
Taiwan's Forest Sector

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**December 2001
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Taiwan's Forest Sector

December, 2001

Taiwan, the Republic of China, is one of East Asia's economic "Tigers," posting real economic growth averaging 8% during the past three decades. Taiwan has long played an important role in forest products trade. Today, that role has shifted from being a major hardwood supplier and wood products manufacturer, to an important raw material importer, woodworking equipment supplier, and investor in offshore forestry enterprises. Despite a large forest estate covering more than half the land area of this island nation of 22.4 million people, Taiwan's high labor costs, changing public values over the utilization of forests, and overharvesting in the past have significantly diminished the domestic wood processing industry.

Taiwan's major forestry challenges lay in the question of balancing its demand for wood products in light of limited domestic fiber, and in managing its forests to minimize environmental damage and conserve resources. Native forests are virtually off limits in terms of harvesting, leaving only a small but growing plantation base as Taiwan's main domestic source for commercial fiber. Consequently, imports are expected to continue to satisfy most of the country's wood fiber needs.

Forest Types

Taiwan is a small, mountainous island with a diverse range of habitats and climates, from the tropics to the subalpine. The forests of Taiwan cover 58% of the island area, and include five natural forest types on 1,527,500 ha.

Harvesting on natural forests, which occupy 72.7% of the total forested land area, has been banned since 1991. These natural forests are being managed for the purposes of water supply, soil protection, recreation, and conservation.

Timber production had been the major source of income in the 1950s and 1960s, when it supplied

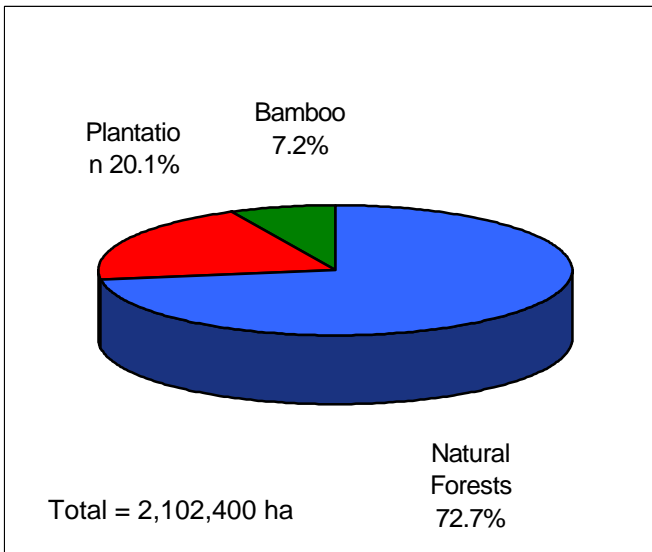
Taiwan Fast Facts

- The island of Taiwan is located in the sub-tropical and tropical transition zone of the Asian Pacific (21°45' to 25°38' N; 119°81' to 122°61' E) and accompanied by abundant rainfall and high humidity.
- Comprises the islands of Taiwan, Penghu, Kimen, Matsu, and some other small islets.
- Total land area = 36,179 square kilometers
Population = 22.4 million in 2000
- 2000 GNP per capita = US\$14,216
- Export Value = US\$ 148,321 million
- Import Value = US\$ 140,011 million
- Agriculture contributes 3% to GDP
- Taiwan is a major investor in China, Thailand, Indonesia, the Philippines, Malaysia, and Vietnam.
- Mean annual temperature > 20° C.
- Mean annual humidity is 81%.
- Average annual precipitation = 2,500 mm ranging from 1,100 - 4,980 mm.
- Taiwan is characterized by complicated topography and high elevations with more than 200 peaks over 3,000 meters.
- Over 4,000 vascular plant species, more than 400 species of birds (about 40% resident), 90 species of reptiles, 30 species of amphibians, 140 species of fresh water fish, and an estimated 50,000 insect species, including more than 400 species of butterfly.

the expanding and successful plywood and furniture export industries. However, the country's shift in forest policy from timber production to resource conservation has put all of the fiber sourcing needs onto imports and plantations.

Man-made plantations, occupying 20.1% of total forestland, are still at a relatively young stage and hence have low stock volumes. These plantations are being intensively managed to meet some of Taiwan's annual timber demand, currently averaging around 4.5 million cubic meters. Taiwan also has 152,300 ha of bamboo plantations, covering 7.2% of total forestland.

Forest Type



Third Forest Resources Inventory, Taiwan Forestry Bureau

Natural Forests

1. Spruce-fir-hemlock mixed forests

This type of coniferous mixed forests are commonly found at elevations of 1,700-3,000 m. The fir trees (*Abies kawakamii*) generally grow at higher altitudes, near 3,000 m, and sometimes are found to aggregate in small pure stands. Most of the spruce (*Picea morrisonicola*) and hemlock (*Tsuga formosana*) grow at lower portions of the distribution range. The land area of spruce-fir-hemlock mixed forests is 79,700 ha and accounts for approximately 3.8% of total forestland, and 5% of natural forestland.

2. Cypress forests

Cypress forests cover an estimated area of 48,500 ha, which is only 2.3% of total forestland, and 3% of natural forestland. However, due to their fine wood properties for construction and furniture, these forests are considered the most valuable commercial species in Taiwan. The two species making up these forests are *Chamaecyparis obtusa* var. *formosana* (yellow cypress), and *Chamaecyparis formosensis* (red cypress). Their distribution ranges from 1,500 m-2,800 m in elevation, but tend to form more pure stands at higher elevations for yellow cypress, and at lower elevations for red cypress.

