Forestry Department
Food and Agriculture Organization of the United Nations

FAO'S NATIONAL FOREST ASSESSMENT (NFA) APPROACH, FOREST BIODIVERSITY AND POLICY

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National Forest Monitoring

Forests are crucial for the well being of humanity. They provide foundations for life on earth through ecological functions, by regulating the climate and water resources and by serving as habitats for plants and animals. Forests also furnish a wide range of essential goods such as wood, food, fodder and medicines, in addition to opportunities for recreation, spiritual renewal and other services.

Today, forests are under pressure from increasing demands of land-based products and services, which frequently leads to the conversion or degradation of forests into unsustainable forms of land use. When forests are lost or severely degraded, their capacity to function as regulators of the environment is also lost, increasing flood and erosion hazards, reducing soil fertility and contributing to the loss of plant and animal life. As a result, the sustainable provision of goods and services from forests is jeopardized.

In response to the growing demand for reliable information on forest and tree resources at both country and global levels, FAO initiated an activity to provide support to national forest monitoring (NFM). The support to NFM includes developing a harmonized approach to national forest assessments (NFAs), information management, reporting and support to policy impact analysis for national level decision-making.

The purpose of the NFM initiative is to introduce countries to an alternative approach designed to generate cost-effective information on forests and trees outside forests, including all benefits, uses and users of the resources and their management. Special attention is placed on monitoring the state and changes of forests, and on their social, economic and environmental functions. Another main objective is to build national capacities and harmonize methods, forest related definitions and classification systems among countries.

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TABLE OF CONTENTS

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Introduction

In response to the growing demand for reliable information on forest and tree resources at national, regional and global scales, FAO has initiated a programme to provide support to national forest assessments (NFA). This programme includes developing a harmonised core method for field assessment to generate information on forests and trees outside forests, supporting information management and analysis, and building national capacity for each of these elements.

The harmonised assessment method is based on systematic sampling of 1 km^2 tracts of national territory, with nested plots and subplots used for different parameters (FAO 2004). The NFA approach has so far been implemented in four countries (Cameroon, Guatemala, Lebanon and Philippines), which have now completed most of their field programmes and preliminary analysis of the resulting data.

This report aims to provide guidance on how NFA results can best be used to provide information relevant to forest biodiversity and how the NFA approach could be modified in future to enhance its ability to provide such information. It is based on a rapid review of the countries' reports of the field campaigns and preliminary analyses and on the presentations and discussions that made up the technical meeting on "*Evaluation of NFA Approach and Influence on Policy Development*", which took place in Rome 9-11 March 2005. It includes: brief summary comments on each of the individual countries' experience and outputs to date, general comments on the NFA approach as it has been implemented so far, and recommendations both to FAO and to countries for implementing and using the NFA approach in future to provide information relevant to forest biodiversity.

National Experience of NFA to Date and Results in Relation to Biodiversity:

All four countries that have implemented NFAs have sampled very thoroughly the grid identified at the outset of the study, recording a standardised set of parameters, and have completed at least a preliminary analysis of the results. What remains to be done is to match those results with identified national information needs. In the case of biodiversity, this will probably require further consultation with potential information users to articulate further their needs for forest biodiversity information that can be met from the NFA data. It will then be necessary to conduct some additional analyses of the data in conjunction with ancillary data sources and to communicate the results in a series of products appropriate to different audiences.

None of the country reports is particularly thorough in documenting information needs that may have been articulated in consultation with information users at the outset of the NFA process. This is particularly true in relation to biodiversity and suggests that further consultation with relevant stakeholders may be needed. Documenting these needs and their refinement in the light of NFA results is essential both to ensure that subsequent iterations and expansion of the NFA within these countries is as useful as possible and for NFA informing implementation in other countries.

While it is still too early to document evidence of the influence of NFA results on biodiversity (or other) forest decision-making, clearly articulating and documenting information needs is the basis for predicting where that influence is most likely to occur, and indeed ensuring that it can take place. The evidence of uptake and use of NFA results will take some time to accumulate because it will be based on references to NFA-derived data and indicators in policy and other documents.

The results of the NFAs and their relevance to biodiversity issues vary between countries. The comments given below on a country-by-country basis are based on the summaries of the data collected given in the reports and workshop presentations. They include some suggestions for other forms of analysis and presentation, as well as ways of improving future iterations of the NFA.

