Food and Agriculture Organization of the United Nations

SOCIETY, ECONOMY AND FORESTS

THE UNFOLDING FOREST TRANSITION IN CHINA AND LESSONS FOR THE FUTURE










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Foreword

In recent decades, deforestation and forest degradation have emerged as major issues adversely affecting the flow of many ecosystem services that are vital to the existence of life on our planet. Apart from producing a wide array of products, forests play an invaluable role in combating climate change, regulating water flows, conserving biodiversity and providing various amenity values. The demand for these products and services changes in response to larger socio-economic changes. The Food and Agriculture Organization of the United Nations (FAO), through its global and regional outlook studies, has been providing long-term perspectives on the pathways of change, including emerging scenarios, and on what needs to be done to have a more balanced relationship between society and forests. Pursuant to the recommendations of the Asia-Pacific Forestry Commission in 2019, FAO completed the Third Asia-Pacific Forest Sector Outlook Study, and the publication *Forest Futures: Sustainable Pathways for Forests, Landscapes and People in the Asia-Pacific Region* provided a comprehensive view of recent trends in forestry and possible scenarios of what could emerge by 2030 and beyond.

While the Third Asia-Pacific Forest Sector Outlook Study provided a regional overview, it was felt that some of its findings needed to be elaborated and examined in detail, focusing on specific subregions, countries and issues. Because Asia and the Pacific is an extremely diverse region, there is a need to look at the varied experience and attempt to identify lessons that are of wider relevance. In this regard, the experience of China in relation to forests and forestry stands out in several areas, including its reversal of deforestation and forest degradation, and its emergence as a global leader in the production of several forest products. Evidently the experience of China in forest transition needs to be discussed in-depth and shared considering its wider relevance.

It is in this context that the present paper provides a comprehensive assessment of the changes witnessed in the forest sector in China during the last three decades and the key drivers that have contributed to the country's forest transition. Clearly such a transition is an outcome of the convergence of several factors, including the emergence of China as an industrial economy, clear and consistent policies, tenure reforms, investment in key forestry programmes, and strengthening science and technology capabilities. The paper also provides an indication of the emerging challenges, including the larger uncertainties stemming from inward-looking policies and the outbreak of global pandemics and crises. Every situation is unique, but the key messages emerging are indicative of the different options available. This study on forest transition in China will provide valuable insights into what is required to build and sustainably manage forest capital in order to meet the needs and aspirations of all stakeholders, whether global, national or local.

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Summary

While deforestation and forest degradation persist in many countries in Asia and the Pacific, China has witnessed a phenomenal transformation of the forest sector in the last three decades. The country has not only succeeded in arresting deforestation but also greatly expanded its forest area and inventory. Currently, China leads the region in planted forests and agroforestry. It has made impressive gains in wood processing and is currently the largest exporter of several forest products, such as wood panels, paper and paperboard, and furniture. It is also a leading producer and exporter of several non-wood forest products.

A number of policy changes and institutional reforms, including those relating to forest tenure rights, served to mobilize private sector investments in forestry. Further, environmental concerns have triggered several interventions, such as a ban on logging natural forests to protect and conserve existing forests and woodlands. Rapid urbanization and the consequent demand for timber and environmental services have led to increased investments in afforestation, reforestation and conservation. Significant developments in science and technology, including the strengthening of skills and capacities both within and outside the sector, have contributed to the efficient functioning of value addition, trade and market services all along the value chain, and have further helped to accelerate the transformation. The experience of China is particularly noteworthy considering the scale and speed of the forest transition.

This paper endeavours to explain the factors influencing forest transition in China and the diverse pathways that have helped to accomplish stability and improvements in the forest sector. The case of China provides particularly valuable lessons to countries keen on improving the forest sector in the larger context of change and the broad nature of the interventions required.

Introduction: A changing world

The society–nature relationship is undergoing continuous changes that affect all human pursuits, including those in forestry. Ever since human civilization began, people have modified their environment, affecting forests, including the goods and services they provide. Almost all countries have gone through, and many are currently going through, a phase of deforestation and forest degradation due to agricultural expansion, increased exploitation of wood and non-wood forest products, mining and infrastructure development. Transitions from agrarian to industrial, and later to post-industrial societies, have led to key changes in the use of forests (FAO, 2019). While deforestation and forest degradation persist in many countries, many have succeeded in arresting forest loss and increasing the extent of forests, a phenomenon often referred to as 'forest transition'.

In the Asia-Pacific region, China, India, Japan, the Republic of Korea and Viet Nam have been particularly successful in accomplishing forest transition (FAO and UNEP, 2020). Several studies attempt to explain the factors influencing forest transition and the diverse pathways being pursued to accomplish stability and improvements on the forest frontier (Zhang, 2019). Though the circumstances under which forest transition occurs differ, the experience of these countries provide valuable lessons in the larger context of change and the broad nature of the interventions required. Among these, the experience of China is particularly noteworthy considering the scale and speed of forest transition. There are several studies on different aspects of forest transition in China (see, for example, Li, Chhatre and Liu, 2019; Ke *et al.*, 2020). This paper provides an overview of the transformation of forests and forestry in China, giving particular attention to the following:

- important changes in the condition of forests, especially relating to area, growing stock, and the production, trade and management of key products for the provision of important ecosystem services;
- factors that have contributed to the transformation of the forest sector;
- emerging scenarios and their implications; and
- lessons from the experience of China.

Increase in forest cover and growing stock

Changes in the forest sector are assessed on the basis of a number of parameters, such as forest cover, growing stock, the extent of the area protected, and growth in the production, consumption and trade of forest products, all of which are a collective outcome of effective policies, investments and science-based inputs. Though challenges exist in defining the various parameters (for example, how forests are defined in national and global assessments), they do form the basis of assessments of long-term trends and cross-country comparisons. Some of the key changes observed in forest resources in China are outlined below.

Fastest growth rate in forest cover

A major development in the forest sector in China during the last 30 years has been the reversal of deforestation through massive investments in afforestation, resulting in an increase in forest cover from 157 million ha in 1990 to 220 million ha in 2020 (see Table 1) (FAO, 2020a) and in an increase in the proportion of forests from 16.4 percent to 22.9 percent of land area. Figure 1 provides an indication of the upward trend in the extent of forest cover in China. Globally, the country registered the highest increase in the area under forest cover from 1990 to 2020.

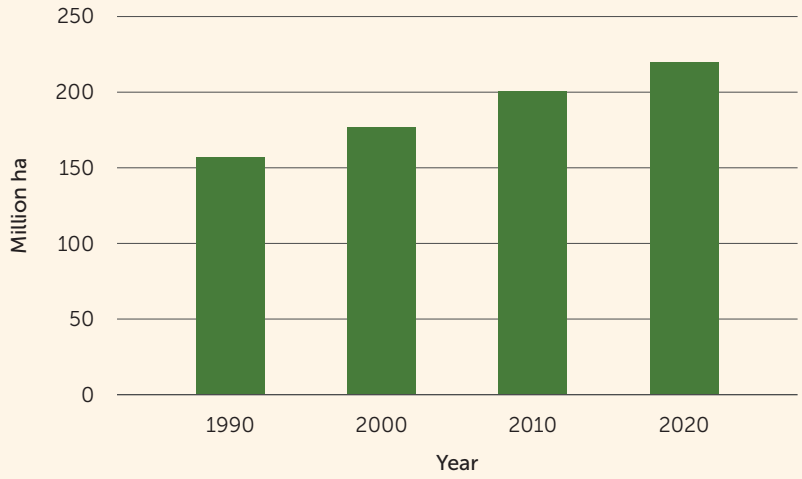
Among the 236 countries and territories covered by the FAO Global Forest Resources Assessment (FAO, 2020a), China stands out in terms of its high and consistent increase in forest cover from 1990 to 2020.

Table 1 Rate of forest cover increase in China

Year	Forest cover (million ha)	Annual increase (000 ha/year)	Annual increase (%)
1990	157.14		
2000	177.00	1 986	1.20
2010	200.61	2 361	1.26
2020	219.98	1 937	0.93

Source: FAO, 2020a.

Figure 1 Forest cover change in China (million ha)

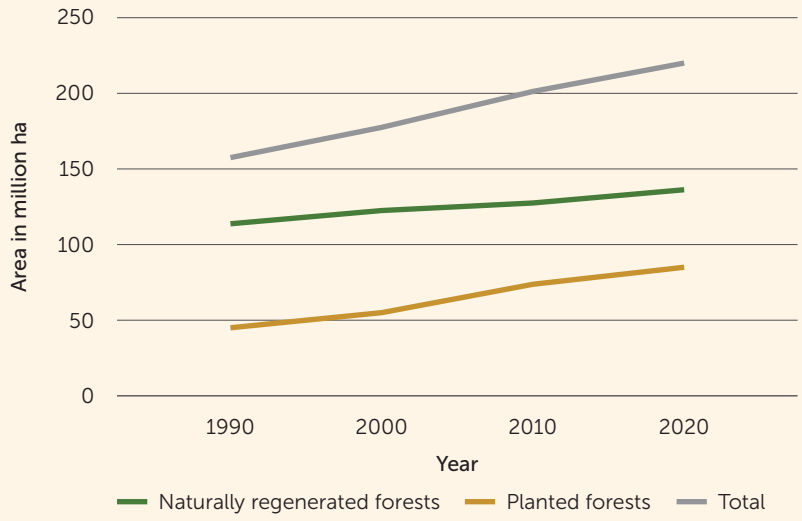


Source: FAO, 2020a (developed from Table 1).