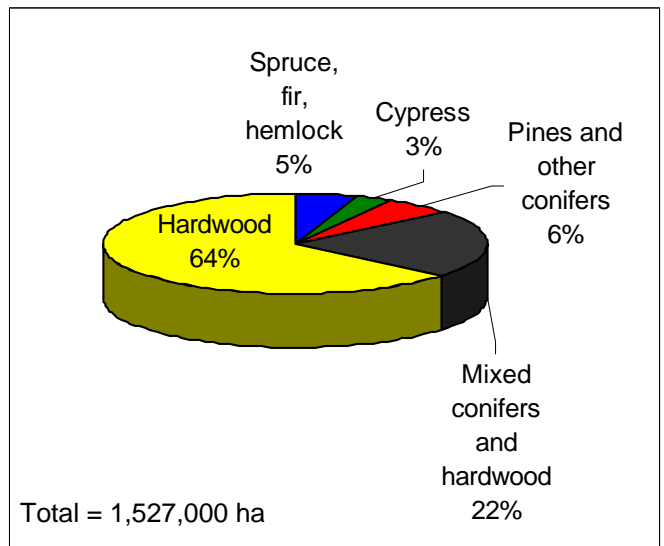
3. Pines and other coniferous forests

This coniferous forest type is composed mainly of *Pinus taiwanensis*, *P. massoniana*, *P. armandi*, *P. morrisonicola*, *Cunninghamia konishii*, *Calocedrus formosana* and *Taiwania cryptomerioides*. Their distribution extends from 1,000 m-2,800 m in elevation and covers 91,900 ha, which is 4.4% of total forest area and 6% of natural forests.

4. Mixed conifer-hardwood forests

These are mixed stands of coniferous species mentioned above, along with hardwood species from the families of *Fagaceae* and *Lauraceae*. These types of mixed stands cover approximately 331,600 ha (15.8% of total forestland and 22% of natural forest) at elevations of 1,000 m-2,000 m.

Natural Forest Species



3 Third Forest Resources Inventory, Taiwan Forestry Bureau

5. Hardwoods

Most hardwood forests are composed of the *Lauraceae* and *Fagaceae* families, and are widely distributed from 100 m-2,000 m in elevation. Hardwoods cover 975,800 ha, accounting for 46.4% of total forestland and 64% of natural forestland.

Area and Altitude distribution for various forest types

Forest type	Area		Altitude (m)
	hectare	%	
Natural Forests	1,527,500	72.7	
Spruce-fir-hemlock	79,700	3.8	1,700-3,000
Cypress	48,500	2.3	1,500-2,800
Pines & other conifers	91,900	4.4	1,000-2,800
Mixed conifers-hardwoods	331,600	15.8	1,000-2,000
Hardwoods	975,800	46.4	100-2,000
Man-made Forests	422,600	20.1	
Conifer stands	218,400	10.4	1,000-2,000
Hardwoods stands	144,600	6.9	300-1,200
Conifers-hardwoods mixed stands	59,600	2.8	750-1,500
Bamboo plantations	152,300	7.2	500-1,200
Grand total	2,102,400	100.0	

Third Forest Resources Inventory, Taiwan Forestry Bureau

Commercial Plantations (Man-made Forests)

In addition to natural forests, 20.1% of Taiwan's total forestland is comprised of man-made forest plantations covering 422,600 ha. These have been established in the past 40 years at elevations below 2,000 m. They include coniferous stands (218,400 ha, 10.4%), hardwoods stands (144,600 ha, 6.9%), and mixed stands (59,600 ha, 2.8%). Bamboo plantations, also classified as a type of man-made forest, accounts for 7.2% (152,300 ha) of forested land in Taiwan.

The coniferous species grown in man-made forests are *Pinus taiwanensis*, *Cryptomeria japonica*, *Chamaecyparis formosensis*, *Cunninghamia lanceolata*, *Taiwania cryptomerioides* and others. *Cryptomeria japonica* and *Cunninghamia lanceolata* are acclimated exotic species but are vulnerable to the Taiwanese red-belly squirrel, whereas the indigenous *Taiwania* trees exhibit high resistance and growth potential. The hardwoods species used for man-made plantations include *Acacia confusa*, *Fraxinus formosana*, *Zelkova serrata*, *Cinnamomum camphora*, *Liquidambar formosana* and others. All are indigenous tree species of Taiwan.

The average age of these plantations is 22 years. They require tending treatments such as pruning, thinning or even understory planting where the survival rates would otherwise be low due to drought, pest or other damage. Taiwan plans to establish uneven-aged, multi-layered and species-mixed stands from what was originally young, even-aged stands. Such management strategies not only may provide suitable wildlife habitats, but will also yield significant timber harvest over the long run. Under this management system, timber in national forests would not be harvested until the trees are at least over 40 years of age. For the most valuable species, *Chamaecyparis formosensis*, the rotation age has been set at 100 years.

It is interesting to note that although hardwoods occupy a higher percentage of natural forestland, for plantations Taiwan has opted to establish more coniferous plantations because of the high initial survival rate of conifer seedlings. In addition to tree species, the major bamboo species for plantations include *Dendrocalamas latiflorus*, *Phyllostachys makino*, and *Phyllostachys pubescens*.

Originally, the primary purpose of establishing these plantations was to build up an alternative fiber supply to feed Taiwan's heavy wood products demand. However, recent demonstrations by environmental groups are putting increasing pressure on forest managers to opt for purchasing timber from abroad, instead of harvesting from natural forests or man-made plantations.

Plantation Area and Uses for Most Common Species

Species	Uses	Area	
		hectares	%
<i>Pinus taiwanensis</i>	Paper making	52,100	23.9
<i>Cryptomeria japonica</i>	Construction, utility poles	47,000	21.5
<i>Chamaecyparis formosensis</i>	Construction, furniture	26,300	12.0
<i>Cunninghamia lanceolata</i>	Construction, utility poles	21,300	9.8
<i>Taiwania cryptomerioides</i>	Construction, furniture	6,100	2.8
Other mixed conifers		65,600	30.0
Conifers total		218,400	100.0
<i>Acacia confusa</i>	Flooring, charcoal	21,200	14.7
<i>Fraxinus formosana</i>	Furniture	9,900	6.9
<i>Zelkova serrata</i>	Construction, furniture	5,500	3.8
<i>Cinnamomum camphora</i>	Construction, furniture	5,000	3.5
<i>Liquidambar formosana</i>	Furniture, mushroom raising	3,100	2.1
Other mixed hardwoods		99,900	69.0
Hardwoods total		144,600	100.0

Third Forest Resources Inventory, Taiwan Forestry Bureau

Forest Stock Volume

The total estimated forest stock volume is 358 million cubic meters, which includes 310.5 million m³ for natural forests and 47.6 million m³ for man-made plantations. The table below illustrates the stock volume of various forest types with the highest stock volume per hectare belonging to hemlock and cypress forests. Hemlock is mostly used for making school desks. The most valuable cypress timber, commonly referred to as Hinoki by the Japanese, has long been harvested and exported to Japan since the start of the 20th century.

