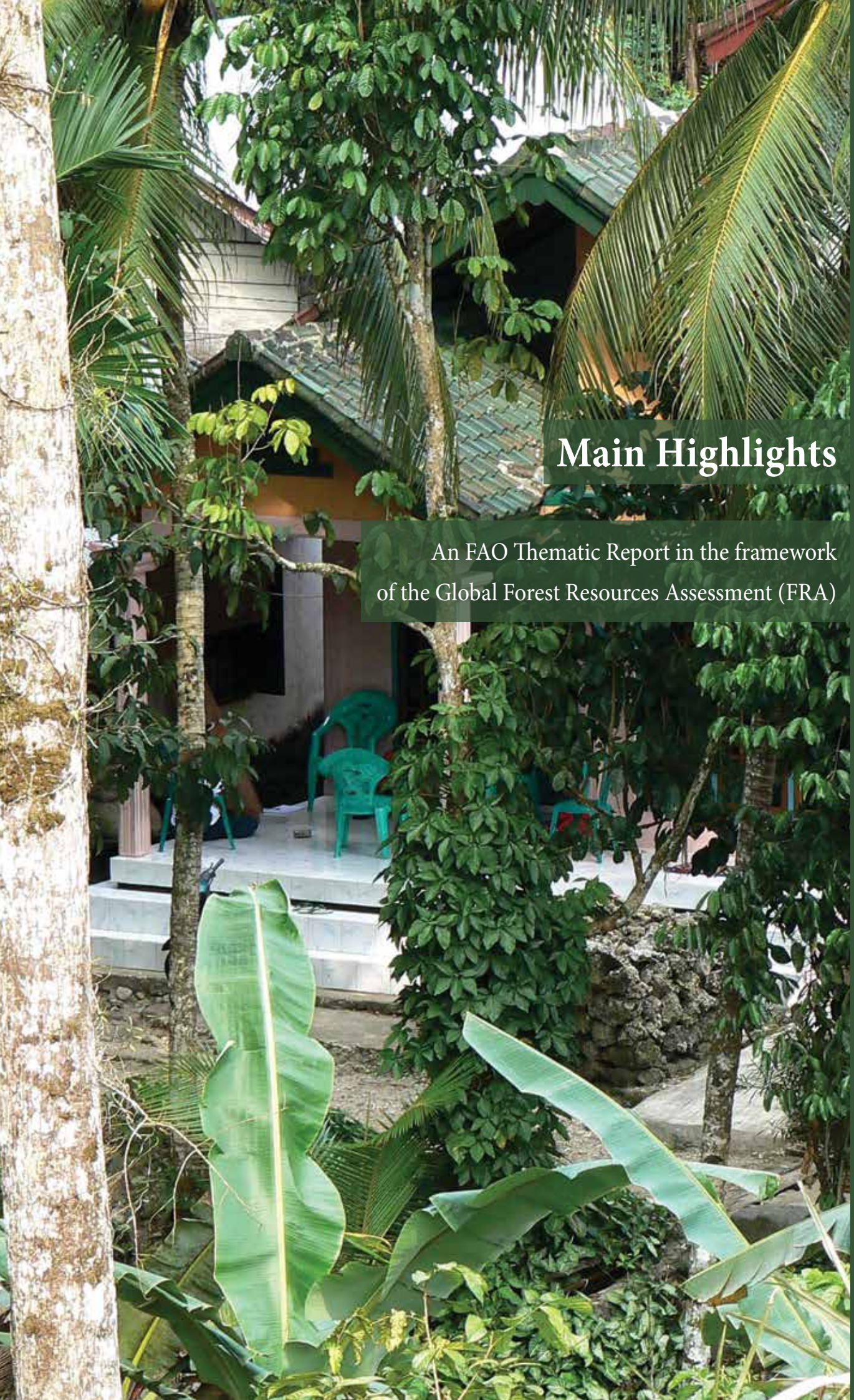


Towards the Assessment of Trees Outside Forests

Main Highlights

An FAO Thematic Report in the framework of the Global Forest Resources Assessment (FRA)

Towards the Assessment of Trees Outside Forests

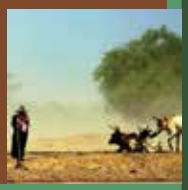
FAO, in cooperation with its member countries, has monitored the world's forests at 5 to 10 year intervals since 1946. These global assessments provide valuable information to policy-makers in countries, to international negotiations, arrangements and organizations related to forests and to the general public. The Global Forest Resources Assessment (FRA) is the most comprehensive assessment on forest that examines the status and trends for all types of forests in the world.

