

Mexico's Forests Sector and Policies: A General Perspective

by Gerardo Segura

Instituto de Ecología, Universidad Nacional Autónoma de México, UNAM.
Cd. Universitaria. 04510, México D.F. México.
e-mail: segura@servidor.unam.mx

I. Introduction

Mexico has more than 141 million ha of forests and wildlands that have broad national and international importance. Biologically Mexican forest ecosystems bear 10% of the world's biological diversity, are stabilizing elements in soil and water regimes and can play an important role in the global carbon balance; commercially, they are a source of important timber and non-timber products for domestic or international consumption; and socially they are a source of a range of subsistence products used by many rural indigenous and non-indigenous peoples.

Despite their importance, forests have not been conserved or managed sustainably. In the last two decades Mexico has experienced one of the largest deforestation rates of Latin America and its forest sector is undergoing a severe crisis, in which production has severely declined, and imports have increased significantly. Although the reasons of this crisis have complex social, economic and political roots, negative impacts are currently being exacerbated by a lack of competitiveness of Mexican forest products in international markets after active policies to liberalize the economy were put in place in the early 1980's, and particularly after Mexico joined the GATT and NAFTA. These present conditions are reducing incentives to a sustainable use of forests, which could have serious negative implications for their long term conservation.

The purpose of the present document was to integrate a comprehensive analysis of the current state of Mexico's forest resources management and conservation, and identify alternatives for regional cooperation in forest ecosystems conservation. The document analyzes in detail the major environmental, economic, social and political issues affecting the use of forest resources, it also reviews the history of policies and explores potential effects of trade on the forest sector, and finally identifies areas where regional cooperation could have important contributions to the sustainable management and conservation of forest ecosystems. An important effort was made to integrate and synthesize widely dispersed information in a form not reported elsewhere.

II. Key Mexican Forest Habitat Issues

A. Current state of forest ecosystems

1. Forest cover

Forest ecosystems and wildlands cover more than 140 million hectares representing 72% of the national territory. These forests include a wide range of forest types that can be summarized in four major categories: temperate coniferous and broadleaf, tropical evergreen, semi-evergreen and deciduous, arid and semiarid, and wetlands (Table 1).

Table 1. Forest cover by forest types

Forest Type	Land cover (million ha)	Percent of territory
Temperate (coniferous, broadleaved and cloud forests)	31.8	16.1%
Tropical (evergreen, semi-evergreen and deciduous)	23.5	12.0%
Arid and Semiarid (scrublands, deserts and grasslands)	58.5	29.7%
Wetlands (aquatic and sub-aquatic vegetation and mangroves)	4.9	2.5%
Other associations	0.8	0.4%
Degraded forest areas	22.2	11.3%
Total	141.7	72%

Source: SARH, Inventario Nacional Forestal Periódico, 1994.

Temperate and tropical forests cover more than 55 million ha (25% of total land), 32.5 of these are classified as closed forests and 22.9 as open forest. Temperate forests, which include mixed coniferous, broadleaved and cloud forest types cover 21, 9.5 and 1.4 million ha respectively and are distributed along the most important mountain ranges (Sierra Madre Oriental, Occidental, and del Sur, and Eje Neovolcánico), mainly in the states of Chihuahua, Durango, Michoacán, Jalisco, Guerrero and Oaxaca. Tropical forests include tropical evergreen and semi-evergreen types (5.8 million ha), of which 80% are located in the states of Campeche, Chiapas, Oaxaca, Quintana Roo and Veracruz; and tropical deciduous types (11 million ha) mainly occurring in coastal plains of the Pacific Coast, the Isthmus of Tehuantepec and the north of the Yucatan Peninsula (Fig. 1).

In addition, there are extensive areas of fragmented tropical forests that add up to 6.7 million ha mainly located along coastal areas and the Yucatan Peninsula.

2. Biodiversity

Mexican forest ecosystems represent a highly valuable global biological resource. They contain most of the biodiversity that makes Mexico a megadiversity country, ranking in 4th place with 10% of the world's species (Table 2).

Table 2. Species diversity and endemism in Mexico

Species Group	No. of Species	Endemism	World Rank
Flowering plants	30,000	40-50%	N/A.
Pines (<i>Pinus</i> spp)	55	85%	1°
Oaks (<i>Quercus</i> spp)	138	70%	1°
Reptiles	707	56%	1°
Mammals	439	33%	2°
Amphibians	282	62%	4°
Birds	980	12%	7°

Source: Flores Villela and Gerez, 1988.

Both temperate and tropical forest offer habitat conditions for a large number of wildlife species of plants and animals. A large percent of this diversity occurs in forests such as the pine-oak forest, which are the most diverse in the world in its kind, with 55 species of pines and 138 species of oaks. Temperate cloud forest which cover only 1% of the territory contain more than 10% of all plants species in the country. The highest species diversity is concentrated in the south and southeast regions, particularly in the states of Oaxaca and Chiapas. Mexico also offers habitat conditions for 51% of all migratory birds from Canada the United States, many of them using forest habitats during six to nine months of the year.

3. Social conditions

Of the total country's population of 91.6 million, 23 million live in rural areas, and of these approximately 10 million people live in forest areas (CONAPO 1996). Population growth has increased exponentially since 1950; the current national growth rate is 2.0% (Fig. 2). Average growth in rural areas in the last 20 years has been 2.4% compared to 4.7% of urban areas. Although rates of migration from rural forest areas to urban centers is not available, the large difference between rural and urban growth rates suggests migration is high in some regions. In states with important forest resources such as Michoacán, Oaxaca and Guerrero, overall rural to urban migration rates were more than 15% during this same period.

Most forest lands are under one form or another of communal property and only a smaller proportion is under private and federal ownership (Fig. 3). A large percent of rural communities in forested areas belong to native indigenous groups and many of them are below average poverty levels, where their basic subsistence needs have been poorly internalized by the country's economic system. Poverty is mainly concentrated in the southern states of Chiapas, Oaxaca and Guerrero, while northern states like Chihuahua and Durango are relatively prosperous. Of a total of 8,417 rural communities with forest resources (28% of all rural communities) in only 421 forestry activities represent the major economic activity and most of these are concentrated in the states of Chihuahua (99) and Durango (122).

Forests represent an important source of a range of subsistence and informally marketed products for these communities. The most important products obtained from forests include firewood, food, medicinal plants, and construction materials. More than 2000 plants species associated to forests have been identified to have local uses (Bye 1993). Fuelwood is the main source of energy for cooking and home heating in many rural areas and its national consumption has been estimated at 37 million m³/year (Masera 1993). Forests are also important areas for grazing, and in tropical areas are also used in rotation in the traditional slash and burn agricultural systems.

4. Protected areas

There are five major categories of protected areas that cover 10.3 million ha and represent 5.2% of the national territory. Of a total of 83 areas, 44 are National Parks, 18 are Biosphere Reserves, 18 are Special Biosphere Reserves, 8 are Protection Zones for Flora and Fauna, and 3 are National Monuments. Although not evenly represented, there are protected areas in all major vegetation types occurring in the country (Table 3).