Because the plantations are still at a relatively young stage, the stock volumes in plantations are much lower than those of natural forests. However, productivity can be enhanced through silvicultural treatments since the site conditions are highly productive, having once been occupied by natural forests. For instance, a 29-year old *Taiwania* plantation at Liu-Kuei Experimental Forest of the Taiwan Forestry Research Institute now shows growth potential of 500 m³/ha, a rate comparable to over 100-year old natural hemlock (599 m³/ha) and cypress (598 m³/ha) forests.

The plantations are intensively managed, through pruning and thinning. However, the volume growth of hardwoods is much lower than that of conifer species. This may be due to branching habit, low growth rate or inferior site conditions for most broad-leaved tree species.

Forest stock volume by forest types

Forest type	Stock volume		m ³ /ha
	m ³	%	
Natural Forests	310,533,000	86.7	203
Spruce-fir	10,564,000	3.4	391
Hemlock	31,490,000	10.1	599
Cypress	29,045,000	9.4	598
Pines & other conifers	20,671,000	6.7	218
Mixed conifer-hardwoods	94,608,000	30.4	285
Hardwoods	124,155,000	40.0	127
Man-made Plantations	47,676,000	13.3	113
Conifer stands	34,065,000	71.5	156
Hardwoods stands	8,818,000	18.5	61
Conifer-hardwoods mixed stands	4,793,000	10.0	80
Total	358,209,000	100	
Bamboo plantations	358,429,617 culms ¹		2,353 ²

1 Growing stock of bamboo plantations is measured in the number of bamboo pieces or "culms".

2 The average unit is "culm/ha".

Third Forest Resources Inventory, Taiwan Forestry Bureau

Forest Ownership

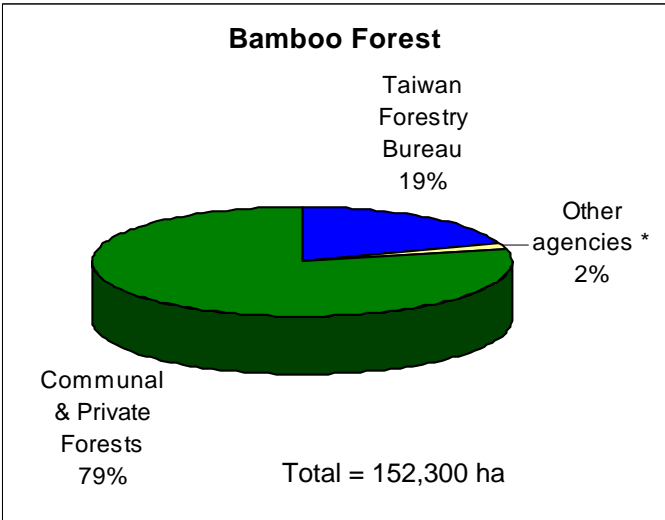
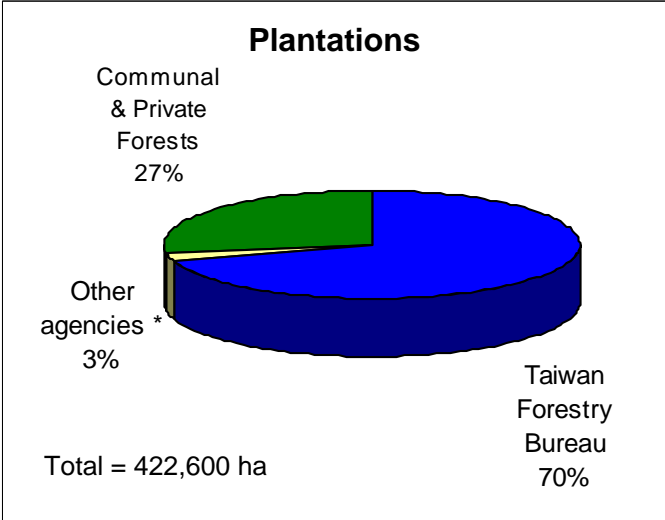
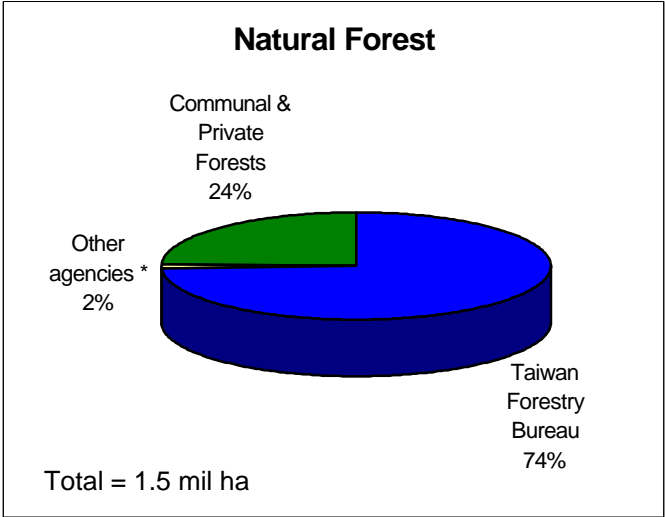
According to Taiwan's constitution, the central government owns most forestland in Taiwan. Therefore, central government agencies, such as the Taiwan Forestry Bureau (TFB) of the Council of Agriculture, are responsible for managing most forestland, including 74% of natural forests, 70% of man-made forests and 19% of bamboo plantations.

Designated by related laws and based on forest plans, these forests are being managed as national parks, natural reserves, protected natural areas, wildlife refuges, protection forests, forest recreational areas, and in some cases, for timber production.

