

Contribution of poplars and willows to sustainable forestry and rural development

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Status and trends in the cultivation, management and use of poplars and willows, based on reports from member countries of the International Poplar Commission.

An estimated 70 countries grow poplars and willows in mixtures with other natural forest species, in planted forests and as individual trees in the landscape (including agroforestry systems). Country reports to the International Poplar Commission (IPC) in 2004 indicated that their area exceeds 80 million hectares globally. The Russian Federation, Canada and the United States have the largest reported areas of naturally occurring poplar and willows, while China, India and Pakistan have the largest planted areas.

Native to the temperate and subtropical zones, trees and shrubs of Salicaceae – which include poplars (*Populus* spp.) and willows (*Salix* spp.) – are fast growing and easy to propagate vegetatively. Many of the species are adapted to a wide range of climatic and soil conditions, from the heat of the Chinese desert to the cold, windy conditions of

the South American Andes. They are easy to cultivate and form an important component of forestry and agricultural systems, often for small-scale farmers. They provide a wide range of wood products (including industrial roundwood and poles, pulp and paper, reconstituted boards, plywood, veneer, sawn timber, packing crates, pallets and furniture), non-wood products (fodder, fuelwood) and services (shelter, shade and protection of soil, water, crops, livestock and dwellings). Poplars and willows have an important role in phytoremediation (i.e. taking up heavy metals to purify polluted soils) of degraded sites, rehabilitation of fragile ecosystems (including combating desertification) and forest landscape restoration. They are often integrated with agriculture, horticulture, viticulture and apiculture. Because of their rapid growth they are effective for carbon sequestration. They provide employment oppor-

Salicaceae (Populus alba and Salix babylonica) planted to shelter a remote government outpost at around 3 000 m in the Andes of Argentina; at this altitude they are the only trees that will grow, and the protection they offer from wind makes the community livable



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*Naturally occurring poplars (such as *Populus euphratica* in China) are primarily managed for environmental purposes including in situ conservation*

tunities, boost exports and contribute to social and economic development and sustainable livelihoods in rural areas.

This article summarizes issues, highlights status and identifies trends affecting cultivation, management and utilization of poplars and willows in temperate and boreal regions of the world. It is based on country reports submitted in 2004 by 21 member countries of IPC (see Box) – Argentina, Belgium, Bulgaria, Canada, Chile, China, Croatia, Egypt, Finland, France, Germany, India, Italy, the Republic of Korea, New Zealand, Serbia and Montenegro, Spain, Sweden, Turkey, the United Kingdom and the United States – as well as the Russian Federation, which is not an IPC member. All statistics cited in the article (including those in tables and figures) come from these country progress reports. Poplars and/or willows also grow in almost 50 other countries, but not in significant amounts. The only



exception is Ukraine, where their area is known to be extensive but has not been officially recorded.

POPLAR AND WILLOW AREA

The great majority of poplars and willows grow in natural forests and woodlands. Globally, 91 percent of poplars grow in natural forests, 6 percent in plantations and 3 percent in agroforestry systems and as trees outside forests. For

willows, the respective figures are 94, 5 and 1 percent.

Natural forests and woodlands

The total area of natural poplars reported by IPC member countries is over 70 million hectares, 97 percent of which occur in Canada, the Russian Federation and the United States, where they are predominantly managed for wood production. In the other main countries with

The International Poplar Commission

The International Poplar Commission (IPC), one of FAO's technical statutory bodies on forestry, promotes the cultivation, conservation and utilization of species in the family Salicaceae. It supports the study of the scientific, technical, social and economic aspects of poplar and willow cultivation and promotes research and exchange of ideas to translate policies and science into implementation and development programmes.

Established in 1947 by nine countries, IPC now comprises 37 member countries including developing and developed countries and countries with economies in transition. IPC

is the only forum that brings together managers, users and researchers of poplars and willows to discuss topics of common interest in a cross-disciplinary way.

Six working parties address genetics, conservation and improvement; diseases; insects and other animal pests; production systems; logging and wood utilization; and environmental applications. There is also a Subcommittee on Poplar and Willow Nomenclature and Registration.

IPC meets every four years. The 22nd session was held in Santiago, Chile, from 28 November to 2 December 2004; it was

hosted jointly by FAO and the National Poplar Commissions of Chile and Argentina. The session focused on the contribution of poplars and willows to sustainable forestry and rural development. Associated study tours in Chile and Argentina demonstrated the diversity of social, environmental and economic application of poplars and willows for sustainable forestry and rural development.