Table 3. Natural protected areas by vegetation type and percent of total land area (Thousand ha)

Category ^(*)	Type of Forest					Total area	Percent of total land area
	Temperate	Tropical Humid	Tropical Dry	Arid and Semi Arid	Wetlands		
National parks	585.6	94.6	3.4	4.5		688.1	0.4
Biosphere Reserves	406.2	942.7	903.6	4 852.8	447,574	7,552.9	3.9
Special Biosphere Reserves	16.1	72.2	227.8	175.1	176.0	491.3	0.2
National Monuments	6.0	7.0				13.0	0.008
Flora and Fauna Protection Zones	245.7	12.2	243.2	361,556	705.0	1,567.6	0.8
Total area	1,260.7	1,128.8	1,377.9	5,393.9	1,152.8	10,312.9	5.3
Percent of total land area	0.6	0.6	0.7	2.8	0.6	5.3	

Source: Instituto Nacional de Ecología, 1995

^(*) National Marine Parks and Forest Protection Zones are not included

The first protected areas were decreed in the early 1930's. Between 1930 and 1970, however, the total area under protection increased marginally. It was not until the late 1970's when an important number of new areas were decreed. This trend has continued in the last two decades when the total area under protection has increased from 1.4 to 10.3 million ha since 1970 (Fig. 4).

Although the national system of protected areas (SINAP) has become a government priority during the current administration, several problems related to their effectiveness in conservation and administration still remain. An important limitation of these areas is that their average size is small (1000 and

2000 ha) to sometimes ensure adequate protection. Also, these areas do not adequately represent the country's geographic zones and ecoregions, and many important areas with high biodiversity and endemism are still not included in the system. Major administrative problems of most reserves include low enforcement, lack of boundary demarcation and definition of property rights, which induces problems of open access, absence of adequate management plans, and lack of institutional and financial support to carry out management activities. For these reasons very few of the national protected areas have been officially recognized by groups such as the International Union for the Conservation of Nature and Natural Resources (IUCN), which question that an effective protection of biodiversity is occurring.

5. Deforestation

There are controversies over the estimates of rates of deforestation in Mexico. Rates range from 370 thousand to 1.5 million ha/year for the decade of the 1980 (Table 4). These discrepancies result from studies with different objectives, methodologies, definitions of deforestation, and forest cover types considered. Probably the closest estimates are in the range of 620 to 680 thousand ha/year reported by FAO and other independent sources.

Table 4. Reported rates of deforestation by forest type.

Source	Temperate Forests	Tropical Forests	Arid and Semi Arid Vegetation	Total
Toledo et al. 1989 ^a	N/A	N/A		1500
Repetto 1988	N/A	460	N/A	460
Myers 1989	N/A	700	N/A	700
FAO 1988	125	470	20 N/A	615
FAO 1995	N/A	N/A	N/A	678
WRI 1992	N/A	N/A	N/A	615
WRI 1994	N/A	N/A	N/A	678
SARH 1990 ^b	127	202	41	370
SARH 1991	127	189	54	370
Castillo et al. 1989 ^c	273	473	N/A	746
Masera et al. 1992	273	501	N/A	668

Source: Masera, 1996.

N/A not available

^a Includes deforestation in closed and open forests

^b Adjusted to exclude open forests. The official rate was 370,000 ha/yr.

^c Corresponds to annual averages of projected deforestation rates for the period 1988-1994.

The main causes of deforestation vary among regions and forest types (Table 5). Forest land conversion to agriculture and livestock activities have been the dominant force of deforestation during the last three decades in all regions and forest types. Between 1970 and 1990, agricultural lands increased in 39% and the area dedicated to pasture increased in more than 100%, while forests declined in 13%. Other important cause of deforestation include insects and diseases and forest fires, which in most cases are initiated by peasants to increase grass re-sprouting for grazing in areas adjacent to forests. Although

highly variable, the annual average area affected by forest fires exceeds 200 thousand ha, while insects and diseases destroy around 33 thousand ha/yr.

Table 5. Deforestation rates and main causes

Forest type	Deforestation		Main causes (1)
	Thousand ha/yr.	%/yr.	
Temperate coniferous	108	0.64	Forest fires, grazing, Illegal logging, agriculture
Temperate broadleaf	59	0.67	Forest fires, grazing, Illegal logging, agriculture
Tropical evergreen	195	2.00	Grazing, agriculture, Infrastructure, forest fires, Illegal logging
Tropical deciduous	306	1.90	Grazing, agriculture, Illegal logging, forest fires.
Total	668	1.29	

Source: Masera et al., 1992.

(1) In order of importance

Significant deforestation has occurred since the beginning of the century but was more severe during the decade of the 70's and 80's. Although the current deforestation rate appears to have declined in the 1990's, mainly as a result of a reduction in profitability and competitiveness of agricultural and livestock activities, the current annual loss of tropical forests is estimated to be between 189 and 500 thousand ha (0.8% to 2%), in temperate forests is between 127 and 167 thousand ha (0.5% to 0.8%), and in arid and semi-arid regions it reaches 50 thousand ha. These current patterns of deforestation result in important amounts of carbon emissions.

Table 6. Carbon emissions from deforestation and energy use (*)

Source	Mt / yr.	Percentage
Energy	74	56.92
Deforestation and forest fires	53	40.77
Cement manufacturing	3	2.31
Total	130	100

Source: Masera, 1992.

(*) Base year is 1985.

B. The forest sector in the National economy

1. Economic value of Mexican forests

a. Timber products

Of a total of 32.5 million ha of closed forests, 21 million ha have been identified as commercial. Of this total, only 7 million are under management yielding an average of 7.5 million m³/year with a global annual increment of 33.4 million m³ (Table 7). The National Periodic Forest Inventory of 1994 reports a

total standing volume of 2800 million m³; of which 1,800 million is from temperate forests and 1000 million is from tropical forests (Fig. 5).

Table 7. Standing volume and increment by forest type

Forest type	Standing volume		Annual increment	
	million m ³	%	million m ³	%
Temperate	1,821.9	65	25	74.9
Tropical	981.1	35	8.4	25.1
Total	2,803.0	100	33.4	100

Source: SARH, Inventario Nacional Forestal Periódico, 1994.

Productivity of commercial forests vary widely depending on the region and the type of forest. Conifer forests of Chihuahua and Durango, where more than 50% of commercial forestry takes place, yield between 1-3 m³/ha/yr but under a more intensive silviculture, productivity can increase to 5-7 m³/ha/yr. Conifer forests in central and southern states like Jalisco, Michoacán, Oaxaca, Puebla and Veracruz, in areas with warmer and more humid climates produce up to 10 m³/ha/yr, and up to 15m³/ha/yr with more intensive silviculture systems. Despite of this important potential, the national average productivity is 1.3 m³/ha/yr, which is 3.5 times less than that reported for the US and 2.3 times less that that of Canada.

b. Non-timber forest products

In addition to timber products, Mexican forests are also a source of a large number of important non-timber products. There are more than 250 of these products that have an important local or regional economic value (CONAF 1996).

Plants associated to forest ecosystems used for food, medicine, grazing and industrial purposes (e.g. resins) have been estimated to produce 2.77 million tones (World Bank 1995). The most important non-timber forest products for which a formal market exists are wild mushrooms, resins, some medicinal plants, palm leaves and *chicle*. Palm leaves and *chicle* generate an annual average of 20 and 2.8 million US dollars respectively. It has been estimated that a total income of 1,500 million US dollars is annually generated in formal and informal markets of non timber products in Mexico (World Bank 1995) .