The managing agency, the Taiwan Forestry Bureau, has to propose forest management plans to the Council of Agriculture for review and monitoring purposes. Only small portions of national forests are owned and managed by other agencies, such as the Taiwan Forestry Research Institute and Experimental Forest Administrations at some universities. Forest science research is implemented in these areas. These research findings serve as references for the Taiwan Forestry Bureau to manage national forests accordingly.

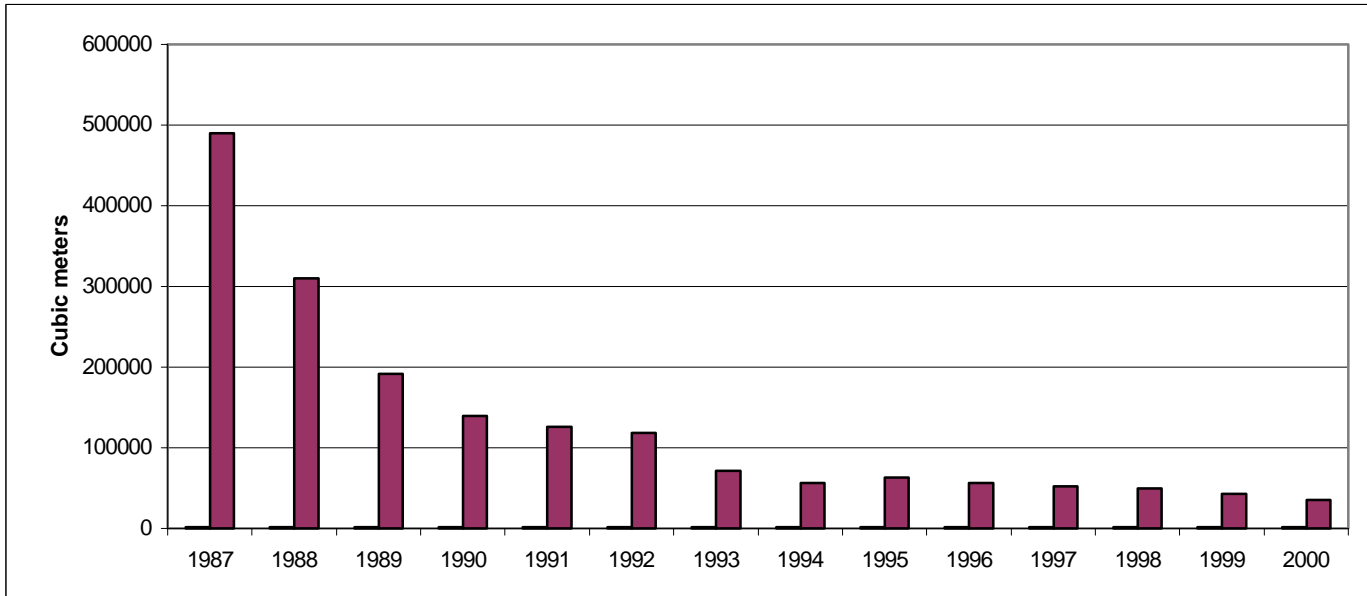
Forests not owned and managed by the central government fall under county governments, aboriginal groups, private cooperatives and individuals, managing communal & private forests. This category accounts for 24.4% of natural forests, 27.1% of wood plantations and 78.6% of bamboo plantations. Most of these forests are managed for timber production while the remainder is divided into aboriginal reserves and protection forests. However, some of these forests have been illegally converted into orchards, tea, and vegetable farms, due to its high economic revenue. The bamboo plantations are mostly managed for production of bamboo shoots that are consumed as a health food, with high fiber content and low calories. Only a small portion of bamboo culms are used as raw material for the craftworks industry. More recently, a bamboo charcoal industry with promising potential has developed.

Ownership by Forest Type



* e.g. Taiwan Forestry Research institute
Third Forest Resources Inventory, Taiwan Forestry Bureau

Timber Production Volume 1987 - 2000



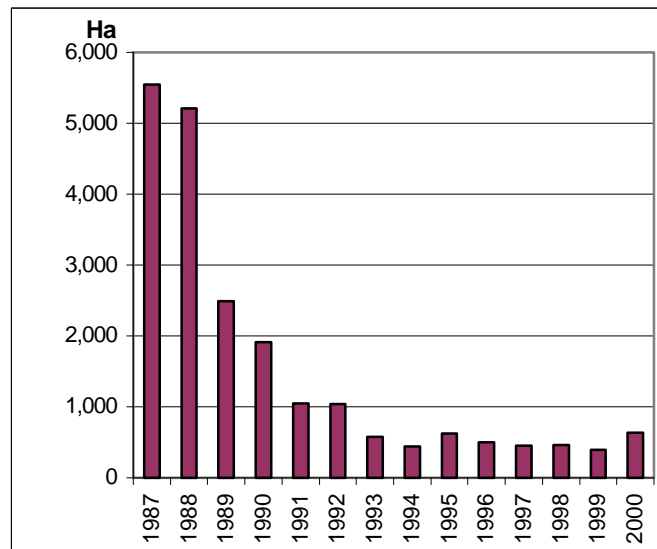
Forestry Statistics of Taiwan, Taiwan Forestry Bureau, 2001

Forest Policy

Taiwanese forestry developed vigorously during the 1950s and 1960s, with large-scale harvesting supplying commercial timber to the domestic industry. During this period, the plywood and furniture industries boomed, and wood products contributed more than 90% of total forest output values. However, since the 1970s, forestry policy has gradually shifted from timber production toward resource conservation. Taiwan's industrialization and modernization both shifted its economic base from manufacturing to a high-technology driven economy, and its consumer preferences towards higher living standards and a cleaner environment. The public, with growing incomes, has gradually begun to emphasize the importance of living quality, environmental protection, and natural resource conservation.

In 1975, the government approved the Taiwan Forestry Management Reformation Act, which outlined that the major objective of forest management would be long-term protection of natural forests. Then in 1989, the main forest management agency, the TFB, was elevated to a governmental budget administration, which meant that it was no longer dependent on timber sale revenue.

