Vulnerable to crown fires

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Open forest structure

December 1896

International Union for Conservation of Nature

Expected benefits of landscape restoration in South Platte Watershed

- Reduced risk of catastrophic crown fire and post-fire erosion; return to natural fire regime
- Reduced forest density
  - converts understory to grass and shrubs
  - favors rapid understory recovery after fire and reduced post-fire erosion
- Increased runoff water for riparian areas
- Improved habitat for wildlife

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Ideal restored landscape in Denver means:

- **Diverse landscape structure**
- **Openings**
- **Low-density forest**

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CONCLUDING THOUGHTS

- FLR is an obvious remedy to degradation as currently defined and is a useful way of framing the enhancement of carbon stocks
- Flexibility is required – no single blueprint (specifically the REDD opportunity should not become a carbon straight-jacket)
- Several learning sites indicate that countries are not bound to follow the forest transition curve.

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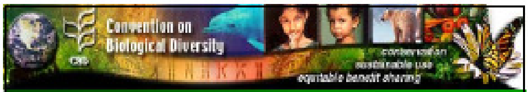
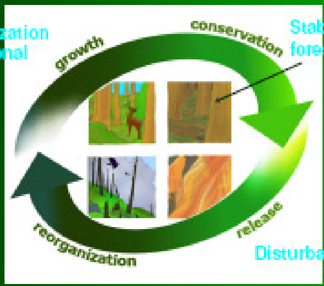


The relationship between forest biodiversity and ecosystem resilience

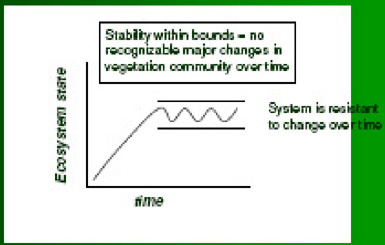
Ian Thompson, Canadian Forest Service
Brendan Mackey, Australian National University
Alex Mosseler, Canadian Forest Service
Steve McNulty, US Forest Service

Rome, Sept. 2009

Resilience is the capacity of an ecosystem to recover after disturbance



Stability of a forest state is a concept related to resilience



Boreal forests are not especially resistant to fire, but they are resilient

This boreal conifer forest will self-replace within 50 years, hence it is highly resilient

Tropical wet forests are resilient and stable gap dynamics forests

Tropical forests undergo gap dynamics in space and time, but the characteristic species remain the same and so these forests exhibit long-term resilience and resistance to change

Resilience is an emergent ecosystem property

- Resilience of a forest is a function of biodiversity at many scales: genes, species, and regional diversity among ecosystems
- Most primary forest ecosystems are resistant and resilient to natural disturbances
- Biodiversity also underpins the ecological goods and services from the forest
- Loss of biodiversity may alter the forest resilience and will result in reduced goods and services
- Loss of resilience means uncertainty about future forest condition

Tipping points exist where the resilience capacity is overcome and the system moves to a new state

- e.g., if a forest becomes dry, it loses species, is subject to increased frequency of fire, and moves to a savannah or grassland state
- this new state is stable and will require considerable change to move to another state
- the biodiversity has been lost and so have most of the goods and services from the ecosystem


Tropical dry forest → 
Drier climate → 
savannah

Degraded forest systems may be highly stable or unstable

- In many systems, loss of functional species*, or invasion by superior competitors, can result in new stable and resilient states
- New functional species now 'control' the system by occupying most niches or out-competing endemic species
- Most often, degraded forests are unstable because they lack diversity and functionality
- Degraded forests always provide fewer ecosystem services

** Functional species are key 'drivers' of the system. They are not necessarily the most abundant species.*

Two examples of invasive species forming highly resilient but highly degraded ecosystems


Removing invasive acacia forest in California


Invasive black wattle (*Acacia mearnsii*) in South Africa - a very stable and resilient system

Mechanisms for the linkage between biodiversity and ecosystem stability and resilience

- biodiversity results in strong functional connectivity in the system: e.g., pollinators adapted to plants and vice versa, decomposers adapted to inputs
- diseases and disturbances do not affect all species equally, more diversity = less loss to these factors
- redundancy among species - lose one driver, another previously less important species fills the vacated role
- genetic capacity within species enables adaptation to environmental changes
- general tendency for greater productivity in diverse forest = more goods and services (e.g., carbon storage)