TABLE 1. Main countries reporting natural poplar stands

Country	Area (1 000 ha)
Canada	28 300
Russian Federation	21 900
United States	17 700
China	2 100
Germany	100
Finland	67
France	40
India	10
Italy	7

TABLE 2. Main countries reporting natural willow stands

Country	Area (1 000 ha)
Russian Federation	2 850
France	67
China	60
Italy	35
Croatia	7

TABLE 3. Main countries reporting planted poplar areas

Country	Area (1 000 ha)
China	4 900
India	1 000
France	236
Turkey	130
Italy	119
Argentina	64

TABLE 4. Main countries reporting planted willow areas

Country	Area (1 000 ha)
Argentina	46
Romania	24
New Zealand	20
Sweden	15

naturally occurring poplars (Table 1), they are primarily managed for environmental purposes including *in situ* conservation, soil and water protection and landscape restoration.

The largest reported area of natural willow forests is in the Russian Federation, followed by France, China, Italy and Croatia (Table 2). Willows, usually in mixed stands, are also found in other countries (e.g. Canada, Chile) that do not include them in national inventories so their extent is not known.

Most natural poplar and willow resources are under public ownership (Figure 1).

Planted forests and trees outside forests, including agroforestry

The global reported area of planted poplar stands (established in block plantations for wood production or environmental purposes, or in agroforestry systems) was 6.7 million hectares, of which 3.8 million hectares (56 percent) were planted primarily for wood production and 2.9 million hectares for environmental purposes. Thirty percent of the total reported planted area was established in agroforestry systems, which also accounted for 40 percent of the global poplar wood production.

China accounts for 73 percent of the world's total poplar plantation area (Table 3), including 53 percent of the global plantations for wood production, nearly all of the plantations for environmental purposes and 49 percent of the plantations established in agroforestry systems. India also accounted for 49 percent of the agroforestry plantations.

The global area of planted willows (Table 4) was 176 000 ha, of which 90 000 ha were for wood production (51 percent) and the balance for environmental purposes. Few countries have established willows in agroforestry systems, except for New Zealand, whose willows were planted for river bank stabilization. In Argentina and Sweden the entire willow plantation area is for

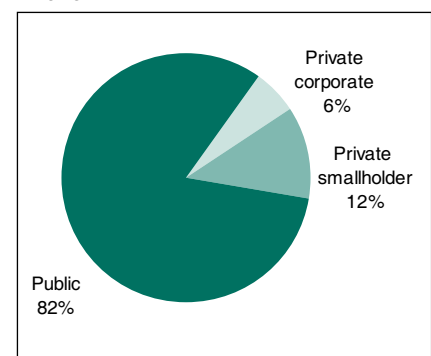
production purposes (in Sweden for renewable energy). China has the second largest area of willow planted for production (21 000 ha) and the largest area of willow planted for environmental purposes (59 000 ha, planted to combat desertification).

More than half of the poplars and willows in plantations, in agroforestry systems and outside forests are publicly owned (Figure 2). Yet private smallholders own a significant portion (one quarter of the total).

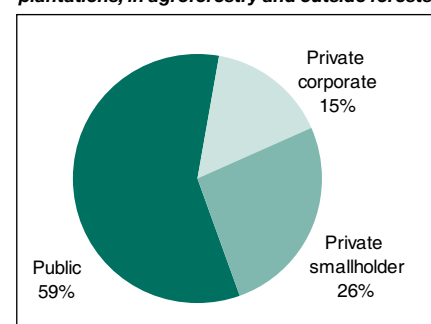
PRODUCTION TRENDS

Reported annual removals from natural stands of poplar were significant only in the Russian Federation (100 million cubic metres) and Canada (16 million cubic metres), while only the Russian Federation reported significant annual

1
Ownership of natural forests of poplars and willows



2
Ownership of poplars and willows in plantations, in agroforestry and outside forests



removals of willow from natural stands (15 million cubic metres).

Five countries (Turkey, China, France, Italy and India) reported annual removals of more than 1 million cubic metres of poplar wood from planted forests. All removals in India came from agroforestry systems. Agroforestry production was also significant in Italy (0.5 million cubic metres) and China (0.2 million cubic metres).

Argentina reported removals of planted willow of 340 000 m³ per year, and Bulgaria reported 311 000 m³ per year.