Area Harvested 1987-2000



Forestry Statistics of Taiwan, Taiwan Forestry Bureau, 2001

The change would make it easier for the agency to focus on forest protection. In 1990, red cypress on natural forestland became the first species to be banned from all harvesting. By 1991, the harvesting ban had been extended to all natural forestland. The result was a steep decline in timber production in Taiwan.

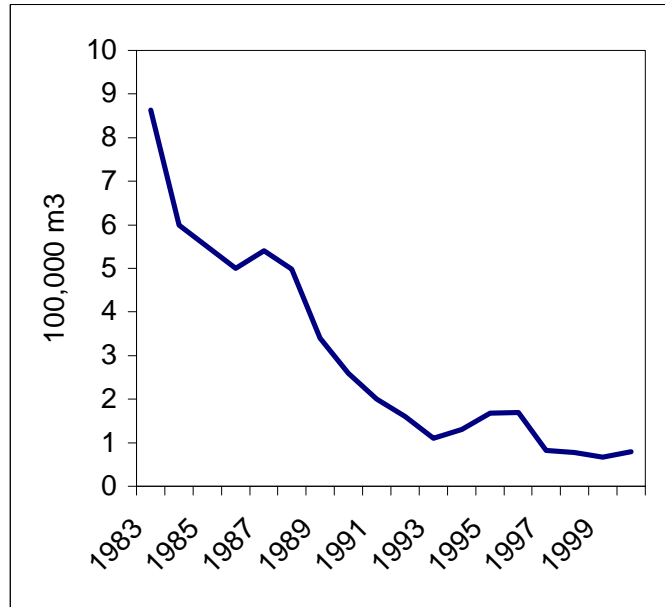
Forest Industry

Taiwan's forest products industry boomed in the 1960s-1970s, producing and exporting lumber, furniture, paper and other wood products using domestic resources. This would eventually change as Taiwanese companies sought more competitive countries to establish manufacturing bases, and Taiwan's natural resources came under increasing conservation pressure.

The plywood industry had been an engine of growth for the export-oriented economy, with an annual plywood export volume exceeding one million cubic meters. But in 1980, the plywood trade did an about-turn, from a mainstay of exports to an imported item due to huge domestic demand and depleting domestic fiber resources.

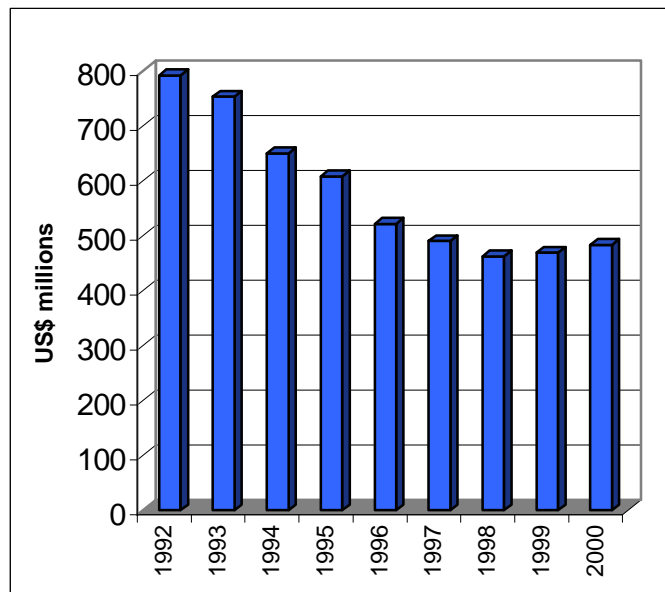
The furniture industry remains an important export sector for Taiwan, reaching an export value of \$483 million in 2000. The industry grew rapidly in the 1960s and 1970s. In the following decade, automation of production