Native forests also contain more than 613 species of plants with potential market value that could generate 1.17 metric tones of products with a value of more than 500 million US dollars, while tropical forests, with 574 species, could produce 1.6 million metric tons with a value over 700 million US dollars. Major limitations to use these products commercially include a lack of information on the resource base, poor management techniques, and absence of formal markets for their commercialization.

c. Commercial Plantations

Although commercial plantations are scarce in Mexico, recent efforts have been made by the government to promote investments in this activity, mainly to increase production of pulp and paper products to respond to the rapidly increasing demand for these products.

More than 8.1 million ha have been identified with appropriate soils and climate conditions to bare commercial plantations. Most of these areas are currently under marginal agricultural and livestock use. The regions with the largest potential are located in the northern (Chihuahua and Durango), central western (Jalisco and Michoacán) and southeastern (Tabasco, Campeche, Veracruz and Chiapas). This last region, which is basically tropical, contains more than 5 million ha with adequate conditions for fast growing local and exotic species. For example, an average productivity of 35 m³/ha/yr. Has been estimated for tropical eucalyptus in Tabasco and Campeche, which is comparable to some of the most productive eucalyptus plantations in Brazil and southeast Asia.

d. Other environmental values

Values such as watershed protection, tourism, recreation, carbon sequestration, and potential pharmaceutical and food products are important environmental values that have not been adequately internalized in the country's formal market economy. A rough estimation of the values that some of these services could represent if more formal markets existed has been recently estimated by the World Bank (1995). The role of forest ecosystems to sequester and conserve carbon pools, for example, could represent an estimated value of 650 to 3,400 US dollars/ha. Ecotourism and recreation could generate an annual income of more than 30 million US dollars. And the potential future value of pharmaceutical and food products could be in the range of 26 to 4,600 million US dollars/yr.

Water is a scarce resource in Mexico and its consumption has significantly increased in the last three decades both in rural and urban areas. Forests play an important role in determining the amount and quality of water produced in most watershed areas of the country that feed water to urban areas as well as reservoirs for irrigation and dams for generation of electricity. Although not yet quantified, the value that forests represent in generating these environmental services needs to be properly evaluated and internalized in the local economy.

2. The market of forest products

The forest sector has substantially reduced its participation in the GNP during the last decade. Only Between 1987 and 1994, forest industries registered a 16% decline, which represented a reduction in its contribution to the national GNP from 1.3% to 1% (7.7% of the of the GNP of the agricultural

sector). In contrast, the contribution of the agriculture and livestock sectors increased in 0.5% during the same period. Employment in the sector has also shown a tendency to decrease. Between 1987 to 1990, for example, more than 12 thousand jobs were lost in the sector.

Although forests production has increased substantially since the early 1950's, during the last eight years it has dropped from 9.8 to 6.4 million m³ (Fig. 6). In contrast, the volume of imports almost quadrupled in this period going from 0.544 to 1.899 million m³, while exports did not increase at the same rate (Fig. 7). This increase has raised the negative trade balanced from 356 to 1,743 million US dollars; 80% of this belonging to pulp and paper products alone. As a percentage of the total national production, the participation of imports of timber products alone increased from 6.1 to almost 30% in this period

More than 80% of forest production is concentrated in 5 states (Durango 30%, Chihuahua 16%, Michoacán 17%, Jalisco 8%, and Oaxaca 7%). Of this total, around 90% is from conifer species (mainly pines), 7% is from temperate hardwoods (mainly oak) and only 4% is from tropical hardwoods (mainly mahogany and cedar). Recent trends in consumption by forest product are illustrated in table 8.

Table 8. Total forest production, imports, exports and apparent consumption for the period 1987-94 (million m³/yr.)

	1987	1988	1989	1990	1991	1992	1993	1994
Total forest production	9.791	9.314	8.888	8.166	7.683	7.682	6.346	6.407
Pulp and Paper	2.664	2.591	2.349	1.965	1.631	1.593	1.185	1.006
Imports	2.633	1.283	1.879	2.282	2.690	2.716	2.857	3.427
Exports	0.263	0.289	0.184	0.279	0.211	0.241	0.118	0.191
Apparent consumption	5.064	3.580	4.040	3.968	4.110	4.068	3.924	4.242
Others timber products *	7.127	6.723	6.539	6.201	6.052	6.089	5.161	5.401
Imports	0.173	0.493	0.540	0.826	1.211	0.986	0.675	0.347
Exports	0.829	0.955	1.092	0.692	0.517	0.267	0.116	0.146
Apparent consumption	6.471	6.261	5.987	6.335	6.746	6.808	5.720	5.602

Sources: Cámara Nacional de la Industria Forestal, 1992.

SEMARNAP, Dirección General Forestal, 1995.

Includes all timber forest products except for pulp and paper

C. The productive process

1. Social organization for production

Since forest lands are mainly under communal ownership, the modes in which communities are organized to manage their forests is of great importance to ensure production and competitiveness in an open market economy. The efficiency of the forest community enterprise is a function of the degree of

internal organization of the community, and is related to the importance that the forest resource represents for them. All decision related to the forest community enterprise are collectively made in community councils integrated by authorities and other representative members of the community. Based on their level of organization for managing their forests and the type of resource they have, communities can be classified in the following large categories :

- Indigenous and non indigenous communities that have adjusted their social structure to integrate competitive forest enterprises, similar to those of the private sector (5%).
- Indigenous and mixed communities with relatively good forest resources but with strong social constraints to constitute and efficiently manage their community enterprise (30%).
- Indigenous and non-indigenous communities with relatively poor forest resources, that would have to limit their income from the forest, but where in some cases non-timber benefits may represent an important alternative (60%).
- Indigenous communities with a history of slash-and-burn or agroforestry-based farming systems, mainly located in the tropical regions (5%).

Open access to their forest resources is an important problem common to most rural communities, particularly in highly populated areas and where forests are close to towns or well communicated areas, that leads to forest degradation and deforestation. The main causes that exacerbate this problem are related to insecurity in land tenure rights, mainly derived from conflicts of boundary demarcation; internal divisions of mixed-indigenous and non-indigenous communities, associated with conflicts around social organization, and cultural and ethnic issues; and conflict of interests over management objectives.

2. Forest management and silviculture

Forest management both in temperate and tropical forests has been generally inadequate for the type of forest. Since the end of the 1950's and until the mid-seventies a single silvicultural system was mandated by law for any type of forest management in the country. This system consisted on polycyclic, selective, diameter-limit harvesting regardless of the forest's species composition or ecological characteristics. This method was intended to conserve the country's forests by controlling the rate of harvesting, but it was not derived from an understanding of the ecology of the forest. As a result, this system has limited natural regeneration of commercial species and induced severe high-grading of the forests that results from the systematic harvesting of

the largest and best quality trees, assuming that remaining trees will respond to treatments by attaining maximum growth rates.