In China, significant expansion of poplar plantations is expected as part of the country's plan to increase wood pulp production considerably. In addition, six tree planting projects for wood production and shelter, which began in 2002, include poplars and willows. These plantations will accelerate the shift of wood supply from natural forests to plantations.

Although smallholders own a greater area of the planted resource than private corporate owners, wood production from corporate plantations is higher owing to their more intensive management.

MAIN PRODUCTS AND SERVICES

Forest products

In Europe, pulp, paper and cardboard are the most favoured uses for poplar.



In New Zealand, poplars are pollarded for use as sheep fodder

Other important uses in Europe include packaging (pallets, boxes and crates) and reconstituted wood panels; the latter is also an important use in Argentina and North America. Many countries produce plywood from species of the Salicaceae. In Chile, the Russian Federation, India, the Republic of Korea and Sweden they are used to produce matches. Timber and general construction are important end uses in Turkey, Finland and Argentina. In the United States, a surge in house-building resulting from lowered interest rates has led to increased demand for poplar-based composite board. Handicrafts and wicker work are important

uses in Chile and the Russian Federation. In Belgium and Chile, species of the two genera are also used in furniture manufacturing.

The use of poplar wood for fuelwood or bioenergy has attracted some attention, particularly in European countries, although at present this use has economic importance only in Sweden, the United Kingdom and Turkey. In Egypt, *Populus euphratica*, which grows naturally in newly reclaimed saline lands, is used locally as fuelwood.

In New Zealand, work is under way to encourage pollarding of poplars and willows to produce young branches and foliage for use as an alternative fodder, particularly during droughts.

Environmental uses

In several countries, poplar and willow resources are principally used for environmental purposes, including soil and water protection, providing valuable services rather than forest products.

With increased public awareness of environmental policy issues such as air and water pollution, global climate change and soil erosion, several coun-



Veneer is one of the many products for which poplar wood is often used (India)

tries have been developing new knowledge, technologies and techniques for the cultivation of poplars and willows for environmental uses. In the United States, for example, hundreds of small poplar plantations are used as riparian buffers, in wastewater treatment and reuse and in phytoremediation, and some are used for carbon sequestration. In China, poplars are used extensively for shelterbelts and sand dune stabilization. In the United Kingdom, they provide shelter and ground cover for free-range chickens whose produce is sold as “woodland eggs”. In Bulgaria and Chile, willows are planted along river banks to stabilize them and reduce sedimentation.

In Canada, the Forest 2020 programme is establishing fast-growing plantations, of which poplar is a major component, on previously non-forested lands (primarily agricultural lands) for carbon storage. Through short-rotation coppice management, *Salix viminalis* has produced the highest woody biomass production ever reported in Canada.

Several countries have been exploring the potential applications of poplar and willow planting for phytoremediation. In New Zealand, for example, poplar clones that accumulate high concentrations of boron, a common contaminant in timber industry sites, are being used commercially for the remediation of a 5-ha wood-waste dump. In Serbia and Montenegro, field studies have been carried out on the use of poplar for cadmium phyto-extraction. Sweden is exploring the use of willows for phytoremediation.

Poplars and willows are able to absorb nitrogen arising from intensive livestock farming. Research reported from Sweden has shown that 1 ha of willow plantation can potentially take up 150 to 200 kg nitrogen per year. In the Republic of Korea, research is being carried out on planting poplars and willows on landfill sites and irrigating them with livestock waste water. A project in New Zealand investigated the efficacy of using poplars and willows in a coppicing system to



Environmental uses: willows (*Salix matsudana*) planted in New Zealand for erosion control as well as stock feed

reduce the amount of nitrate leaching from dairy shed effluent that was normally applied to pasture.

AGROFORESTRY

Several countries have reported positive experiences with the use of poplars and willows in agroforestry, as trees outside forests and as shelterbelts for protection against wind. In Egypt, some landowners have begun to plant poplars on farms. In India, an agroforestry programme of over 30 000 ha has been supplying poplar wood for matches and plywood; however, a decrease in prices led to a reduction in the numbers of poplars planted in 2003.

Poplars and willows in agroforestry systems are receiving rising attention in the United States, with increased funding for tree planting along waterways to prevent soil erosion and runoff of agricultural chemicals, to enhance wildlife habitat and to provide bioenergy and wood products for the rural economy. At least six major agroforestry centres in the country are planting poplars and willows.

