Trees Outside the Forest: Towards Rural and Urban Integrated Resources Management

Elements for Consideration

Contribution to the Forest Resources Assessment 2000 Report

Working Paper

Forest Conservation, Research and Education Service
Forest Department
Rome, 2001
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Foreword

Rural people all around the world share the same concern for trees inside and outside the forest, with respect to resource use, availability and sustainable products and services. These men and women make no distinction between field trees and forest resources, perceiving the clear and close link between the two. Policy-makers and planners tend to view these same resources as different entities. It seems clear that trees outside the forest have not yet succeeded in arousing real interest at the top. So there is a need to describe and comprehend the dynamic effect of the trees outside the forest on rural and urban land and to relate this in turn to forest dynamics. This should lead to a better understanding of non-forest tree management and towards sustainable management of natural resources and of forest, farm, pastoral and urban land.

A look at trees outside the forest can lead to an appreciation of their contribution to local economies, some sense of their importance at country levels, and a glimpse of their impact at the international level. The outline of this image remains fuzzy, however, in the overall picture of progress in the constant search for sustainable development, because we lack the hard facts and figures beyond the spontaneous use of this resource. These remarks apply to countries with little forest cover where conservation, and indeed expansion of woody resources is crucial, as to countries with abundant forest resources where degradation is still a real problem even in the absence of actual deforestation.

Planners in developing and developed countries alike are asking the same questions about the future and management of tree resources inside and outside forests, reflecting the implicit challenges of demographic pressure, supplying wood and non-wood products, farmland productivity, and environmental quality. Growing populations, shrinking forests and degraded ecosystems all suggest that trees outside the forest are destined to play a larger local and global role in meeting the challenges of resource sustainability, poverty reduction and the search for food security. Trees outside forest areas are unquestionably in a very strong position to substantially relieve the pressure on forest resources, conserve farmland, boost agricultural productivity, blunt the harmful impact of urban growth on the environment, boost food supplies and supply local, national and even international markets.

This paper, in reviewing the situation of trees outside the forest, is a contribution to FAO’s Forest Resource Assessment 2000, and a response to the expressed concern by the expert consultation on this question held in Kotka, Finland, 1996 (Kotka III), concerning the lack of hard data on the trees outside the forest. It follows the recommendations of Kotka III approved by the 1997 and 1999 Committee on Forestry.

The paper is based on the analysis of data collected by and in collaboration with FAO member countries, and on the results of studies and discussion workshops with experts from national and international institutions. It aims to foster awareness of the diversity and importance of trees outside forests in a context of area-specific and integrated management. The work has revolved around a number of questions: the contribution of this resource to rural development and to the quality of life and of the environment, its dynamics, the eventual link with forest tree dynamics, the advance or regression of these trees in agrarian systems, resource appropriation, land ownership, the impact of policy on its evolution and role, the rationale for its assessment, who is to assess the resource and how.
The answers to these questions are still pending. FAO and its members need to pursue their investigations and discussions in a permanent and interactive exchange. But the first fruits of multidisciplinary group efforts are already sufficiently solid and numerous to provide arguments in favour of policies and strategies to promote trees outside the forest on the part of policy-makers, planners and donors.

This paper attempts to outline the resource, define its importance and dynamics, pinpoint the most influential factors, and, finally, review its assessment. It draws heavily upon the examination and in-depth analysis of the relevant literature on trees outside the forest done by CIRAD-Forêt, in collaboration with FAO, and shortly to be published in the FAO Conservation Guide series.

FAO wishes to thank CIRAD (France), and especially CIRAD-forêt: indeed, this paper is based on preliminary work done by CIRAD-forêt in collaboration with FAO in preparation for the FAO Conservation Guide on trees outside the forest to be published at the end of the year 2001. The writing and technical editing were the work of Agnès Le Magadoux; the make-up of Mattia Biasioli and Matthieu de Carbonnel, participant to the FAO Volunteer Programme. The original French version has been translated into English by Julie Rice.

The project was supervised by Michelle Gauthier, under the general supervision of Tage Michaelson, Chief of the Forest Conservation, Research and Education Service of the Forest Resources Division. It is the fruit of collaboration among several FAO services, especially that of the Forest Resource Assessment Programme.

And so, while the paper claims to offer no universal answer, it does hope to help institutions and resources users in their efforts for intelligent and humane management of trees outside forest heritage, so that we may hand these resources down to society needs.

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Director
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LIST OF ACRONYMS

CBD : Convention on Biological Diversity

CITES : Convention on International Trade in Endangered Species of Wild Fauna and Flora

IFF : Intergovernmental Forum of Forests

IPF : Intergovernmental Panel on Forests

IPCC: Intergovernmental Panel on Climate Change

NWFP: Non wood forest products

ONG : Non Governmental Organization

UNCCD: Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa

UNCED : United Nations Conference on Environment and Development

UNFCC : United Nations Framework Convention on Climate Change

UNFF : United Nation Forum on Forests
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Introduction

So many trees grow outside the forest, in a kaleidoscope of situations ranging from trees in fields to urban trees, and single trees clinging to mountain slopes to those growing in rows and clumps. These trees, such a familiar sight and so integral a part of the landscape, were long overlooked by law, ignored by policy, neglected by scientists and absent from the public debate. The main focus has always been more on trees in forests, viewed as a resource and as a store of biological diversity.

But international and other institutions have recently awoken to the importance of trees outside the forest, an item which now appears increasingly on the agenda of scientific, economic and policy discussions. This is a direct outcome of environmental and development history. During the 1970s, environmental degradation provoked a rush of aid to countries hit by drought and desertification. This was followed in the 1980s by a wealth of agroforestry research that acknowledged the major role of trees in rural development and soil fertility. Environment, sustainable development and biological diversity were high on the agenda of the 1992 United Nations Conference on Environment and Development (UNCED).

Rainforests, threatened by logging and agricultural expansion, received unprecedented consideration at that time, and tree-planting was encouraged. During the 1980s and 1990s, interest mounted in non-wood forest products, previously relegated to the status of rather minor products. Trees, and especially trees outside the forest, or TOF – a neologism coined in 1995 – began to be perceived in terms of their contribution to the well-being of people and their environment in both developing and industrialized countries. Policy-makers and planners have now evolved and converged in their thinking to conclude that this extremely promising resource, in all its many forms and functions, can be a key factor in sustainable development and integrated multisectorial approaches.

Trees outside the forest may be a spontaneous resource, or they may have been planted, domesticated, cultivated and tended by people, and there is a strong human influence on their dynamics. Such trees have a more direct impact on society than forests: their cultural significance is as strong as their productive and ecological role. They supply some of the wood resources used by the wood industries, but their role in household production strategies is equally important. They supply food and non-food products for home consumption or sale, and help to boost household income.

The myriad uses and services of trees outside the forest are plain to see, but hard numerical data and information on this important resource are lacking worldwide. Deforestation has been mapped and quantified, but we know very little about the fate of land formerly under forest, and the parallel changes in tree cover in fields and towns. What we do know about trees outside the forest comes mostly out of local studies on agroforestry, sylvipastoralism, and urban, social, community or rural forestry. And this is scattered knowledge, much of it lodged in the traditional and empirical lore forged over time by rural societies.

This widespread and many-purpose resource, familiar to farmers but poorly defined by managers and mostly absent from official statistics and development policies, cries out for comprehension and a reconciliation of the various approaches of all stakeholders and sectors.
1. Definition

FAO’s proposed definition of trees outside the forest is not a direct definition. It is framed in the forest context, explaining by default that trees outside the forest (TOF) are trees not belonging in the category of forests and other wooded land (Annexe 1).

According to this definition, trees outside the forest are located on “other lands” such as farmlands, human settlements and bare lands. Trees outside the forest comprise agroforestry systems, orchards and small woodlots. They may grow in meadows, pastoral areas and on farms, or along rivers, canals and roadsides, or in towns, gardens and parks.

This definition may be applicable to a specific technical context, but it does demand a careful mastery of the definitions of forest and other wooded lands (Annexe 1). The boundary between what does or does not constitute a forest can be rather blurred, due to the great range of wooded formations throughout the world, and according to the actual objectives of the definition. Biological definitions are usually based on structural parameters, whereas legal definitions attest to the legal status of land and may ignore the vegetation and land cover. Moreover, many lands legally defined as forests now bear very few trees though their status remains unchanged.

The classification of such a multi-purpose, multi-form resource as trees outside the forest can also give rise to confusion when linked to such closely related definitions as land cover and land use, or such global (though sometimes overlapping) terms as agroforestry, social or farm forestry, or even urban forestry.

In short, the FAO definition of forest is quite clear, and so the term ‘trees outside the forest’ can appear equally clear at first sight. And yet, the application of this definition reveals the limitations of the term. Ambiguities persist for a number of plant formations such as oil palm plantations, agroforests, and agroindustrial agroforestry systems such as coffee and cocoa plantations. Trees outside the forest embrace a wide range of tree and shrub formations which may be conceptually similar, and a number of woody species which can take many and varied forms in urban and rural environments. Such pluralism argues in favour of further discussions with a view to coining a better working definition of trees outside the forest. The issue is far from innocuous; a lot depends on the definition, for it can effect planning and management decisions, and ways and means of access and usage.

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1 Forests or forested land.
2. Functions, importance and challenges

Any tree can have more than one purpose, but greater use is made of this potential in trees outside the forest, – indeed, this is probably one of their distinguishing features. Trees outside the forest and multi-purpose trees are often one and the same. The clear socioeconomic significance of the countless potential uses for this resource suggests that the environmental stakes are very high here, since it unquestionably play a major role in household economies. Moreover, though the hard facts are not yet in, it would appear that TOF are also a factor in the constitution of major national corporations, with a stake in international market flows.

2.2 A wealth of uses and services

Trees outside the forest are part of everyday life everywhere. In the tropics, farmers derive food security and subsistence from the woody species they grow, preferring those providing more than one product such as wood, fodder, fruit, and medicine, as well as services such as shade and shelter, fences, and the like. In the industrialized countries instead, farmers list shade and shelter, soil protection and improvement of the landscape and rural environment as their main reasons for growing trees (Auclair et al., 2000).

A population with access to fewer species or fewer trees tends to have greater recourse to the many products these trees provide, leading to the assumption that people select and plant trees to meet their needs. Walter (1996) notes that, intensive use is made of trees in the islands of Vanuatu, where trees are protected as biological diversity diminishes. Populations living in a more diversified environment, on the other hand, make less diversified use of trees (ibid).