After the mid 1970's the application of silvicultural regimes was deregulated, and new and more intensive silvicultural methods, focused on even-aged management and natural regeneration, have been developed and successfully applied in many temperate coniferous forests of the country. Unfortunately the old selective cutting system is still being applied in 57% of the country's managed forests causing important changes in the forests species composition and reducing their natural capital and productivity.

As in other tropical forests of world, no effective silviculture systems for timber production has been developed to ensure sustainability in Mexico. One of the main complexities of sustainable management of these forests is the large diversity of tree species of which only a small proportion has commercial value. The natural capital of the forest is mainly reduced to the volume occupied by a handful of species that rarely exceeds 10% of the total stand volume and on which the economic viability of the forest is based. These forests have also been managed under selective cutting methods. As in the case of most pine species in temperate forests, the most important commercial species of these forests (e.g. mahogany and cedar) require abundant light to regenerate. Since selective cutting systems usually do not create large enough openings in the canopy to generate these conditions these species tend to be eliminated from the forest canopy. Areas with reduced volumes of commercial species have less value to their owners and tend to be converted to other uses such as cattle ranching and agriculture.

3. Transportation

Transportation of forest products from the forest to timber or pulp mills and from these to local or regional markets is one of the most important bottlenecks limiting the profitability and competitiveness of forest products in Mexico. Road infrastructure is generally poor and inadequately maintained by the government. This situation contrasts with that of the US and Canada where governments have developed and effectively maintain an efficient road network in forested areas. The lack of government support on road infrastructure has forced many forest landowners to invest in these activities at the expense of significant increase production costs of wood products.

4. Forest industry

Most forest industry is small scale and dispersed throughout the country. Of a total of 2,612 installations, 1,659 are sawnwood and lumber mills, 659 woodbox plants, 14 impregnation plants, 32 plywood mills, 9 particle board plants, 2 fiberboard, 13 resin-processing plants and the rest are smaller scale shops. Industry is mainly located in the northern states of Durango, Chihuahua and Michoacán. The industrial base includes a modern pulp and paper industry that satisfies less than 50% of the national demand.

The majority of timber industries are small scale, old, inefficient and poorly located. These industries have a total installed capacity to transform 10 million m³/year, the average capacity of these industries, however, is only 7,600 m³/yr. This situation contrasts with that of the US and Canada where a medium size timber mill has an average capacity of 47,000 m³/yr.

The installed capacity of timber industries is also inadequate in relation to the potential production in each region. The state of Chihuahua, for example, has the largest installed capacity of the country (30.2%), which is 75% larger than its annual projected forest yield. This means that the Chihuahuan industry is only processing 45% of its local industrial capacity, and is either being under-used or having to import round wood from other regions. In contrast, states like Durango and Oaxaca have an installed capacity inferior to their annual yield which limits them to consume only 64% and 47% of its local production respectively.

5. Commercialization

Another important element in the production process that has influenced the competitiveness of forest products in Mexico has been associated with the strategies of marketing and commercialization, both local and regional. The major problems forest producers face can be summarized as follows:

- Lack of general information systems on production volumes, stocks and prices both at local and regional scales. This has prevented the development of local marketing systems as well as a national system that warranties supply.
- Lack of formal certification mechanisms, and official commercial measurement norms of forest products that are compatible with those of the country's mayor trade partners.
- Lack of a classification system of wood quality.
- Insufficient trade protection mechanisms, particularly with countries with which Mexico does not have commercial agreements.

III. Historical Background of Forest Policies and Management Activities

The economic and environmental value of forest has been traditionally underestimated throughout colonial and post-colonial history. After the constitutional reform of 1917 and the agrarian reforms that followed the revolution of 1910, government policies to develop rural areas focused on agriculture and livestock activities ignoring the potential of forestry activities. In

addition to policies of the sector, the policies that have influenced the development of the forest sector, those related to land tenure and the agriculture and livestock sector have had the most influence.

A. Land tenure

Land rights were defined in the 1917 constitution allowing three types of property: *ejidos*, communal property (*comunidades*) and small property. *Ejidos* constitute a land grant for usufruct to a community of peasants (*ejidatarios*). Until the constitutional reforms of 1992, *ejido* lands essentially belonged to the state and could not be sold. Communal property is similar to the *ejido* but social organization is based on historical rights of pre-Hispanic indigenous communities who have maintained their traditional communal property structure. Small property is privately owned and is subject to size limits according to quality of land and type of land use. Since most of the country's forest lands are under either *ejido* or community property, community forestry is the major type of organization for production.

Following the agrarian reform of 1934 large areas of land were allocated to peasants under the *ejido* regime promoting the occupation of forest lands. This process was oriented to occupy the best agricultural lands and ignored forest lands, thus promoting the conversion of forests to agriculture or livestock use. In many cases such conversion was a condition for approving land grants to peasants. Even after a new constitutional reform in 1947 that mandated ambitious government programs of land allocation and demarcation, forested lands were not considered.

Under the *ejido* and communal property structure, property rights were defined clearly in agriculture and livestock lands by allocating well demarcated parcels to individual *ejido* or community members. In contrast, forest lands were assigned for informal community use and thus were not parceled, and in most cases not even demarcated. The frequent presence of boundary conflicts caused by this situation has encouraged over-exploitation of forests along boundaries even among the most organized forestry based communities.

The lack of clear tenure allocation over forests, in addition to the absence of formal markets for land in *ejido* and communal property areas has created serious problems of open access and an underestimation of the value of land in general. This situation has induced important incentives for deforestation and degradation of the resource base.

B. Agriculture and livestock policies

An aggressive expansion of the agricultural frontier took place after the 1910 agrarian reform, particularly between 1940 and 1970 (Fig. 8). During this period the sector grew at an annual rate of 4%, which was higher than any other country in Latin America and exceeded the local population growth rate. After the best lands for agriculture had been occupied, and productivity could not be

increased significantly, this rapid growth rate could not be sustained. Between 1965 and 1980 the growth of the sector declined to 2.8%, which was below the rate of population growth and as a consequence Mexico became a net importer of agricultural products.

The livestock sector also experienced a rapid growth since the early 1940's (Fig. 8). Only between 1970 and 1985 the number of cattle increased in 15%, which was accompanied by a 100% increase in pasture lands. As in the case of agriculture, the expansion of cattle ranching has occurred at the expense of forests, which was encouraged by official programs of forest land conversion, particularly in southern states of Chiapas, Tabasco, Campeche, Quintana Roo and Yucatán. Most of these areas have shallow and highly erodable soils, where non-forestry land uses are unsustainable.

During the 1980's agriculture and livestock government policies focused in the promotion of activities through direct and indirect subsidies that included fertilizers, pesticides, fuel, electricity, water, seeds, credits and crop insurance. In 1987 alone, the total costs of these subsidies exceeded US\$ 2 billion. Credits for rural development were also heavily subsidized and tended to favor agriculture and cattle ranching over forestry activities. Between 1985 and 1987, 57% of all credits were for agriculture, 28% for cattle ranching and only 15% for forestry activities, mainly to support investments in industry.

C. Forest sector policies

Although forest policies have been designed as a countervailing force to the effects of land reform and agricultural policies by promoting forestry and conservation, they have been partially successful. As will be discussed in the next section, these policies have been oriented to over-regulate productive activities and have imposed costs to forest owners and added to incentives for land conversion to other uses.