Cameroon

The high species-richness of the forests of Cameroon, as evidenced by the low frequencies of individual tree species, present challenges in both species identification and meaningful presentation of the results of the NFA in biodiversity terms. At the same time, forest biodiversity information should be a high priority given the important role the country plays in this respect globally.

The data presented on tree species frequencies are useful, especially because they highlight the relative rarity of high value timber species. However, the data would be more meaningful if combined with *measures of forest disturbance* that could help to confirm whether this rarity is because the species have already been logged out or because they are naturally rare (each explanation is likely to hold for some species).

A clearer way of presenting the results would be to group species and quantify the area of forest or the area of each forest type in which particular groups are present above a total threshold frequency. Criteria for grouping could include commercial value or ecological role (e.g. pioneer species, large fruited species important as wildlife food). Thus, for example, a calculation of forest area with a high frequency of pioneer species (*Musanga* and others) would provide an estimate of highly disturbed forest area (subject to the estimation errors resulting from the coarse sample grid) that could be compared with the field assessments of disturbance from the NFA (if these were recorded as in Guatemala).

Frequencies of national endemics and tree species of conservation concern (red list species) should also be presented and where possible connected to forest types. This will require consultation of ancillary data on species status and distribution, including global (and national) red list databases. Trends in these frequencies established by subsequent NFAs will highlight where management action is needed to preserve species and where changes may affect other species (e.g. wildlife).

Additional valuable information can be obtained by examining dbh distributions for the common species and species of commercial or conservation interest. Trends showing

declining frequencies of large individuals could indicate high harvesting pressure and a declining population of reproductive individuals, while absence of smaller individuals could signal suppressed recruitment.

The wildlife observations, while laudable, are not useful in any quantitative sense. It would be worth identifying areas where any endangered species among them were observed, but the impact of the survey teams and likely inconsistencies among observers and methods mean that they are not useful as presence/absence data.

It is possible that more relevant data on wildlife may be obtained in future by including in the interviews questions on the presence based on recent sightings (or possibly frequency of sighting) of particular wildlife species of interest (e.g. endangered an/or endemic). However, this approach will only be appropriate for a limited number of species that are easy to observe and identify. If a robust assessment method can be developed, then trends in species sightings could provide valuable evidence of changes in species status.

Guatemala

The major problem in assessing forest biodiversity for the Guatemalan NFA has been the identification of tree species. This constrains any detailed discussion of all but the most common and easily identified species. More information could be gained in future through the involvement of more taxonomic expertise and/or para-taxonomists, who could at least provide reliable separation of morpho-species and thus coarse assessments of variation in species richness among the sample tracts. Future NFAs could obtain further useful information by pre-selecting tree species of biodiversity interest or concern, such as endemic and/or endangered species, and training field teams to identify them reliably. This would allow the establishment of baseline estimates of their distribution and frequency as a basis for future monitoring and/or stratification for more intensive sampling.

Given the difficulties associated with detailed evaluations of species composition in Guatemala, it is especially important to provide information on forest biodiversity at the ecosystem level. To this end it would be useful to report on more detailed ecosystem types by linking the data from the sample tracts with the abundant mapped data on forest ecosystem types within Guatemala. This approach would help to reduce the errors associated with many of the estimates resulting from the relatively sparse grid used by the NFA.

Similarly, providing reliable data on the protection status of the forests requires using mapped data in addition to the NFA sample tracts. The information derived by combining the NFA data with remote sensing and mapped information would provide for more useful protection figures to provide more accurate estimates of forest extent by ecosystem type. Further detail on the different types of protection in relation to the different forest types would also be more policy-relevant.

The analysis of forest fragmentation is potentially very useful in relation to forest biodiversity and as a basis for future monitoring. It would help if the relationship to the field sampling were explained more clearly, perhaps using an illustration. It is also critical that this promising approach should be validated relative to other measures of forest fragmentation. The most obvious basis for comparison would be with remotely sensed maps of forest cover and metrics of fragmentation derived from them (see for example Kapos et al 2000).

The analysis of disturbance status of the sample plots also provides a useful baseline. As for other data, these analyses would be more useful if they could be applied to more detailed forest types.

Lebanon

The forests of Lebanon are much less species-rich than those of the other countries that have so far implemented NFA. This has reduced problems of species identification. Forest type characterisation was available to quite a detailed level from previously existing maps. It is therefore surprising that relatively few of the data acquired are presented in relation to the forest types that are more meaningful at national scale (level 3). Characteristics of individual forest types (volume, biomass, use) will help to place their biodiversity value in context.