Growth in the extent of planted and naturally regenerated forests

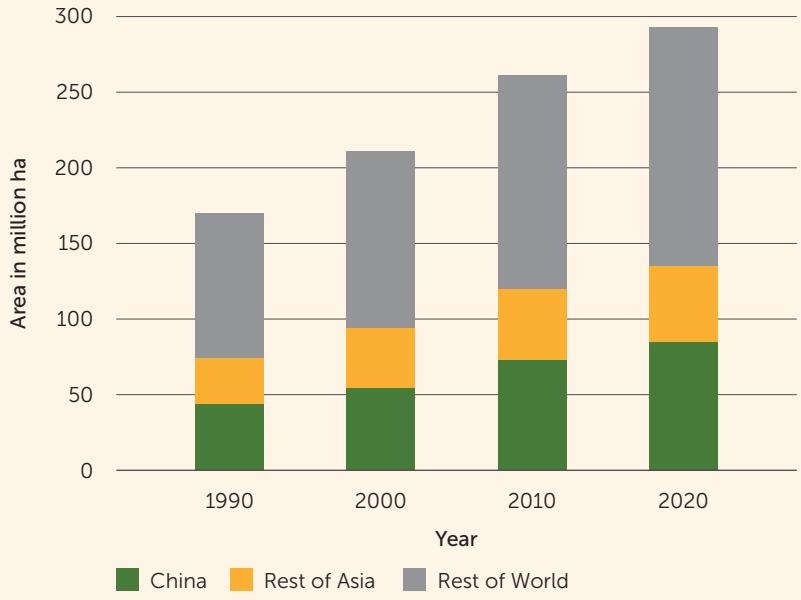
The increase in the extent of forests encompasses both naturally regenerated areas and planted forests, the former on account of the improved conservation of natural forests, including the imposing of a ban on logging, and the latter through systematic afforestation and reforestation efforts. While the extent of naturally regenerated forests increased from 113 million ha to over 135 million ha between 1990 and 2020, planted forest area increased by over 40 million ha (see Figure 2). China is one of the very few countries in the world where the extent of naturally regenerated forests has seen a significant increase during the last three decades. While naturally regenerated forests registered a decline of 7.5 percent and 4.7 percent in the world and in Asia, respectively, it increased by 19.5 percent in China.
The increase in the extent of planted forests is much sharper. Globally, the extent of planted forests increased from 170 million ha to 292.6 million ha, while in Asia the increase during that period was from 74.2 million ha to 135.2 million ha. China accounted for almost one-third of the increase in the global area of planted forests, while its share in planted forest growth in Asia was nearly two-thirds. The country's share in global planted forests increased from about 26 percent in 1990 to nearly 29 percent in 2020 (see Figure 3) (FAO, 2020a, 2020b).

Figure 2 Change in the extent of naturally regenerated and planted forests



Source: FAO, 2020a.

Figure 3 Share of planted forests



Source: FAO, 2020a, 2020b.

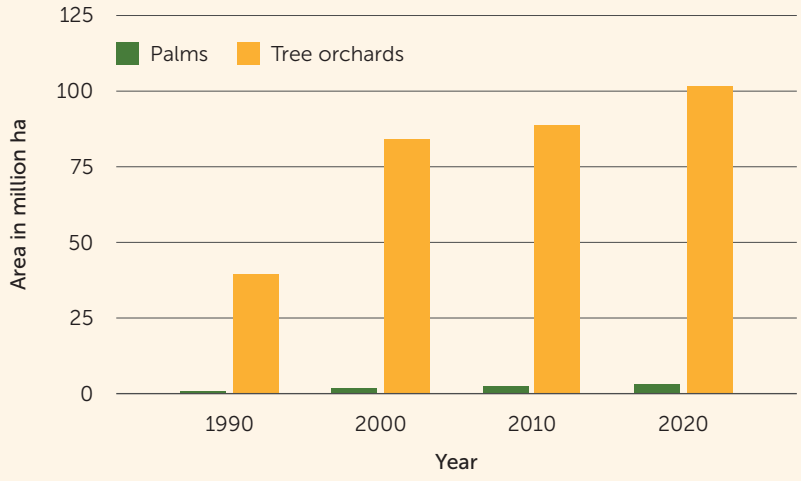
Extent of other wooded land

It is not just the extent of forests that has registered an increase. There has also been an increase in the area of other wooded land, from 101.5 million ha in 1990 to 109.5 million ha in 2020, which is about 12 percent of the land area of China. The country accounts for about 57 percent of other wooded land in Asia and 11 percent of that in the world (FAO, 2020a, 2020b).

Other land with tree cover

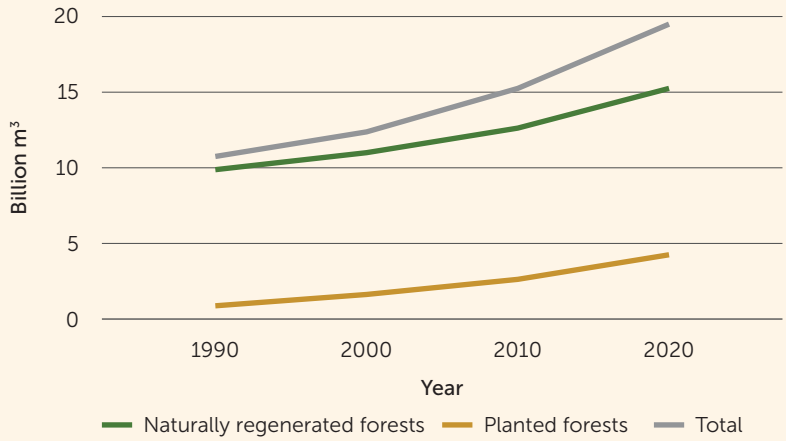
In addition to the area classified as forests and other wooded land, there are extensive areas of other land with tree cover. Available statistics also indicate an increase in the extent of other land with tree cover during the last three decades (see Figure 4), which suggests an increase in planting activities outside forests. Both the area under tree orchards and the area under palms have increased during the last three decades largely due to various initiatives, including large-scale public involvement in tree-planting activities (FAO, 2020b).

Figure 4 Change in the extent of other land with tree cover (area in million ha)



Source: FAO, 2020a.

Figure 5 Change in forest growing stock



Source: FAO, 2020a.

A number of studies have shown that tree cover on agricultural land has registered an increase. In 2000, the mean tree cover on the 1.69 million km² of agricultural land in China was estimated to be 11.36 percent. This figure had increased to 12.84 percent by 2010 (Zomer, Öborn and Xu, 2019). The study by Zomer, Öborn and Xu, (2019), which also provides disaggregated information on the extent of agricultural land under different canopy cover classes, also notes that, in China, the extent of agricultural land with a tree canopy of more than 30 percent had increased significantly – by about 57 500 km² – between 2000 and 2010.

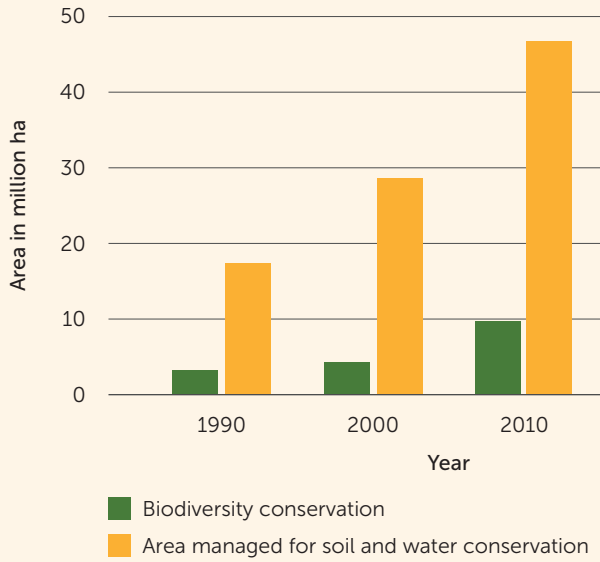
Rapid increase in growing stock

Changes in growing stock are an indication of the extent of efforts to manage forests sustainably. The forest sector in China has performed well also in this area, as both the total growing stock and the per-hectare growing stock have increased. The total growing stock in forests in China increased from 10.48 billion m³ in 1990 to 19.19 billion m³ in 2020 (see Figure 5). This amounts to a compounded annual growth rate of 2 percent, which enhanced the country's share of growing stock in Asia from 20.3 percent in 1990 to 30.7 percent in 2020. More remarkable is the increase in the growing stock of planted forests, which increased from 739 million m³ in 1990 to 4.05 billion m³ in 2020, an annual compounded growth rate of 5.8 percent. The per-hectare growing stock increased in both naturally regenerated forests and planted forests, from 86.2 m³ per ha to 111.9 m³ per ha in the case of the former and 16.7 m³ per ha to 47.8 m³ per ha in the case of the latter. This has paved the way for the enhancement of the country's self-reliance in wood production (FAO, 2020a, 2020b).

Growing prominence of forest ecosystem services

The last three decades have also witnessed a change in the objective of forest management. Increasing emphasis is being placed on improving forest ecosystem health and resilience, especially mitigating and adapting to climate change impacts, conserving biodiversity and protecting watersheds. With the significant improvement in people's living standards and a rise in public awareness, the demand for forest ecosystem services has increased significantly. Accordingly, the Government of China is paying particular attention to enhancing the ecological, cultural and spiritual values of forests. There is a clear recognition that the sustainability of economic development is very much dependent on the health and vitality of ecosystems, and this has led to the implementation of various ecosystem restoration programmes and the expansion of national parks, nature reserves, urban forests and other green areas.

Figure 6 Forest area managed for key environmental functions



Source: FAO, 2020a.