Forest policies historically divided the sector activities among three major actors: community land owners (the social sector), government agencies (the public sector), and private investors (the private sector). As discussed earlier, forest lands have been mainly under communal property since the early 1940's and acquisition of these lands by private owners has been very limited.

The social sector, mainly consisting of poor and unskilled peasants, who inherited inaccessible forest resources or mined forest areas left over by private concessions, held most utilization rights. The public sector maintained a close control over forest management and administration of the sector through its historically strict legal framework (discussed in the next section), government intervention was characterized by a poor performance of regulatory agencies and a weak institutional support to ensure legal enforcement. The private sector controlled most of the industry and tended to take advantage of poor land owners by monopolizing markets and establishing unfair forest utilization contracts. These conditions have induced conflicts and distrust among different

actors that have severely affected the development of the sector and still limit relations today.

IV. Recent Significant Legal Reforms and Political Changes Concerning the Forest Habitat Management and Conservation

A. Historical forest legislation

Mexico has had forestry legislation since the end of the 1800's. With a European influence, forest regulations have been traditionally oriented to control most forestry activities, ensure a sustaining yield and preserve forest resources. Most of these regulations have not been effective due to lack of enforcement by government institutions.

With the first forest law of 1884, the government offered concessions in large forest areas, principally in the northern states of Chihuahua and Durango, to local and foreign private timber companies. Between 1884 and 1910 large forest industries and an extensive road system were created in many forest regions of the country. Forestry practices during this period were mainly characterized by timber mining, elimination of large extensions of the most accessible old growth forests, and extensive forests high-grading.

After the 1910 revolution, concessions to foreign companies were canceled, most timber industries were expropriated and forest lands began to be transferred to ejidos and comunidades as a result of the new land tenure policies. This redistribution of land continued until the early 1970's when most forest areas had been converted from federal or private to communal ownership.

In 1926 a new forestry law was passed by Congress that introduced more strict conservation regulations. Its effects, however were neutralized as a result of the post-revolutionary policies of land tenure and the agrarian reform described earlier.

With a new forest law in 1942 more control by communities and ejidos over forests was promoted. After this year large extensions of private forest lands were expropriated and the acquisition of forest lands by the private sector was prohibited. This situation induced a large decapitalization of the sector, since the poor peasants inheriting the land were not in the position to invest in management or infrastructure to increase the value of their forests and the efficiency of their industries. The state continued to intervene by creating government own enterprises that monopolized timber extraction, industrialization and commercialization activities in the most important forestry regions of the country.

In 1986 a new forestry law was approved that promoted the development of stronger and more organized community forestry enterprises and established strict environmental protection regulations of forestry activities. The state,

however, continued to have heavy regulations on almost every activity of the sector.

B. Recent land tenure reforms

In 1992 an important reform to the 27th article of the Constitution was approved by Congress, which included fundamental changes in land rights, mainly to allow land under communal property to be sold. This reform, accompanied by radical reforms to the agrarian, forestry, and water use laws, was mainly targeted to create a market for land that never existed before.

These reforms have allowed transactions of agricultural and livestock lands, which can now be legally parceled and sold. Although compared to these lands, forests can neither be parceled nor sold, and thus have to remain as communal property, full property rights over these collective resources can now be legally claimed by peasants. This condition allows forest owners to form legal associations with private enterprises to manage forests, in which peasants can become partners of private companies by using their forest land holdings as shares. These holdings can be sold, and private companies can buy up to 20,000 ha of forest lands for management.

These reforms offer a unique opportunity to redefine property rights and avoid open access problems that could lead to a better and sustainable management of the forest. However, there is also an important risk of continuing with degradation and deforestation problems in communal forest lands, which can result from poor boundary definition of forest areas, and incentives that have not been removed to convert forest lands to agriculture in order to claim privatization of parcels.

C. Environmental legislation

The first environmental law in Mexico was created in 1988. This law is still current and incorporates regulatory measures for several forestry activities. The most important regulatory instruments dictated by this law include general environmental impact assessments of specific regions or representative ecosystems, the requirement of environmental impact assessments for all forest management activities in tropical forests or in protected areas, notifications of management activities in temperate forests, and specific environmental protection norms.

Most of these regulations have been oriented to identify and mitigate environmental impacts on soils, stream sides and other water bodies, and critical habitat conditions of wildlife species. Although the law is considered revolutionary and advanced in many of its principles, its effectiveness has been relatively limited, mainly due to a lack of institutional support and conflicts of interest with other government agencies to ensure its implementation and enforcement.

D. Current forest legislation

The new 1992 forest law represents an important departure from the historical intervention role of the state in the activities of the sector. Based on the constitutional reform of 1992, this new legislation redefines the role of the state in regulating the use of forest resources.

The major elements of this new law include: (1) the requirement of a forest management plan as the centerpiece to regulate forest use in native forests and forest plantations, which incorporates environmental protection and impact prevention measurements; (2) the creation of a technical forestry advisory committee as a way to incorporate public participation and technical assistance to the decision making process; (3) separate criteria to regulate management of tropical and temperate forests, commercial plantations, and non-timber forest products; (4) the deregulation of the transportation, industrialization and commercialization of forest products; and (5) the liberalization of the technical assistance services provided to communities to manage their forests. The new law also dictates a greater coordination of efforts between the natural resources and environmental protection agencies with less duplication of initiatives and bureaucratic efforts in the authorization and supervision of management activities.

Together with the constitutional reforms, the new forest law offers a good opportunity to improve the conditions for a sustainable forest resource use. For these reforms to be successful, however, it is essential that they are accompanied by adequate and strong policies to create appropriate incentives to develop a stronger forest sector. Critical aspects include the conciliation of needs of both community forest owners and private enterprises to promote successful investments, the removal of biases in the allocation of resources credit, information and technical assistance; and support for institution building to ensure enforcement of laws and regulations.

V. Potential Issues Related to the Impact of Trade on the Forest Resources Management and Conservation

Mexico has made major policy reforms in the last few years that have had important implications on all natural resource management activities. These policies have been mainly oriented to redefine the role of the government moving from high government intervention toward a market economy where the role of the state is more that of providing public goods and dealing with social inequities.

These reforms were accompanied with market liberalization policies that initiated when Mexico joined the GATT in 1986 and the NAFTA in 1992. Although the long term impact of this liberalization on forest management and conservation are difficult to predict, short term effects have had severe impacts on the productive activities of the sector. As described earlier in this paper, the forest sector appears to be in a crisis where its participation in the GNP has been significantly reduced, production has severely declined and a substantial

increase in forest product imports has been registered during the last 10 years (Figs. 6 and 7). If these conditions continue in the future, productive activities will severely decline in forested areas with a subsequent increase in the incentives for land owners to convert their lands to other uses.

Recent studies predict that deforestation is expected to continue after trade liberalization mainly because the large number of subsistence farmers that are concentrated in marginal forest lands will not be affected in the short term by the liberalization of crop markets. While more intensive agricultural practices will probably be conducted in productive agricultural lands, land owners of marginal areas with forests and wildlands will continue their existing crop practices, which with the expected population growth will continue to expand their agricultural frontier (World Bank 1995).