Reliable and comprehensive information on "Trees outside Forests" - TOF - across large areas (sub-national and national levels) remains scarce. Recognizing the importance of all tree resources, FRA has included activities for the assessment of trees outside forests in the process. FRA 2000 has defined the concept and discussed its importance in the FAO Conservation Guide 35 "Trees outside Forests – Towards better awareness" (2002). FRA 2005 presented results from some pilot assessments supported by the National Forest Monitoring Programme (NFMA) and reported on a sub-category of TOF called "Other Land With Tree Cover".

The Thematic Report "Towards the Assessment of Trees Outside Forests" responds to the request made by FAO member countries to support identifying methods and techniques for TOF assessment on large areas that promotes harmonization between countries, quality data and respond to the requirements related to global processes such as the CBD, UNCCD and UNFCCC.

The Thematic Report consists of three parts:

Part 1 – Towards Assessing Trees Outside Forests: why, what and how. Building on definitions currently used by FAO, this part identifies the situations where trees can be encountered outside forests; based on the FAO land classification framework, it analyses the relative place of land where TOF are located. It proposes an operational definition of "Other Land with TOF" as a sub-category of "Other Land". It also reviews large-area assessments that include TOF. Finally, it puts forward recommendations for national TOF assessments.



Part 2 – Case Studies on Trees Outside Forests Assessment. This part presents the 38 large area assessments (20 countries) and the 4 international support programmes that are reviewed in Part 1. These assessments cover a very large range of environmental and socio-economic conditions. They also cover the main TOF assessment methods used in agricultural lands, in urban lands and in other land uses with TOF.

Part 3 – Trees Outside Forests from the air - a guide for identification. The third part is a collection of high resolution satellite images, covering the three TOF sets in a variety of biophysical and human settings. The images are analysed and used as examples for the classification of any land into the FRA classificatory framework.

TOF potential area: almost half of the land area on Earth

Forested land accounts for 32 percent of the total 13 billion hectares of land area on Earth (FAO-FRA 2010). A large area (21 percent of these 13 billion hectares) is considered unsuitable for crops, pasture, and forests, for soil or climate reasons. The remaining 47 percent are shared between cropland (12 percent), pastureland (26 percent) and urban land (9 percent). **These remaining 47 percent of the global land area, or 6.3 billion hectares, represent the area where TOF are encountered.**

Trees that are not in "Forest" are "Trees Outside Forests"

Trees that cannot be assigned to the category "Forest" are called "Trees outside Forests" (TOF). For FAO, TOF includes the trees and shrubs that are neither in "Forest" nor in "Other Wooded Land" (OWL). The analysis of the current definitions of "Forest" and "OWL" allows the identification of 3 well defined TOF sets located on "Other Land", each in relation with a different land-use: agricultural, urban, and neither one or other.

All trees that grow on agriculture land and on urban land are TOF

Set 1: TOF on Agriculture Land (TOF-AGRI)

This set includes all agroforestry systems except those which main purpose is forestry; it includes also all non forestry tree crop plantations and orchards.

Set 2: TOF on Urban Land (TOF-URB)

This set includes trees in private gardens, in parks, along streets, in parking lots, etc. It excludes forests located in urban areas when their use is not predominantly urban.

In other land-uses, all trees that do not reach the biophysical thresholds for Forest or OWL are TOF

Set 3: TOF on Non Agricultural/Non Urban Land (TOF-NON A/U))

TOF-NON A/U are found on any land that is not classified as Forest or OWL and that is not predominantly under agricultural or urban use. It is composed of four subsets:

- Subset 1: small tree stands (area<0.5 ha).
- Subset 2: linear tree formations, narrow (width <20 m).
- Subset 3: large stands (area ≥ 0.5 ha), trees (height ≥ 5 m) with low canopy cover level (cc < 5 percent).
- Subset 4: large stands (area ≥ 0.5 ha), shrubs and/or trees with low canopy cover level (cc < 10 percent).