To fulfil different functions effectively, the Government of China has grouped forests into two broad categories: ecological forests, which include protected forests and special purpose forests; and production forests, which produce timber, woodfuel and other economically important products. According to various reports of the national forest inventory of China (National Forestry and Grassland Administration, various years), there was an increase in the proportion of ecological forests to total forests from 17 percent in 1993 to 56 percent in 2018.

Most often forests are managed to accomplish multiple objectives. While a particular area is managed to fulfil a primary objective, it often also contributes to other objectives. In fact, in the early stages of afforestation, much of the thrust was on establishing a green cover and this was accomplished through the monoculture of exotic species. Growing concern about the loss of biodiversity has led to considerable attention being paid to diversifying the species composition and to promoting native species. This is helping to provide a balanced approach, fulfilling both productive and protective functions. The current trend is to increase the area earmarked for the provision of environmental services, such as biodiversity conservation, and soil and water conservation. Based on the national forest inventories carried out during different periods, the Global Forest Resources Assessment 2020 identifies broad trends and provides information on the extent of forests designated to fulfil some of the ecosystem functions (FAO, 2020a). As indicated in Figure 6, the extent of forests managed for soil and water conservation registered a significant increase between 1990 and 2010, and has remained stable since then. The area designated for biodiversity conservation has increased by more than fourfold, clearly suggesting that it is a priority.

China has also paid considerable attention to the provision of amenity values by establishing forest parks and other green spaces, keeping in mind the needs of a rapidly urbanizing society. Apart from providing recreational opportunities, forest parks help to protect the natural heritage of the country. Between 1995 and 2017, the number of national parks increased from 750 to 3 505, while their designated area rose from 6.6 million ha to 20.28 million ha (Ke *et al.*, 2019). The development of green spaces is well integrated in urban planning, and one of the approaches is to develop "national forest cities". Accordingly, Guiyang was designated as the first national forest city. By 2019 about 194 cities had been given that status (Xinhuanet, 2019), and it has been proposed that their number be increased to 300 by 2025 (National Forestry and Grassland Administration, 2018).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China as a major producer of forest products

At the same time that there have been changes in the condition of forests, China has witnessed the rapid growth of forest industries, making it a leading producer of value-added wood products. Some of the key changes in the wood-processing sector are outlined below.

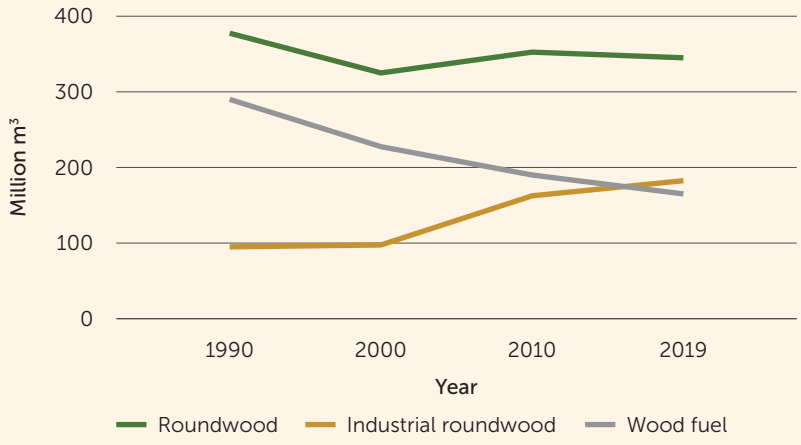
Decline in roundwood production; increase in industrial roundwood production

Between 1990 and 2019 roundwood (comprised of industrial roundwood and woodfuel) production declined from 378 million m^3 to 345 million m^3. Interestingly, there has been a significant change in the proportion of industrial roundwood and woodfuel as a proportion of total wood production. While industrial roundwood production doubled from 91 million m^3 in 1990 to 182 million m^3 in 2019, woodfuel production declined from 287 million m^3 in 1990 to 163 million m^3 in 2019 (see Figure 7). In 1990, woodfuel accounted for 76 percent of roundwood production, with the remaining 24 percent being industrial roundwood. By 2019 the relative proportion of woodfuel and industrial roundwood had changed to 47 percent and 53 percent, respectively (FAO, 2020c). This change itself is an indication of the major transformation in the forest sector, which is attributable to:

- the energy transition from woodfuel to liquid petroleum gas and electricity, as a result of higher incomes and the ease of access facilitated through urbanization; and
- the increased use of wood for industrial purposes owing to technological advancements.

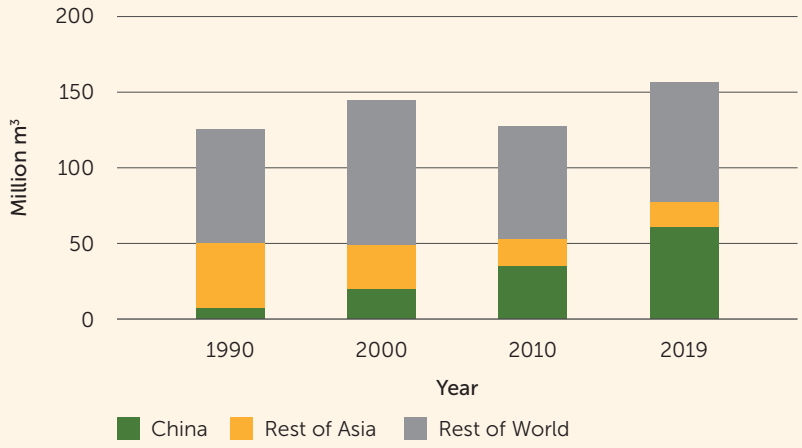
Further, China has invested in improving energy efficiency in the use of woodfuel, which has enabled a reduction in its production and consumption.

Figure 7 Trend in the production of wood in China



Source: FAO, 2020c.

Figure 8 Industrial roundwood imports by China

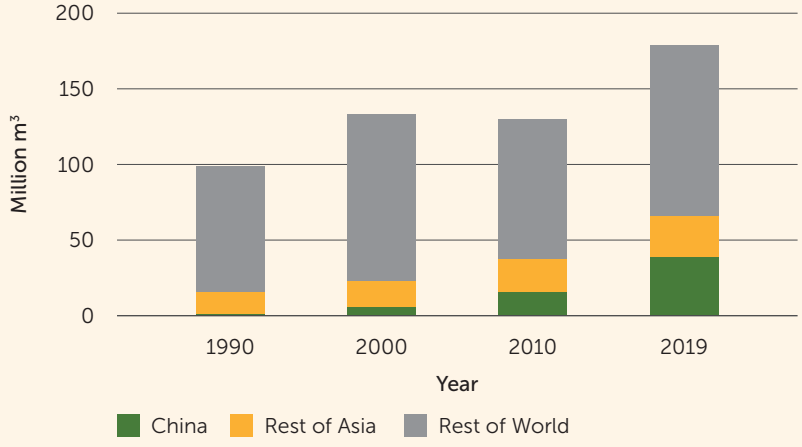


Source: FAO, 2020c.

An important transition in the forest industry in China has been the country's emergence as a major importer of industrial roundwood and an exporter of value-added products, such as wood-based panels, paper and paperboard, and wooden furniture. The most remarkable change has been the growth in the share of imports of industrial roundwood (see Figure 8). In 1990 China imported just 7.25 million m^3 of industrial roundwood, which was about 8.8 percent of the total global import. By 2019 the number had increased to 61.11 million m^3, or almost 43.6 percent of the total global import of industrial roundwood. Thus, the country's dependence on industrial roundwood imports has increased significantly during the last three decades. In 1990, its import value accounted for about 7.3 percent of the production of industrial roundwood, while by 2019, it had increased to 55.2 percent. This percentage increase is reflected in the value of imports, which increased from USD 745 million in 1990 to USD 9.6 billion in 2019 (FAO, 2020c).

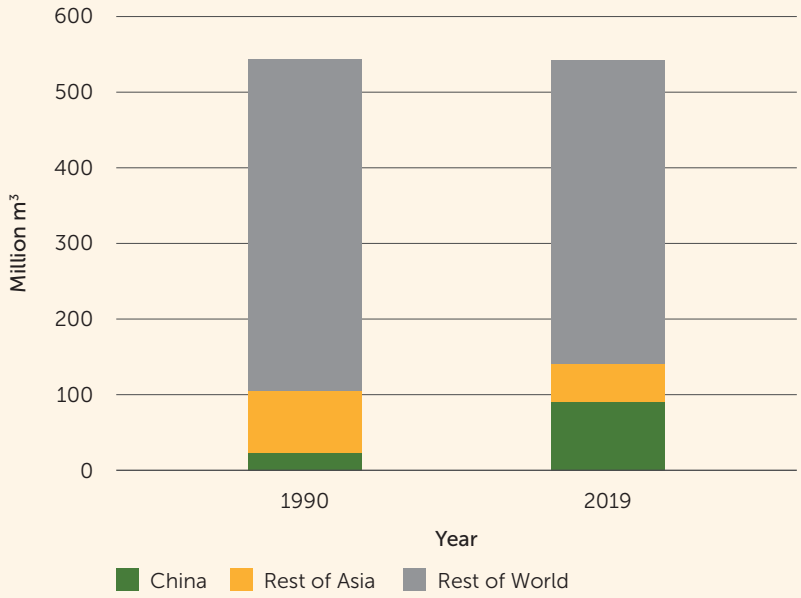
China has also become a major producer and importer of sawnwood during the last three decades. In 1990 it produced just 23.6 million m^3 and imported 1.3 million m^3, or 1.6 percent of the world's total import, while in 1990 it imported 39.5 million m^3, amounting to 26 percent of the total global import (see Figure 9) (FAO, 2020c). By 2019 domestic sawnwood production had increased to 90.3 million m^3 while imports had increased to 39.5 million m^3. Figure 10 provides an indication of the change in sawnwood production in China, Asia and the world during that period.