The high errors associated with the forest area calculations, even at the national scale, are presumably due to the small patch size (fragmentation) of the forests. These errors could be reduced by use of the remote-sensing based map, which seems so far to have been produced, but not used. Both the NFA data and the map can and should be used to establish a useful baseline on forest fragmentation, which is important for biodiversity.

The treatment of biodiversity is so far restricted to listing common tree species both inside and outside forests. To the extent possible, it should include information about both common and rare species in relation to forest type. The persistence of forest species outside forests should be summarised. There is also potentially useful information to be gained by considering the ecological characteristics of the species in relation to the areas where they are of highest frequency. For example, are fire-resistant species dominant in particular parts of the country? This will require consultation with national experts and data sources external to the NFA.

Other important biodiversity information is how much of which forest types harbour national endemics and/or species of global or national conservation concern. This will require cross-referencing with other sources of data, but is a vital part of determining the biodiversity value of Lebanon's forests. Making use of the dbh data to say something about which of these priority species are regenerating would also be useful.

The protection statistics also seem to suffer from the 'rare event' effect on errors. It will be important to use data from other sources to supplement those from the NFA field samples for this important parameter.

There is no mention in the Lebanese report of any measures of forest disturbance, and reporting of forest area by disturbance category would also be a very useful basis for monitoring.

Philippines

The Philippine NFA appears to have done a relatively good job of analysing national forest information needs and how the NFA can best help to supply them. As pointed out in Mr Acosta's presentation, many of the policy issues in the Philippines are connected with knowing where the resources of greatest concern are located and how best to make use of or preserve them appropriately. The team has done a good job of evaluating the precision of its estimates and has highlighted the importance of increased sampling intensity and supplementary data to meet those needs with respect to forest types that occur relatively infrequently (plantations, mangroves). These concerns also seem to apply to data like the protection statistics.

The presentation of species frequencies should address the conservation status (global and national) and distribution (national endemic or widespread) of these species as a way of further quantifying the forests' biodiversity value. Similarly expressing frequencies of species groups with particular their ecological roles (pioneer, etc) would also be useful. Both analyses will require applying knowledge and data from other sources.

It would also be useful to calculate areas of forest (or numbers of tracts) characterised by particular classes of richness in tree species or by classes of frequency of species of conservation concern or playing particular ecological roles. The richness categorisation could also usefully be done in relation to diameter class (e.g. numbers of species above a particular diameter threshold) .

The finding about the importance of trees outside forests in volume and biomass terms is a very useful one. However, to be meaningful in biodiversity terms, it would be useful to consider what fraction of these trees are forest species and therefore may represent important genetic resources and what proportion is made up of alien species.

The data on forest canopy stratification are presented with no assessment of their accuracy or interpretation of their significance. If the data are valid, then they could be combined with dbh distribution data to identify forests of greatest structural complexity, which could be interpreted as having high biodiversity value. Other countries (e.g. Guatemala) have expressed concern about the validity of the field assessment of the stratification. Dbh distribution data alone could also be used for this purpose, by presenting information on the area of forest in which very large trees occur (rather than the average distribution per forest type).

Including interpretation of the data (an explanation of what they might mean) is fundamental and requires application of national knowledge and (often) ancillary data.

The NFA Approach in General

The NFA approach is well-suited to providing a national overview of the total forest resource within a country. In principle it can also be used to describe and summarise the variation within that resource, which is the basis for forest biodiversity. However, its ability to identify and describe such variation adequately is limited by the systematic sampling approach and the sparseness of sampling necessary to keep the NFA affordable in terms of time and financial resources. These factors mean that there is the potential for large errors in quantifying the extent and characteristics of forest types that are limited in extent, as seen for Mangrove forests in the Philippines.

Stratification of the sampling is one way of avoiding or reducing these errors. Another is combination of the ground data with remote sensing data to improve the estimation of the extent of individual forest types. This should become a routine part of NFA. Of course there is a trade off between these approaches and affordability and rapidity of the assessment. It will be important not to overemphasise the investment of resources in detailed characterisation of forests that are of trivial importance at national scale. However, an important part of including a wider range of values and benefits of forest in the NFA is the recognition that forests unimportant for one set of values may be disproportionately important for another.