Trees outside forest areas are a major source of food, which has earned them the designation of “nurse trees” (Bergeret and Ribot, 1990). Scoones et al. (1992) emphasize the importance of edible products from forests or complex agroforestry systems. In Sahelian and sub-Saharan Africa, the pericarp of the fruits of doum palm (Hyphaene thebaica), and Boscia senegalensis are pounded to provide a meal that substitutes for cereal grains in times of shortage (Bernus, 1980). Néré (Parkia biglobosa) and shea-nut (Vitellaria paradoxa) parklands remain because of the food value of the pods and nuts these trees provide. Date palms in Iraq are valued for their fruit, not to mention shade and crop protection. Fruit plantations in Brazil cover 2.3 million ha, with citrus groves alone covering one million ha with mandarin, orange and lemon trees. This tree system supplies over four million tonnes of fruit and latex products (Kleinn, 1999).

The leaves, roots, bark and other products of many trees are used to make medicinal or veterinary remedies. Among Fulani pastoralists of West Africa, the term lekki is used to designate both the tree and the medicinal products derived from it. This dual significance clearly indicates how tree resources can be crucial to human and animal health.

The very valuable livestock fodder produced by TOF can be a matter of life and death in semi-arid or mountainous areas. Fodder trees may be planted or left standing near their homes by herders who either no longer have access to certain rangelands or else lack the manpower to drive their livestock out to graze.
Trees outside the forest contribute to check wind and water erosion, improve soil fertility, facilitate the percolation of rainwater and guarantee long-term crop production. In some countries such as Egypt, Iraq and Libya, windbreaks substantially boost production (FAO, 1993b). In the dry regions of Africa, scattered trees such as *Faidherbia albida* keep the soil fertile, protect the herb layer and provide welcome shade for people and animals. In the mountainous parts of Iran, peasants leave 20-100 trees/ha standing to provide soil and crop protection. Afghan peasants grow mulberry, poplar, eucalyptus and fruit trees around their plots and along irrigation canals for the same reason (FAO, 1993b). Leguminous shade trees in Latin American coffee and cocoa plantations help to boost soil fertility.

The trees and woodlots that dot farmland often provide refuge for wild plants and animals, constituting islands and corridors of biodiversity. In this role they are well-known to hunters, who defend hedge and woodlot conservation, whereas farmers would prefer to get rid of these sanctuaries for bird and rodent crop pests. Shade trees, providential for people living in hot climates, are equally indispensable for cocoa production, or for tea as in Sri Lanka and coffee as in Latin America.

Trees outside the forest also often have symbolic and, in some cases, religious value. They mark boundaries and indicate ownership, border property and decorate living quarters. In arid landscapes they serve as landmarks, looming on the distant horizon and acting as beacons for nomadic peoples. Most place names in Tuareg lands refer to the names of trees (Bernus, 1980).

This long list, to which wood as a source of fuel or building materials, wooden handles for tools, and wood for furniture should be added, gives some indication of the range of current and potential goods and services offered by trees outside the forest. Some trees are tapped for their sap in the form of resin, latex and gum arabic, others provide essential oils. And while we have listed uses and products separately for the sake of clarity, any tree may fulfil a number of functions, and indeed a species is rarely maintained for just one service or product.

### 2.2 Economic significance

Access to and control over productive resources are certainly crucial socioeconomic factors for rural dwellers. In this sense trees outside the forest have market value, and may indeed be essential for resource-poor peasants (Arnold, 1996). The lack of hard and fast data on the economic significance and output of TOF makes them an occult resource⁷. Their quantitative contribution may well be higher than that of forests in countries with little forest cover, as is also true of heavily forested countries. Trees outside forest areas furnish products used directly by rural households for food, medicine, crafts, fuel and the like, and may also provide regular income from the sale of fuelwood or occasional income from the sale of logs or lumber.

It is hard to assess the economic value, output, consumption and profitability of this resource at the household level, and national level estimates would be even riskier because such goods are used for home consumption or informal sales, and do not appear in the statistics except in the case of official export and trade products such as gum arabic, shea-nut, cocoa, coffee, etc. While the products that pass through these international channels are tracked,

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⁷ This term refers to species or types of value which are not reckoned into the economic accounts and remain outside the ken of researchers and policy-makers (Gujit and Hinchcliffe, 1998).
much less is known about the production system and resource dynamics, although we do know that the growers of these commodities are often small farmers subject to international market fluctuations.

All these benefits of tree resources can be classified under: i) wood products; ii) non-wood products, including non-wood forest products (plants and animals and products of plant or animal origin); and, iii) forest services.

2.2.1 Wood products from TOF

*Fuelwood*

Fuelwood (Box 1) remains the prime source of energy in developing countries, where fuelwood represents 81 percent of the wood harvest (FAO, 1999b). In contrast, in the industrialized countries, traditional fuel (basically fuelwood) accounts for only seven percent of total fuel consumption (FAO, 1998a). Very few studies have reported on overall fuelwood output from stands and single trees outside the forest, though we do know that agroforestry systems provide a large part of the resource. At the same time, while the main point of orchards is to produce fruit, fuelwood is often an important product, especially in developing countries. More surprisingly, trees outside the forest are also seen as a source of fuelwood in the urban forestry context. In the industrialized countries logging residues are under-exploited due to the widespread availability of electrical energy.

**Box 1: Fuelwood**

In the Asia-Pacific area, over two-thirds of the energy demand is supplied by fuelwood from non-forest sources, providing fuel for two billion people (FAO, 1998c). Jensen (1995) sets relative values for the consumption of fuelwood from non-forest sources at 50 percent for Thailand and 75-85 percent for Vietnam, Pakistan, Sri Lanka, the Philippines and Java. Agroforestry provides 63 percent of the fuelwood in eastern Java (Ben Salem and van Nao, 1981).

In the Sahel, wood energy accounts for an average 90 percent of total energy consumption (Minvielle, 1999; Nouvellet et al., 1999). In Sudan, forest fallow systems of *Acacia senegal* for gum arabic production also supply fuelwood (Ben Salem and van Nao, 1981). Néré (*Parkia biglobosa*) trees in Mali generate some 0.15-0.2 m³/ha/yr of fuelwood, in addition to the fruit they supply (Bagnoud et al., 1995). Also in Mali, fruit-tree pruning not only boosts production, it provides a substantial amount of fuelwood: the owner of a mango grove can produce some 10-13 m³/ha/yr. In Morocco, rejuvenation pruning and renewal of fruit trees supplies 0.8-1.5 m³/ha/yr of fuelwood (M’hirit and El-Tobi, 2000).

Trees such as laurel (*Cordia alliodora*) grown for shade in the coffee and cocoa plantations of Central America supply both fuelwood and timber during the 10-15 years of their rotation (Ben Salem and van Nao, 1981; Mussak et Laarman, 1989; Somarriba, 1990). Over a fifteen-year period in Paraguay, the average output of a one hectare woodlot of paraiso (*Melia azedarach* var. “Gigante”) was estimated at 110 m³/ha, the wood being used for fuelwood, poles and posts (Evans and Rombold, 1984).

( Box continuing next page )
In small urban areas of Asia and Africa where biomass supplies 50-90 percent of the domestic energy need, a fairly substantial proportion of the wood is gathered inside the towns (Kuchelmeister, 2000).

One kilometer of linear hedge in France produces 8-15 steres of wood/yr, the energy equivalent of 1 500-2 000 litres of fuel (Schmutz et al., 1996). In the United States, only three percent of the 13.3 million m³ of urban woody residue is sole as fuelwood and three percent is burned to supply energy, with the remainder having no direct utilization (Whittier et al., 1995a,b).

NB. For instance, a family of six persons in Mozambique consumes an average annual 7 m³ of fuelwood. The total consumption of fuelwood was estimated in 1985 at 18 million m³ for a population of 17 million. Now that the estimated population is 18 million, fuelwood consumption is probably around 20 million m³ (Saket, 1998).

Timber and service wood

With few exceptions, the prime objective of trees outside the forest is not to produce timber. In the American tropics, the pejibaye palm (Bactris gasipaes), common in agroforestry systems, is used for craftwork or parquet flooring (Clement, 1989). Timber from TOF can be numerically significant. It accounts for up to 70 percent of the construction and industrial wood supply in Sri Lanka, and 84-95 percent in the Indian State of Kerala (Krishnankutty, 1990, quoted in Kumar et al., 1994; Sharma, 2000). Tree production can also be directed towards the production of service wood, often based on associations between forest industries and small agricultural enterprises. We can cite Wimco Ltd, a firm in northern India which makes matches and is driving agroforestry in the region (Newman, 1997), or again small KwaZulu-Natal farmers in South Africa subsidized by several pulp and paper firms for setting aside land for tree-planting (Arnold, 1998).

2.2.2 Non-wood products from trees outside the forest

Non-wood products from trees outside the forest may be derived from either forest or non-forest tree species (e.g., growing around the home, in orchards, or as part of groforestry systems...). The non-wood products of forest species are termed "non-wood forest products". (Unasylva, 1999).

Non-wood forest products are among the oldest trade goods in the world. In the year 2000 B.C. the Egyptians were already importing gum arabic from Sudan for food, paints, gum and for use in mummification (Seif el Din and Zarroug, 1996). The trade in sandal wood oil goes back to the twelfth century A.D. (FAO, 1995). In 1989, Peters et al. showed that non-wood forest products from just one hectare of tropical forest could generate a higher income than that from logging an equivalent area for timber. This was a milestone publication that induced other scientists in the 1990s to rediscover the value of non-wood products, with health foods already a leading informal sector. Over the last two decades,

3 Since 1999, FAO definition of non-wood forest products (NWFP) mention trees outside the forest: “Non-wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded land and trees outside the forest” (Unasylva, 1999).

4 Health foods are natural foods with therapeutic properties which can check or prevent the development of certain illnesses.
non-governmental institutions and organizations have joined the private sector in promoting highly diversified non-wood products (Table 1). The statistics do not reveal the origin of these products, however, and it is difficult to work out whether they come from forests, single trees, orchards, plantations, agroforestry systems or farmlands.