Figure 9 Change in the quantity of sawnwood imports



Source: FAO, 2020c.

Figure 10 Change in the share of sawnwood production

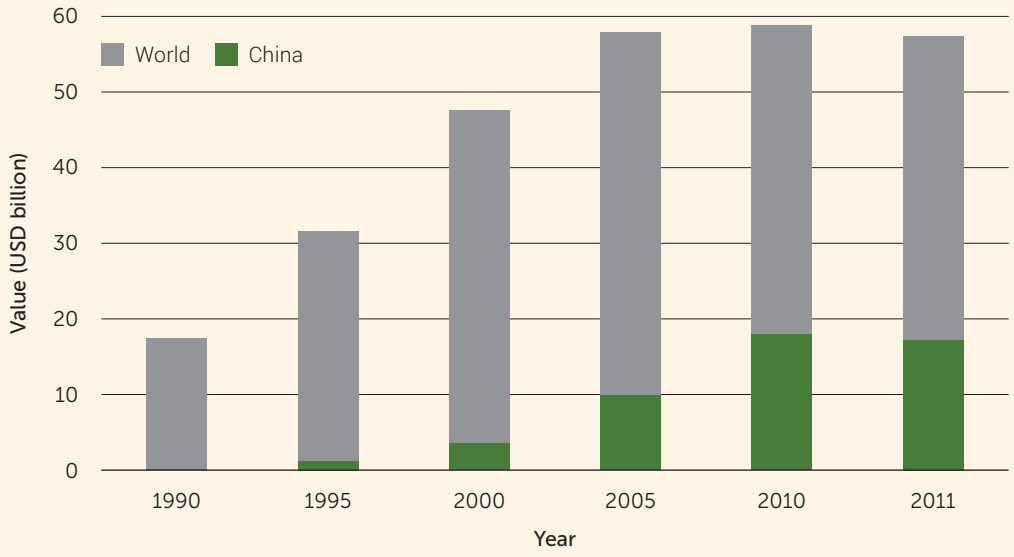


Source: FAO, 2020c.

The production of value-added products, especially wood-based panels, pulp for paper and paperboard, also witnessed a phenomenal expansion in China, as indicated below (FAO, 2020c):

- Wood-based panel production was just 3 million m^3 in 1990. This number increased to 18.9 million m^3 in 2000, 106.1 million m^3 in 2010 and 200 million m^3 in 2019. In 1990 China accounted for just 2.4 percent of total global production; by 2019 it produced almost half (49.8 percent) of the world's wood-based panels.
- The growth of paper and paperboard production is very similar. It grew from 17.4 million tonnes in 1990, accounting for 7.3 percent of global production, to 111.7 million tonnes, increasing the country's share of global production to 27.7 percent.

Figure 11 Export value of wooden furniture



Source: Lebedys and Li, 2014.

The production and export of secondary wood products, especially wooden furniture, is another area where China has made remarkable progress. In 1990 China was an insignificant player in the wooden furniture sector and accounted for about 0.7 percent of the gross value added by the furniture sector globally. By 2011 this figure had soared to 16.3 percent. At the same time, China has become a leader in furniture exports. In 1990 it accounted for just 1.5 percent of the global value of exports; by 2011 this figure had risen to about 30 percent (Lebedys and Li, 2014) (see Figure 11). This trend persisted in subsequent years, and in 2018 China accounted for 31.6 percent of the global export of wooden furniture (ITTO, 2018). However, Chinese dominance in the production and export of wooden furniture is facing challenges in view of increasing wages in China and unresolved trade disputes with the United States of America, a major importer of Chinese furniture.

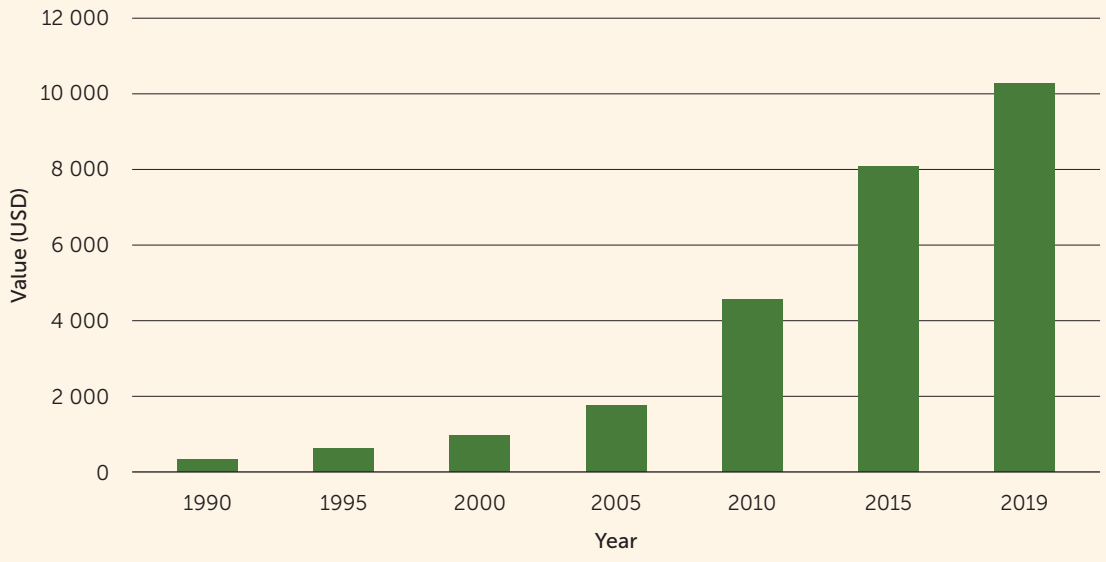
What contributed to the forest transition?

The changes in forests and forestry outlined above are an outcome of the collective impact of multiple factors. Generally, most forest transitions are policy- or market-driven, or a combination of both (FAO, 2019). However, policy and market changes are themselves driven by larger changes in society, as is the case of the transformation of China from an agrarian society to an industrial society. This fundamental change has led to wide-ranging policy and institutional changes, along with increased investments through key programmes, and backed up by developments in science and technology. The expansion of global trade and the accession of China to the World Trade Organization enabled the rapid growth of manufacturing and trade, which has directly and indirectly contributed to the rapid growth of the forest sector, especially the production and trade of various forest products. Below is a brief account of the key drivers that have directly and indirectly contributed to the transformation of the forest sector.

Emergence of China as an industrialized economy

During the last three decades China has witnessed major changes, especially on the economic front. Foremost among these changes is the rapid growth in income, making it the largest economy in purchasing power parity and the second largest economy in current exchange rates. The gross domestic product (GDP) of China in 1990 was just USD 360.86 billion; this figure increased to USD 2.29 trillion in 2005 and to USD 14.34 trillion in 2019 (World Bank, 2020a). Per capita income has grown rapidly, from only about USD 318 in 1990 to USD 10 262 in 2019 (see Figure 12).

Figure 12 Growth of per capita GDP in China



Source: World Bank, 2020a.

Along with the rapid increase in incomes, the Chinese economy has undergone fundamental structural changes during the last three decades, mainly in the form of a significant reduction in the GDP share of agriculture and a corresponding increase in the share of manufacturing and services sectors. In 1990, the primary sector (agriculture, forestry and fisheries) accounted for 26.6 percent of GDP, while the industrial and services sectors accounted for 41 percent and 26.6 percent, respectively. By 2019, the share of the primary sector had declined to 7.1 percent, while the shares of the manufacturing and services sectors had changed to 39 percent and 53.9 percent, respectively (World Bank, 2020b). These changes reflect a significant reduction in land dependency, thus reducing the pressure of agricultural expansion on forests and expanding the scope of releasing land for afforestation.

Among the various implications of such a rapid growth in income, the following are of particular relevance:

- With the rapid growth of the manufacturing and services sectors, the importance of agriculture in providing income and employment declined, reducing the pressure on land, and this to some extent created conditions favourable for the conversion of marginal agricultural land to tree plantations.
- Higher revenues have enabled the Government to allocate more resources for afforestation and to implement various forest protection measures; moreover, the opportunities to import wood reduced the pressure on forests in the country, making logging bans more effective.
- Increased household incomes, rapid urbanization and changes in policies and rules relating to home ownership have led to a massive spurt in construction, fuelling the demand for sawnwood, wood-based panels and furniture.
- Urbanization and higher incomes have also led to an increase in the demand for recreation and a consequent increase in investments in urban green spaces, parks and so forth.

Thus, the rapid growth in incomes, industrialization and urbanization provided a solid foundation for policy and institutional reforms and increased investments in the forest sector, paving the way for forest transition.

Environmental concerns driving key policy changes

In the early decades of development, much of the focus was on agricultural and industrial development, and environmental considerations were given little attention. Consequently, there was an effort to expand agriculture, which resulted in the cultivation of low productivity land, especially on steep slopes, while the impact on soil erosion and hydrology was ignored. Similarly, meeting the demand for wood led to unsustainable logging, again resulting in land degradation.

As the negative impacts became obvious, there were several global and national initiatives to pursue corrective action. At the global level, the United Nations Conference on the Human Environment, held in Stockholm in 1972, provided the initial impetus for the pursuit of a development agenda taking into account the environmental dimension. The United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, in 1992, and the international conventions stemming from it were the major turning point in encouraging various national-level initiatives. In pursuit of Agenda 21, outlined during the Conference in Rio de Janeiro, China developed its own "Agenda 21" in 1994. In follow-up, the State Forest Administration (the precursor to the National Forestry and Grassland Administration) developed the Forestry Action Plan for China's Agenda 21.