Ecological principles for restoring degraded forests to improve stability and resilience

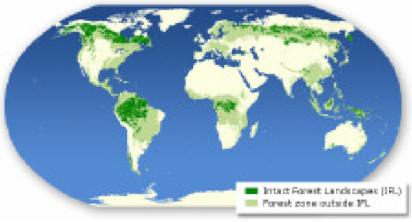
- biologically diverse systems tend to be more productive, stable, and produce more goods and services than simple ecosystems (e.g., monotypic plantations)
- re-forest by using native species and by using natural forests as models
- maintain landscape connectivity
- manage to maintain genetic diversity (e.g., reduce selective harvest of 'best' trees) and plant several seed stocks
- protect primary forests and species at the edges of their ranges
- plan to reduce invasive species

Conclusions

- evidence supports the concept that biodiversity confers resilience within a forest ecosystem at many scales
- mechanisms include redundancy, resistance to disease, increased productivity, genetic capacity to adapt to change
- loss of biodiversity can result in an ecosystem condition that is difficult to change or that provides an uncertain future condition
- biodiversity also provides most ecosystem goods and services
- degraded forests may be stable, although more often they are not, but they will provide reduced goods and services

Global Mapping and Monitoring of Forest Degradation: The Intact Forest Landscapes Method

Peter Potapov, South Dakota State University
Lars Laestadius, World Resources Institute



The IFL Method – Overview

Purpose
To map and monitor forest degradation over large, possibly inaccessible areas (e.g. for a country, a continent, or the world)

Degradation
Defined here as loss of ecological integrity (intactness), or loss of "degrees of freedom" to make trade-offs

Assessment Logic
- A binary classification of the landscape (either intact or not)
- Inverse logic (landscape considered intact until proven otherwise)
- Two types of criteria (alteration and fragmentation)

Data
Satellite images (Landsat or finer), publicly available maps

Characteristics
- Method – whole area (no sampling), tested, ready to use, replicable, suitable for monitoring, adaptable, non-prohibitive cost
- Results - Spatially explicit, consistent in time and space

The IFL Method – Methodology

A Simplified Classification of the Landscape

In reality – a gradient

Degraded — Intact

In the IFL method – either intact or not

Degraded — Intact

NB! Method allows more classes

The IFL Method – Methodology

Definition

An *Intact Forest Landscape* (IFL) is
- an unbroken expanse of natural ecosystems
- with no signs of significant human activity
- and large enough to maintain all native biodiversity, including viable populations of wide-ranging species.

An IFL may contain significant portions of naturally tree-less ecosystems.

Minimum size: 50 000 hectares

Intact – no loss of freedom to make trade-offs

The IFL Method – Methodology

Inverse Logic - Intact Until Proven Otherwise

Step 1: Assume entire study area to be intact

Step 2: Collect evidence of human influence

Step 3: Reject all areas where evidence is sufficient

Step 4: Intact areas appear as a residual

The IFL Method – Methodology

Criteria, Type 1 - Human Caused Alterations

(What's inside a polygon)

- **Settlements** (including a buffer zone of 1 km);
- **Transport infrastructure**, including roads (except unpaved trails), railways, navigable waterways (including seashore), pipelines, and power transmission lines (including in all cases a buffer zone of 1 km on either side);
- **Agriculture and forest plantations**;
- Industrial activities during the last 30–70 years, such as **logging, mining, oil and gas exploration and extraction, peat extraction**, etc.
- **Burned areas** adjacent to infrastructure or developed areas

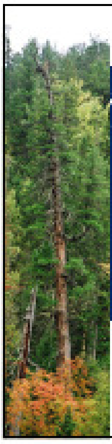
Old or low intensity human influence is considered *insignificant*, e.g. diffuse grazing by domestic animals, low-intensity selective logging, and hunting.