Plywood Exports



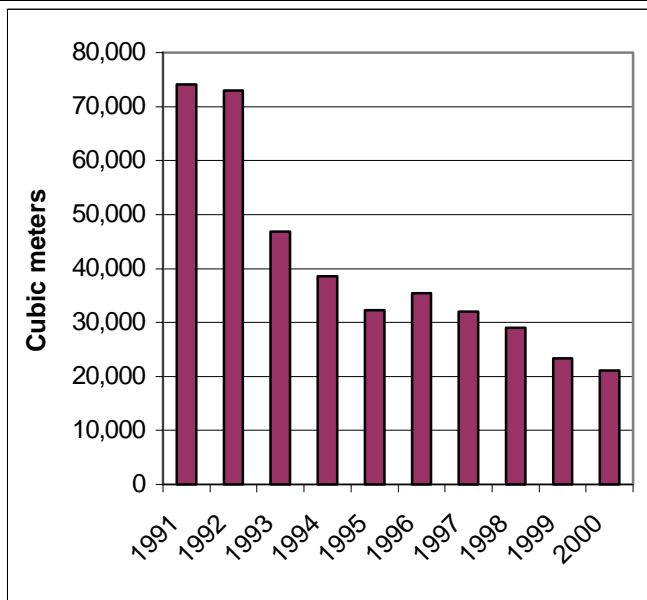
Division of Forestry Economics, TFRI

Wooden Furniture Exports



Division of Forestry Economics, TFRI

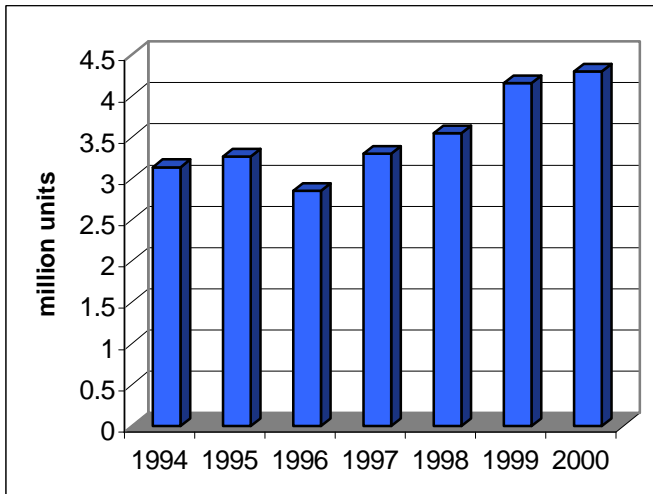
Lumber Production 1991-2000



Division of Forestry Economics, Taiwan Forestry Research Institute (TFRI), 2001

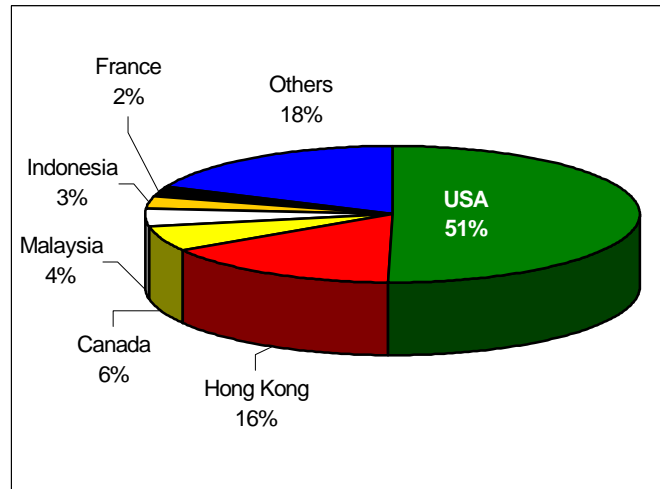
techniques further facilitated the expansion of furniture exports, reaching a peak of US\$934 million in 1987. But by 1990, the furniture industry had lost ground due to increasing costs of raw material and labor, and a recession in the global economy.

Woodworking Machinery Exports



Taiwan Association of Machinery Industry, Customs

Machinery Exports by destination



Taiwan Association of Machinery Industry, Customs

Manufacturers moved production lines to cheaper southeast Asian countries, and metal furniture began taking up market share from wooden furniture (more than 65% of total furniture exports are plastic and metal). In recent years Taiwanese furniture exporters have shifted to more developed markets such as the U.S. and Japan, where they can sell higher-end products using logs and lumber imported from abroad (including the U.S.). Some lower-end furniture producers moved offshore, but Taiwan's demand for wood sheets and panel products is expected to continue to grow.

Softwood log and lumber exports have remained virtually unchanged in the last 10 years, reaching 2,710m³ and 11,548 m³ respectively in 2000. Hardwood log and lumber exports have actually increased in recent years, reaching 9,254 m³ and 27,989 m³ respectively in 2000. But the biggest change has been the destination of hardwood exports—whereas before most hardwood exports went to Japan, today most hardwood exports go to Hong Kong. Despite these increases, log and lumber exports remain insignificant compared to Taiwan's huge imports. Taiwan is now 99% dependent on imported wood.

Taiwan is the world's fifth largest producer of woodworking machinery. This includes sawing and drilling machines, jointers, sanders, surface treatment equipment, and panel and drying machines. In 2000, total woodworking machinery exports reached US\$793 million, with the US absorbing US\$400 million, followed by Hong Kong at US\$123 million. Other important markets were Canada, Malaysia, Indonesia, and France. Sawing machinery is the main export product, accounting for 46% of exports.

Top five exporters to Taiwan in 2000 (cubic meters)

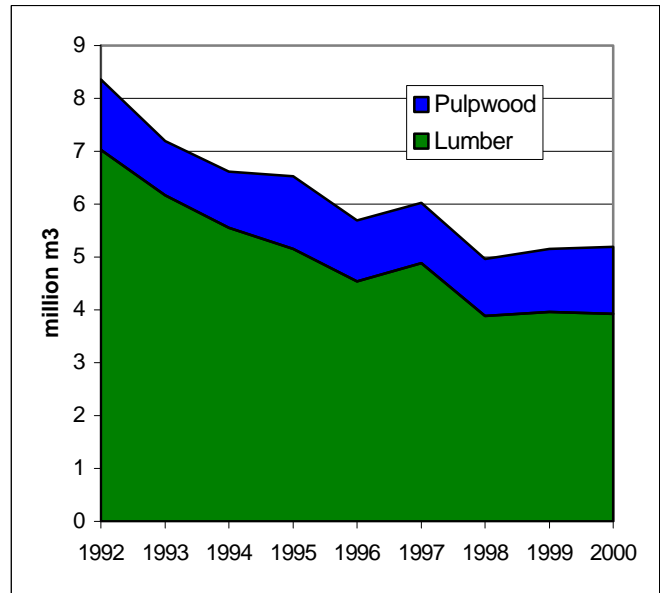
Softwood Lumber	Canada	New Zealand	Chile	Austria	United States
	144,877	89,457	49,991	11,586	8,219
Softwood Logs	New Zealand	Canada	United States	Vietnam	Malaysia
	53,166	12,571	3,249	1,059	989
Hardwood Lumber	Malaysia	Indonesia	United States	Canada	Burma
	257,234	167,099	52,756	22,207	17,399
Hardwood Logs	Malaysia	Gabon	Papua	United States	Germany
	749,714	45,122	37,017	33,805	11,375

Between 1960 to 1970, wood industry consumption was fed equally from both domestic and imported fiber sources. Since then, lumber consumption has shifted heavily in favor of imported wood, with more than 99% of timber supply sourced from abroad. In 2000, Canada and Malaysia were the two largest sources of imported softwood and hardwood, respectively.

Yet even an increase in Taiwan's dependence on imports could not stop the shrinking of the domestic processing industry. Both local timber production and consumption have been on long-term declining trends since the 1980s. Imports have also fallen across most products. Taiwan's surviving wood products sector is composed of small-sized production facilities. About 40% are in furniture, 25% in lumber, 10% in plywood, and 2% in wood composites.