Box 1 Floods in China in 1998: A turning point

The Yangtze River, at a length of 6 300 km, is the longest river in Asia. It originates in the Qinghai-Tibetan Plateau and flows eastwards into the East China Sea. About 85 percent of its river basin comprises mountains and hills, and 11 percent is densely populated plains with high economic activity. It traverses through 11 provinces, and important cities along the river are Chongqing, Yichang, Wuhan, Nanjing and Shanghai.

Although flood events occur along the Yangtze River and its drainage system annually, the disastrous flood in 1998 was the second largest flood event of the twentieth century, after the flooding of the Yangtze River in 1954, which was a painful lesson for Chinese society in terms of both lives lost and economic losses. In the summer of 1998, torrential precipitation caused by the strongest El Nino phenomenon in the twentieth century triggered the devastating flooding of the Yangtze River and its tributaries. According to the Government of China, the disaster affected about one-fifth of the country's population (223 million) and 3 004 people lost their lives. In addition, the direct economic damage was estimated to be at least USD 20 billion, with damage to crops and agricultural facilities and infrastructure (such as houses, schools, roads, and the water supply and irrigation system) (UNDAC and United Nations Inter-Agency Mission, 1998; Yang, 2017). Furthermore, a long history of unsustainable land-use practices (such as deforestation) in the upstream of the Yangtze River and land reclamation alongside the water drainage system led to severe soil erosion, water discharge and accumulated sediment loading in the middle and lower reaches of the river basin (Xu et al., 2005), thus contributing to the development of the disaster and increasing the difficulties of the rescue, prevention and mitigation measures as the floods hit.

The floods in 1998 raised the alarm to rethink the strategy for restoring degraded ecosystems and improving disaster control and warning systems. Specifically, these actions included the reconstruction of drainage systems, dredging the main channels of river water, relocating people living in flood detention polders, and reforesting deforested mountainous areas in the upper reaches of the catchment area.

While these efforts drew attention to the environmental functions of forests and the need to manage them sustainably, critical events at the national level triggered concrete action. Undoubtedly, a severe drought in 1997 and devastating flooding in 1998 mark the turning point that led to a number of policy and programme initiatives giving primacy to environmental protection, as discussed in the following sections. The enormous damage caused by the flooding of the Yangtze River basin in 1998 (see Box 1) underpinned the need to protect uplands in order to ensure that the massive urban/industrial investments in the downstream were safeguarded.

Policy and institutional changes

Since the founding of the People's Republic of China, there have been systematic efforts to improve the policy, legal and institutional framework for the management of land and other natural resources, including forests. The annex to this paper provides a chronology of major policy, legal and institutional changes implemented in the forest sector in China. Key changes in land ownership and management during the last seven decades are outlined in Table 2.

Table 2 Changes in land ownership in China

Year	Main policy and legal changes	Important outcomes
1949–1952	• Land reform legislation was promulgated in June 1950. • All lands were confiscated and redistributed to individual farmers to enhance food production.	• Dominance of small-scale, privately owned farms.
1953–1958	• Policy on developing agricultural cooperatives. • Arable and forest lands were pooled into collectives, thus increasing households' share of benefits from their work.	• Increased centralization of forest management. • Decline in the area of forests.
1958–1978	• Acceleration of the collectivization process during the "Great Leap Forward" and the "Cultural Revolution", resulting in the formation of large communes, production brigades and production teams. • The policy of *"Siguding"* was launched in 1960 to stabilize the tenure of essential resources for the collectivization of production.	• No differentiation between State and collective land. • Large-scale deforestation and upland reclamation.
1978–2002	• Decisions on several issues concerning forest protection and development, including the reform of collective forest land. • Forest policies of *"Linyesanding"* and *"Liang-shan-dao-hu"* were enacted to allocate forest resources. The policy of *"Siguding"* was reassessed so certificates for collective forests could be issued. • Officially defined land-use rights and land ownership. Forest land ownership certificates were issued in 1984. • Under the household contracted responsibility system, collective lands were allocated to members of the collective equally for a period of 30 years.	• Improvement of collective forest management. • Due to unclear boundaries, ambiguous tenure and inconsistency in policies, forest resources continued to decline.
2003 onwards	• The policy of "Accelerating Forestry Development" was elaborated to improve rural resource management, and pilot projects (in Fujian, Jiangxi, Liaoning and Zhejiang provinces) on collective forest tenure reform were begun. • In 2008, the full implementation of the reform of collective forests tenure and the issuance of tenure certificates to individual households were announced.	• Increased incentives to forest farmers to plant trees supported through awareness campaigns on environmental protection. • A wide array of flexible models of cooperation and collaboration emerged involving landowners and the private sector.

Prior to the 1970s, the main objective of forest management was timber production, which supported post-war reconstruction. Inefficient management and unsustainable logging practices led to the rapid depletion of resources. Recognizing the decline in forest resources, the Government fine-tuned the legal and institutional framework, placing more attention on forest protection and on decentralizing forest management through the household responsibility system, as follows:

Box 2 Reform of collective forests: A major turning point in Chinese forest governance

Of the 304 million ha of forest lands in China, nearly 60 percent have been under collective ownership, with the rest under direct government control. Collective forests have been facing a number of challenges stemming from ambiguous ownership, a lack of trust among local communities, and an ill-defined mechanism for sharing management responsibility, as well as the benefits from forests. These challenges resulted in poor management and a consequent decline in productivity. Realizing the need for major reforms, the Government initiated a trial reform of collective forests in Fujian Province in 2003, and drawing upon that experience, the reforms have been implemented throughout the country since 2008 (Ren *et al.*, 2018). Collective forests are assigned to households on long-term lease, which clearly specifies how the land is to be managed systematically. Collective forest tracts are divided into small plots and allocated to households in an equitable manner, with the households receiving forest property certificates. Those who receive forest lands have four rights, namely information, management, disposition and benefit-sharing, for a period of 70 years. Under such a tenure regime, forest farmers can transfer their tenures in various ways, such as through a lease, subcontract, mortgage or joint venture.

By 2015, about 180 million ha of collective forests had been assigned to households. Financial mechanisms have been developed to support the reform of collective forests. In 2009 the Bank of China, the Ministry of Finance, the China Banking Regulatory Commission and the State Forest Administration jointly developed guidance on financing services to support forestry development in the context of collective forest tenure reform in order to encourage households to manage the land efficiently. Forest tenure mortgages to individual households have amounted to RMB 22.14 billion (approximately USD 3.2 billion), covering an area of 1.63 million ha.[a] In collaboration with government agencies, banks have developed various tenure reform support measures, including a microcredit system, a subsidized loan system and a mortgage loan system.

If collective forests are designated as ecological forests (and thus foreclose income-generating opportunities from logging), farmers are compensated for the potential income losses. For example, a farmer maintaining an ecological forest at the national level was compensated in the amount of RMB 150/ha in 2010 (approximately USD 22/ha). By 2016, this figure had been increased to RMB 170/ha (approximately 26/ha).[b] Such compensation has encouraged farmers to protect and sustainably manage the forests.

[a] Data based on various years of the National Forestry Yearbook of the National Forestry and Grassland Administration.
[b] Data based on various years of the Forestry Development Report of the National Forestry and Grassland Administration.

- The opening up of the Chinese economy in 1981 was a turning point and directly and indirectly impacted all sectors, including forestry.
- In 1998, the ban on the logging of natural forests was introduced.
- In 1984, a nationwide voluntary tree-planting programme was launched.
- In 2000, a two-category system – dividing forests into two classes, namely ecological forests and commercial forests – was introduced. To encourage the protection of ecological forests, a compensation system was introduced.

The most far-reaching policy reform during the last two decades has likely been the reform of collective forests (see Box 2). Assigning responsibility to individual households to manage forests on a long-term basis was a major step, incentivizing improved management. Apart from assigning rights, the Government put in place a wide array of arrangements, including financial and technical support mechanisms, to encourage improved forest management. The development of markets and changes in tax systems further encouraged landholder involvement.

Table 3 Key national forestry programmes

Name	Key objectives and priority areas	Year or decade programme launched
Fast-Growing and High-Yielding Timber Plantation Development Programme	Augments wood supply through the establishment of plantations to meet the growing demand for wood.	1980s
Shelterbelts Development Programme	Aims to establish a protective belt in the Three-North Region, the middle and lower reaches of the Yangtze River and other ecologically fragile areas.	1980s
Conversion of Croplands to Forests and Grasslands Programme (Sloping Land Conversion Programme)	Also known as the Grain-for-Green Programme, it aims to reconvert croplands in sloping areas to forests and grasslands through the provision of incentives to landholders.	1999
Natural Forest Protection Programme	Primarily focused on protecting natural forests in the upper and middle reaches of the Yellow and Yangtze rivers. This programme has three components: (a) restricting the logging of natural forests, (b) strengthening forest protection and (c) resettling workers affected by logging restrictions.	2000
Sandification Control Programme for Areas in the Vicinity of Beijing and Tianjin	Aims to curb sandstorms and the spread of sandy desert in the cities of Beijing and Tianjin, the provinces of Hebei, Shanxi and Shandong, and the Inner Mongolia Autonomous Region.	2000
Wildlife Conservation and Nature Reserve Development Programme	Aims to conserve biodiversity and protect flora and fauna through the establishment and management of protected areas, including nature reserves and wetlands.	2001

Implementation of key forestry programmes

Apart from such path-breaking tenure reforms, what distinguishes the post-1990 period is the massive investment in forestry through six key national forestry programmes (see Table 3). No doubt China had implemented various programmes earlier as well, but they did not have a strong impact, and restoration and reforestation efforts did not often yield the desired outcomes. In many cases the survival rate of seedlings was low and there was a need to mobilize resources and institutional capacity on a much larger scale. Undoubtedly the destruction caused by the floods in 1998 provided the impetus to improve the vegetative cover in the upper reaches of the rivers and there was strong political commitment to arrest and reverse forest degradation. Several studies have been undertaken on the rationale of the six key forestry programmes (see, for example, Delang, 2016) and how they have contributed to fulfilling the Government's commitments.