The IFL Method – Methodology

Criteria Type 2 – Fragmentation

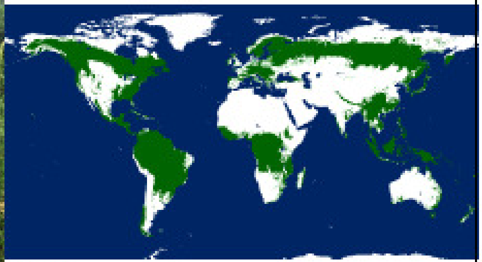
(The geometry of a polygon)

- **Minimal Area** of at least **50,000 hectares (500 km²)**
- **Minimal Width** of at least **10 km** (the diameter of a largest circle that can be fit inside the contour of an area)
- **Corridors or appendages** of areas meeting minimal area and width criteria must have a minimum width of **2 km**



The IFL Method – Methodology

1. Define The Area of Study



Included

Forest landscapes with a canopy density of at least 20%

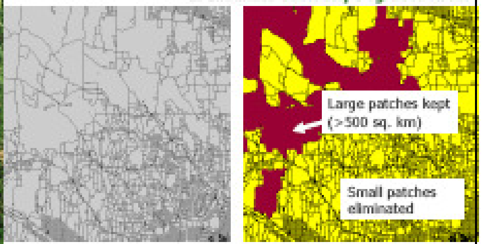
Naturally tree-less areas within forest landscapes

Excluded

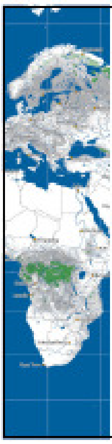
Small remote forest patches (less than 4 sq. km)

The IFL Method – Methodology

2. Eliminate Obviously Degraded Areas



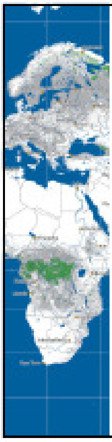
Pre-existing maps are used. Example: TIGER dataset (USA)



The IFL Method – Conclusion

Advantages

- Suitable for all countries and continents.
- Cheap and quick to apply.
- Data from public satellite images
- Rigorously defined, replicable, independently verifiable
- Suitable for monitoring
- Can be adapted and refined, e.g. to assess smaller landscapes.
- Suitable for remote and inaccessible landscapes
- Results are consistent and comparable in time and space
- The result is a map with has many uses
- The method is tested and ready to use
- High level of transparency



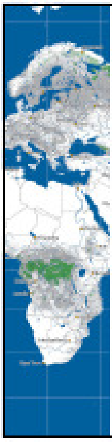
The IFL Method – Conclusion

Limitations

- Skills in GIS and image interpretation are required.
- Measures the presence/absence of human impact
- Current criteria are only suitable for large areas (province, country, region, the world)
- Current criteria are not geographically differentiated
- Fire classification is an issue

Possibilities

- The method can be modified.
- Alteration criteria can admit more human influence
- Fragmentation criteria can admit smaller areas
- Classes of alteration and fragmentation can be created
- Criteria can be geographically differentiated ("quilt" type assessment)
- **But differentiation may cause loss of consistency!**



The IFL Method – Conclusion

Opportunities

- IFL method is ready to use
- IFLs are strongly associated with permanence, biodiversity, indigenous peoples
- IFLs allow countries to make MRV-able commitments in early phases of implementation
- Integrate in emerging "REDD-Plus" mechanism

Recommendations

- Maintain consistency within study area
- Consider adding classes of alteration/fragmentation
- Integrate in FRA (global and/or national assessments)
- Integrate in "REDD-Plus"
- CBD?
- Support additional development and assessment work

Working Group 2 - presentation

Definition

- **Reduction of the capacity of a forest to provide goods and service**

- Agreed that the definition was sufficient and no need to refine

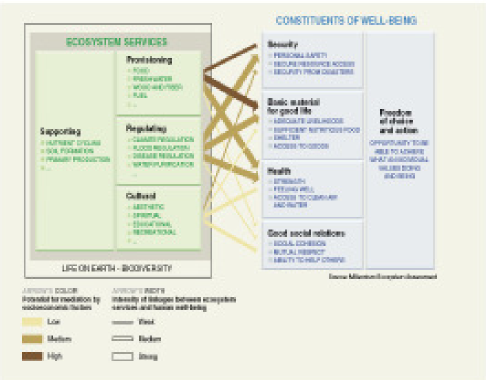
Key issues / conclusions

- Degradation is location-specific
- Degradation is scale dependent (spatial and temporal)
- Degradation is both a state and a process (thresholds)
- Obvious need for flexibility but also need for some indicators that permit cross site comparability