This studies also explore the potential effects of liberalization on the forest sector. When comparing the pre-liberalization situation with a fully liberalized economy, the results of the study suggest that commercial forestry will decline more than the agricultural sector activities. Assuming that domestic timber prices continue to be higher than international prices, liberalization would have an important effect on which few regions of the country can remain competitive, basically as a result of the location of these regions in relation to the market and the high transportation costs associated with this location. According to this study, only the states of Jalisco, Michoacán and Guerrero would be able to compete at the current lower international prices. Under this scenario timber volume harvested and area under forestry would decline 14% and 5% respectively, and most forest industries would disappear.

References

- Bye, Robert A. 1993. Non-Wood Forest Production. Universidad Nacional Autónoma de Mexico/Helsinki University Knowledge Systems study. 18 pp.
- Cámara Nacional de la Industria Forestal. Memorias Económicas 1966-1993.
- CONAPO. 1996. Programa Nacional de Población 1995-2000. 113 pp.
- Consejo Técnico Consultivo Nacional Forestal CONAF. 1996. Los recursos forestales no maderables de Mexico. Mexico, DF.
- Flores-Villela, O y P Gerez. 1988. Conservación en Mexico: Síntesis sobre vertebrados terrestres, vegetación y uso del suelo. Instituto Nacional de Investigaciones sobre Recursos Bióticos-Conservación Internacional. Mexico, DF.
- Grupo Asesor Mexico. 1994. La Industria Forestal Mexicana. Mexico, DF
- Instituto Nacional de Estadística, Geografía e Informática INEGI. 1981. VI Censos Agrícola-Ganadero y Ejidal.

- Instituto Nacional de Estadística, Geografía e Informática INEGI. 1994. Estadísticas Históricas de Mexico. Tomo I. Mexico, DF
- Instituto Nacional de Estadística, Geografía e Informática INEGI. 1995. Estadísticas del Medio Ambiente.
- Instituto Nacional de Ecología INE, Dirección General de Aprovechamiento Ecológico de los Recursos Naturales. 1995.
- Masera, O., M. Ordoñez and R. Dirzo. 1992. Carbon emission and sequestration in forests: case studies from seven developing countries. Volume 4: Mexico. Berkeley: Climate and Change Division, EPA, and Energy and Environment Division, Lawrence Berkeley Laboratory.
- Masera, O.R. 1993. Sustainable Fuelwood Use in Rural Mexico, Volume I: Current Patterns of Resource Use. Energy and Environment Division, Lawrence Berkeley Laboratory – US Environmental Protection Agency EPA – Mexican Energy Savings Commission CONAE.
- Masera. 1996. Desforestación y Degradación Forestal en Mexico. Grupo Interdisciplinario de Tecnología Rural Apropiada GIRA AC. Michoacán, Mexico. 50 pp.
- Moncayo, F. 1981. Relación de algunas cosas de los montes de Mexico. Mexico. DF.
- Rzedowski, J. 1978. Vegetación de Mexico. Limusa, Mexico, DF.
- SARH. 1976. Atlas del Agua de la República Mexicana
- SARH. 1980. Vademecum Forestal Mexicano. Sistema General de Información.
- SARH. 1991. Inventario Forestal de Gran Visión.
- SARH. 1994. Inventario Nacional Forestal Periódico. Mexico, DF. 127 pp.
- SEMARNAP, Dirección General Forestal. 1995. Producción forestal maderable: tendencias y factores que han afectado su comportamiento.
- SEMARNAP, Dirección General Forestal. 1996. Estadísticas Forestales.
- SEMARNAP, Dirección de Reforestación y Manejo de Suelos Forestales. 1995.
- SEMARNAP, Pronare. 1996. Estadísticas de Reforestación.
- World Bank. 1995. Mexico Resource Conservation and Forest Sector Review. Report No. 13114-ME

Figure 1. Potential distribution of forest types.

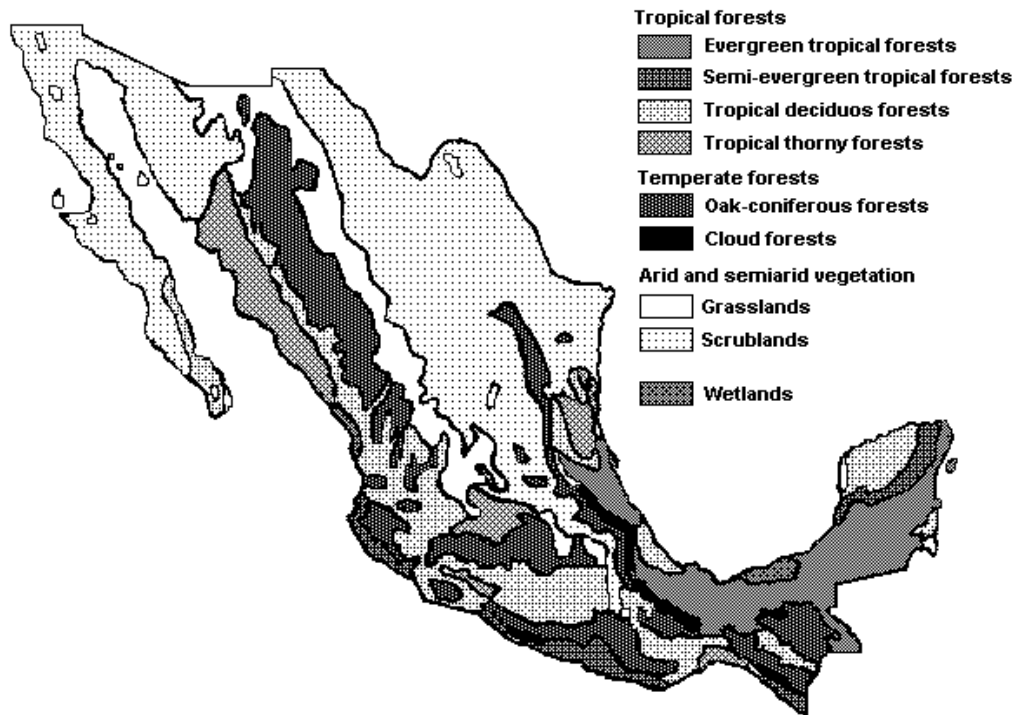


Figure 2. Population growth.