These key forestry programmes are considered as landmark initiatives, with the Government allocating substantial financial and administrative resources to ensure their success. It is reported that these six programmes together cover about 300 million ha with an estimated cost of RMB 900 billion (approximately USD 142.8 billion) (see Delang, 2016). There has been clear recognition of the importance of forestry in the provision of ecosystem services critical to the country's economic development. Together these six programmes cover almost the entire country, addressing all the key forestry issues, including the protection of natural

Box 3 Conversion of Croplands to Forests and Grasslands Programme

Being a densely populated mountainous country (with 65 percent of the land area being mountainous), sloping lands have been under cultivation in China for a long time, raising challenges with regard to watershed protection. The severe flooding in 1998, which led to the death of over 3 000 people and affected 223 million people in 29 provinces, underpinned the need to improve the management of sloping lands. However, most of the land is held by smallholders, and farming is critical for livelihood security. It was in this context that China launched the Conversion of Croplands to Forests and Grasslands Programme in 1999 to restore vegetation on sloping lands by incentivizing farmers to shift away from farming. Through the Programme (also referred to as the Sloping Land Conversion Programme or the Grain-for-Green Programme), cash or grain subsidies have been provided to farmers who convert their farmlands to tree or grass cover in order to reduce soil erosion and to protect watersheds. Initially compensation was paid in grain, but in 2004 this was changed to a cash subsidy. The duration of the subsidy varies depending on the type of vegetation re-established: eight years for ecological forests, five years for economic forests and two years for grasslands. In addition to the cash or grain subsidies, technical support is provided, particularly in relation to the choice of species, the provision of planting materials, and planting and maintenance.

Poverty reduction and the improvement of livelihoods in rural communities are integral to the Programme, and support is provided for a wide array of alternative means of livelihood. While monoculture plantations dominated the Programme in the early years, the emphasis has recently been on the development of multispecies uneven-aged forests. By mid-2019 some 33.5 million ha of croplands had been converted under the Programme. At a cost of about RMB 500 billion (approximately USD 72.5 billion) so far, it is likely the largest public investment in an ecosystem service programme in the world. Several studies have highlighted the positive impacts of the Programme, including its role in improving vegetative cover and carbon stocks, and in increasing rural incomes (see Rodriguez *et al.*, 2016).

forests, the conversion of low productivity sloping agricultural land to grasslands and forests to reduce soil erosion and to protect watersheds, arresting desertification by way of the establishment of shelterbelts, the restoration and rehabilitation of degraded lands, the conservation of flora and fauna, and the strengthening of wood production through high-yielding plantations to reduce the pressure on natural forests. In the past, natural forests were the main source of wood supply. The logging ban not only affected the wood supply but also led to large-scale unemployment among those employed by forestry enterprises. Yet, the Government went ahead with the programmes, demonstrating the commitment to arrest degradation notwithstanding the short-term challenges.

The Government has developed a wide array of mechanisms to encourage and incentivize the participation of stakeholders, especially landholders. The most notable is the provision of compensation or subsidies to incentivize the implementation of the Conversion of Croplands to Forests and Grasslands Programme. Landholders converting their agricultural land to forests and grasslands are compensated through cash or grain subsidies for the losses they suffer (see Box 3). It has become the largest publicly funded ecosystem services programme focused on the provision of watershed services in the world.

Overall the post-1998 period witnessed a rapid increase in government funding for forestry, rising from USD 680 million in 1998 to USD 1.8 billion in 2000, and then to USD 12.7 billion in 2015 (FAO, 2015). Furthermore, the Government provided various incentives to the private sector, especially in the form of tax concessions to establish industrial units. Tenure reforms, coupled with improved access to funding through non-traditional mechanisms, have boosted investments in forest conservation. Provincial and city-level administrations have been competing with each other, offering concessions for the establishment of industrial units. In addition to foreign direct investments, China has also been able to garner support from bilateral and multilateral institutions.

Table 4 Number of students graduating from forestry educational institutions

Degree	1990	2000	2010	2016
Doctoral degree	11	97	598	580
Master's degree	331	420	4 800	6 505
Bachelor's degree	4 578	5 826	32 698	50 087
Technician certificate/diploma	7 483	27 506	63 809	91 405

Source: FAO, 2020a.

Science and technology transforming the forest sector

Advancements in science and technology play a critical role in enhancing efficiency in the use of resources, and there are direct and indirect implications for forestry. China has made major strides in technological developments, especially through heavy investments in science and technology infrastructure, human resources and building strong international partnerships. All of the key indicators of science and technology development suggest a rapid surge in the country's position as a leader in global science and technology efforts. The gross domestic expenditure on research and development of China is an example: the country's GDP ratio increased from 0.9 percent in 2000 to 2.1 percent in 2018. In 2000 China's expenditure on research and development (R&D) was only USD 33.1 billion and by 2017 this figure has soared to USD 496 billion. Some notable indicators of R&D growth in China are (see NSF/NSB, 2020):

- The country's annual R&D expenditure grew at the rate of 17.3 percent during the period from 2010 to 2017, which was the fastest growth rate of any country.
- China accounted for one-third of the total global growth in R&D expenditure between 2010 and 2017.
- In 2018 China accounted for nearly half (49.4 percent) of all of the patent families registered worldwide. Japan occupied the second position with 17.5 percent, clearly indicating the magnitude of scientific outputs from China.
- In 2000 China accounted for only 5 percent of refereed science and engineering publications worldwide. By 2018 this figure had increased to 21 percent.
- The impact of investments in science and technology is evident from the share of value added generated by R&D intensive industries. In 2003 the country's share of value added in R&D intensive industry was just 6 percent, while that of the European Union and the United States of America was 25 percent and 38 percent, respectively. By 2018 the share of China had reached 21 percent while the share of the European Union and the United States had declined to 19 percent and 12 percent, respectively.

Forestry has benefited considerably from the overall thrust given to the development of science and technology, which has helped to improve every aspect of forestry, including the conservation and management of forest resources, and the development of new processes and products from wood and non-wood forest products. Since the 1980s, considerable progress has been made in the application of information and communications technologies, with three segments, namely e-governance, e-commerce and e-community, receiving particular attention. By 2010 the e-governance system had been established and further efforts continued to modernize forest management (Li, 2011). In 2010 China launched a 20-year forestry development strategy to be implemented in three stages. The first stage, implemented in 2011–2015, focused on using digital forestry to improve forest resource

Box 4 Bamboo resources in China and technologies for their utilization

With 39 genera and 837 species, China has the richest bamboo resources in the world (State Forestry Administration, 2006). Realizing the multiple benefits from bamboo, the Government of China has paid considerable attention to the development of bamboo resources and their efficient utilization, adopting innovative technologies with particular attention paid to enhancing the livelihood of rural communities. The extent of bamboo plantations grew from 3.86 million ha in 1990 to 6.50 million ha in 2010.[a] Some 12 756 businesses are involved in the processing of bamboo, and emphasis is placed on making use of every part of the bamboo to produce a wide range of products. The integrated approach adopted by the businesses ensures nearly 100 percent utilization of bamboo (Fei, 2019). Businesses deploy a wide range of processes that benefit the local communities. The wide array of products made from bamboo includes bamboo board, laminated bamboo flooring, furniture, handicrafts, paper, food (especially bamboo shoots and bamboo drinks), various bamboo fibre products and charcoal. According to some reports, bamboo is used in the production of nearly 10 000 products, largely on account of the wide range of technologies deployed (Fei, 2019). Considerable efforts are underway to develop bamboo-based structural material as a substitute for wood through bamboo recombination technology (see Huang *et al.*, 2019).

China has emerged as the largest producer and exporter of bamboo and bamboo-based products. Bamboo shoot production increased from 174 500 tonnes in 1995 to 771 160 tonnes in 2015. In 2017 the value of the bamboo industry was estimated to be RMB 245.6 billion (approximately USD 36.7 billion), and by 2020 this figure is expected to increase to RMB 336 billion (approximately USD 50.1 billion).[b] Apart from the income and employment generated through various bamboo products, bamboo is also becoming important in the context of ecotourism, considering the fact that bamboo has been an integral part of the culture of a large number of people in China.

[a] Data based on the 1990 and 2010 editions of the China Forestry Statistical Yearbook of the National Forestry and Grassland Administration.

[b] Data based on the 2017 and 2020 editions of the China Forestry Statistical Yearbook of the National Forestry and Grassland Administration.

monitoring, forest-related disease monitoring, forest industry development and Internet infrastructure development. The current phase (2016–2020) of science and technology focuses on developing a framework for 'smart forestry' through the wider use of mobile communication networks, the Internet and cloud computing. The third stage (2021–2030) will further deepen the fusion of information management and modernization to optimize the provision of forest ecosystem services striving to achieve a balance between conservation and development (Li, 2011).

Advancements in forestry science are spearheaded by national institutions such as the Chinese Academy of Forestry and the large number of universities providing the foundation for forestry research and education. The significant increase in the number of graduates acquiring various levels of qualification during the last three decades (see Table 4) is an indirect indication of the Government's efforts to enhance the scientific workforce in forestry (FAO, 2020b).

