



Forestry Department

Food and Agriculture Organization of the United Nations

FRA 2000

**ON DEFINITIONS OF
FOREST
AND
FOREST CHANGE**

Rome, 2 November 2000



The Forest Resources Assessment Programme

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 expanding human populations, 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.

FAO, at the request of the member nations and the world community, regularly monitors the world's forests through the Forest Resources Assessment Programme. The next report, the Global Forest Resources Assessment 2000 (FRA 2000), will review the forest situation by the end of the millennium. FRA 2000 will include country-level information based on existing forest inventory data, regional investigations of land-cover change processes, and a number of global studies focusing on the interaction between people and forests. The FRA 2000 report will be made public and distributed on the world wide web in the year 2000.

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Abbreviations

BEF	Biomass Expansion Factor
BV	Biomass of inventoried volume
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
Cirad	Centre de coopération internationale en recherche agronomique pour le développement
EDC	Eros Data Centre
FAO	Food and Agricultural Organization of the United Nations
FORIS	Forest Resources Information System
FRA	Forest Resources Assessment
GIS	Geographic Information System
SNU	Sub National Unit(s)
Tof	Trees outside forests
UN-ECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOB	Volume Over Bark
WD	Wood Density
WCMC	World Conservation Monitoring Centre

1 Introduction

FAO has developed and implemented global terms and definitions of various forest parameters since its first worldwide assessment in 1947. Information presented in FRA Working Paper 1 (FAO 1998) for the current global assessment, FRA 2000, reports on this subject. This paper takes into consideration over 50 years of cumulative experience in FAO working in the field of global forest resources assessments.

The terms and definitions applied in FRA 2000 are artificial constructs which help us to understand and describe the world's forest vegetation, and how it is changing through time. By necessity, the global definitions are compromises, and their application is subject to interpretation. The sheer magnitude and variability of the forest resources information produced by countries, make this so. Moreover, the wide range of forest formations, ecological conditions and forest cover types, which exist on a global scale, make global definitions necessarily broad.

One of the major analytical tasks in a global assessment is to group and classify detailed information from national classifications according to global definitions. For this exercise, there are many cases where assumptions or approximations must be made. For example, in FRA 2000, more than 650 definitions of forest were assembled from 132 developing countries (from 110 independent surveys). Reducing this information into a highly compressed and discrete set of global classes was a major challenge. At the same time, the original classifications are kept in the Forestry Information System (FORIS) making it possible to make alternative interpretations of national data, should this be needed.

To develop a standard definition of forests, FAO adapted the threshold of a 10% crown cover to describe the minimum canopy density where naturally occurring formations of trees exist as communities. This is opposed to areas where trees exist scattered in the landscape or in rows. The 10% threshold was first used in FAO's 1963 global assessment and later recommended in 1973 in UNESCO's landmark study on worldwide vegetation classifications, in which the scientific basis for the limit was established.

The FAO global classification scheme is understandably a subject of debate within the scientific community. However, FAO recognizes that it is not appropriate for all purposes – no classification scheme is. One of the frequently disputed aspects is the use of the threshold of a 10% canopy cover. Some feel that this is too generous a definition for forests. However, these arguments frequently overlook the fact that the definition also excludes areas where other land uses dominate, such as agricultural or urban areas. Another contention is that the global definitions are difficult to apply uniformly at the global level. This is a valid claim, but would hold true for any global classification scheme.

It is recognized that the classification of particular vegetation types according to global classes is difficult. Dry tropical formations present a particular challenge. These areas often contain large expanses of land where tree vegetation is sparse and mixed with woody shrubs. Applying the 10% threshold in such areas is particularly difficult as no distinct boundaries exist between areas of varying canopy cover.

The Kyoto Protocol raises the issue of forest and forest change definitions. KP identifies three change parameters (deforestation, afforestation and reforestation) as a basis for carbon monitoring. The idea is that these area change parameters will give an indication on how the forest carbon storage changes.

The current understanding of these definitions definitions, as reflected in the Special Report on Land Use, Land-use Change and Forestry (IPCC 2000) is not far from FAO's definitions. Given the importance of the atmospheric carbon issue, and how forests interact with the atmosphere, FAO is presently reviewing its definitions, and improving its terminology with the intent of making it applicable for carbon studies. At the same time, it should be noted that the FAO definitions must also take other land use perspectives into consideration.