Key features of Trees Outside Forests

TOF concerns a very large range of stakeholders: farmers, pastoralists and institutions linked to agriculture and rural development; people living in settlements and cities and institutions linked to urban management and development; environmental organizations, rural and urban planning institutions, etc.

TOF are vital for human livelihood: in particular, trees on agricultural land and trees on urban land are managed to ensure a multitude of environmental, economic, social and cultural services and functions.

TOF occur in all countries: TOF can be encountered almost anywhere as far as local climate and soil are favorable to the growth of trees: on farms, in cities, in lowlands and mountains, in temperate and in tropical regions, in humid and in arid areas.

Trees in parkland

Trees in agroforest and homegarden

Trees in city and village

Trees in cropfield and pasture

Trees in linear formation

Trees in smallwood

Trees in arid area

Integrating TOF into the FRA classificatory framework

For country reporting (and thus for assessment) purposes, an operational definition of "Other Land with TOF" has been prepared so that TOF can be integrated into the FRA land classificatory framework. The definition includes minimum biophysical thresholds already used in TOF assessments by some countries.

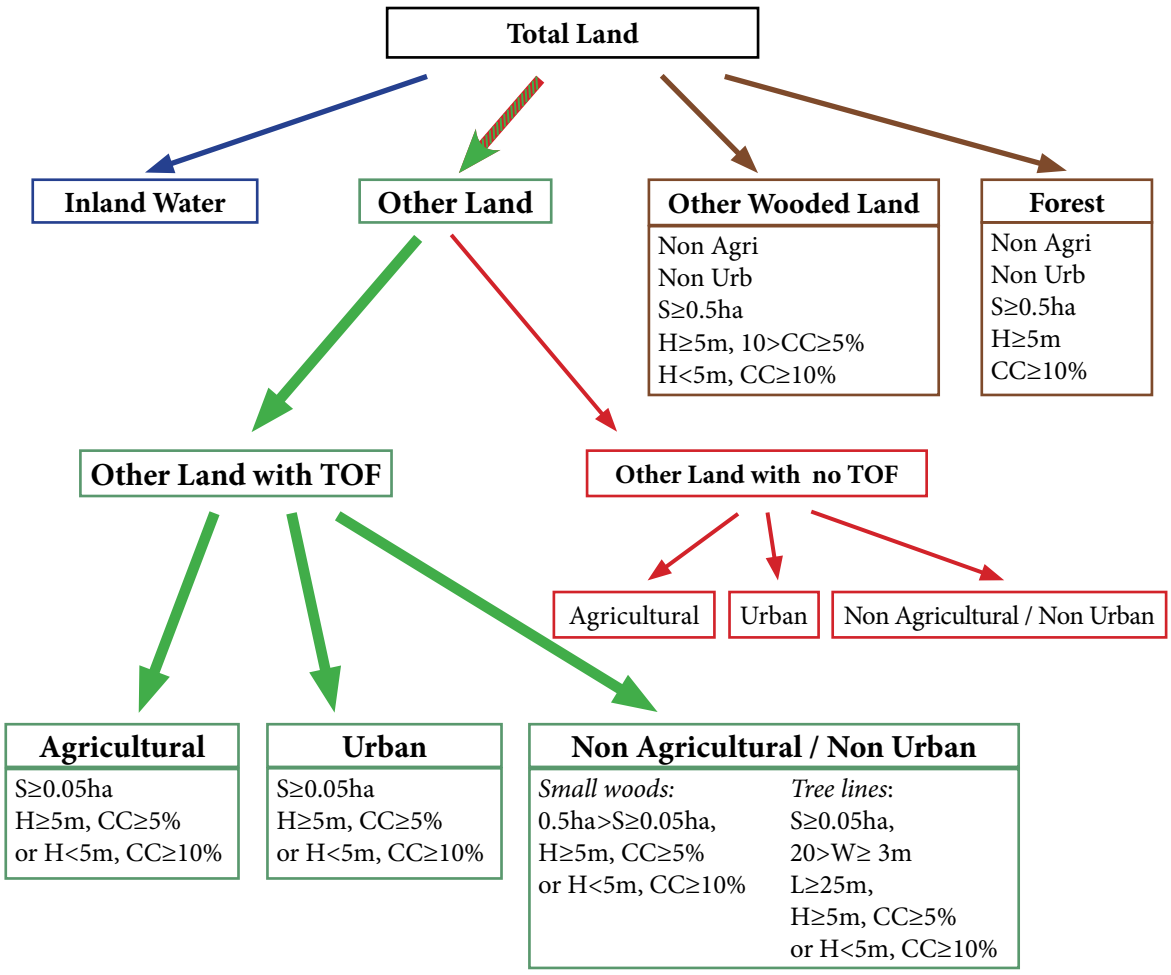
Definition of Other Land with TOF (OLwTOF) - subcategory of Other Land:

Land classified as Other Land (i.e. not classified as Forest or Other Wooded Land), spanning more than 0.05 hectares with trees higher than 5 m and a canopy cover above 5 percent, or with trees able to reach these thresholds in situ; or with a combined cover of shrubs and trees above 10 percent.

Explanatory notes:

1. Includes land that is predominantly under agricultural land use if it meets the area and tree/shrub canopy cover thresholds.
2. Includes land that is predominantly under urban land use if it meets the area and tree/shrub canopy cover thresholds.
3. Includes land that is not predominantly under agricultural or urban use, which comprise:
   - areas spanning less than 0.5 hectares and more than 0.05 hectares;
   - windbreaks, shelterbelts and corridors of trees and shrubs, with an area spanning less than 0.5 hectares or a width of less than 20 m but more than 3 m.

Position of "Other Land *with TOF*" in the FRA classification

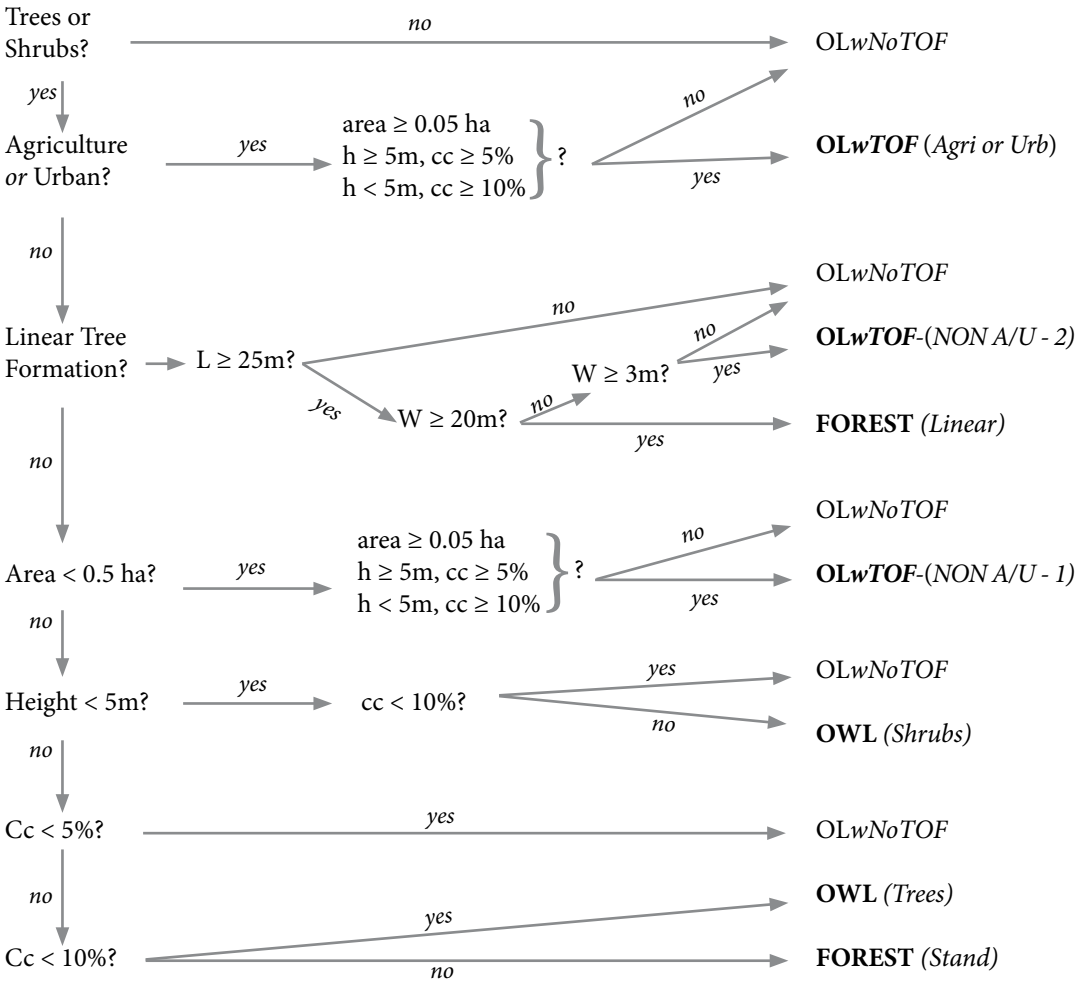


A tool for classifying land in the FAO-FRA classificatory framework

Including **Other Land *with TOF*** and its alter ego **Other Land *with No TOF*** as two sub-categories of Other Land allows the formal integration of TOF into the FAO-FRA land classificatory framework. To help classificatory decisions in assessments based on this proposed new framework, a Decision Tree Algorithm has been prepared. It allows the classification of any land into either **Forest, Other Wooded Land (OWL)**, **Other land with TOF (OL*wTOF*)** or **Other Land *with No TOF* (OL*wNoTOF*)**

The Decision Tree Algorithm uses seven (7) decision criteria:

- 1 = Presence of trees or/and shrubs on the land (yes/no),
- 2 = Land Use (Urban [URB] or Agriculture [AGRI] / Other = Non A/U),
- 3 = Spatial pattern of trees or/and shrubs (linear tree formation / other pattern),
- 4 = For linear tree formations: Length (L, minimum threshold: 25 m) and Width (W, thresholds: 3 and 20 m),
- 5 = Area (thresholds: 0.05 and 0.5 hectares),
- 6 = Tree height at maturity (threshold: 5 m),
- 7 = Canopy cover (thresholds: 5 percent for trees, 10 percent for a combined cover of shrubs and trees).



Decision Tree Algorithm - An example of use