<table>
<thead>
<tr>
<th>Tree parts</th>
<th>Some products</th>
<th>Production systems</th>
<th>Some uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits and seeds</td>
<td>Fresh and dried fruits, seeds (coffee, shea-nut)).</td>
<td>Fruit orchards, home gardens, parklands.</td>
<td>Food, cosmetic and pharmaceutical products.</td>
</tr>
<tr>
<td>Foliage</td>
<td>Animal fodder, leaves for human consumption.</td>
<td>Agrosilvipastoral systems.</td>
<td>Feeds, food and medicinal uses.</td>
</tr>
<tr>
<td>Stems and bark</td>
<td>Latex, gum arabic, resin, tannin, fibres.</td>
<td>Plantations, home gardens, parklands.</td>
<td>Food, tires and treads, hides and textiles, agrofood and pharmaceutical industries, cosmetics.</td>
</tr>
<tr>
<td>Flowers</td>
<td>Honey, essential oils.</td>
<td>Agrosilvipastoral systems.</td>
<td>CORKS, wall coverings, insulation, pharmaceutical derivatives.</td>
</tr>
</tbody>
</table>

_Fruit and seeds_

Fruit may come from cultivated tree orchards or from agroforestry systems. Fruit trees are intensively managed in the industrialized countries just like farm crops, frequently monocropped and genetically improved. Production is one link in the agro-food chain of growers, processing plants, distributors, and the research and technical institutes. The numerical data on production, consumption and yields are ready to hand and reliable, as in the European Union. Fruit production circuits are less tightly organized in the developing countries. In some, such as Peru, agroforestry systems and fruit farms set up expressly for the export trade, both produce fruit (Kleinn, 1999).

Fruit is a very important item in the diet of people in the developing countries (Falconer and Arnold, 1989). While it may simply provide a snack at work or while travelling (Ogle and Grivetti, 1985), it may also, like the baobab, be eaten during periods of famine (FAO, 1992). Again, it may be a basic item in the diet, such as breadfruit (*Arturocarpus altillis*) or Tahiti chestnut (*Inocarpus fagifer*) (Walter, 1996). Fruit is also a major source of Vitamin A in the form of carotene and vitamin C.

Trees and bushes are grown in traditional home vegetable gardens, in association with annual and permanent crops, and livestock. Such systems are found almost everywhere in the tropics, especially in densely populated areas. The preferred woody species tend to have more than one use, especially fruit tree species. Up to two thirds of the trees used by farmers in Bangladesh are fruit or nurse trees (Mehl, 1991). The point of growing fruit trees
in such systems is that the resource is close at hand, allowing more intensive management and boosting productivity (Box 2).

**Box 2: Productivity of home or village gardens**

Along the flood plains of the Brazilian Amazon from Para to Brazil, açai palm (*Euterpe oleracea*) produces from 7.34-12.2 t/ha/yr in secondary forest whereas the figure is 13.7-18.2 t/ha/yr for home gardens (Muñez *et al.*, 1996). Proximity to a local market also favours sales and enhances the value of fruit production. This is true in Cibitong, for example, 50 km from Jakarta, Indonesia, where village vegetable gardens near the capital have been turned into diversified fruit orchards focusing on several commercial products (Mary and Dury, 1993).

In the Sudano-Sahelian part of Africa, parklands where the presence of trees is regular, systematic, and ordered provide fruit for rural populations (Sauter, 1968, quoted in Bagnoud *et al.*, 1995). Shea-nut (*Vitellaria paradoxa*) is one of the most important species. Aside from timber and fuelwood, its main value lies the myriad uses made of its fruit (Bagnoud *et al.*, 1995). The pulp is eaten raw, and the kernel supplies an oil used in cooking, soap-making, pharmaceutical products, cosmetics, candles, and even for waterproofing the walls of farmers’ homes. Shea-nuts are exported for use in cosmetic, pharmaceutical and bakery products (Boffa *et al.*, 1996; Sallé *et al.*, 1991; Wickens, 1995). Despite the international market for shea-nut, we still lack clear economic data on the importance of this commodity.

<p>| Table 2: Coffee production 1999 (tonnes) |</p>
<table>
<thead>
<tr>
<th>World, regions, countries</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>6 476 250</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>3 708 593</td>
</tr>
<tr>
<td>Brazil</td>
<td>1 630 140</td>
</tr>
<tr>
<td>Colombia</td>
<td>648 000</td>
</tr>
<tr>
<td>Mexico</td>
<td>303 191</td>
</tr>
<tr>
<td>Other Latin American and Caribbean countries</td>
<td>1 127 262</td>
</tr>
<tr>
<td>Asia</td>
<td>1 465 001</td>
</tr>
<tr>
<td>Vietnam</td>
<td>486 831</td>
</tr>
<tr>
<td>Indonesia</td>
<td>455 119</td>
</tr>
<tr>
<td>India</td>
<td>265 000</td>
</tr>
<tr>
<td>Other Asian countries</td>
<td>258 051</td>
</tr>
<tr>
<td>Africa</td>
<td>1 232 718</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>365 000</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>232 020</td>
</tr>
<tr>
<td>Uganda</td>
<td>198 000</td>
</tr>
<tr>
<td>Other African countries</td>
<td>437 698</td>
</tr>
</tbody>
</table>


Much more is known about the coffee and cocoa sectors, which arose out of the agroforestry systems. While 85 percent of the world’s coffee is consumed in Europe, the United States and Japan (Alvarez *et al.*, 1992), most of it originates in Latin America and the Caribbean (Table 2). In 1996, coffee accounted for 14.9 percent of Colombian exports valued at US$ 1.5 billion, contributing to the 80 billion of GDP. In 1989, coffee exports in
El Salvador accounted for 44 percent of value added (in constant prices) within the national economy (Rice and Ward, 1996). The coffee trade generates from 9 to 15 billion US$, depending on world prices and how good the season was, and of this figure 40-80 percent goes back to the small farmer (Follin, 1999). Coffee production is often an essential factor in the economy of these countries. The same may be said of other permanent crops such as date palms, especially in oasis systems, or of coconut and cocoa. Côte d’Ivoire, for example, produces in 1999 close to 40 percent of the 2.9 million tonnes of cocoa traded on the world market (1999 FAOSTAT data, in FAO, 2000).

**Fodder**

From 30 to 40 million pastoralists whose livelihood derives mainly from animal husbandry are dependant on herb and tree layer fodder and browse. When grasses are scarce, trees become the essential source of livestock feed. In the temperate countries, trees growing in stumped hedges traditionally supply winter fodder reserves for goats (Bortoli, 1987). Tree species play a more important role in feeding livestock in the more arid parts of the world. In the Sahel and the Sudan-sahelian areas, there is not enough good quality grass to assure fodder all year round (Couteron et al., 1991). Three quarters of the 10 000 woody species that grow in Africa are thought to be used for “aboveground” pasture (FAO, 1992). This resource can be overexploited, however. Where branches are broken off too fast and the bark is gnawed away, leaving wounds, parasites often flourish (Bortoli, 1987; Cissé, 1985). Such systems need to be carefully managed. In Asia, farmers are beginning to plant trees they can use as fodder resources. In western Nepal, trees bordering sloping fields cover 41-58 percent of the fodder demand (Fonzen and Oberholzer, 1984).

**Saps**

Most gums, resins and latex, as well as being used by peasants, are world trade items. This is true of latex from rubberwood, produced in both forest plantations and agroforestry systems, as it is of commercially and industrially valuable gum arabic. *Acacia senegal* and *Acacia seyal* are grown in the Sahel in agroforestry systems call “gum orchards”, or in forest fallow tree systems. The world output of gum arabic topped 60 000 tons in the 1960s, dropping to 33 800 tons in 1994 (Spore, 1991; Noru and Osman, 1997). Sudan is the world’s leading producer of gum arabic, a valued component of more than one industry for which no synthetic replacement exists.

**Bark products**

Bark products are agroforestry products. The bark of *Irvingia gabonensis* (tree exploited primarily for its fruit in Gabon and Cameroun), and shea-nut bark are both used locally for their medicinal and pharmaceutical properties. *Grewia tenax* bark, of which an estimated 900 tons is produced in Sudan, is used to make toothbrushes (Ayuk et al., 1999; Boffa et al., 1996; Ezeldeen and Osman, 1998; Ladipo et al., 1996). Tree bark may have wider commercial uses, as in the case of cork from cork oak (*Quercus suber*), which is grown especially in *dehesas*, which are typical agrosylvipastoral systems still current in Portugal and southwestern Spain (Pointerau and Bazile, 1995).
1.1 Environmental challenges

An African adage has it that “Earth is not a legacy we inherit from our parents, but rather a loan from our children”. It took two million years to arrive at the one billion men and women alive on the planet by the year 1800, but by 2025 the world’s population is expected to approach nine billion, over seven billion of whom in the developing countries. Food security and poverty reduction are going to be a daily challenge for these men and women. The environmental stakes will also be very high in monumental agglomerations which are expected to house from 30 to 40 billion people. The various environmental and ecological roles played by trees outside the forest and outlined in section 2.1 are illustrated in Boxes 3 and 4.

Box 3  Ecological functions of linear tree systems

TOF play an extremely important and prominent ecological role in linear tree systems. Line plantings of trees and shrubs in fields help to check runoff and water erosion (Perez et al., 1997). They also act as flood regulators. In intensively cropped areas their roots reach down to capture the nitrates and phosphates carried by percolation or runoff (IDF, 1992), and they also purify water by taking up a considerable portion of water-borne pollutants. Line plantings also protect against wind, rain and cold.

Trees lining rivers and streams are a source of great biological richness, providing spawning-beds for fish and shellfish, even as their shade acts to limit the development of aquatic flora, thus reducing the problems of eutrophication. These riparian woods also provide biological corridors for terrestrial wildlife.

Woody species, often sprouting from seeds distributed by animals, tend to reestablish themselves at the foot of linear tree systems. Some are rare or infrequent species that enrich biodiversity. Many animal species survive thanks to the planting, restoration and maintenance of bocage hedges.

The world’s rising need for food cries out for agricultural systems that respect the soil, for by now the rate of soil degradation has largely outstripped soil regeneration. Trees, in the form of dense or even thin stands, line plantings of trees, single trees and tree hedges preserve the organic matter contained in the soil (Roose, 1994). The unique role of trees in soil protection and conservation, checking wind and water erosion and maintaining soil fertility is universally acknowledged. In much of the world, pioneer encroachments upon the forest continue, and it is therefore essential to conserve sufficient tree systems in all their various forms and arrangements to offset this trend. Biological approaches such as conservation-oriented water, biomass and soil fertility management give preference to production systems which provide ground cover, recycle organic matter and help to disperse runoff energy. Line plantings or woodlots of TOF fit neatly and naturally into such schemes.