National needs for forest biodiversity information vary widely and are often poorly defined. A fundamental part of national assessment efforts is working with policy and decision-makers in articulating these needs in order to ensure that the assessment meets them to the greatest extent possible. This process requires careful facilitation and (probably) the participation of individuals outside the technical forest assessment team. If successful, such a consultation process will add to the sense of national ownership of data that are eventually generated to respond to the articulated needs.

The process of articulating information needs is an iterative one, which can be vastly facilitated by the provision of some information as the basis for discussion. It is also important to recognise that providing information will always raise additional questions.

One set of biodiversity information that most countries need is that required to track their progress in implementing international agreements and progressing towards internationally agreed targets, such as the '2010 target' of the Convention Biological Diversity (CBD). The CBD has defined some indicators of progress towards this target for immediate testing (Box 1). Because of its emphasis on tracking trends through time, the NFA process can potentially provide useful input to the indicators on trends in extent of selected biomes, ecosystems and habitats and, potentially, coverage of protected areas. The utility of what the NFA provides depends to a large degree on both the detail to which forest types are resolved and the use of remote sensing and other ancillary data to improve the statistics on forest area by type.

Presentation of these indicators can usefully be both in terms of absolute area of each forest type (e.g. as bar graphs) and as the relative contribution of each type to the total

forest resource (e.g. as pie charts). As trend data become available, the former will be most usefully shown as a single trend per forest type, while the latter may be converted to stacked area graphs. Protection status of different forest types will be best presented as a stacked bar graph showing protected and unprotected area of each forest type in the first instance and then later as a stacked area graph to show the trends for each forest type.

Box 1 Provisional indicators for assessing progress towards the 2010 biodiversity target (CBD 2005).

Focal Area	Indicator for immediate testing
Status and trends of the components of biological diversity	Trends in extent of selected biomes, ecosystems and habitats
	Trends in abundance and distribution of selected species
	Coverage of protected areas
Sustainable use	
Threats to biodiversity	Nitrogen deposition
Ecosystem integrity and ecosystem goods and services	Marine trophic index
	Water quality in aquatic ecosystems
Status of traditional knowledge, innovations and practices	Status and trends of linguistic diversity and numbers of speakers of indigenous languages
Status of resource transfers	Official development assistance provided in support of the Convention

Other pointers to useful measures of forest biodiversity were provided by Newton and Kapos (2003) based on the various processes defining criteria and indicators for sustainable forest management (Box 2). As these authors made clear, few of these indicators can be derived from forest inventory data alone (as is generated by the NFA), but they depend heavily on combining good inventory data with ancillary datasets.

Box 2. Indicators of forest biodiversity drawn from criteria and indicators for sustainable forest management (Newton & Kapos 2003)

- Forest area by type, and successional stage relative to land area
- Protected forest area by type, successional stage and protection category relative to total forest area
- Degree of fragmentation of forest types
- Rate of conversion of forest cover (by type) to other uses.
- Area and percentage of forests affected by anthropogenic and natural disturbance.
- Complexity and heterogeneity of forest structure
- Numbers of forest-dependent species
- Conservation status of forest dependent species

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about their forest resources that can resolve patterns and trends at scales below national level. This is clear both *a priori* and from the experience of the NFAs that have been carried out so far. With respect to biodiversity, they will need to know, among other parameters, which forests harbour the greatest biodiversity, which forests, forest types

and species are best protected and which are under the greatest threat or most disturbed. While the NFA alone cannot provide all of this information, it is vital that NFA data be combined with appropriate ancillary data from remote sensing, global and national species conservation status assessments and other sources to provide the forest biodiversity information needed to support national decision making.

National decision makers also need to be aware of the full range of values and services provided by subsets of their forests. For this reason it will be important to express other parameters measured by the NFAs relative to nationally significant forest types. These measures might include biomass and commercial volume in both absolute terms and as a percentage of national totals.

Among the most useful information generated by the NFA is the beginnings of a systematic overview of tree species surviving outside forests. By combining the data on trees outside forests (ToF) with other sources of information on species status (red lists, lists of endemics, etc) NFA teams will be able to provide much-needed intelligence on the existence of remnant populations and genetic resources.