In the analysis of this satellite image (Sumatra, Indonesia - 3°30'03"N ; 98°49'14"E), the first step of the classification process is the delineation of land units based on a relatively homogeneous land-cover. In the present example, four categories of land units have been identified. Results of the use of the Decision Tree algorithm are detailed for each category.

A: OL*wTOF* - *AGRI* (Ol*wTC*)

B: OL*wNoTOF*

C: OL*wTOF* - *URB* (Ol*wTC*)

D: OL*wNoTOF*

A: Mosaic of large oil palm plots with a regular and very dense tree cover. All trees are TOF *(because the use is predominantly agricultural).*

The whole area is classified as **Other Land *with TOF*** *because the land is predominantly under agricultural use (thus classified as Other Land), tree height is more than 5m, the tree canopy cover is more than 5 percent, and the area is more than 0.05 hectares.* This area can be further classified as **Other Land with Tree Cover** (a sub-category of Other Land satisfying to the same biophysical thresholds as the Forest category), *because the area is more than 0.5 hectares, and the canopy cover is more than 10 percent.*

B: Mosaic of crop fields and houses, with no or scarce isolated trees. All trees are TOF *(because the use is predominantly agricultural).*

The B patches are classified as **Other Land *with No TOF*** *because the land is used for agriculture and housing structures (thus classified as Other Land), and the tree canopy cover is lower than 5 percent, which is the minimum threshold for the Other Land with TOF category.*

C: Settlement area with homegardens, houses, streets, with a dense but heterogeneous cover of trees. All trees are TOF *(because the use is predominantly agricultural and urban).*

The area as a whole is classified as **Other Land *with TOF*** *because the land is mainly used for housing structures and homegardens (thus classified as Other Land), tree height is more than 5m, the tree canopy cover is more than 5 percent, and the area is more than 0.05 hectares.* This area can be further classified as **Other Land with Tree Cover** *because the area is more than 0.5 hectares, and the canopy cover is more than 10 percent.*