Among the environmental functions of TOF, the cumulative benefits of trees on smallholdings to soil and water conservation in the larger context of mountain watershed management also deserve mention, along with their contribution to maintaining biodiversity, their positive impact on climate, and their role in checking desertification and drought.
We should point out that forests act as reservoirs, sequestering carbon within their biomass and as a carbon sinks when they are expanded or their productivity is enhanced, allowing them to absorb more atmospheric carbon. When the situation is reversed, and the forest biomass decomposes or is burnt, as in the case of slash-and-burn cultivation, they become a source of greenhouse gases. Changes in land use, first and foremost deforestation in the tropics, are currently responsible for about 20 percent of the CO₂ emissions attributable to human activities. There are specific forest management practices such as conservation-oriented management, storage and replacement which help to slow the accumulation of atmospheric carbon. According to The Intergovernmental Panel on Climate Change (IPCC), the world figure for carbon fixation from deforestation reduction, forest regeneration, intensified planting and agroforestry practices to account for the equivalent of 12-15 percent of carbon emissions from fossil fuels between 1995 and 2050 (FAO, 2001a). Unruh et al. (1993) made estimates of the stored carbon in aboveground and underground biomass in 21 different agroforestry systems in sub-Saharan regions, concluding that the environmental role of agroforestry in terms of retaining organic matter in the soil and reducing deforestation (thereby reducing carbon emissions), is more important than its straightforward effect of carbon sequestration.

**Box 4: Environmental impact of agroforestry systems of coffee-growing**

In coffee-growing area of El Salvador represents the major manmade treed area; the tree cover it provides is a key element in the conservation of agricultural soils, especially on sloping lands. The contribution of leaf litter and twigs, leaves and branches to the soil by shade trees provides plant cover to check runoff and water erosion, while continually enriching the soil with organic matter. At the same time, the uneven surface created by the tree strata makes the system more resistant to exceptional weather events such as hurricanes.

Babbar and Zak (1995) demonstrated a lower rate of nitrate leaching in plots with coffee grown in association with *E. poeppigiana* compared to coffee planted alone. Coffee grown in full sunlight also required more nutrients than coffee grown under shade, and the lower nutrient inputs for shaded coffee also reduced the loss of mineral elements through leaching.

By supplying organic matter to soil and regulating microclimates, trees can induce conditions favourable to the development of wildlife diversity. Traditionally managed coffee and cocoa plantations in Latin America are home to at least 180 bird species, more than in an equivalent area of farmland, and exceeded only by primary tropical forest (Rice and Ward, 1996). The tree strata seems to provide essential habitats for specific bird species while coffee-growing systems provide the biological corridors that are a major component of maintaining biodiversity.

It became clear during the international negotiations on world climate leading up to the Kyoto Protocol that carbon will become a new “product” needing to be monitored, quantified and managed in new ways compared to past treatment of the issue, and that the element will provide a new rationale for activities affecting climate change. Decisive changes must be made in the energy, transport and industrial sectors, as in agriculture and forestry. The impact of trees outside the forest on reducing deforestation, stabilizing soils and ecosystems and sequestering carbon will become increasingly meaningful.
Another key factor in environmental quality will be urban forestry. This includes arboriculture, urban green belts and areas and peri-urban afforestation (Besse et al., 1998). There is a great demand by urban dwellers for the presence of trees, though their expectations are often dashed by the expansion of road systems and new housing, which tend to extirpate trees from the fabric of urban life, even though the quality of life and the aesthetics of the landscape in a wholly manmade environment owe so much to the presence of greenery. City trees have to adapt to a great many constraints such as lack of space and soil, air pollution, damage by man and animals, and repeated cutting (Greye et Denede, 1978, cited in FAO, 2001b).

The maintenance and renewal of trees is a current expense on the budgets of old cities in the industrialized countries, whereas in newer cities and in the developing countries the presence of trees often owes more to citizen initiative, as people beautify their gardens with ornamental, shade or productive trees. In west Africa, residential districts have more tree cover than do working-class neighbourhoods (Besse et al., 1998). Greater and greater attention has been paid to urban forestry since the 1980s, and the trend is expected to continue in the future. Stakeholders and policy-makers should nonetheless lend their support to this trend in urban and peri-urban zones. Integrated rural and urban development policies should be designed to offset the negative impact of urban systems on ecosystems.
3. Patterns of change, trends and dynamics

The uses and services of trees outside the forest are known and valued but the hard facts and figures on tree cover and wood production for this resource still need to be quantified and reckoned into the economic accounts. It is very difficult to appraise TOF dynamics in the absence of such vital data. What is known is that TOF and forest dynamics are often linked. Observations in a number of countries reveal that deforestation induced farmers to plant trees in their fields to supply wood and non-wood products for their own needs and in response to urban demand (Arnold and Dewees, 1995). Combining data on forest dynamics with the dynamics of trees growing on agricultural and urban land should give new insight into world trends for wood resources, confirming locally observed trends for shrinking or expanding tree cover.

3.1 State of forest resources and trees outside the forest

The 1980, 1990, and 2000 Forest Resources Assessments inventoried areas under forest and forest plantations\(^5\). In 1996, the objectives of this world forest assessment were reviewed in the course of an expert consultation held in Kotka, Finland (Nyyssonen, A. and Ahti, A, 1996) Following this meeting, Forest Resources Assessment 2000 (FRA 2000) was divided into three major fields of activities: assessment based on existing data, remote sensing surveys and special studies, which include studies on trees outside the forest.

The data of this Forest Resource Assessment Programme (Box 5) reveal particularly heavy deforestation in the tropics, without, however, specifying what use is made of these former forest lands. We do know that forest clearing is often followed by the establishment of production systems of which trees are an integral part. Not much is known about the tree dynamics of farmlands, and to what extent such wood resources might offset the regression of forest, providing people with wood and other products.

Throughout the world, the combination of demographic pressure and human activity acts to the detriment of forests. A growing population on the move is pushing back the agricultural frontier, encroaching upon the forest to feed both rural and urban dwellers. Some farm practices involving trees come into play at this stage: parklands and woodlots, multi-story farming, grazing on treed pastures, windbreaks and the like, as well as a whole series of ancient or modern agroforestry practices such as corridor cropping, hedgerows along contour bunds, and planted fallow.

In developing countries where the rate of population growth is still high, trees outside the forest are especially important, and seemingly much more so in future. In the industrialized countries, the key factors in the situation are quite different. While it is generally forecast that 60 percent of the world’s population will be living in urban areas by the year 2025 (World Bank, 1995), that percentage is already much higher in the developed countries, where forests are gaining ground. Trees outside the forest thus cannot claim the status of an alternative to the forest resources which are so important in the developing countries. Urban and peri-urban trees, green belts, noise abatement green walls, riparian trees and perhaps line plantings of trees are destined to become very prominent in the near future.

\(^5\) Plantations are defined as tree stands established from transplanting and/or seeding by a process of afforestation or reforestation, composed of introduced species or of stands of local species (one or two planted species, even-aged and regularly spaced) (FAO, 1998b).
future. The social and productive dynamics of trees outside the forest are thus closely bound up with their ecological dynamics (Alexandre et al., 1999).

**Box 5: Decline of world forest resources**

According to the Forest Resources Assessment Programme (FAO, 2001c), natural and plantation forests together covered a total area of 3 856 million ha in 2000, i.e. 90.45 million ha less than in 1990. This decline is marked in the developing countries which have lost 118 million ha (Mha), whereas forested area increased by 24 Mha in non-tropical regions. Forest cover in the tropics dropped from 1 973 Mha in 1990 to 1 856 Mha in 2000, the equivalent of an average annual deforestation of 11.8 Mha, or 0.8 percent of the aggregate annual rate of deforestation. The rate of deforestation was strikingly higher in Africa with a percentage change rate of 0.8.

These general trends towards greater or lesser forest cover can also be reviewed in the context of the agricultural and pastoral sectors bordering upon the forest.

**3.2 Shrinking tree cover**

In the developing countries, the following factors have considerably thinned tree cover in the tropics since the dawn of the twentieth century: logging for tropical wood, drought, agricultural development, pioneer settlements and forest fires. Forest cover declined considerably as logged-over forest was developed as farmland or tree plantations. This is true of Côte d’Ivoire, for example where a great many cocoa, coffee and fruit plantations were established on cleared forest land. Deforestation also accompanied the implantation of irrigation schemes and the introduction of farm mechanization in the 1970s and 1980s, as in Senegal along the river and in Mali in the agroforestry parklands. Deforestation has also been favoured by “village development” schemes which failed to include trees in most of the development plans. Tanzania is a striking example of this. At the same time, the mounting demand for fuelwood has ringed towns and villages in much of the world with deforested areas. All of these logged-over or transformed forests have, at best, given way to impoverished forest, and, in the worst-case scenario, to scattered, isolated trees.

Agricultural development in the industrialized countries, passing through the various stages of mechanization, drainage, irrigation, land consolidation, and ever larger plots and farms, has been responsible for the gradual but steady eviction of most of the trees that used to be found in rural landscapes. During the last thirty years in France, 100 million single or line-planted trees have disappeared (Pointereau and Bazile, 1995). This destruction has been paralleled by a drop in non-forest wooded areas form 4.5 million ha in the 1900s to 1.6 million ha in 1990, whereas the amount of forest area grew steadily over the course of the last century. In England and Scotland, there was a 25 percent drop in the linear coverage of hedgerows from 1950 to 1970. Orchards in meadows have become a rarity everywhere, and trees are an ageing resource (ibid.). Braudel (1986) pointed out the link between the frequency of trees outside the forest and the type of crop rotation practised, a clear proof of how the presence of trees is partly dependant on farm practices in rural areas.
3.3 Expanding tree cover

Paralleling the phenomenon of shrinking tree cover is the inverse trend, in the form of rural landscapes where tree cover is expanding through natural regeneration or tree-planting on cleared land (Bellefontaine and Ichaou, 1999).