Almost all areas of forestry and forest product development have improved during the last three decades. Significant contributions to improving the condition of forests have been made through advancements in the assessment of resources; in the monitoring of change, including the outbreaks of pests and diseases; in the emergency response to fire; and in silviculture and the management of forests; as well as the wider use of improved information and communications technologies. While many of the developments in technologies with regard to the conservation and management of forests are spearheaded by public sector institutions, the development of new products and processes are undertaken by the private sector, often in collaboration with public sector research institutions.

Box 5 Combating desertification in northern China

Desertification remains a major problem in China and, as per the national desertification report published in 2006, some 263 million ha, or about 27.5 percent of the country's land area, is affected by desertification (CCICCD, 2006). Most of the country's desertified land is found in the autonomous regions of Xinjiang Uighur, Inner Mongolia and Tibet, and the provinces of Gansu and Qinghai; and 95 percent of the areas of those regions and provinces are made up of desertified land. Desertification is a process driven by multiple factors, including global warming, land reclamation, overgrazing, the removal of vegetation and unsustainable water management practices.
Some 400 million people are affected by desertification and the annual economic loss resulting from the phenomenon is estimated to be about RMB 50 billion (approximately USD 6.3 billion).

Tackling desertification has emerged as a thrust area for the Government, as articulated in the Law of the People's Republic of China on Prevention and Control of Desertification of 2001 and implemented through various key programmes (such as the Three-North Forest Shelterbelt Programme and the Sandification Control Programme for Areas in the Vicinity of Beijing and Tianjing). The application of science and technology plays a key role in these efforts. Considerable emphasis is given to cultivate species and provenances that are able to withstand the harsh environmental conditions, especially drought and outbreaks of pests and diseases; to breed suitable livestock; to provide renewable energy sources (solar, wind and biofuel); and to put in place a comprehensive monitoring system to assess performance and to improve the various practices. These programmes are designed and implemented through a strong collaborative effort involving research institutions, local communities, government agencies and international organizations. Much of the success of the desertification control programmes stems from an integrated approach based on the latest developments in science and technology and fully adapted to the local context with the full involvement of key stakeholders.

China has made significant technological progress in several areas of forestry, including genetics, tree improvement, the assessment of resources, the breeding of rare and endangered plants and animals, the monitoring of ecosystem services, and the development of advanced materials and products such as nanofibres. One area that demonstrates the progress in science and technology is the cultivation and processing of bamboo (see Box 4). Important advances have been made in new technologies for afforestation and reforestation, especially in environmentally challenging areas where adverse conditions affect plant growth. Combating desertification involves improving technologies in several connected areas, covering all aspects of ecosystem restoration linked to increasing resilience and improving livelihoods (see Box 5).

The future of forest transition in China

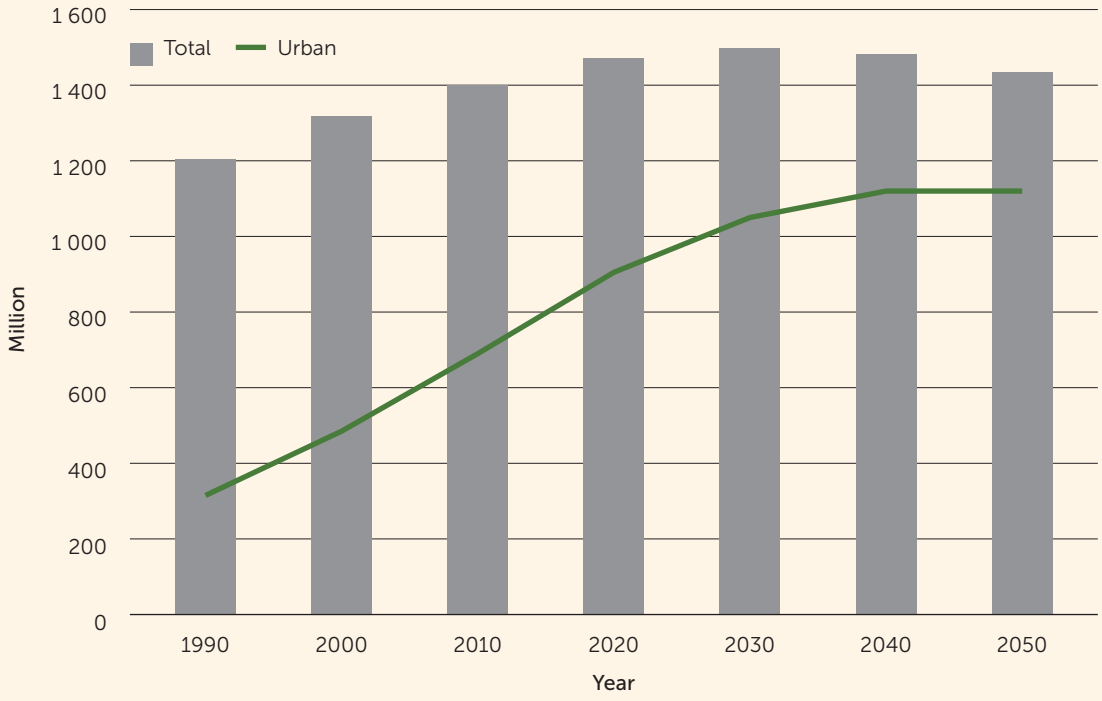
While the assessment thus far clearly indicates that China has been able to accomplish forest transition and has emerged as a major global player in forestry, it is pertinent to consider how the future may unfold and what could happen to forests and forestry in the next few decades. Most of the transition observed so far in the world has been sustained and no reversal has been reported yet, though such a possibility cannot be entirely ruled out in the context of certain drivers. For example, events relating to climate change – drought, fire and pest outbreaks – could have a devastating impact, negating the accomplishments made thus far. There are also several other uncertainties that stem from changes in the national and international situation. The outbreak of COVID-19 and its impact on the global economy is of particular concern considering the contraction of the global economy and its consequences on investments, trade, travel and tourism. Some of the factors that could impact future developments in the forest sector in China are:

- demographic changes;
- economic changes, including growth in incomes, deglobalization and changes in trade and investments; and
- environmental challenges, especially those stemming from climate change.

Demographic changes

The population growth rate will continue to decline, notwithstanding the repeal of the One-Child Policy in 2016, and it is estimated that, after reaching a peak of 1.46 billion people in 2030, the population will start declining, reaching 1.43 billion by 2050 (see Figure 13). At the same time the pace of urbanization will continue to accelerate, reaching almost 70 percent in 2030 and 78 percent in 2050. Another key demographic change will be an ageing population, with the median age of the population increasing from 24.9 years in 1990 to 38.4 years in 2020, 46.3 years in 2040 and 47.6 years in 2050. Old-age dependency as the ratio of people 65 years or above divided by those in the age range of 15 to 64 years reached about 17.0 in 2020, and this figure will increase to 38.3 and 43.6 in 2040 and 2050, respectively (World Population Prospects, 2019). These demographic changes are expected to have important direct and indirect impacts on the economy and the forest sector, especially on the demand for products and services and the availability of forestry workers, among others. An ageing population has often led to major shifts in housing demand, thereby impacting the demand for wood.

Figure 13 Change in total and in urban population in China



Source: World Population Prospects, 2019.

Economic changes

The growth in incomes will undoubtedly remain a key factor impacting forestry directly and indirectly. As discussed above, the rapid growth in incomes during the last three decades and structural changes in the economy, and in particular the increase in the share of the manufacturing and services sectors, have reduced the pressure on land and contributed to an unprecedented reduction in poverty.

However, the outbreak of COVID-19 has led to economic contraction, which in 2020 is estimated at about 5.2 percent (World Bank, 2020c). Assuming an early recovery, the World Bank estimates that in 2021 the global GDP will grow by about 4.2 percent. The timely intervention of China in dealing with COVID-19 has helped the country to minimize the impact on growth: the World Bank has projected the country's GDP growth to be 1.0 percent in 2020 and 6.9 percent in 2021. Though COVID-19 has disrupted global supply chains, and there is considerable uncertainty about the nature of future supply chains, all indications are that in the long run new supply chains will emerge and globalization will be back on track, and there could be qualitative differences in the nature of globalization. The experience of the recessions that have occurred during the last 150 years, including those triggered by pandemics, clearly indicates that their negative impacts tend to be largely short- or medium-term. In considering post-COVID-19 scenarios for the forest sector in China, the following require in-depth assessment:

- The inward-looking policies of some countries could accentuate the supply chain disruptions affecting imports and exports, including forest product production and trade in the short- and medium-term. Historical trends suggest the inevitability of continued globalization, although there may be qualitative changes. New producers and consumers may emerge, which would alter the locations of production and consumption, and help to develop new supply chains. Ongoing efforts, such as the Belt and Road Initiative, could help to accelerate the pace of post-COVID-19 globalization.

- During the initial phase of economic development in China, emphasis has been on export-led growth, making it the factory of the world. However, a shift is already evident, as China begins to rely more on domestic demand, facilitated by the growth of per capita income and the continued swelling of the middle class. This will also impact the forest sector, with the possibility of bringing about changes in the wood-processing sector.
- A major shift is already evident with regard to the nature of the goods produced and exported. China has become a major producer and exporter of capital goods, while its share of the production and export of consumer goods has been declining since 1990. It has become a major source of capital goods for countries such as Australia, India, Japan and the United States of America. There are already indications that labour-intensive production is moving out of China, while the country is increasingly becoming a producer of technology-intensive capital and intermediate goods. Taking advantage of developments in science, China could emerge as a leader in forestry machinery, tools and so forth, with the production of consumer goods shifting to other countries.