D: Area with no or scarce isolated trees, probably a flooded area. All trees are TOF *(because, although the land is not under predominantly agricultural or urban use, the tree canopy cover is lower than 5 percent, which is the minimum threshold for the Other Wooded Land category).*

The area is classified as **Other Land *with No TOF*** *because it satisfies neither the land-use criteria nor the biophysical thresholds of the categories Forest and Other Wooded Land (thus classified as Other Land),* and *because the tree canopy cover is lower than 5 percent, which is the minimum threshold for the Other Land with TOF category.*

Removing ambiguities: Terms in need of operational definitions

The Thematic Report identifies some ambiguities arising from the FAO-FRA definitions of "Forest" and of "Other Wooded Land". These ambiguities result from the use of undefined terms and expressions in those definitions. They mainly concern the following terms:

- Agricultural land-use
- Urban land-use
- Shifting cultivation
- Rubber plantations

When the land-use is not obvious, these ambiguities may lead to a high degree of subjectivity in the identification not only of "Other Land *with TOF*", but also of "Forest" and of "Other Wooded Land". This is important for the FRA process as it implies that different countries may use different criteria for reporting. It also implies that "Other Land with TOF" could be unduly classified as "Forest". Recommendations for removing these ambiguities are formulated in the report.

An example of ambiguity: "Forest" or "Other Land with TOF"?

Distinction between "Forest" and "Other Land *with TOF*" is not always obvious. In the following case (Spain, 39°14'56"N ; 6°35'35"W), the landscape "A" surrounding the farm compound "B" has a relatively homogeneous cover of trees with a canopy cover of more than 10%; so, landscape "A" could qualify as "Forest" on pure biophysical criteria. However the present case is a typical example of a traditional agro-sylvo-pastoral system known as "Dehesa" in Spain where it spreads over 2.3 million hectares. The main use of landscape "A" is thus livestock farming, which is recognized in most countries as an integral part of agriculture, but is considered as distinct from agriculture in some countries. In the first group of countries, all trees will be considered as TOF and the land will be classified as "Other Land *with TOF*". In the second group of countries, the land will be classified as "Forest".

Progress in large area assessments

Thirty eight case studies of large-area assessments distributed in 20 countries worldwide and covering a large range of environmental and socio-economic conditions have been reviewed and analyzed. They include land use and land cover assessments, national forest inventory assessments, and specific assessments for TOF.

World distribution of case studies: Support programmes, global, regional, national and sub-national assessments

World Regions / Programmes	Countries or Programme for case study
Support Programmes	Land Degradation Assessment in Drylands (LADA) Land Cover Classification System (LCCS) National Forest Monitoring and Assessment (NFMA) Woodfuels Integrated Supply/Demand Overview Mapping (WISDOM)
Global	"Trees on Farm" (ICRAF)
Regional	Corine Land Cover (Europe)
National: Eastern and Southern Africa Northern Africa Western and Central Africa East Asia South and Southeast Asia Europe Central America North America South America Oceania	 Zambia Morocco Cameroon, Senegal China Bangladesh, India, Philippines France, Italy, Norway, Slovenia, Sweden, United Kingdom Nicaragua Canada, USA Uruguay New Zealand

- **Approximately 1 billion hectares, or 46% of the total "agriculture land", have more than 10% tree cover**. This important result comes from the first global assessment of trees on agricultural land (Trees on Farm, 2009).

- **Assessing TOF at National scale is possible, as demonstrated by**

  - Countries that have successfully carried out national specific TOF assessments.

  - Countries that have implemented highly detailed assessments of their tree and forest resource: they can provide sound estimates of most biophysical variables related to TOF.

  - Countries that have implemented the NFMA approach: they have successfully integrated TOF issues into their national forest (and tree) assessments, and can provide estimates of the various variables related to the TOF resources.

- **There is no methodological or technical obstacle to large-area TOF assessments.** Assessing TOF on large areas does not require methods radically different from those used in assessing forests: Low- and high-resolution remote-sensing images are used in the same way. Sampling, field inventory protocols and survey questionnaires proceed the same way as for forests.