Population growth is frequently cited as a cause of deforestation. Unquestionably, repeated and excessive picking and gathering activities, though vital to everyday rural life, can be a factor in the degradation of specific areas, such as semi-arid or peri-urban zones and trees bordering grazing lands. Above a specific threshold of deforestation, tree cover tends to be restored by the people who live there, though less easily in arid and semi-arid zones than in wetter ones. Despite Kenya’s annual population growth rate of 3.7 percent, for example, the actual per hectare density of trees has increased (Banana et al., 1999). The overpopulated but heavily treed island of Java is an edifying case in point, despite the island’s omnipresent rice paddies.

Towns in the developing countries are becoming more rural as small-scale animal husbandry, trees and agriculture invest urban areas in a mutual trade-off between rural and urban space. Forests are expanding in the industrialized countries through simple regeneration tied in with the en masse flight of people from the countryside and the abandoned farmland that is the result. In Europe, seed and seedlings now colonize fields that have come under the agricultural set-aside provisions of European Union farm policy.

Since the late 1970s and partly as a result of the mounting, worldwide interest in agroforestry spurred by the Béné Report (Béné et al., 1977), research has boomed in almost every developing country and some industrialized countries on the association between, trees, crops and animals. Recent work on the enhancement of multipurpose trees and the domestication of trees for non-wood products (Leakey et al., 1996) has led to many new opportunities for using trees in non-forest situations. We still need to work out the underpinnings of tree dynamics, so that positive trends can be encouraged where observed and similar processes fostered in other areas. Another thing that remains to be done is to quantify the ratio of shrinking to expanding tree cover, and to determine whether this is a positive or a negative trend.
4. Management mechanisms

Trees outside the forest are formally appropriated and managed, producing laws and policies based on cultivation practices and on social and cultural patterns. The role and place of specific sectors of the population, and particularly that of women, may well not receive due recognition, and this has a negative impact on natural resource protection and enhancement.

4.1 Forest policy and legislation

Trees outside the forest may come under farm or forestry legislation, or a combination of the two, or they may be totally neglected by either or both. Forest law defines forest land for the most part, and only rarely deals with trees as such. Forest policies often extend their prerogatives to all trees, even those located outside the forest.

National forestry policy guidelines are influenced by the extent of forest cover and the economic role of wood. In countries with extensive forest cover, the state will intervene in the logging sector, stimulating the wood industries and fostering tree-planting. In the arid countries the distinction between forestry, agricultural and livestock production policies tends to be rather blurred. Agricultural, forestry and livestock policies aim to meet the need for wood products and improve rural production systems. They favour the integration of the forestry, agriculture and livestock production sectors and rural community participation (FAO, 1999a). They associate desertification control with poverty reduction and the goal of food self-sufficiency.

Forest laws deal with land under the forest regime, and may apply to any area suitable for forest cover, thus making the administration competent to act over a large part of the territory. Some forest laws have provisions concerning rural production and agroforestry systems.

Trees outside the forest come under either private or public domain. From the legal or land ownership standpoint, the status of the land on which a tree is growing is often the prime determinant of rights, and whether or not a tree is actually growing there is a secondary consideration. Planted trees mostly come under the regime of individual private ownership. National law is, on the whole, not particularly favourable to private investment in wood resources, even those located outside the forest. Furthermore, modern law in laying down written rules has ignored customary law, which is perceived as complex and ambiguous. Customary rules, in their broad diversity, may overlap or even conflict with the provisions of national law.

Formal acknowledgement of rural peoples’ user rights over trees growing on farmland would provide a major incentive for the conservation of such trees. Some countries have enacted customary usage into law (Kinara, 1993, quoted in FAO, 1999a). Gambia (Republic of Gambia, 1998) promulgated a new forest law in 1998 that covers community forestry law and community participation in forest management. Agroforestry, forest trees outside the forest, non-forest trees and urban forestry are all mentioned. This

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6 Non-forest trees are trees planted outside the forest by a person or a community within existing vegetation which does not constitute a forest (Forest Bill, 1998, Gambia).
law encourages tree-planting on farmland, in pastures, and along roads. Through its recognition of trees outside the forest it represents a step forward in motivating users to plant trees.

Land ownership has a parallel in tree ownership (a tree may belong to an individual or to the community); depending on the nature of the tree (wild or planted) and how it is used (commercially or on a subsistence basis). Tree ownership is broken down into the right to own and to inherit, the right to plant, rights of usage and the right to dispose of the tree though sale or lease. In the industrialized countries, land ownership frequently includes the resources flourishing on, below and above the land, thereby determining access to these resources. But in the developing countries the appropriation of the tree frequently precedes and leads to land ownership — as in frontier areas. The planting of exotic species or re-introduction of indigenous species (Box 6) entitles one to appropriate the land. Trees which have sprung up spontaneously are usually considered communal property. In some cases the entity or individual considered to be the owner of the land retains rights over what this land produces, and the planting of trees by leases may be discouraged. In other cases the tree may constitute a permanent marker, conferring de facto and privileged user rights over the area on which it grows upon the person who planted it. In this latter case, obtaining the right to plant may become a factor in establishing tenure. Insecure land tenure is widely perceived as a factor in resource degradation, whereas much of the technical knowledge of traditional management systems, based on carefully planned resource use and conservation, could be very valuable if certain specific sectors of the population, particularly women, were granted more secure land tenure and guaranteed rights of usage.

**Box 6: Individual appropriation through agroforestry reconstruction**

In the late 19th century in southern Sumatra, peasant societies began to see rifts develop in the economic and institutional systems, the social breakdown of collective models of land and resource control, agrotechnical problems in the rice/coffee/fallow system, decline in over-active systems through resource degradation, particularly of “damar” (*Shorea javanca*) resins (Michon, 2000). At that point peasant farmers began to grow damar. The cleared parcel was occupied first by rice, and then coffee among which damar was planted. As the coffee plantations were abandoned, over time the parcel evolved into tree fallow, then secondary forest, gaining further complexity by the later re-establishment of forest species.

The innovation of damar establishment is just one facet of a deep-seated change in modes of production and the relations governing them. Planting the damar was the social expression of a determination to refute a bankrupt forest economy and hierarchical model of agroforestry society. The damar made individual appropriation of parcels possible within universally recognized borders, on the former communal forests, and allowed the planter to establish land tenure for his descendants, a right formerly denied younger brothers. This agroforestry transformation led to a change in the legal status of an area from communal to private ownership (Peluso, 1993).

4.2 Local management and knowledge

Since the 1970s, a new and interdisciplinary approach to the relationship between people and nature has broadened our knowledge of the environment (Jollivet, 1992). In the TOF context, people are much less a single link in a chain of irreducible ecological
dynamics, and much more the close and constant core of an evolving resource. By selecting, tending and protecting trees outside the forest in connection with material and spiritual usage and needs, following practices laid down by a tradition that respects the environment and reflects a vast backlog of local knowledge, people have adapted to the random winds of ecological, economic and political change. This is why trees are managed differently in peasant and pastoral societies, where the continuum between forest management and the management of farmlands and grazing lands is preserved, as is the link between their dynamics.

Herders use vast stretches of rangeland on which they try to conserve a great variety of plant species. Trees are an essential source of fodder, ingredients for veterinary remedies, and marketable products. The rules of appropriation on trees outside the forest vary greatly from one region to the next, and have a strong impact on the rules governing management. Trees growing in rangeland grazed by pastoralists’ herds are considered a communal resource just like grass. On ranches instead, trees are at the mercy of their owner’s decision as to whether to conserve, favour or destroy them. Planted fodder trees are thought of as permanent crops and receive the care their production justifies. In parklands and savanna, pastoralists may contract with landowners for access to foliage, especially at pruning-time. Depending on the season, pastoralists use one plant strata or the other: the herb layer is grazed during the wet season, the shrub layer is browsed at the height of the dry season and the tree layer at the end. Livestock unquestionably constitute the wealth of pastoral peoples, but also of agro-pastoral and sedentary farmers, who have devised agrosilvipastoral systems in which soil fertility is enhanced by grazing animals.

For peasants intensively farming a small area, trees supply products to supplement their basic source of income, farming. Here the tree assumes its most universal function as the regenerator and protector of fragile or eroded soils (Pélissier, 1980), so that the same field can be worked several years running without fertilizer inputs (Guinko, 1997). The domestic and commercial value of the fruits of many species guarantee these trees a permanent place on agricultural land. Farmers are past masters in the association of tree crops with farm crops. Populations who alternate shifting cultivation or crop rotation with fallow periods view treed land and farmland as two sides of the same coin, to be exploited in turn. Trees planted in fields are also an invitation to agricultural diversification. Tree savannas are reconstructed landscapes in which the rate of afforestation can be quite high. By establishing agroforestry resources, peasant farmers demonstrate their skill in preserving and maintaining useful trees. Appearances notwithstanding, these deliberate practices leave little to chance: they are the fruit of a vast body of knowledge which remains largely undocumented.

Ethnobotany teaches us the local names and classifications of vegetation. But the virtues of plants and their uses, and the empirical knowledge of natural resource management, are far harder to find in the literature, because this lore was long ignored by technicians and scientists. More attention began to be paid to local expertise in the early 1980s. A dawning awareness that tree-tending practices are based on observations that give local people a deeper understanding of the environment led to the recommendation that this data be incorporated into rural development projects. Local knowledge can show practical and technical uses for tree and management systems in a given rural region. They also offer a glimpse of forms of social organization and cultural representations concerning trees. Plant and tree classifications can of course be defined in terms of economic purposes and needs, but they are also mental constructs or representations on which people base their
decision to intervene in nature. This meaningful interaction between our world and the world of trees has much to teach about ecology, even as they show how ingrained trees are in everyday human society. There is a great need to factor in these representations in terms of their impact on practices. This can further understanding of the key factors and inner logic of peoples’ impact on the future of trees. Men and women need to regain their rightful place at the heart of the issue when we speak of TOF and the sustainability of ecosystems.

4.3 Gender-differentiated management

Men and women’s different activities due to gender-based divisions of labour imply that the two have different and complementary knowledge and skills about the environment, tree species, tree products, and their uses. These gender-differentiated management systems are crucial to the conservation of biodiversity. The practices women use in exploiting tree resources are often more subtle than those of men. Women actively select and protect the trees growing in the fields. The division of household labour and the fact that women bear most of the responsibility in providing for the family’s daily needs and subsistence force women to take a greater interest in trees, which provide fuelwood, food and pharmaceutical products. When times are hard, this situation is accentuated. And yet, despite the growing recognition of the feminine contribution to rural economies, women still lack land tenure in many parts of the world, a constraint to access and management of wood and non-wood products on the part of women.