Environmental challenges

Climate change will remain a critical concern for China and the world, and how the issue is addressed nationally and internationally will have multiple direct and indirect impacts on forests and forestry in China. In compliance with the Paris Agreement, China has prepared its nationally determined contribution, outlining a multipronged policy and strategy aimed at reducing emissions and enhancing forest carbon sinks. Forestry has been given a key role in climate change mitigation and adaptation, with an emphasis on:

- enhancing afforestation, promoting voluntary tree planting by all citizens, continuing the implementation of key ecological programmes (including the Natural Forest Protection Programme, the Conversion of Croplands to Forests and Grasslands Programme, the Sandification Control Programme for Areas in the Vicinity of Beijing and Tianjin, and the Shelterbelts Development Programme), controlling desertification, conserving water and soil, strengthening forest tending and management, and increasing the forest carbon sinks;
- strengthening forest disaster prevention and forest resource protection, and reducing deforestation-related emissions;
- strengthening the protection and restoration of wetlands, and increasing the carbon storage capacity of wetlands; and
- continuing the restoration of grasslands, maintaining the balance between the restoration of the grassland ecosystem and the raising of livestock, preventing grassland degradation, restoring the vegetation of grasslands, strengthening disaster prevention and farmland protection, and improving the carbon storage of soil.

Other components of the nationally determined contribution, such as reducing emissions from building construction and the overall objective of promoting a low carbon footprint life, will also have important implications for forestry and the forest industry.

A major climate change-related challenge that China will have to confront is the need to safeguard the forest and carbon stock that has been built up during the last couple of decades from loss due to fire, pests and diseases. Forest fires, accentuated by droughts, have become a major problem in many countries. In fact, fires could become a key factor that could reverse forest transition within a short period. Between 2003 and 2006 fire incidences increased in China, with an area of 269 000 ha affected. The area affected by pests and diseases is also showing an upward trend, increasing from 7.7 million ha in 2002 to 10.4 million ha in 2017. Maintaining the health and vitality of forests will be a major challenge, especially with regard to reducing the risks due to fire and pests, potentially reversing the gains made thus far.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Lessons from the forest transition in China

A major accomplishment of China during the last three decades has been its ability to reverse deforestation and build up its forest capital through a wide array of interventions, including arresting degradation by putting a ban on logging natural forests, and large-scale afforestation and reforestation. In comparison with the situation elsewhere, the forest transition in China has been quite rapid, largely because of the collective impact of several factors, as summarized below:

- China has been going through a process of rapid economic development that has resulted in an increase in incomes and major structural shifts in the economy, with a significant decline in the role of the primary sector in employment and income. This process has also led to rapid urbanization and industrialization (and the expansion of urban employment in industries and the services sector), reducing the pressure on land.
- Higher revenues have enabled the Government to increase its support for wide-ranging environmental protection measures, including afforestation and reforestation. There has been a significant increase in the allocation of resources to forestry through a wide range of financing arrangements that have incentivized conservation and reforestation efforts.
- Environmental concerns, especially climate change, watershed degradation, desertification and biodiversity loss, have triggered a number of responses, including bans on logging natural forests, an increase in the extent of protected areas, and efforts to afforest and reforest degraded lands. The devastating floods in 1998 brought strong political support to forestry.
- A significant number of effective policy and legal changes, and institutional reforms, along with increased investments, have helped to accelerate the forest transition process. The reform of collective forests, which conferred important rights to individual households, was one of the most important policy reforms.
- These efforts have been accelerated through improved human resource development, especially the development of highly competent professionals and institutions. China has made considerable investments in building science and technology capabilities within and outside the forest sector, which has improved all aspects of the conservation and development of forest resources, as well as value addition through the development of new products and processes.
- An economic boom, coupled with rapid urbanization and the consequent demand for housing and other infrastructure, has increased the demand for wood and wood products. Higher incomes and growth in trade have enabled China to source wood from other countries. There has been a rapid expansion of wood processing capacity, enabling China to meet the burgeoning domestic demand and to become a net exporter of various products.

- The post-1990 period has witnessed an acceleration in the pace of globalization, enabling increased investments, the transfer of technology and the trade of products – both raw material and finished products. China has been able to take full advantage of these opportunities, which has helped it to become the world's largest importer of tropical timber, as well as the largest exporter of several products, such as panel products, paper and paperboard, and furniture. The surge in domestic demand for various products, especially in the context of rapid growth in construction, could be met through imports of timber and its domestic processing in China.

The experience of China during the last three decades provides important lessons and is the outcome of a unique confluence of factors. Taking into account that each country's situation is different, it is difficult to offer broad recommendations about what may be done to accomplish forest transitions and to make sustainable forest management workable. Yet the experience of China does give some indication of key elements that need to be in place in a country in order to accomplish forest transition, as discussed below:

- Almost all countries have accomplished forest transition in the context of rapid industrialization and growth in incomes, reducing the dependence on land. A favourable macroeconomic environment that enables the development of an industrial economy helps to reduce the direct and indirect pressure on land. This is particularly so in the case of countries with high population density and low per capita land resources.
- A robust policy and legal framework and the effective coherence of policies, legislation and institutional arrangements are key to the success of sustainable forest management. China has managed to develop an appropriate combination of a strong policy framework and market driven responses. It is this robust policy framework that has enabled China to take full advantage of the opportunities provided by globalization. The robustness of the policy and institutional framework in all sectors is a reflection of effective governance and leadership.
- Translating policies and legislation requires effective institutions. Over time China has invested heavily in building its institutional capacity at every level – national, provincial and local. This includes forestry administration, whose mandate has been continuously improved. The private sector has been supported to play a pivotal role in managing enterprises involved in the production and processing of wood and non-wood products and in the provision of ecosystem services. There have also been substantial efforts to improve forestry science and technology capacity and to enhance human capital.
- Having well-conceived long-term programmes with adequate resources is another key requirement for forest transition. As noted above, forest transition in China is largely due to the implementation of the six key national forestry programmes, most of which are long term.

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Annex: Key policy, legal and institutional changes in forestry in China

Period	Year	Important policy, legal and institutional changes
1949–1970: The primary goal of forestry was to produce timber. Agriculture was the priority, which led to the diversion of forests for agriculture, resulting in a decline in forest cover.	1950	• Constitution of the People's Republic of China and the enactment of the Land Reform Law, which defined forest ownership as vested in the Government. • The Ministry of Forestry and Land Reclamation was established.
	1951	• The Ministry of Forestry and Land Reclamation was changed to the Ministry of Forestry.
	1956	• The Ministry of Forestry was bifurcated into the Ministry of Forestry and the Ministry of Forest Industry. • Establishment of State-owned forest and nature reserves.
	1958	• The Ministry of Forestry was merged with the Ministry of Forest Industry.
	1970	• The Ministry of Agriculture and the Ministry of Forestry merged to become the Ministry of Agriculture and Forestry. • Forestry became a department within the Ministry of Agriculture and Forestry.
1970–1990: Efforts to strengthen forest administration continued, with a greater focus on forest conservation, but pressures of economic development led to continued forest decline.	1975	• Ministry remained the Ministry of Agriculture and Forestry.
	1979	• Increased attention paid to forestry development. Fine-tuning of institutions, with a focus on structure and functions, and the Ministry's name was changed to the Ministry of Forestry. • Launching of the Shelterbelts Development Programme to improve ecological conditions and to enhance resilience to natural hazards.
	1981	• Economic reforms and opening up of the economy. • Several decisions made relating to forest protection and development, including the Nationwide Voluntary Tree-Planting Campaign, whose implementation commenced in 1982.
	1982	• Reorganization of the Ministry of Forestry with independent status under the State Council. • Introduction of the One-Child Policy.
	1985	• Promulgation of the Forest Law.
	1987	• Centralized allowable harvesting quota for wood and the requirement of a transport permit.
	1988–1992	• The forest administrative system was expanded and its mandate defined at all levels. • Establishment of a timber cutting quota and harvest licencing system for industrial forestry enterprises. • Launch of the Fast-Growing and High-Yielding Timber Plantation Development Programme to enhance domestic wood supply.

Period	Year	Important policy, legal and institutional changes
1990–2011: Improved international cooperation and increased efforts to restore and conserve forests and ecosystems and to combat deforestation.	1994	• Promulgation of the Regulations of the People's Republic China on Nature Reserves.
	1995	• Forestry Action Plan for China's Agenda 21.
	1996	• Deepening of reforms and strengthening the development of State-owned forest lands. • Wild Plant Protection Ordinance.
	1998	• Floods and sandstorms. • Logging ban imposed in natural forests. • The Ministry of Forestry renamed State Forest Administration. • Launch of the Forest Ecosystem Compensation Programme.
	1999–2001	• Implementation of key national forestry programmes. • Classification-Based Forest Management system put in place.
	2003	• Decisions on accelerating forestry development, with a focus on rural resource management. • Several policies in support of increasing incomes of farmers.
	2008	• Reform of collective forest tenure.
	2009	• Redline policy on arable land to ensure a minimum area of land under regular farming.
	2010	• Strategic Economic Forest Development Plan with local features (2011–2020) formulated.
2012 onwards: Improvement in forest health in support of the development of ecological civilization and the continued increase in forest cover.	2012	• Establishment of the environmental policy Ecological Conservation Redline, a critical component of building an ecological civilization. • Water resource policy established. • Technological innovation to promote the development of modern forestry.
	2014	• Amendment and adoption of the National Environment Protection Law.
	2018	• Management of grasslands integrated with forestry through the formation of the National Forestry and Grassland Administration.

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