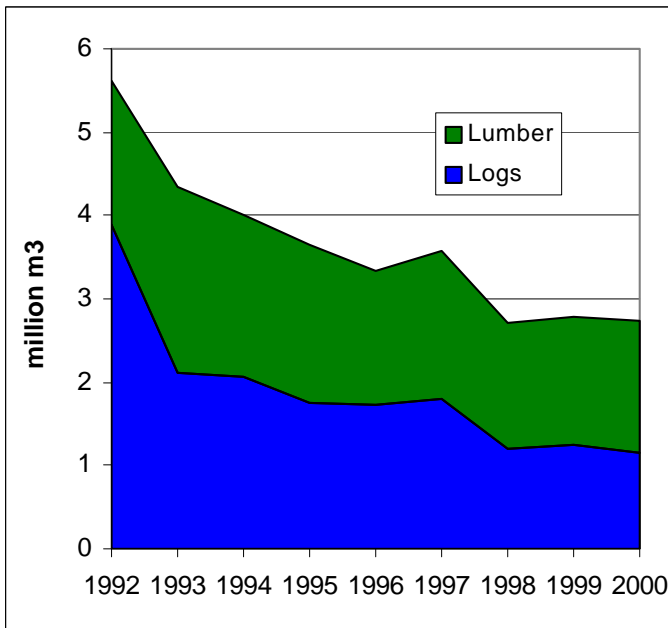
One area of growth is the engineered wood market, which currently is dominated by low-end plywood and particleboard. This segment is starting to see increased growth in such higher-end products as structural glulam for commercial exhibition halls and bridges, and structural components made from medium density fiberboard (MDF). Demand for these higher-end product segments is expected to triple over the next three years, with continued demand growth afterwards.

Wood Consumption



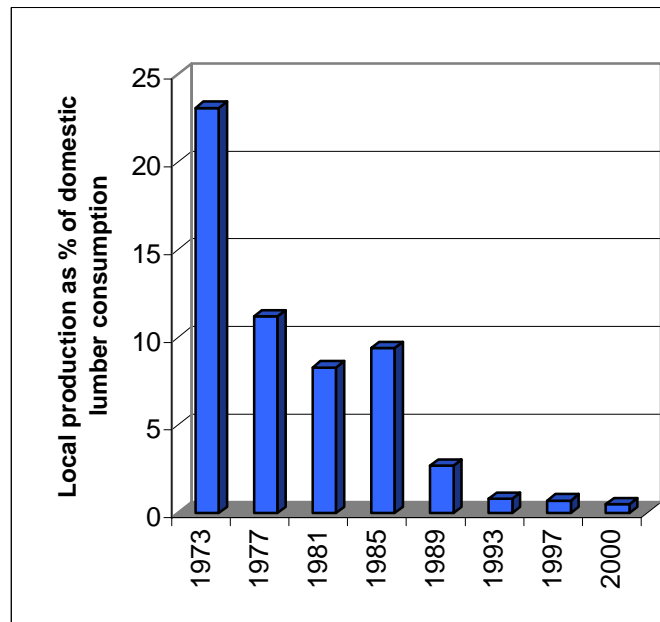
Division of Forestry Economics, TFRI

Lumber & Log Imports



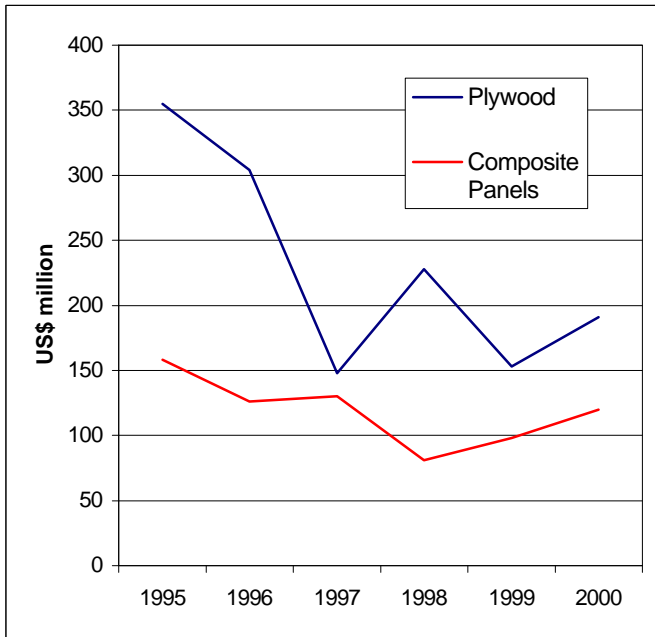
Division of Forestry Economics, TFRI

Declining role of local production



Division of Forestry Economics, TFRI

Panel Imports



Division of Forestry Economics, TFRI

Outlook

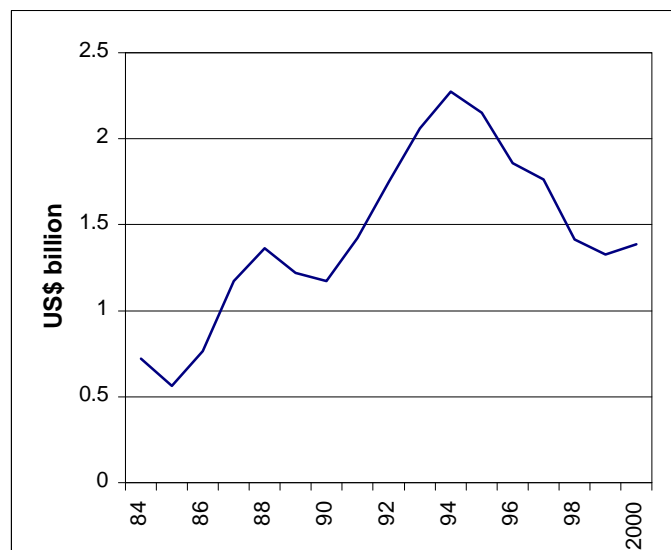
The forests of Taiwan have served varying roles throughout the country's economic development. First as an important engine of growth via exports of wood products, and now as a critical resource to be conserved and managed for multiple benefits.