POLICY AND LEGAL FRAMEWORK

Environmental restrictions in some countries affect the cultivation of poplars. In Belgium, for example, 43 percent of Flemish poplar plantations are located

within the Flemish Ecological Network, where nature conservation has absolute priority. It is uncertain whether in the long term poplar plantations will have to be transformed into forests composed of native species, or even into non-wooded areas such as flower-rich grasslands. In France, national regulations concerning sustainable management and the multi-functional character of forests could have an important impact on the area of poplar plantations, notably where there is conflict for land use between maize and poplar growers and associations for the protection of the environment.

In Canada, some provinces have regulations that directly or indirectly restrict poplar cultivation. In British Columbia, for example, poplars intensively cultivated in plantations are considered primary agricultural production, with favourable tax treatment, but only up to 12 years of age – which is before the culmination of mean annual increment, especially when the trees are grown for saw logs or peelers. Some provinces, such as Ontario, offer benefits for managed forest land, and this practice is not necessarily favourable to the growing of poplars. Québec Province restricts the planting of tree crops on prime agricultural land.

In the European Union, a regulation on the marketing of forest reproductive



Some 30 percent of planted poplars are in agroforestry systems; shown, turmeric, mango and litchi planted under poplars in India, which is reported to have almost half of the world's poplar agroforestry systems

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION

material which came into force in 1999 affects poplars and poplar hybrids, but not willows.

All willow plantations in Sweden are subsidized by the government, but frequent rule changes make it difficult for farmers to make long-term plans, proving an obstacle for the further development of energy forestry based on willows. In the United Kingdom, policies to encourage greater uptake of renewable energy by the electricity generating and supply industry have boosted the market for woodchips from short rotation coppice, currently dominated by willow.

The United States was the only country to report that most companies growing poplars in block plantations for production of wood and fibre were participating in the Forest Stewardship Council (FSC) certification programme in order to provide market access and be more socially and environmentally conscious.

FOREST PROTECTION

Diseases. Attacks of poplar rust, *Melampsora larici-populina*, have led to a reduction or halt in the use of susceptible poplar cultivars in France but were not considered to represent a significant danger in Croatia. *Marssonina brunnea*, another foliar disease of poplar, has been reported in Italy, Serbia and Montenegro, Spain and the United States. Bac-

terial cancer, *Xanthomonas populi*, has caused significant damage to poplars in Croatia and Serbia and Montenegro. *Septoria musiva* stem canker is important in Argentina and has been spreading in Canada. The resistance of native cottonwood (*Populus deltoides*) to *Septoria* spp. in the United States may provide opportunities for breeding resistant species hybrids.

Diseases of willows include watermark disease, observed in agricultural areas in Belgium.

Insects. In Argentina, *Platypus sulcatus* causes significant damage to poplars, and work to find control methods continues. In central Italy, 30 percent of the total national cost of poplar phytosanitary protection was spent on the control of the borer *Cryptorhynchus lapathi*; the recent introduction of *Platypus mutatus* also represents a potential threat to poplar cultivation. In Chile, the main damage to poplars is caused by *Tremexfuscicornis*, which affects physiologically weakened trees. Continued and spreading massive attacks of *Phloeomyzus passerinii* have been reported in France, although different cultivars show varying susceptibility to attack. The poplar defoliator, *Clostera cupreata*, is considered the most damaging pest of poplar in India; it has inflicted large-scale defoliation, especially to

Populus deltoides. Large-scale attacks of the gypsy moth *Porthetria dispar* have occurred in Serbia and Montenegro since 2000. Attacks of *Paranthrene tabaniformis* continue in Spain and Italy but are controlled.

In New Zealand, the willow sawfly (*Nematus oligospilus*), which feeds exclusively on willows, has spread throughout the country since its arrival in 1997, causing extensive defoliation to willows on the East Coast of the North Island, sparking the initiation of an integrated research and management programme. Chile has reported serious damage to willows by *Nematus desantisi*, which can cause death of the trees.

Abiotic factors. Abiotic factors affecting poplars include long-term droughts, for example in Bulgaria. Increasing levels of atmospheric CO₂ and ozone, coupled with more variable and extreme weather predicted for the next century, are likely to increase damage by insects and pathogenic fungi to forest trees, including poplars and willows. Moose are a threat to willow plantations in Sweden.