The increasingly massive exodus of men from the countryside that is emptying villages of a large part of the labour force, leaving farm women as the only permanent workers, makes it all the more imperative to enhance and strengthen the role of women in the management of farm trees. Labour availability affects the intensification of any given production system, and can be decisive in tree-planting systems because they are less labour-intensive than agricultural crops. Tree crops, however, with few exceptions such as cocoa, spices and resin do not normally produce enough income to meet the needs of the family.

All these choices and decisions which households must take and act upon revolve around getting enough to keep the household going, and maintaining social cohesion. The latter can be upset, especially during times of crisis, aggravating social inequalities and especially resource access. Moreover, the exploitation of TOF produced by certain economic and social trends is increasingly sidelining certain sectors of the population. This includes women, who have little access to land and even less to tree ownership and use. Such trends include the marketing of the products of select species, population growth, dwindling resources, and social and market-oriented management practices. These is why it is absolutely essential for agroforestry projects to associate men and women on an equal footing and to meet the special needs and interests of both. This also means reducing the cultural opposition to equitable access to resources, shared responsibility for management, and ensuring an equal share of the benefits for all.
5. Support and promotion strategies

Ways must be found to bridge the different approaches of partners in strategies to promote and support trees outside the forest. Institutions are becoming increasingly involved in TOF issues at all levels, hammering out policy, considering options and offering support. The primary users and managers of this resource have, in fine, their own technical and socioeconomic rationales. The interests of these various sectors may diverge, or even conflict. This inevitably implies a process of negotiation and compromise to resolve any conflicts of interest.

5.1 Major international conventions and initiatives

The international community, increasingly aware since the 1970s of the degradation of treed areas in the tropics, has looked for ways to check this process. An international programme to halt desertification was one result. Since the UNCED’s debates on the forest, a great many international initiatives have sprung up: the Intergovernmental Panel on Forests, the Intergovernmental Forum on Forests (IFF), the United Nations Forum on Forests (UNFF), the United Nations Framework Convention on Climate Change (UNFCCC), the Conventions on Biological Diversity (CBD), Combating Desertification (UNCCD), on International Trade in Endangered Species of Wild Fauna and Flora (CITES), etc. Many countries are now working toward viable management of forests and forest areas.

A number of mechanisms have been set up to help developing countries which are signatories to these and other conventions and agreements to fulfil their obligations. The Kyoto Protocol on climate change is one example that deals explicitly with forestry questions. It urges the parties involved to apply and/or devise policies and measures to promote sustainable methods of forest management, afforestation and reforestation. Trees outside the forest could become an integral part of these strategies.

5.2 Research, training and extension

These major initiatives paralleled the rise of the Green Revolution concept in India which hoped to solve the problem of food self-sufficiency. This experiment was basically built around crop specialization and monospecies introductions of input-dependant new varieties and the assumption that people can master the ecological environment. These new technological guidelines were accompanied by policies to stabilize and subsidize farm prices (Griffon, 1997). In some areas where ecosystems were already fragile, this extreme intensification of agricultural systems engendered serious ecological problems on vast swaths of cleared areas. Loss of soil fertility, erosion, the depletion of groundwater reserves and polluted rainwater were some of the unwelcome results.

The second green revolution learned from this experiment, adding a new objective of maintaining biodiversity and ecosystem resilience. Maximum sustainable yield was replaced by satisfactory yield at a lower economic and ecological cost. Low-input techniques and low-risk plant associations would be favoured (Griffon and Weber, 1996). This is also one of the domains of agroforestry research, especially those components designed to optimize crop/tree ecological and economic interaction (Griffon and Mallet, 1999).
The above clearly shows how trees outside the forest can provide new research orientations. It also hints at the promise of these orientations in terms of closer integration, even where TOF are part of systems that retain a certain food and socioeconomic self-sufficiency. Extension and training will certainly demand a major effort from research and development. Training curricula and extension efforts to promote trees are still too sectorial and discipline-ridden to promote integration. A much more holistic concept will be needed to embrace the concerns of all stakeholders, and to enhance individual technical capacities and management skills so as to make coherent and integrated use of wood and non-wood resources.

5.3 Dysfunctional practices and conflict-resolution

Agronomical research papers have often called attention to practices considered to be environmentally detrimental. Quite frequently “the analysis of phenomena of degradation exclusively concern (…..) the physical environment, failing to establish the link with production systems and simply citing their negative impact on the environment” (Jaubert, 1997). And yet, certain practices such as cropping on slash-and-burn lands have demonstrated the viability of the system (Vidal, 1972, quoted in Dufumier, 1996). Many papers have reported on the unsuitability of specific technology packages, not only in cost terms, but also for their detrimental impact on cultural interiorization and ecosystems. Some overly sectorial modern agronomical decisions have helped to destroy the sense of “solidarity” that once linked trees to fields.

Moreover, local practices which are attuned to home consumption and escape the production-oriented logic of the market often receive little attention from scientists, technicians and experts. They therefore tend to be sidelined by development projects as well (Boffa, 2000b). Policies tend to encourage and enhance tree-planting of species which can meet national and international economic needs. This is true of high value-added species such as gum, mango, shea-nut, teak and eucalyptus. Development strategies designed to favour particularly lucrative species can easily cause a loss of biodiversity through monospecies cropping. Biodiversity, however, should be thought of primarily as a “capital handed down by our ancestors, and managed by present populations in terms of their needs and their history for the coming generations” (Walter, 1996).

There is no question that the economic approach is often profitable, generating the foreign exchange that national economies so desperately need. It is also true that it tends to destroy traditional management methods. Frequently, traditional user rights in developing countries clash with the logic of the market. In Vanuatu, earmarking land for commercial plantations runs counter to traditional land management practices, even as access to economically enhanced resources gives rise to social conflicts among the various stakeholders (traders and users, and users among themselves) (Walter, 1996). Clashes between livestock producers and farmers in Chad are aggravated by the enhanced value of gum arabic production. When the economic value of land and the trees that grow on it shoots up, appropriation mechanisms spawning serious conflict can arise, especially in a context where resource overexploitation and poverty already go hand in hand.

Negotiations among stakeholders are essential to ensure the implementation of action to promote trees outside the forest. This will ensure that each stakeholder, in accordance with his or her priorities, will be aware of the impact of TOF on social and economic benefits and environmental quality. A case in point in the last ten years has been Niger’s
management of fuelwood markets which was designed to ensure that rural people and institutions jointly controlled the wood production sector and reaped the benefits of careful, sustainable wood exploitation (Bertrand, 1989; Montagne, 1997). A long period of deforestation and institution/user conflict in the Dominican Republic was followed by a series of NGO-led interventions during the 1980s and 1990s which sparked renewed interest in tree-planting. Many new species and techniques were proposed to farmers, and the ensuing plantations proved profitable (Gelfus, 1998). Peasants are quite prepared to adopt a new technique if it is economically advantageous, meets some demand, can be marketed and fits in with local land management. To ensure that resources will be permanent, all stakeholders in the economic and social benefits need to be able to discuss among themselves and come up with sustainable and user-friendly solutions (Box 7).

**Box 7: Negotiations among stakeholders**

Deforestation of the Maffia Valley watershed in Niger began around the year 1930. After that, the valley was desiccated every dry season by violent and persistent winds. In 1975, the Forest Service planted neem (*Azadirachta indica*) windbreaks. This fast-growing tree crop soon came to be seen by farmers as a nuisance. The subsequent and numerous questions that then arose asked who benefited from such products as posts, service wood, fuelwood, fodder, and the neem’s insecticidal fruits. People also wondered to whom the trees belonged and how they could be exploited, as well as how to reconcile effective crop protection and sustainable management of the windbreaks.

The operation, which took place on privately owned land, had been perceived as beneficial to the community in that it protected both land in the valley and the watershed environment. But the farmers were convinced that the trees and their products were the property of the Forest Service. In 1980 they demanded that branches hindering their crops be trimmed. In 1988 the foresters came up with a land use plan that provided, inter alia, for the pollarding of 35 km of windbreaks. Rules had to be hammered out for sharing the income from the exploitation of these trees (Thomson, 1992). In 1994 discussions involving most economic actors produced a set of rules, which, though not to everyone’s complete satisfaction, were temporary and could be improved over time. The administrative managers of the zone are now examining a new allocation of income to motivate the owners of the windbreaks and at the same time tackle the environmental issues.

The breakdown of traditional agrarian systems due to radical changes in farm economies is exacerbated by the mounting needs of urban agglomerations (Le Roy et al., 1996). The rates of population growth in the developing countries are among the world’s highest. In Africa the population growth rate rose to an annual average 4.1 percent (Gendreau, 1993) in 1980-85. In some African capitals, such as Dakar (Ribot, 1990) or Ndjamena (BCR, 1995), the rate is pushing 7 percent per year. Agrarian systems in rural areas close to urban centres are increasingly and visibly disfunctional. In Africa and in Asia -- Laos is one example -- the areas around big cities are experiencing loss of biodiversity and soil fertility in what could be termed a process of “savannization” (Dufumier, 1996). Deforestation due to drought, removals of wood to supply fuelwood to towns, clearing for the expansion of agriculture and grazing and the creation of industrial forest plantations are placing a grave burden on natural resources in rural areas. By 2050 most of the world’s population will be living in urban areas: the environmental stakes are therefore going to be
highest around the future mega-cities. Careful coordination between town and country is the only chance for sustainable management of tree resources (FAO, 1990; Griffon, 1997).

Decentralization policies have now been launched in developing countries and in countries in transition. Competence and responsibility is devolved to various lower levels and institutions, especially for natural resource management. Responsibility is to be shared among forest institutions, the administration and the local community. This is definitely a step forward in the direction of integrated resource management adaptable by and acceptable to the various stakeholders. The participatory approaches advocated for agroforestry and urban forestry can be extended to all TOF resources in order to negotiate the definition and implementation of economic incentives for control and regulations such as subsidies, premiums, taxes, fees, quotas, trading of carbon rights, eco-certification, and the like.