Since it ceased natural forest harvesting a decade ago, Taiwan has focused more attention on forest management policies that balance social, economic and environmental objectives. Heavy rainfall in this hilly nation has resulted in serious mud slides and rock flows, problems which were exacerbated following the 1999 earthquake, and which brought increasing pressure on the administration to manage forests to mitigate these effects. Changing demographics and public desire for a cleaner environment and greater recreational opportunities have also meant a fundamental shift in how Taiwanese value their forests. The trend is clearly towards sustainable forest management more for conservation and recreational purposes

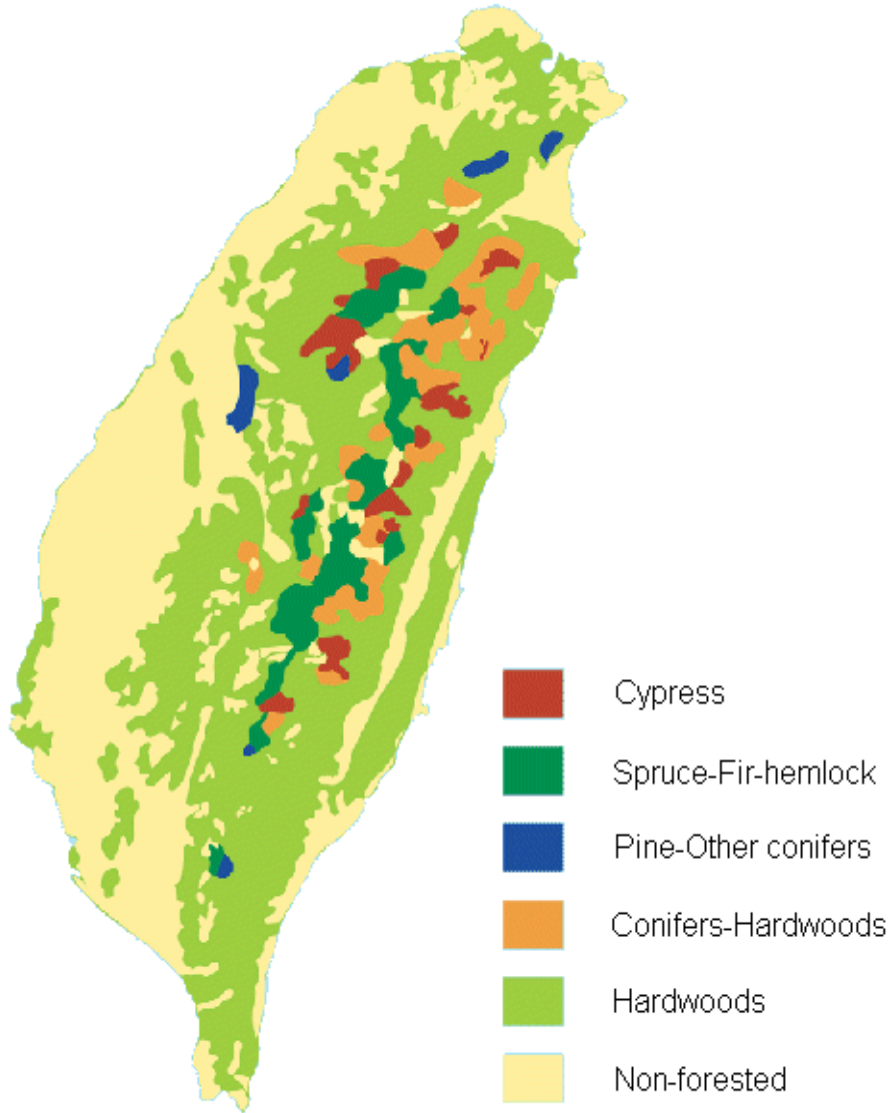
than wood processing. Not surprisingly, forest recreation and ecotourism are growing sectors. On average, more than 3 million people visit Taiwan's forest recreation areas each year, and this number is projected to reach 5 million. Even Taiwan's plantations, originally established as an alternative fiber resource to natural forests, is facing similar public pressure to be protected from harvesting.

Amidst these changes, Taiwan remains an important global trading nation, with high demand for wood products. Recent economic tides have been stormy; although Taiwan weathered the Asian economic crisis better than most countries, it is currently experiencing an economic slump, with unemployment at a record high of 5.33% in 2001. Still, analysts believe that with its stable political base, rising incomes and small but growing interest in wood frame construction and DIY applications, Taiwan offers opportunities for wood products suppliers. The disastrous 1999 earthquake also created demand for new residential construction in Taichung and Nantou counties, and some rebuilding projects are experimenting with wood frame construction. Fire code regulations have made it difficult to use wood in multi-unit and multi-family homes, although this is expected to slowly change as Taiwanese authorities revise building codes to allow wood as a normal construction material.

Total Wood Products Imports



Forest Species Map



FORESTRY AGENCIES AND CONTACTS

Taiwan Forestry Bureau

The Taiwan Forestry Bureau manages national forests, which account for the majority of forestland in Taiwan. The Bureau has five branches and four offices at its headquarters in Taipei.

#2, Sec. I, Hangchow S. Rd.

Taipei, Taiwan, 100

Tel: 886-2-2351-5441

Fax: 886-2-2341-4281

<http://www.forest.gov.tw>

Taiwan Furniture Manufacturers' Association
Room 905, Fl. 9, No. 100, Sec. 2, Chung-Hsiao
E. Road

Taipei, Taiwan

Tel: 886-2-23215791

Fax: 886-2-23951754

Taiwan Lumber Exporters' Association
Rm. 400, Fl. 4, No. 201-2, Tun-Hwa N. Road
Taipei, Taiwan

Tel: 886-2-27121732

Fax: 886-2-27172429

Taiwan Forestry Research Institute

The TFRI, under the aegis of the Council of Agriculture, conducts forest science and forest products research, and manages a small portion of Taiwan's forestland. The headquarters of the Institute consists of the Forestry Research Center, Forest Products Hall, Wood Processing Plant, Demonstrative Paper Mill, Seed Cold Storage, eight research laboratory buildings, Herbarium and Forestry Exhibition Hall.

53 NanHai Road

Taipei, Taiwan, 100

Tel: 886-2-2303-9978

Fax: 886-2-2314-2234

<http://www.tfri.gov.tw>

Taiwan Plywood Manufacturers & Exporters Association

Fl. 9, No. 82, Sec. 1, Chung-Shan N. Road

Taipei, Taiwan

Tel: 886-2-25212548

Fax: 886-2-25626290

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