Recommendations to participating countries

a. Identify forest biodiversity information needs through continued consultation with decision-makers and other stakeholders in environment ministries, conservation authorities and NGOs and others outside the forest sector
b. Recognise and encourage stakeholders to recognise that only some forest biodiversity information needs can be met by the NFA can be met by NFA
c. Express results in relation national forest types at the finest classification that is feasible. This will require working with additional sources of data and information (remote sensing, vegetation maps, etc.)
d. Assess explicitly the correspondence between NFA results with those from other types of assessment (e.g. remote sensing) and combine with these where it can make forest biodiversity-relevant information more accurate and/or meaningful.
e. Use added sources of information to improve the accuracy and utility of the forest protection statistics, and if possible express these by type or category of protection
f. Synthesise information on tree species by considering functional groups of species, including species characteristic of primary and secondary forests, pioneer and mature forest species, species important for supporting wildlife populations, those of conservation concern (endemic and red-listed) and those of commercial importance. Trends in the frequencies of these groups will be vital for supporting decision-making.
g. Further develop measures of fragmentation from the sample plot data and validate them relative to other sources of similar information (GIS analysis of remote sensing data) for at least a subset of sample tracts.

h. Express data on disturbance and fragmentation on a proportional area basis (preferably by forest type) that gives a baseline for trends to be determined in future NFAs.
i. Develop clear information products (e.g. fact sheets, issues papers) that present NFA results relevant to biodiversity in simple graphical presentations that demonstrate their applicability to specific policy issues and show how future trends relate to existing policy objectives (e.g. goals for protected areas networks and forest type representation within them, halting increases in forest fragmentation).
j. The value of the NFA will derive principally from the comparability of successive assessments and the information on trends they provide. Therefore, the next NFA needs to be planned explicitly at this stage so that necessary resources (financial and human) can be identified and obtained and key improvements can be planned.
k. Seek input from national stakeholders on improving future assessments (e.g. through stratified and denser sampling) and identifying trends of interest.
l. Improve the information obtained on tree species of interest (e.g. endemics, red-listed species) by developing lists of these species and 'pre-training' field crews in their identification.
m. Consider developing a module of the interviews to address the occurrence of some wildlife species.

Recommendations to FAO

There needs to be an explicit recognition that the NFA on its own can meet only a limited set of needs for forest information. Much decision-making at national level requires information that is robust at sub-national level. While the NFA must continue to meet FAO's needs for national scale information as a contribution to the GFRA (and other outputs), it is essential to promote national ownership of the NFA process by helping to articulate and meet national needs for forest biodiversity and other forest information. NFA teams need help in delivering these outputs in clear and understandable forms. Components of achieving this include:

a. Increasing the amount of consultation with a broad spectrum of national users of forest information that takes place prior to the initiation of the NFA. This will require liaison with organisations and individuals outside the forest sector.
b. Analysing the data and information that exist prior to the NFA to determine how they can be used to improve the NFA, by using them as context both for the design (stratification) of the NFA and for the interpretation of the NFA results.
c. Using remote sensing data as a matter of routine both to stratify sampling and to refine area estimates of the extent of 'rare' forest types.
d. Comparing explicitly the NFA results with other sources and providing explanations of discrepancies.

The biodiversity-relevance of the NFA can be improved by:

e. Expressing results in relation to nationally relevant forest types at the highest resolution possible – this requires use of ancillary data

f. Developing lists of species of interest as part of the preparation for NFA. This will make it possible to train field crews to recognise these species and/or to include relevant questions in the interviews.

g. Developing and validating an accepted method for assessing forest fragmentation in the NFA and for reporting it and forest disturbance in proportional area termsrelative to forest types.

In order to increase the usefulness of the NFA results and thus enhance their uptake and use at national level it will be important both to build support for them through consultations as suggested above and to present them in useful formats. To this end it will be important to:

h. Improve the presentation of NFA outputs with both analyses that match nationally identified information needs and, especially, interpretation of the results. While it will be important to avoid crossing the line into advocacy, it is vital that basic objective interpretive text accompany the graphical presentation of the results.

i. Enhance outreach to ensure maximum distribution and uptake of the results among users at national level.

j. Track uptake and use of data, plus feedback on its utility to decision makers as a basis both for improving the NFA approach and for demonstrating its utility to other countries considering implementing it.

The greatest utility of the NFA approach is its ability to generate reliable trend data. Such data are vitally important for a range of national and international policy needs. Therefore:

k. Re-surveys need to be planned explicitly in accordance with these needs. The interval should be decided with the national teams, and they should be given help in finding resources to support the re-inventory.

l. These plans should be made part of the NFA reporting process.

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