The products of trees outside the forest which have clear and strong social roles paralleling their economic role are still insufficiently targeted by private funds and the competent state, private, and group authorities. The supply of primary markets still suffers from a chronic lack of organization. Co-management by all actors is needed and this implies contractual mechanisms to be drawn up with the populations involved, and probably (though this is not easy to implement), the eco-certification of specific products.
6. Assessment

“Let us begin by reporting, listing, mapping, and the rest will automatically follow” (Couty, 1996). It seems that the world makes more sense when it is explained in figures. Once a reality is quantified and an object qualified we can begin to chart the pattern of trends and changes it engenders or undergoes. This need for hard facts and figures on natural resources is sharply felt today.

The terms assessment and inventory are often used interchangeably, but it is important to make a clear distinction between the two. Inventory is a process of quantitative and qualitative identification of a resource, whereas assessment consists of situating the data thus obtained and attributing values to the specific resource (Kleinn, 2000). The two processes are thus closely interwoven, especially for trees outside the forest. The term inventory is better applied to statistical methods, techniques and calculations for the collection of neutral and representational data, whereas assessment ties in with a more global and comparative, though subtler, approach. All in all, assessment is more realistic in terms of the diversity of local TOF situations. Assessment is based on inventory data plus geographical, ecological, economic, ethnobotanical or other data, enabling a relative or contextual value to be assigned.

A number of classic and fundamental questions arise in speaking of assessment. We want to know why, where, and for whom the assessment is being made, as well as its purpose and how to go about it. This boils down to listing the users, objectives and stakes involved in the assessment, its tools, methods and arrangements, and, lastly, its prospects.

At the present time there is no international-level assessment of trees outside the forest and their products. There are, however, a number of sectorial or geographically specific studies available. The specific approaches vary in accordance with the product, production system and scale of the analysis. It turns out that very few studies mention methods closely resembling those of the conventional forest inventory. Many have recourse to figures found in the literature and estimates drawn from surveys and interviews. The conversion of local units into standard units gives rise to inexactitude. The quantification of products is often based on different parameters: global output, marketed output, observed or potential productivity, or perhaps economic value. The upshot is a significant lack of certitude as to the reliability of the results. This is why the current data on trees outside the forest are still very fragmentary. It would be risky to compare production figures, particularly when not enough detail has been given on data collection methods, making it impossible to double-check the accuracy of the figures. Example of inventories (Boxes 9 and 10) give us a glimpse of some methods developed to gather data on TOF. They are evidence of necessary adaptations to bring conventional forest inventory procedures in line with the specific nature of this resource.

6.1 Challenges and objectives

The top priority challenge – and this is revealed in the very name “trees outside the forest” – is to know the state and dynamics of all tree resources both inside and outside the forest. A country embarking upon a planning exercise cannot confine itself solely to the trees within its forests, especially when its wood resources appear to be insufficient. Even a questionable classification of what is involved broken down by area (Table 3) shows the
many and diverse challenges with respect to current concerns that an assessment of trees outside the forest can begin to answer.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Socioeconomic</th>
<th>Ecological</th>
<th>Cultural</th>
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<tr>
<td>World</td>
<td>Supply of forest products</td>
<td>Desertification control</td>
<td>Conservation of biodiversity</td>
</tr>
<tr>
<td></td>
<td>Food security</td>
<td>Conservation of biodiversity</td>
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<td></td>
<td>Carbon sequestration</td>
<td>Carbon sequestration</td>
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<tr>
<td>Regional</td>
<td>Supply of forest products</td>
<td>Desertification control</td>
<td>Conservation of biodiversity</td>
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<td></td>
<td>Food security</td>
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<td></td>
<td>Carbon sequestration</td>
<td>Carbon sequestration</td>
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<tr>
<td>National</td>
<td>Supply of forest products</td>
<td>Land use planning</td>
<td>Conservation of biodiversity</td>
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<td></td>
<td>Food security</td>
<td>Desertification control</td>
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<td></td>
<td>Land use planning</td>
<td>Conservation of biodiversity</td>
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<td></td>
<td>Income diversification</td>
<td>Carbon sequestration</td>
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<td>Carbon sequestration</td>
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<td>Land use planning</td>
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<td></td>
<td>Food security</td>
<td>Desertification control</td>
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<td></td>
<td>Landscape management</td>
<td>Conservation of biodiversity</td>
<td></td>
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<tr>
<td></td>
<td>Income diversification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Sustainable local land use</td>
<td>Sustainable local land use planning</td>
<td>Conservation of biodiversity</td>
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<td>Food security</td>
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<td>Income diversification</td>
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<tr>
<td></td>
<td>Secure land tenure</td>
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</table>

Possible objectives of TOF assessments may aim to provide: i) data to frame an analysis; ii) data to assess the impact of land use planning policies or operations; and, iii) the acquisition of information to pinpoint the role and operation of TOF as specific ecosystems.

Two major groups of actors emerge from these objectives: policy-makers, planners and prime users, often in positions of authority, on the one hand, and on the other the hand beneficiaries, which are the rural and urban populations. Successful and useful assessments will give weight to the expectations of both. This implies seeking the best possible compromise among the representatives of the sectors directly or indirectly involved, and a careful definition of the objectives. This may seem a banal and somewhat obvious point, but it is also an essential one. Trees outside the forest are a “multipurpose and multisectorial” resource requiring a group approach: which and how much data to gather needs to be determined, and the objectives need to be set and ranked. The problem is to select realistic objectives which meet the needs of everyone involved. This crucial stage in forest resource assessments, is even more crucial for TOF, which are complex for their spatial distribution, highly diversified in terms of use and function, and highly sensitive to interaction with people. While these traits indicate what a rich and complex resource this is, they also show how very hard it is to establish a qualitative and quantitative reading on it.
The objectives and the constraints need to be defined and assessed at the same time because forest assessment even under improved modern methodologies are very complex and costly operations. Working out the right tools to lighten these procedures remains a constant preoccupation. There are aspects of trees outside the forest, such as their structure, spatial distribution, extent of area cover, and so forth, that comprise extra constraints compared to forest formations. The adaptation of the methods as of the sampling technique requires a thoroughgoing review.

Box 8: Inventory of urban trees in Hong Kong (Jim, 1989)

An inventory of roadside or urban trees is based on very detailed designs. The objectives are quite different from a rural area inventory, though they may draw upon a backlog of experience and knowledge which is then transposed and adapted. The usual target is the single tree, its morphology and especially its health status, the latter providing a marker for assessing the danger of dieback and planning for renewal or replacement.

**Objectives:** i) map the tree cover of the city, ii) analyze spatial variations in distribution of tree cover, iii) examine the interaction between types of tree cover and urban development and their implications for town planning.

**Characteristics:** Hong Kong is divided into three sectors, a) the island of Hong Kong, some 8 ha with steep hills and designated parks, b) the downtown area of Kowloon peninsula, an area of rolling hills, and, c), New Kowloon, with its steeper landforms. Most of the trees are cultivated, but there are many small clumps of trees scattered throughout the enclaves.

**Tools:** recent and old maps, large-scale (1/8 000) black-and-white aerial photos from the year 1986, older aerial missions, ground checks.

**Sampling:** Systematic centimetre grid superimposed upon tree cover maps at the 1/20 000 scale drawn up from aerial photos.

Four series of data were gathered: rate of tree cover (seven classes), spatial distribution (ten classes); type of land cover (eight categories); stage of urban growth (four phases). The first two criteria were samples at the dot grid level, and the other two at the level of the square.

**Results, products:** several types of map, land cover, urban growth trends, etc.; graphs combining the data gathered such as land cover, tree cover and spatial distribution, urban growth, tree cover and spatial distribution.

**Remarks:** this study goes far beyond an inventory in the strict sense of the term. The objective was to analyze the relationship between trees and urban transformation, not solely to supply data on individual trees in terms of species, use, or the like. The land cover map prepared from large-scale photographs is the basic working document for the sampling method. The dual use of the grid to interpret individual and surface phenomena is ingenious and might be adopted for an inventory of trees outside the forest. Trends and changes in the vegetation, which has been under study since 1945, show the major urban growth trends and place this study in a dynamic and complementary context.
A further constraint is the classification of trees outside the forest (Box 9). There are existing classifications for agroforestry, but none are applicable to all trees outside the forest (Kleinn, 2000). At the country scale, an unequivocal classification is a major element for legitimizing this resource in the eyes of the various sectors involved, such as agriculture, forestry, towns and capital development. Unless a clear distinction is made between the criteria of “land cover” and “land use”, there is bound to be overlapping and things may be left out, complicating any decisions to be taken on integrated resource management.

Box 9: Problems of TOF classification

A study (Kleinn, 1999) was made of data-gathering on the largest number of TOF categories in eight Latin American countries (Brazil, Costa Rica, Colombia, Guatemala, Haiti, Honduras and Peru). None of these countries had drawn up a register so the search for data was multi-sectorial. The statistics on land cover and land use gave some idea of the relative importance of trees outside the forest. The classification was primarily based on land use criteria. The main source of confusion came from teasing out the separate aspects of land use and land cover (a difficult task), the problem of possibly confounding coffee with cocoa plantations and trees in pasture with forest, given their high density. This clearly shows some of the problems involved in establishing a simple and reliable *a posteriori* classification.

The National Forest Inventory (NFI) and Teruti Land Use Study of the central bureau of statistical surveys and studies, in France, have begun to attempt to coordinated classifications of trees outside the forest. The objective is to eventually use the annual Teruti data to update the NFI ten-year data, with a single national nomenclature as a possible end result (Bélouard et Coulon, 2000).

6.2 Methods, tools and arrangements

The choice of tools and methods used to describe or assess trees outside the forest depends on the scale of analysis, kind of data, and degree of exactitude desired. The tools used are not generally specific or new, what is more original is the way they are combined and implemented.

6.2.1 Spatial analysis

Aerial data can be used to describe spatial distribution and distinguish TOF cover classifications, providing the appropriate scale is chosen. Satellite data are a little harder to use for mapping this resource, which tends to be spread over a wider area. But satellite data do allow a region to be stratified on the basis of ecological criteria and land cover, providing the basis for a good working document for more specific later work. The new one-metre resolution sensors represent a possible future alternative to aerial photography.

6.2.2 Field inventory

Some inventories are modelled on forest inventory methods and hold to biological and physical criteria, others give pride of place to the social aspects, choosing villages as the sampling units. For measurements on the ground, sampling arrangements designed for forests may not be the most effective ones for TOF, in that the trees involved may be
growing in clumps, as single trees, or in rows, quite a different situation from that of forest stands. Less traditional sampling plans which would theoretically be better suited to this resource should be tested on the various categories of TOF, especially those covering fairly large areas.