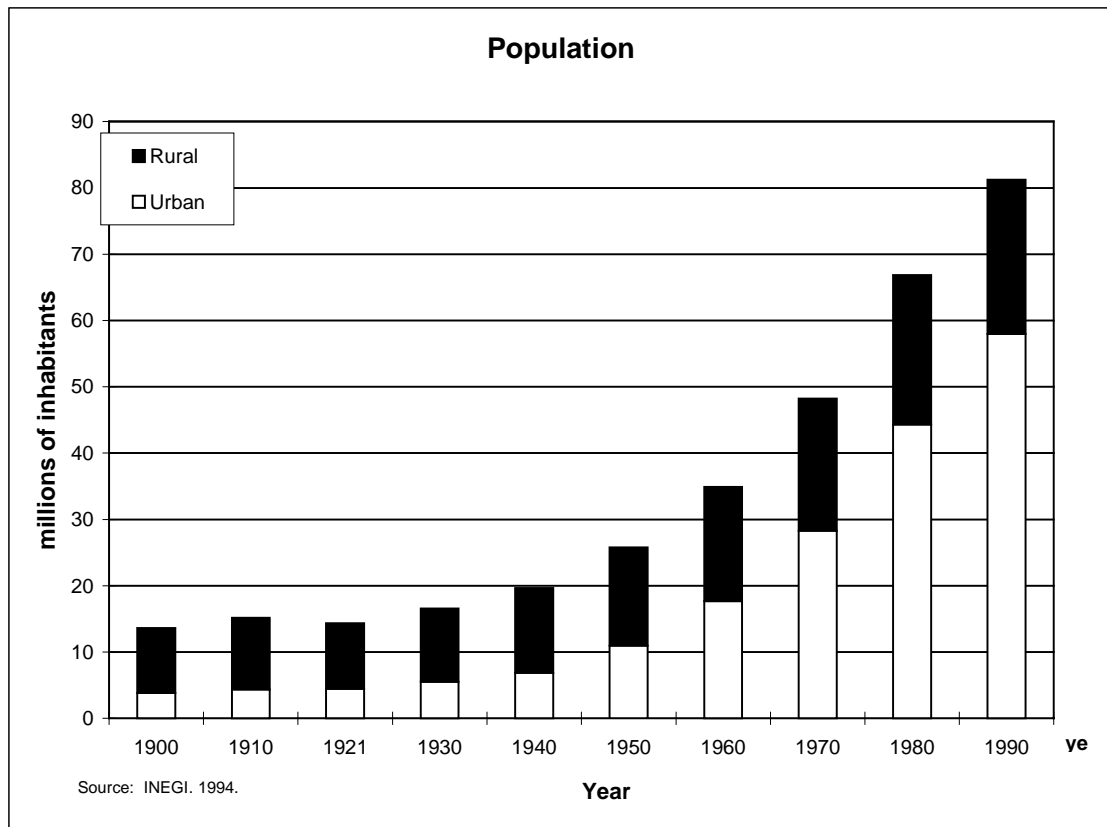


Figure 3. Land ownership

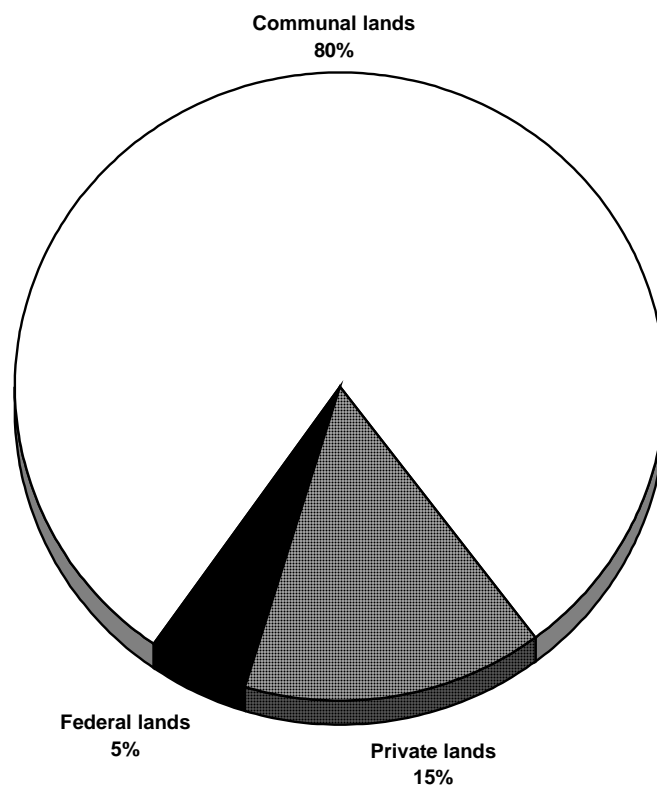


Figure 4. Area of Protected Land.