FAO works with its partners, its member countries as well as the scientific community to improve its definitions for global assessments on forest and forest change. Providing leadership in the development of standards through a participatory and scientific process is an important part of the organization's work. FAO will continue to provide a stable and objective framework for reporting on forests at the global level, while striving to incorporate the needs of other programmes. In this respect, the following information should be viewed as an update of the FRA Working Paper No. 1 and a proposal for extending the FAO definitions to make them more appropriate, and easily understood.

2 Definitions of Forest, other land uses, and Trees outside forests

2.1 Overview

For forest and forestry analysis, land use is classified into four basic categories by FAO:

- Forest,
- Other wooded land,
- Other land,
- Inland water.

These four categories are mutually exclusive and add up to the total land area. A new sub-category to forest - "area under reforestation" is introduced below.

In addition, Trees outside forests is an important category when studying forest products and services. Trees outside forests are not assigned an area, but occur within Other land.

2.2 Forest

Forests are lands of more than 0.5 hectares, with a tree canopy cover of more than 10 percent, which are not primarily under agricultural or urban land use.

Explanatory note

Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters *in situ*. Areas under reforestation which have yet to reach a crown density of 10 percent or tree height of 5 m are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, that are expected to regenerate. The term specifically includes: forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and width of more than 20 m; plantations primarily used for forestry purposes, including rubberwood plantations and cork oak stands. The term specifically excludes trees planted primarily for agricultural production, for example in fruit plantations and agroforestry systems.

2.3 Other wooded land

Other Wooded Land is land with a canopy cover of 5-10 percent of trees able to reach a height of 5 m *in situ*; or a canopy cover of more than 10 percent when smaller trees, shrubs and bushes are included.

2.4 Other land

Other land is, for the purpose of forestry, any land not classified as forest or other wooded land as defined above. Includes agricultural land, meadows and pastures, built-on areas, barren land, etc.

2.5 Inland water

Area occupied by major rivers, lakes and reservoirs.

2.6 Trees outside forests

Trees outside forests are trees and tree environments on land not defined as forest or other wooded land.

Explanatory note

Trees outside forests (ToF) include: (a) groups of trees covering an area of less than 0.5 ha, including lines and shelterbelts along infrastructure features and agricultural fields; (b) scattered trees in agricultural landscapes; (c) tree plantations mainly for other purposes than wood, such as fruit orchards and palm plantations; and (d) trees in parks and gardens and around buildings. ToF are not assigned an area in the overall land use classification, but occurs inside Other wooded land and Other land. Although the definition of ToF is based on the trees, the concept includes also the site and other vegetation at the location.

3 Definitions of forest change processes

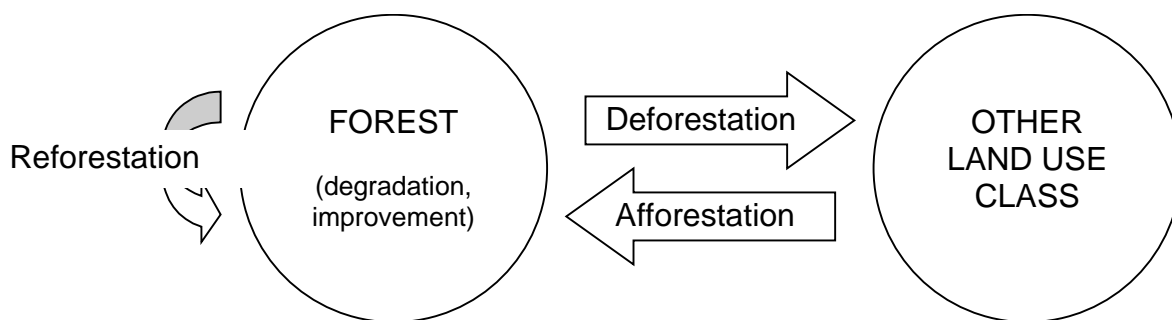
3.1 Overview

Forest change processes are central to several national and international forest policy agendas. They are also of high interest to the public in general and are often referred to by media. Many organisations are engaged in forest change issues, and the definitions are therefore important and also politically sensitive. The below summarizes the definitions as used by FAO's Forestry Department. The definitions have not changed since the previous publication (FRA 1998), but the explanations have been rewritten to be clearer and also better support the discussions on climate change issues. Five terms are defined in this section. Figure 1. gives an overview of how these relate.

Note that to determine whether the removal of trees from an area is a deforestation it is necessary to predict the future development for the area. If new forest trees are established in the relatively near future, the land is classified as forest throughout the regeneration period (and this regrowth is named "reforestation"). If, on the other hand, a sufficient density of trees is not established in the relatively near future, or if land is converted to other land use, the area should be considered deforested.