6.2.3 Sociocultural and economic approach

Here we move from the concept of inventory to that of assessment, which amounts to rounding out the inventory and placing it in a context. The fundamental thing here is knowledge of popular usage and practice. Different data-gathering procedures are used, ranging from interviews to the more or less standardized surveys such as the rapid Rural Appraisal and the Participatory Rural Appraisal.

**Box 10: Inventory of village forests (homestead/village forests) in Bangladesh**


**Objective**: Implementation of community and participatory social forestry programmes.

**Characteristics**: Trees outside the forest constitute a vital resource for local populations, providing food, fodder, fuelwood, and so forth, in Bangladesh where natural forest formations cover less than 6 percent of the country and the population growth rate is extremely high (FAO, 1993a).

**Tools**: agro-ecological and administrative stratification, inventories and surveys.

**Sampling**: The method is based on dual village/household sampling with an agro-ecological and administrative sampling base.

Rural Bangladesh was divided into six major regions considered as agro-ecological strata. Each stratum is subdivided into *thanas* (administrative entities, sub-districts). The households making up the sampling units were chosen at random from a number of villages. The organization of the inventory is based on six “Farming System Research” units located in each agro-ecological zone, working within a circle 3.2 km.

The inventories are not limited to forest resources such as trees, bamboo and thickets, but also sample data on palm trees and cane. The results, expressed per stratum and per inhabitant, provide volumetric data for fuelwood and sawnwood, and species data (all species lumped together) for total amounts under and over 20 cm.

**Remarks**: this village forest inventory is apparently the first to have undertaken a nationwide assessment of trees outside the classified forests. Village sampling is a good solution for taking stock of production, consumption, sales…and, in this case, fuelwood. It is also appropriate for weaving into the inventory those socioeconomic data that can be helpful in drawing up a forest development plan.

The integration of the last two approaches, the biophysical inventory and the socioeconomic analysis, is not simple and calls for some caution given the great variety of social situations which are only meaningful in the local context.
6.2.4 The environmental approach

Assessments of the environmental services of trees, many still at the study stage, are embryonic at this point. However, environmental benefits can be indirectly assessed by linking easily measurable indicators with environmental variables, such as crop yields by distance from windbreaks. The impact of trees on the environment is only expressed over time as trees grow relatively slowly and ecosystems are resilient. Measuring the environmental impact of tree management thus remains a problem common to all natural resource planning or management operations. Scientists should give greater consideration to the development of more easily implemented procedures.

6.2.5 Data analysis

A reasonably complete assessment of trees outside the forest requires geographical, ecological, biophysical, social and economic data, \textit{inter alia}. The problem lies in the relevant and simplified utilization of this mass of data. This dimension has to be tackled at the design stage, even though nowadays computers, software and skilled operators can organize, structure and store much of the data for later access in a user-friendly fashion. Both the results and their presentation are used to establish analyses and for land use planning based on an inventory. Data assembly and processing also need to consider the diversity of requests from different users. It is preferable to assemble the data in the form of maps or graphs. These modes of visualizing the results offer an expressive and sound way to complement a series of tables.

6.3 Assessment of the changing patterns of trees outside the forest

It is important to know the status of trees outside the forest at any given moment in time, but it is even more essential to be able to trace patterns of change over time in the same area. The two preferred approaches up to now have been to compare aerial photos taken at sufficiently long intervals, and surveys among villager/managers combined with field inventories. When we know how trees outside the forest have evolved over time we can make a retrospective assessment of the changes involved, such as increase or decline, amounts, location, and the like, so as to tease out the relevant trends and see how the pattern has varied over time, combining the data obtained with historical data of a political, social and economic nature.

Some countries, such as France and the U.K., have undertaken periodic inventories based on the establishment of permanent plots linked to permanent forest inventories. The stakes here are obvious, but the high cost of this type of operation limits the number of countries able to adopt it. India and Bangladesh are now experimenting with more suitable options for the future.

Many countries should make it their ambition to set up organizations to conduct such exercises, in an attempt to meet the various challenges of TOF assessment. The current trend toward decentralized authority in land use planning combined with other world trends are an incentive for anchoring such organizations at the local level, where the geographical, historical and socioeconomic context is relatively harmonious. A minimum number of common rules concerning methods and arrangements are necessary, however, if the data are to be comparable at the country level.
Certainly, the technical side of assessing trees outside the forest is complex, and more research is needed to better pinpoint the resource. But it is just as important, if not more so, to revisit – or rather to evolve from, a more sectorial stance in the direction of a truly integrated approach to TOF systems.

**Conclusion**

Trees outside the forest have only recently made their appearance on the development stage, as interest mounts among policy-makers, planners and managers for this very ancient resource which has been part of the daily context and culture of rural populations since time immemorial. Much remains to be done in terms of work and discussion before trees growing in non-forest areas can be considered an integral part of planning and development policies. One *a priori* is an exact definition of their domain of application, especially with respect to land, unequivocal classifications covering all sectors and disciplines, and the relevant analytical criteria. We need a working definition that can change with time and circumstances to fit the quick changes inherent in the highly influential economic, ecological, social and cultural dimensions of this resource. An exact definition will facilitate the work of framing laws that are neither sectorial nor contradictory, incorporating rights of ownership, use and access for land and trees. The laws now on the books must be reformed and made more flexible so that all stakeholders can have a hand in managing tree resources, with less regard for the market and a more tangible slant toward sustainable development. This will provide greater guarantees of land tenure and user rights for trees growing outside forest areas, especially for sectors of the population such as women whom tradition has long sidelined.

The database on trees outside the forest, though fairly substantial, is still rather fragmented, too diffuse, sometimes empirical, and all too often sectorial. What we need to envisage is an effort to capitalize on this database aimed at analyzing the true contribution of this resource to economic supply, social demand, ecosystem maintenance and the enrichment of our human legacy. Inventories and assessments of TOF resources based on reliable and accessible methods are the essential underpinning of land use planning. Strategies to promote and support trees outside forest areas need to address the importance of sustainability even as they seek to maintain the traditional advantages to populations whilst expanding opportunities for new benefits from this resource.

In a context of food insecurity and impoverishment, the trend towards devolution in which resource management is put into the hands of local communities should be regarded as a golden opportunity to promote natural resource conservation and sustainability in the form of local community control over wood resources, more responsibility on the part of users, and decision-making that embraces the interests of all stakeholders. Genuine, solid participation on the part of the populations concerned is another requirement. It should tap local lore and knowledge, act to resolve conflicts rising out of resource use and appropriation, give structure to the commercial side of the equation and negotiate the necessary arrangements among stakeholders.

These discussions and guidelines are of concern to the entire world, whether the matter at hand is awareness-building, the assumption of greater responsibility, discussion and agreements, contractualization, the adaptation of new codes or the updating of existing laws and codes for greater relevance, or the extension of appropriate techniques, suitable
research and development, and training for all actors. Where the final goal is sustainability, we need to appeal to the interests of economic agents, farmers, livestock producers, local authorities, and associations to breathe new life into a genuine dynamics of sustainable and integrated management of trees outside the forest.
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ANNEXE
### Annexe I : Forest Resource Assessment Program Definitions (FAO)

<table>
<thead>
<tr>
<th>Class</th>
<th>Definitions</th>
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<tbody>
<tr>
<td><strong>Total area</strong></td>
<td>Total area (of country), including area under inland water bodies, but excluding offshore territorial waters.</td>
</tr>
<tr>
<td><strong>Forest or Forest land</strong></td>
<td>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 metres (m) at maturity <em>in situ</em>. May consist <em>either</em> of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or 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. <em>Includes</em>: 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. <em>Excludes</em>: Land predominantly used for agricultural practices.</td>
</tr>
<tr>
<td><strong>Other wooded land</strong></td>
<td>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 <em>in situ</em>; 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 <em>in situ</em> (e.g. dwarf or stunted trees); or with shrub or bush cover of more than 10 percent.</td>
</tr>
<tr>
<td><strong>Other land</strong></td>
<td>Land not classified as forest or other wooded land as defined above. <em>Includes</em>: agricultural land (including meadows and pastures), built-on areas (human settlements), bare lands, ice and eternal snow.</td>
</tr>
<tr>
<td><strong>Inland water</strong></td>
<td>Area occupied by major rivers, lakes and reservoirs.</td>
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<tr>
<td><strong>Trees outside the forest</strong></td>
<td>Trees’ on land not defined as forest and other wooded land. Includes (not exclusive):</td>
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<tr>
<td></td>
<td>• Trees on land that fulfils the requirements of forest and other wooded land except that:</td>
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<tr>
<td></td>
<td>(a) the area is less than 0.5 ha;</td>
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<tr>
<td></td>
<td>(b) trees able to reach a height of at least 5 m at maturity <em>in situ</em> where the stocking level is below 5 percent;</td>
</tr>
<tr>
<td></td>
<td>(c) trees not able to reach a height of 5 m at maturity <em>in situ</em> where the stocking level is below 10 percent;</td>
</tr>
<tr>
<td></td>
<td>(d) trees in shelterbelts and river galleries of less than 20 m width and below 0.5 ha area.</td>
</tr>
<tr>
<td></td>
<td>• Scattered trees in permanent meadows and pastures;</td>
</tr>
<tr>
<td></td>
<td>• Permanent tree crops, orchards and “prés-vergers” such as industrial fruit trees, coconuts trees, palm trees;</td>
</tr>
<tr>
<td></td>
<td>• Trees of agroforestry systems such as coffee, cocoa, homegarden, agroforest;</td>
</tr>
<tr>
<td></td>
<td>• Trees in urban environment (human settlements) and infrastructure environment such as parks and gardens, trees around buildings and in lines along streets, roads, railways, rivers, streams and canals.</td>
</tr>
<tr>
<td><strong>Tree</strong></td>
<td>A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definite crown. <em>Includes</em>: bamboos, palms and other woody plants meeting the above criterion.</td>
</tr>
<tr>
<td><strong>Shrub and bushes</strong></td>
<td>Woody perennial plants, generally of more than 0.5 m and less than 5 m in height and without a definite crown.</td>
</tr>
</tbody>
</table>

*7 Trees: include trees and shrubs; forest and non-forest species.*