RESEARCH

Populus is the predominant genus used in research on tree genetics. The International *Populus* Genome Consortium has completed the genome sequencing of *Populus trichocarpa* and has nearly completed that of quaking aspen, *Populus tremuloides*.

China has used almost exclusively poplars in genetic engineering research to confer resistance to insect attack and diseases, while Canadian scientists are studying the function of genes that control forest health and wood formation in *Populus* (and *Picea*) species.

In France, the programme POPYOMICS is working on breeding of *Populus deltoides* for resistance to *Melampsora larici-populina* but also for better management of genetic diversity. In addition, a great deal of research is being done into biotechnologies related to the metabo-

lism of lignin, studies on the formation of wood, such as the identification of genes involved in the formation of tension wood, etc.

The United Kingdom has recently begun an important five-year project to improve poplar and willow short-rotation coppice management through such means as breeding and genomics (i.e. the molecular characterization and cloning of whole genomes).

Continuing efforts in *ex situ* conservation of *Populus nigra* was reported by several countries – Belgium, Croatia, France and Serbia and Montenegro, while *in situ* conservation was reported by France and Serbia and Montenegro. Recent collections of seed and vegetative materials have been made in Croatia. Turkey reported on newly found natural populations of *P. nigra* in Anatolia.

Italy reported research on the environmental aspects of biomass production in a poplar agroforestry system. Experiments were carried out to determine the responses of multiclonal planted poplars to changes in atmospheric carbon dioxide concentrations and to assess the potential for carbon sequestration through poplar plantations.

ISSUES AND TRENDS

Country reports by IPC members suggest that the area of planted poplars and, to a lesser extent, willows appears to be increasing globally. Regionally, the area is decreasing or stable in Europe, increasing or stable in Asia, increasing in North America and increasing or stable in South America (Table 5). Globally, willow cultivation and use appear to be expanding.

The cultivation of poplars and willows is no longer considered only a form of forestry land use. Species of these genera are increasingly used for landscape restoration, rehabilitation of degraded lands and combating desertification, particularly in the Near East, Western and Central Asia and North Africa. They are increasingly grown as part of the rural

landscape, integrated with agriculture (including livestock and cash crop production), horticulture and viticulture, thus contributing to sustainable livelihoods and integrated rural development. The planting of poplars and willows in smallholder woodlots and in agroforestry systems is increasingly enhancing land use in Asia (especially China and India) and South America.

Uses of poplars and willows are becoming more diversified, including a wide range of solid and reconstituted wood and fibre products. The use of poplars and willows for carbon sequestration and renewable energy is attracting attention in a number of countries. Phytoremediation using poplars and willows is moving from the development to the implementation stage in several countries, particularly in Europe and North America. The use of poplars for the absorption of nitrate pollutants from farming and other land uses is also attracting attention.

The value of diverse natural stands of

poplars and willows as a basis for tree improvement is well recognized. Programmes for the conservation of natural poplar stands are strong in Europe, but are proving difficult in some countries. Many countries, both developed and developing, have vigorous programmes on genetic modification of poplars, and the poplar genome has been mapped. Significant progress has been made in genetic manipulation to provide resistance against pests and diseases and to improve wood properties, growth and yield. However, insect and disease attacks remain a serious cause of reductions in tree health, growth and stem quality in poplars.

Government policies, especially in the energy and environment sectors, have generally supported the growing of poplars and willows, but the effects of changes in agricultural policies may at times be negative. ♦

TABLE 5. Area trends (▲, increasing; ▼, decreasing; ●, stable)

Country	Poplars			Willows		
	Natural forest species	Planted	Agroforestry/trees outside forests	Natural forest species	Planted	Agroforestry/trees outside forests
Argentina		▲			▲	
Belgium	▼	▼	▼	●	▲	▼
Bulgaria	▼	●	▲	▼	▼	▲
Canada	●	▲	▲			
Chile		●	●	●	●	●
China	▲	▲	▲	▲	▲	▲
Croatia	▲	▼		▲	▼	
Finland	●	▲				
France		▲				
Germany	▼	▼	▲	▼	▼	▼
India	●	●	●	●	●	●
Italy		▲				
Russian Federation	▲	▼	●	▼	▼	●
Serbia and Montenegro	▼	●	▲	▼	●	●
Spain	●	▲	▲	▲	▼	●
Sweden					▲	
Turkey	●	▼	▼	●	●	
United Kingdom	●	▲		●	▲	
United States	▼	▲	▲	●	●	▲