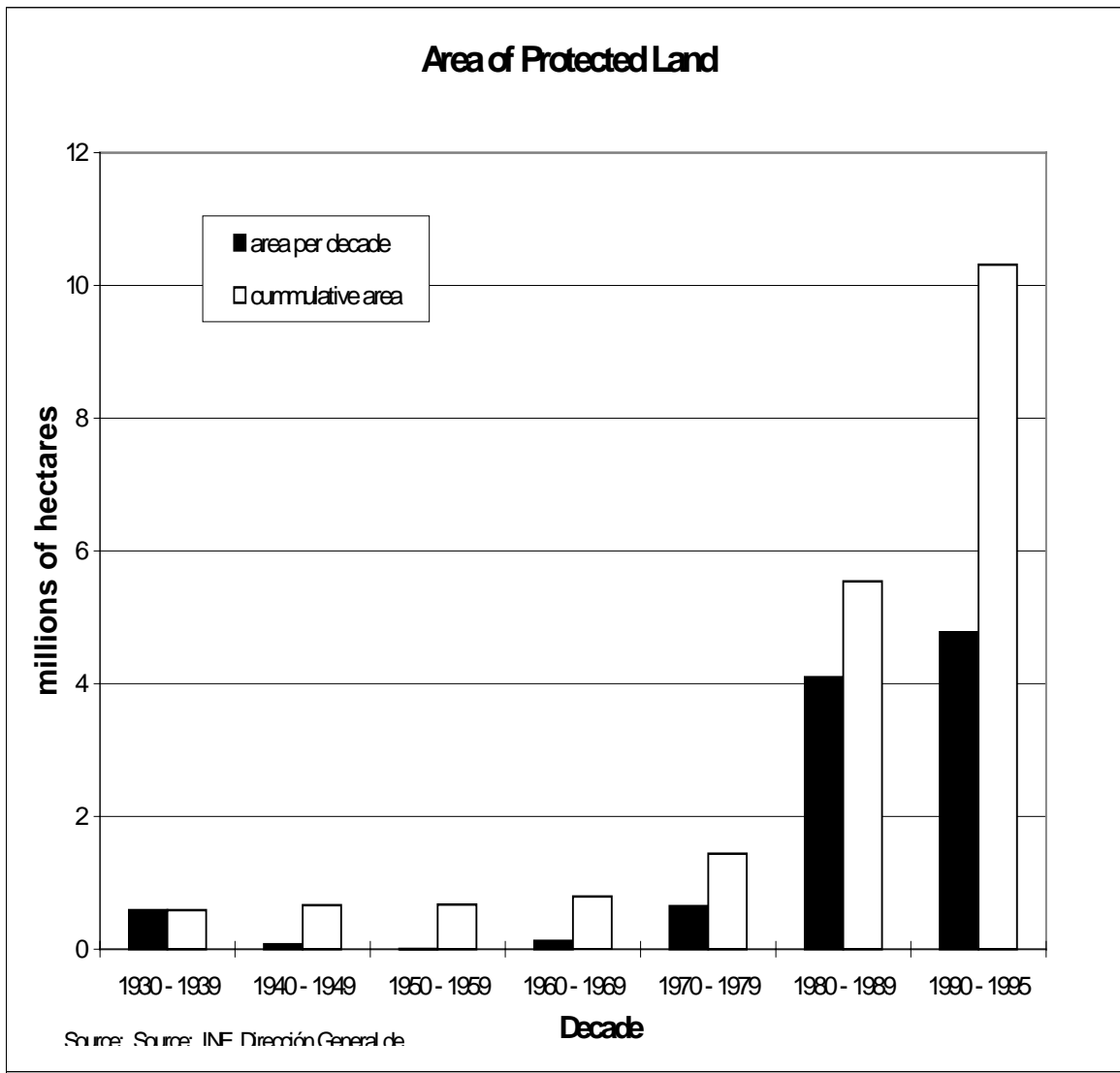


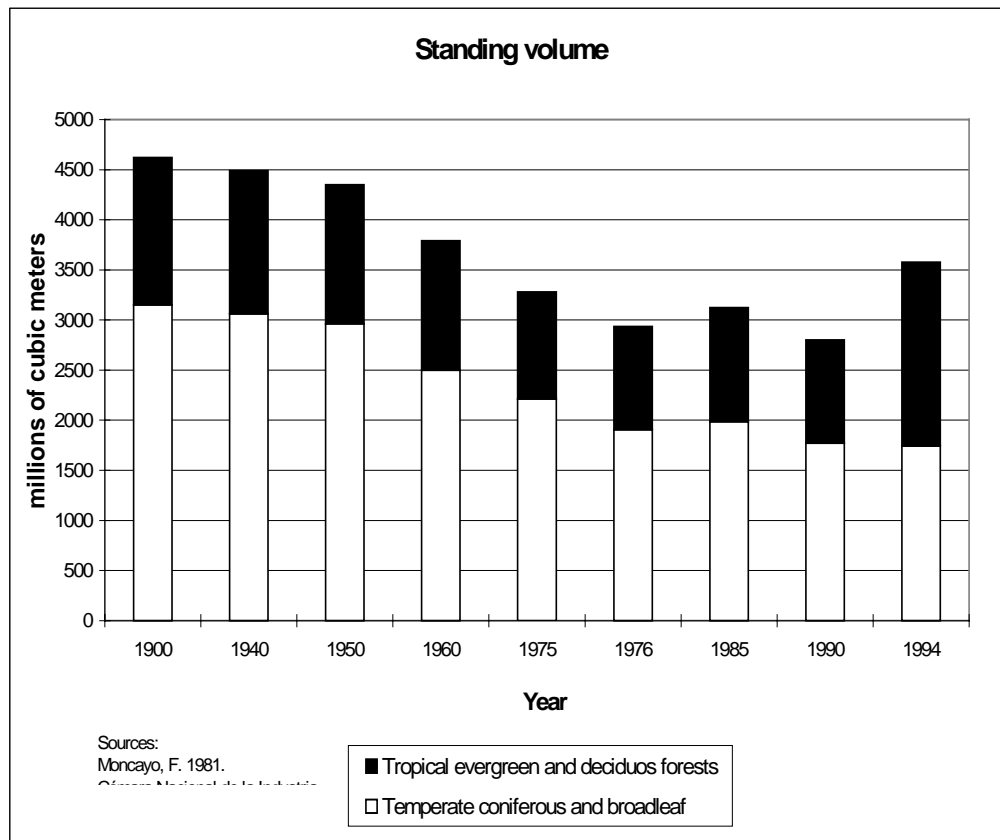
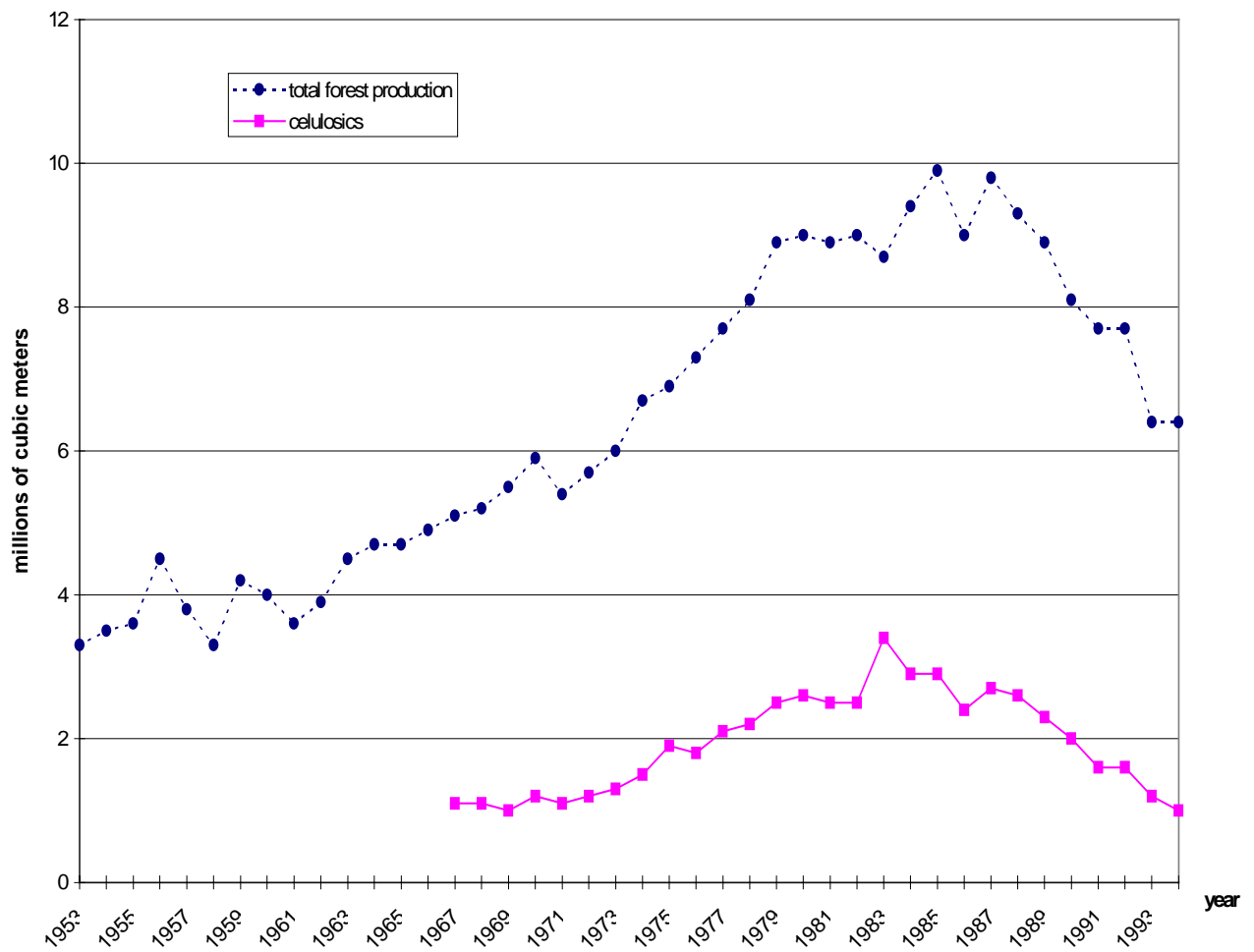
Figure 5. Standing volume (Official statistics)

Figure 6. Total forest and celulosics production.



Sources:
 SEMARNAP, Dirección General Forestal. 1995
 Cámara Nacional de la Industria Forestal. 1967 - 1994

Figure 7. Volume of imports and exports of the total forest production.