- **It is essential to acknowledge the range of land uses that involve TOF for:**

  - **Building an efficient and legitimate institutional framework**. TOF assessments need multi-sector institutional frameworks that include the forest sector and the sectors that are legitimate as regard the three TOF sets (environment, agriculture, rural development, transportation, city planning, etc.).

  - **Setting up a sound land classificatory framework adapted to local reality**, so that the different land-use/land-cover sub-categories can be unequivocally assigned to the various FRA categories.

- **Credibility of results requires sound protocols and sampling schemes**, pre-evaluated by statisticians, to ensure that they will (1) yield credible results, (2) achieve the desired allowable error estimates, (3) permit statistically defensible assessment of uncertainty, and (4) permit assessment of quality assurance and control.

- **The national TOF assessments reviewed in the thematic report provide useful models**. They can play the same role for the development of TOF assessments than pionieer forest assessments did for the development of national forest assessments.

Conclusions

National TOF assessments should be encouraged because of the national importance of TOF resources: National policy makers and others need spatial and statistical data with guaranteed credibility on TOF that they can use for development planning and accounting of the environmental and economic services provided by TOF in terms of energy, food diversity and food security, climate change mitigation, etc. National TOF assessments are a major tool for optimizing the contribution of TOF to the national economy and to the national environment.

National TOF assessments should be encouraged because of the Global importance of TOF resources: The UNFCCC, the CBD, the UNCCD, and FAO, all need much better quality data on TOF than they currently have, and this can only be done through carefully implemented national TOF assessments. This is an important justification for countries to embark on TOF assessments, and for international institutions to support countries that would need assistance.

National TOF assessments should be encouraged because it will increase quality of global FRA assessment data: A fraction, unknown but potentially large in some contries, of the area of Other Land *with TOF* is counted as Forest or Other Wooded Land in country reports to FRA. Developing national TOF assessments will lead to delineating Other Land with TOF. This will in turn contribute to a much better delineation of Forest and Other Wooded Land, and thus to a much better assessment of Forest and Other Wooded Land.

Recommendations.

For FAO and FRA, there is a need to set the goal and adopt a way forward for the integration of TOF in global resources assessments. In view of the growing importance of TOF issues globally, and recognizing its expertise in global assessments of variables related to agriculture and food security, it is recommended that FAO continues leading the process and undertake priority actions such as to:

- Define clear and agreed upon objectives for a global TOF assessment, much alike what was done since the beginning of the global forest resources assessment (FRA).
- Set up a step-by-step agenda with realistic targets for further global TOF resources assessments.

For FAO and Countries, it is imperative to:

- Set up multi-disciplinary, cross-sectoral and multi-institutional mechanisms that facilitate the integration of Trees Outside Forests in global resources assessments.

For FRA 2015 and beyond, there is a need to:

- Clarify the terms that are still subject to varied national interpretations in the definitions of "Forest" and "Other Wooded Land".
- Ensure better country reporting on the extent of "Other Land With Tree Cover", as a reasonable first step towards better TOF reporting.
- Develop a global TOF assessment as a pilot study in the FAO FRA Remote Sensing Survey, aiming at a first approximation of a global estimate of "Other Land *with TOF*".
- Develop Guidelines for FRA national reporting on TOF.
- Support the building of national capacities for developing national TOF assessment.
- Favor an early involvement of national agricultural and urban services reporting to FRA.

Assessing trees on agricultural land increases the global area under a "forest" cover by 25 percent! According to "Trees on Farms" report, one billion hectares of the world agricultural land (46% of total agricultural land), has a tree canopy cover of more than 10%. How much increase would result from assessing trees on urban land?

Small streams form big rivers: How many billion trees are in villages and cities, in pastures, crop fields, hedges, tree lines, and small woods? How many million tons of C do these trees sequester?

TOF can contribute a significant amount of the national tree resource, In Bangladesh, for instance, TOF contributes 67% of the total aboveground tree biomass. What is the real contribution to national green economy and improved livelihoods?

To read more

- Thematic Report "Towards the Assessment of Trees Outside Forests" (forthcoming December 2012)
- FRA 2010 report
- FAO Conservation Guide 35 "Trees outside Forests – Towards better awarenes" (2002)
- 2012 TOF databases (developed with CATIE) available on internet

For more information

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