Note also that the time frame is central to the forest change definitions and that the length of the threshold period, defaulted to ten years, should be used consistently when applying the terms, to avoid overlaps or gaps in the reporting. Thus "long-term" refers to ten years or more, and "temporary" refers to shorter than ten years. Note that local climatological conditions, land use contexts or the purpose of the analysis may justify that a longer threshold period is used.

Figure 1. Relationships between forest change terms. Forest degradation and Forest improvement occur within forests that continuously stay above the 10% canopy threshold. Reforestation occurs when forests regrow after temporarily having had below 10% canopy cover, but were considered as forests throughout that time. Deforestation and Afforestation represent the transfers between forest and other land use classes.



3.2 Deforestation

Deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold.

Explanatory note

Deforestation implies the long-term or permanent loss of forest cover. Such a loss can only be caused and maintained through a continued man-induced or natural perturbation. Deforestation includes, for example, areas of forest converted to agriculture (including agroforestry), pasture, water reservoirs and urban areas. The term specifically excludes areas where the trees have been removed, due, for example, to harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures within the long-term. Unless followed by clearing of the remaining logged-over forest for the introduction of alternative land-uses, and the maintenance of the clearings through continued disturbance, forests commonly regenerate, although often to a different, secondary condition. In areas of shifting agriculture, forest, forest fallow and agricultural lands appear in a dynamic pattern where deforestation and the return of forest occur frequently in small patches. To simplify reporting of such areas, the net change over a larger area is typically used. Deforestation also includes areas where overutilization or changing environmental conditions, influence the forest to an extent that it cannot (currently) sustain a tree cover above the 10% threshold, for example burnt-over areas where severe ground conditions or recurring fires for the long-term prevents the return of forest formations, or areas that after clearcutting cannot regenerate because of frost, competing vegetation, or other natural conditions. The concept “long-term” is central in this definition and is defined as ten years. Local climatological conditions, land use contexts or the purpose of the analysis may however justify that a longer time frame is used.

3.3 Afforestation

Afforestation is the conversion from other land uses into forest, or the increase of the canopy cover to above the 10% threshold.

Explanatory note

Afforestation is the reverse of deforestation and includes areas that are actively converted from other land uses into forest through silvicultural measures. Afforestation also includes natural transitions into forest, for example on abandoned agricultural land or in burnt-over areas that have not been classified as forest during the barren period. As for deforestation, the conversion should be long-term, that is areas where the transition into forest is expected to last less than ten years, for example due to recurring fires, should not be classified as afforestation areas. The concept “long-term” is central in this definition and is defined as ten years. Local climatological conditions, land use contexts or the purpose of the analysis may however justify that a longer time frame is used.

3.4 Reforestation

Reforestation is the re-establishment of forest formations after a temporary condition with less than 10% canopy cover due to human-induced or natural perturbations.

Explanatory note

The definition of forest clearly states that forests under regeneration are considered as forests even if the canopy cover is temporarily below 10 per cent. Many forest management regimes include clearcutting followed by regeneration, and several natural processes, notably forest fires and windfalls, may lead to a temporary situation with less than 10 percent canopy cover. In these cases, the area is considered as forest, provided that the re-establishment (i.e. reforestation) to above 10 percent canopy cover takes place within the relatively near future. As for deforestation, the time frame is central. The concept "temporary" is central in this definition and is defined as less than ten years. Local climatological or land use contexts, or the purpose of the analysis, may however justify that a longer time frame is used.

3.5 Forest degradation

Forest degradation is a reduction of the canopy cover or stocking within a forest.

Explanatory note

For the purpose of having a harmonized set of forest and forest change definitions, that also is measurable with conventional techniques, forest degradation is assumed to be indicated by the reduction of canopy cover and/or stocking of the forest through logging, fire, windfelling or other events, provided that the canopy cover stays above 10% (cf. definition of forest). In a more general sense, forest degradation is the long-term reduction of the overall potential supply of benefits from the forest, which includes wood, biodiversity and any other product or service.

3.6 Forest improvement

Forest improvement is the increase of the canopy cover or stocking within a forest.

Explanatory note

For the purpose of having a harmonized set of forest and forest change definitions, that also is measurable with conventional techniques, forest improvement is assumed to be indicated by the increase of canopy cover and/or stocking of the forest through growth. In a more general sense (cf. forest degradation) forest improvement is the long-term increase of the overall potential supply of benefits from the forest, which includes wood, biodiversity and any other product or service.