Categories of ecosystem function

- **Carbon (biomass)**
- **Biodiversity**
- **Food**
- **Water**
- **Soil**

- Aligns broadly with MA

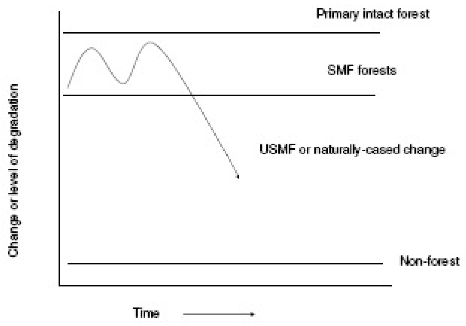


Possible indicators (from cards)

- Soil / water quality
- Watershed quality
- Species composition
- Species richness
- Species presence / absence
- Stand density
- Canopy cover / structure
- Deadwood structure
- Comparison to «natural » reference
- Biomass

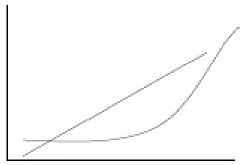
Questions for WG 2

- What is the appropriate scale(s) to consider degradation: Does the current definition sufficiently address the issue of scale?
- What are the best indicators?
- Which indicators are best for national-level reporting?
- Which might also be proxy indicators for several different aspects of degradation?
- Which already have adequate definitions and assessment methods?
- What further actions are needed to facilitate regular monitoring of the indicators?



Thresholds

- Thresholds may exist and we need to look for them over time with data trends.
- Different thresholds for different indicators
- Or, thresholds might be set for socio/political reasons;
- The utility of thresholds is more apparent at the local level and less apparent at higher levels.



Levels are:

- Global
- Regional
- National
- Sub-national by forest type
- Local by landscape
- Stand

- Landscapes can be defined biophysically, functionally, social construct
- Or landscape can be a local level construct.
- Some level of sub-national forest typing
- Appropriate scale is relative to the goods and services being determined.

- Time scale of reporting, depends on what you are measuring.
- **Time scale is relative to the indicator or process which you are measuring.**

	Scales				
Indicators	Global	Regional	National	Forest type	Local
Soil quality				X	X
Erosion rate				X	X
H2O quantity		X	X	X	X
H2O quality		X	X	X	X
Species comp.	X	X	X	X	X
Forest stand Variables (canopy, stocking etc.)				X	X
Landscape variables (land cover, fragmentation, etc.)	X	X	X	X	X
Carbon pools (5)	X	X	X	X	X

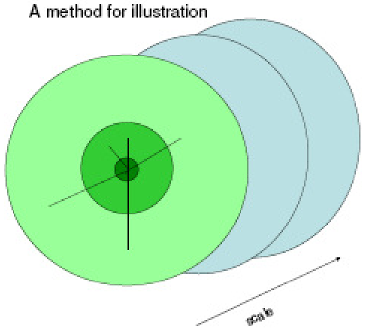
For these indicators, which ones already have adequate definitions and assessment methodologies?

Agreed that methods are available for all.
Lund's proposed common ground indicators:
Soil
Biodiversity
Biomass (carbon)

- As a minimum to define degradation we need to measure species composition, landscape pattern, and carbon pools in some way

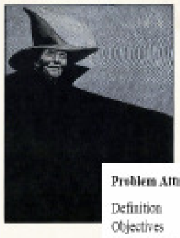
Further actions needed to facilitate regular monitoring of these indicators (e.g. harmonization of definitions, capacity building, R&D).
e.g., NFIs not in all countries and not standardized
By whom?

A method for illustration



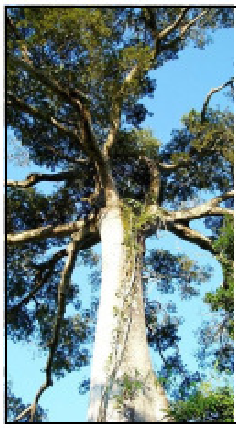
Complex issues with many confounding factors and drivers

- Globalization
  - Pension fund in Europe funding US bank funding industrial company funding local investor logging in Sarawak…)
- Policy environment and legal framework
- Societal choices
  - Use of natural capital to build physical capital
- Institutional settings
  - Lack of capacity to manage / control



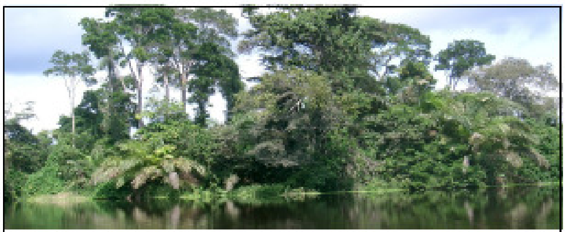
A wicked problem

Problem Attributes	Complexity Spectrum: Simple Problems	Complexity Spectrum: Wicked Problems
Definition	Clear, all agree	Fuzzy, much disagreement
Objectives	Single	Multiple
Stakeholders	Aligned	Fragmented
Factors influencing objectives	Few, controllable	Many, beyond control
Uncertainty	Low	High
Relative risks	Low variability	High variability
Role for science	Leads to clear choice	Informs choices
Coping strategies	Not contentious	Contentious
Decision analysis	Less valuable	More valuable



Forest products (goods)

- Goods differ (wood and wood-based, NTFP…)
- Indicators can be developed at the forest management unit level
- FMU level indicators can be scaled up to national or international levels



GOODS:
- Timber
- Fuelwood
- Medicines
- Mushrooms/berries
- Meat
- Honey

Etc…

STOCKS
- Standing timber
- Deadwood
- Etc…

SUSTAINABLE PRODUCTION LEVELS (SPLs)

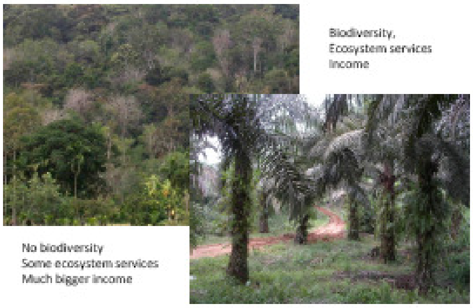
ACTUAL PRODUCTION LEVELS including for local consumption (APLs)

Indicator: set of ratios SPL/AP

Socio-economic services

- Linked to the "goods" but in a non-linear, monotonic way (→ secondary indic.)
- Indicators can be developed at the forest management unit level
- FMU level indicators cannot be scaled up to national or international levels

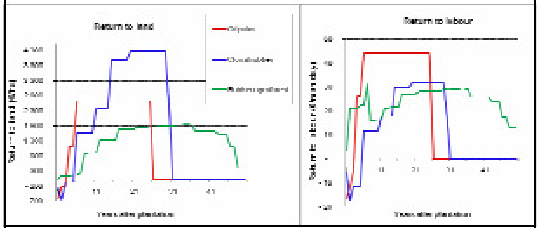
Agroforests vs. clonal plantations



Biodiversity,
Ecosystem services
Income

No biodiversity
Some ecosystem services
Much bigger income

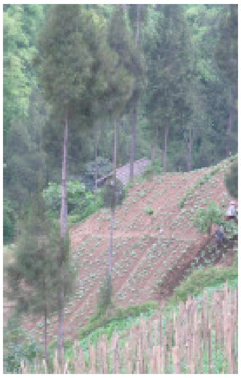
Comparison of different smallholders' plantations



	Oil palm	Clonal rubber	Rubber agroforest
Return to land (€/ha) /year	2 154	2 717	1 172
Return to labour (€/man.day)	36	18	22

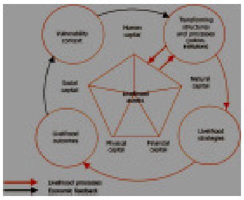
Possible socio-economic indicators

- Local demographic trends
- National population trends
- Employment (forest and extra-sectoral)
- % Household income from forest goods



Recommendations

- Develop meaningful macro-economic indicators for national scale socio-economic services
- Provide training and capacity building to assess indicators at local level
- Use a common conceptual framework to analyze indicators



Annex 4. Working Groups

Some working assumptions and general remarks were provided to the working groups:

1. The general definition of forest degradation (a reduction in the capability to provide goods and services) is broad enough – and we keep this as an overall framework definition
2. Degradation is location-specific
3. Degradation is scale dependent (spatial and temporal)
4. Degradation is both a state and a process (the opposite process is "improvement" which can happen through natural recovery, restoration or rehabilitation). Assessment of the state requires thresholds, monitoring of the process can be done focusing on trends
5. While we should allow flexibility in some interpretation of definitions (to suit local circumstances), there need to be a common definition and comparable data for some indicators of degradation (e.g. when linked to a financial mechanism)