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- IPCC. 2000. Summary for policymakers: Land use, Land use change and Forestry. Special report of the Intergovernmental Panel on Climate Change. Approved at IPCC Pleanry XVI, Montreal 1-8 May 2000.

Appendix 1: Definitions as in FRA Working Paper 1 and comments

Forest

The current, global definition of forest is included in a set of four land cover classes (FAO 1998) as shown in Table 1. Although most of the definition explains how many trees there must be in a forest, the most important line is the last one: "Excludes: Land predominantly used for agricultural practices". This clearly makes the current forest definition a land use definition. One then enters the discussion: what is agriculture and what is not? From the current definitions it is clear that tree plantations with the primary purpose to produce wood or wood-derived products are considered as forests, whereas tree plantations mainly producing other goods, such as coconuts or other fruits, are not. Furthermore, gardens, agroforestry areas and urban parks are not considered as forests.

Another observation is that very small patches of trees (down to 0.5 ha) are included in the forest class. This means that in most densely populated agricultural landscapes, there is often a substantial number of forest pockets in the terrain, and that many small woodlots qualify as forests. These forests are typically difficult to identify and monitor with satellite remote sensing techniques, yet may extend over considerable areas.

Table 1. Global land cover classes, related to forestry (FAO 1998)

<u>Land cover class</u>	<u>Definition</u>
Total area¹	Total area (of country), including area under inland water bodies, but excluding offshore territorial waters.
Forest	<p>Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity <i>in situ</i>. May consist <u>either</u> of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; <u>or</u> open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.</p> <p><u>Includes:</u> forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and width of more than 20 m; plantations primarily used for forestry purposes, including rubberwood plantations and cork oak stands.</p> <p><u>Excludes:</u> Land predominantly used for agricultural practices</p>
Other wooded land	Land either with a crown cover (or equivalent stocking level) of 5-10 percent of trees able to reach a height of 5 m at maturity <i>in situ</i> ; or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity <i>in situ</i> (e.g. dwarf or stunted trees); or with shrub or bush cover of more than 10 percent.
Other land	Land not classified as forest or other wooded land as defined above. Includes agricultural land, meadows and pastures, built-on areas, barren land, etc.
Inland water	Area occupied by major rivers, lakes and reservoirs.

¹⁾ The Total land area is defined as the Total area, but excluding Inland water.

Deforestation, reforestation and afforestation

These terms are not clearly formulated in the previous FRA documentation (Table 2). The definition of deforestation only refers to (permanent) depletion of forest cover and do not connect well to the important part of the forest definition saying that agricultural land use disqualifies tree covered areas as forests. The current definition of deforestation does not mention conversion of land use.

Furthermore, the term reforestation is ambiguously defined. The forest definition clearly says that logged-over forests that are regenerated, is still considered as forest. In common forestry language this is often understood as "reforestation", but the wording in Table 2 imply that the forest must first be gone, before reforestation can happen. This also conforms to IPCC nomenclature which indicate that reforestation and afforestation implies a land use change from other land use into forest. In the main document to this appendix, the term reforestation is defined unambiguously as regrowth of forest without any changes of land use involved in the process, which is a clearer distinction.

Finally, there is no clear explanation why afforestation and reforestation must be "artificial", or what is meant by this word.

In addition to the current FAO definitions, comments to IPCC preliminary definitions include that an area-oriented land classification may be a poor indicator of carbon storages and fluxes.

Table 2. Current forest change definitions (FAO 1998)

Deforestation	Refers to change of land cover with depletion of tree crown cover to less than 10 percent. Changes within the forest class (e.g. from closed to open forest) which negatively affect the stand or site and, in particular, lower the production capacity, are termed forest degradation.
Forest degradation	Takes different forms, particularly in open forest formations, deriving mainly from human activities such as over-grazing, over-exploitation (for firewood or timber), repeated fires, or due to attacks by insects, diseases, plant parasites or other natural sources such as cyclones. In most cases, degradation does not show as a decrease in the area of woody vegetation but rather as a gradual reduction of biomass, changes in species composition and soil degradation. Unsustainable logging practices can contribute to degradation if the extraction of mature trees is not accompanied with their regeneration or if the use of heavy machinery causes soil compaction or loss of productive forest area.
New plantations:	Artificial establishment of forest on lands which previously did not carry forest within living memory.
a) Afforestation	
b) Reforestation	Artificial establishment of forest on lands which carried forest before.

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