Guidance for the working groups:

1. The questions are suggestions for how the discussion could be guided – the group is free to discard or modify these
2. As a general guide we suggest that you:
   - Do not re-invent the criteria and indicator processes and spend time coming up with a long list of potential indicators
   - Look at the ideas on the Blue Wall and those presented in the case studies. Focus on a few of those (those that can be used as proxies for more than one aspect and a few essential specific indicators)
   - Decide whether a common/global definition exists/is needed (and provide ideas if appropriate)
   - Identify suitable assessment methodologies for these
   - Identify further actions needed

Questions:

1. Building on the cards, the presentations and your own knowledge, list the most critical/best indicators of forest degradation in terms of your working group theme
2. Which of these might be used as proxy indicators for several different aspects of forest degradation?
3. Which indicators would this group recommend as key indicators for national level reporting by all countries?
4. For which of these do adequate definitions and proven assessment methodologies exist?
5. What further actions are needed to facilitate regular monitoring of these indicators? (e.g. harmonization of definitions, capacity building, R&D) By whom?

Working Group Discussions

Working Group 1: Forest Degradation in terms of forest extent, condition and health
Key words: Fragmentation, forest cover, structure, dynamics, forest health and vitality

Facilitator(s): Val Kapos, Michael Kleine
Note taker: Jean-Louis Blanchez
Members:
Taoufiq Aadel, Evisa Abolina, Resham Bahadur Dangi, Carmenza Robledo, Carmen Lourdes Meneses Tovar, Nianti Ousmane Tangara, François Wencelius

Main conclusions

- The first step is to define forest using the already agreed indicators and definitions. After, degradation and restoration potential are going to be defined as qualification of the existing forest
- Degradation is considered as a process in time
- Restoration is the vice-versa process (in time)
- Degradation and restoration are related to a specific management or use objective. The group identified the following possible management or use options:
    - Biodiversity conservation
    - Scenic beauty
    - Cultural value
    - Carbon management
    - WFP
    - NWFP
    - Water
- Therefore in determining which are the relevant indicators for measuring and assessing forest (landscape) degradation and restoration depends directly to the management or use objective
- The indicators only make sense depending of the management use options. Therefore the main recommendation for the countries is to define their management priorities even before collecting data.

Working Group 2: Forest Degradation in terms of reduced capacity to provide ecosystem services
Key words: Biodiversity conservation, Protection of soil and water, Forests and the carbon cycle

Facilitator(s): Ian Thompson, Stewart Maginnis
Note taker: Victoria Heymell
Members:
Thomas Baldauf, Sally Bunning, Martin Herold, Lars Laestadius, Pema Wangda, Jenny Wong, Eliakimu Zahabu

Key issues/conclusions:

- Degradation is location-specific
- Degradation is scale dependent (spatial and temporal)
- Degradation is both a state and a process (thresholds)
- Obvious need for flexibility but also need for some indicators that permit cross site comparability

Categories of Ecosystem Function were defined as: Carbon (biomass), Biodiversity, Food, Water and Soil. These align broadly with the Millennium Ecosystem Assessment (MA)

Possible Indicators (as identified from cards):

- Soil / water quality, Watershed quality
- Species composition, Species richness, Species presence / absence
- Stand density, Canopy cover / structure, Deadwood structure
- Comparison to «natural » reference, Biomass

Thresholds may exist and they need to be examined over time with data trends. Thresholds may be different for different indicators; they might be set for socio/political reasons. Their utility is more apparent at the local level and less apparent at higher levels.

Levels or scales for measurements defined as: global, regional, national, sub-national by forest type, local by landscape or by stand. Landscapes can be defined biophysically, functionally, or as a social or local level construct. However there needs to be some level of sub-national forest typing. The appropriate scale is relative to the goods and services being determined.

The time scale of reporting depends on what you are measuring. It is relative to the indicator or process which you are measuring.

Indicators	Scales				
	Global	Regional	National	Forest type	Local
Soil quality				X	X
Erosion rate				X	X
Water quantity		X	X	X	X
Water quality		X	X	X	X
Species composition	X	X	X	X	X
Forest stand variables (canopy stocking)				X	X
Landscape variables (land cover, fragmentation)	X	X	X	X	X
Carbon pools (5)	X	X	X	X	X

It was agreed that adequate definitions and assessment methodologies are available for all of these indicators. Lund's proposed common ground indicators (soil, biodiversity, biomass (carbon)) provide a good starting point. As a minimum to define degradation we need to measure species composition, landscape pattern, and carbon pools in some way.

Further actions are needed to facilitate regular monitoring of these indicators (e.g. harmonization of definitions, capacity building, R&D). National Forest Inventories for example are not in all countries and not standardized.
By whom? Who would undertake the further actions?

Working Group 3: Forest Degradation in terms of reduced capacity to provide goods and socio-economic services
Key words: Wood and non-wood forest products, recreation, education, protection of cultural values, livelihoods, employment

Facilitator(s): Juergen Blaser, Peter Csoka
Note taker: Rebecca Tavani
Members:
Ibro Adamou, Carlos Bahamondez, Faizul Bari, Dominic Blay, Robert Nasi, Marco Lentini Hijaba Ykhanbai

Concluding points:

1) Lots of factors that affect forest state (and degradation) (such as policy, markets, globalization, institutional setting, land tenure etc) – important for forest degradation, but out of reach in terms of measurability for these purposes
2) We can develop indicators for forest goods measurable at local level and which can be aggregated at national level (ex/ ration of sustainable production/gross)
3) Socio-economic indicators more appropriately measured at local level (need for capacity building from FAO) and more appropriately assessed locally (particularly for restorative purposes). These indicators linked to goods, but cannot be aggregated meaningfully at national level. Need to develop meaningful macroeconomic indicator at national level. Some examples of socio-economic indicators: employment, household income, population increase in forested areas, etc. (socio-economic drivers important because theory behind REDD based on clear analysis of drivers of deforestation & FD)
4) Capacity building needs – building awareness of those tools that already exist

Annex 5. Degradation Meeting Cards

Indicators: simple and cost effective
What are the main common characteristics?
Degradation in relation to the objective

Goods and Socio-economic
Trends of goods production
Change of the capacity in economic terms
Sustainable livelihood for people who exploit forest
Human activities affecting forest/carbon
National level market prices and poverty
Socioeconomic services
Socioeconomic users (economic terms)
Existing policies and plans
Forest provides water for hydropower generation
NTFP/NWFP
Medicinal plants

Services
How much services were affected
Ecosystem services
Forest users goods, service

Fragmentation and measurement
Map alteration and fragmentation
Map relationship actual/potential stocking
Map species/age class matrix
Define rehabilitation targets
Number of dying trees
Evidence of cuttings
Landscape level forest fragmentation
Fragmentation
Percentage of area affected by intervention
Extent and severity
Canopy cover structure
Stock change
Stocking level
Regeneration capacity
Long term impact on carbon stock
Percentage opening in forest canopy
Forest cover
Forest extent
Density growing stock, basal area, stem numbers

Biological
Number of key species
Area affected by
Naturalness (respective to the sites, what is there vs. what should be)
Structure

Soil nutrients
Loss of key structures (age/type of forest)
Bird nests
Loss of key species (age/type of forest)
Forest cover specific to typology
Tee species composition
Phenology
Species richness
Species composition
Biodivesity (2)
Number of species
Loss of biodiversity
Biodiversity against natural state reference
Species diversity
Three parameters
Health
Biomass
Basal area
Carbon stock
Species composition
Loss of biomass by age/type

Physical Conditions
Surface
Recovering
Species
Timber
Watershed protection
Definition of functions
Stand structure
Forest cover
Water regulation
Change of species and composition
Soil/hydrological functions
Soul quality
Air quality
Soil conditions
Geological service
Pollinisation

Services
Services trends + service index
Land use change
Land history
Role of watershed management
Environmental productivity
Canopy regeneration status
Condition of forest: services and exploitations
How to differentiate sustained yield system/.... vs depreciation
Disturbed/undisturbed

Annex 6. Background Documents

Background documentation to the study including the analysis of definitions can be found on the CPF site.

Working Paper 154: "Towards Defining Forest Degradation: Comparative Analysis of Existing Definitions" Markku Simula can be found on the CPF site:
http://www.fao.org/forestry/cpf/degradation/en/

Case studies prepared during the study are to be published in a separate document.