



INDIA TIMBER SUPPLY AND DEMAND 2010-2030

An analysis of supply, demand and end use of timber in
India and projections to 2030

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Cover images from top left to bottom: eucalyptus logs, pine logs, teak logs, toon (*Toona ciliata*) logs, all from the Forest Research Institute in Dehradun. All Photos by Raman Nautiyal.

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PREFACE

This report on the dynamics of timber supply and demand in India covers the period 2010 to 2030, analysing historical trends from 2010 to 2019 and forecasting the likely situation in the coming decade, 2021 to 2030. The study methodology was limited by the COVID pandemic which did not allow collection of data through field surveys. The data for the report has therefore been taken from a wide spectrum of sources, including annual and other reports of the state forest departments, Forest Survey of India, Indian Council of Forestry Research and Education, Indian Plywood Industries Research and Training Institute, websites of the Ministry of Statistics & Programme Implementation, Directorate General of Commercial Intelligence and Statistics, and affiliations of wood-based industries. Personal interviews were also conducted with many people connected with these institutions and organisations.

The report is presented in three sections. **Section 1** describes the wood and wood products sector in India, providing estimates of forest cover density, and other important parameters such as growing stock on which the development of the forest sector relies. The development of the forest sector over the past decade is presented in detail along with changes in forest cover, growing stock of timber and growing stock of tree species that are important in the wood products market.

Section 2 provides a detailed analysis of trends and patterns in India's wood-based industry over the past decade, including international trade in important wood products, namely, roundwood, sawnwood, plywood, fibreboard, hoopwood, pulp and veneer. Estimates of current demand and production of industrial roundwood, sawnwood, veneer sheets and plywood have also been provided for the period 2009 to 2019 and all assumptions used have been noted in the text.

Section 3 comprises estimates of demand from 2021 to 2030 which are based on forecasts of population and incomes, wood product consumption trends, and growth in important wood-based industries. Demand has been estimated based on models developed, and possible scenarios over the coming ten years have also been explored. The section concludes with a brief discussion on the roadmap to improve the precision and accuracy of future reports.

LIST OF ACRONYMS AND ABBREVIATIONS

CPPRI	Central Pulp and Paper Research Institute
DGCIS	Directorate General, Commercial Intelligence & Statistics
FDC	Forest Development Corporation
FIPPI	Federation of Indian Plywood and Panel Industries
FRI	Forest Research Institute, Dehradun
FSI	Forest Survey of India, Dehradun
ICFRE	Indian Council of Forestry Research and Education
IPIRTI	Indian Plywood Industry Research and Training Institute, Bengaluru
ISFR	India State of Forest Report
mha	Millions of Hectares
MoEF & CC	Ministry of Environment, Forest and Climate Change
MoSPI	Ministry of Statistics and Programme Implementation
Mtpa	Million Tonnes Per Annum
NITI	National Institution for Transforming India
NTFP	Non-Timber Forest Products
NVA	Net Value-Added
RW	Roundwood
RWE	Roundwood Equivalent
TOF	Trees Outside Forests

EXECUTIVE SUMMARY

The Forest Survey of India undertakes a detailed biennial survey of India's forest resources using remote sensing technology. The most recent survey, the India State of Forest Report 2019¹, reports the total forest cover in 2019 at 712,249 km² which is 21.67% of India's total geographical area. This is a significant increase from 708,273 km² (21.54%) in 2017. The tree cover outside forests is 95,027 km² (2.89%), up from 93,815 km² (2.85%) in 2017. The area of combined forest and tree cover outside forests currently comprises about a quarter of the total geographical area of the country. The total estimated growing stock is 5,915.76 million m³ of which 4,273.47 million m³ lies inside forests with an average growing stock of 55.69 m³ per hectare. The growing stock of trees outside forests is estimated to be 1,642.29 million m³.

Although India's forest and tree cover has been steadily increasing for nearly two decades, India still remains deficient in timber production and an increasingly large proportion of its burgeoning demand is being met from imports. This trend began in the 1980s when roundwood production was in the range of 10 to 15 million m³ per year. The gradual decline in production has been due to increased focus on conservation of forests after the notification of the National Forest Policy, 1988. According to the FAO Yearbook, the Compounded Annual Growth Rate (CAGR) declined every year during the decade 1991 to 2000 in India, by 0.70 for industrial coniferous roundwood, 1.15 for industrial non-coniferous roundwood, 8.72 for coniferous sawnwood, 8.39 for non-coniferous sawnwood and 5.09 for veneer. The decline was even sharper in the following decade with severe restrictions placed by the Supreme Court of India on harvesting from forests, initially in the north-eastern states and later extended to other states of the country.

Total production of roundwood in India is around 47 million m³ per annum of which only about 2 million m³ comes from state-owned forests where harvesting is severely restricted, and the remainder (45 million m³) comes from trees outside forests. The rest of timber demand is provided by imports, which were facilitated in 1996 when the Government of India classified wood under the Open General License (OGL) with the intention of easing the wood shortage and reducing demand for timber from natural forests. A conscious attempt has been made to protect the

domestic wood processing industry through a tariff structure that is biased in favour of unprocessed logs.

India's wood imports are mostly in the form of roundwood (logs) of which pine and teak are destined for high value wood furniture, and other timber species are used for other purposes including middle segment furniture and construction. In value terms, India's imports of pulp rose from about USD 240 million in 2009 to USD 510 million in 2019, while wood and other wood products increased from USD 1,331 million to about USD 1,950 million over the same period. The furniture industry is expected to grow considerably as a consequence of the growing middle-class population, increasing urbanization and rising disposable incomes. The sector is expected to expand at an estimated CAGR of around 13% during the period 2020 to 2024.

Exports of timber and timber products from India are insignificant, with furniture and woodworks constituting the major export items. Exports of plywood and veneer have declined sharply from 1996-1997, when the Supreme Court of India clamped down on severe malpractices in exploitation of forests in the north-eastern states and Andaman Nicobar Islands. However, in recent years the manufacture of high-quality plywood in Yamuna Nagar and other locations has led to noticeable increase in plywood exports. The export of furniture has also shown a continuous, if modest, increase over time.

Using the value inputs of the four broad categories of pulp and paper, furniture, panels and plywood, and construction wood, the current demand for roundwood in India was estimated using certain assumptions explained in Section 2 for current demand, and a model developed in Section 3 for projected future demand. The demand for 2016 to 2020 is given in Table 1.

Total roundwood demand in 2020, in roundwood equivalent volume, is estimated at approximately 57 million m³ of which around 47 million m³ is met from domestic sources and the rest from imports and substitutes.

Growth models were developed to forecast demand over the next decade and are based on past trends in input values for three broad categories of wood-based industries and expected demand accounting for population, incomes, and education. For pulp and paper, the best explanatory model was found to predict no change while for the furniture industry a linear model was the best fit. For plywood and other

¹ Forest Survey of India (Ministry of Environment Forest and Climate Change). 2019. State of Forest Report 2019. Available at: <https://fsi.nic.in/forest-report-2019?pgID=forest-report-2019>

wood-based industries, growth in input was found to follow an exponential model. The projected total

demand for roundwood for all purposes, for 2021 to 2030 is given in Table 2.

Table 1: India, roundwood demand estimates by wood-based sector, 2016-2020 (million m³ RWE)

Year	Pulp and paper	Furniture	Panels and plywood	Construction	Total
2016	12.32	6.88	9.44	30.15	58.79
2017	12.36	7.63	9.00	28.90	57.89
2018	12.50	7.52	10.66	26.25	56.93
2019	12.50	8.01	11.24	26.25	58.00
2020	12.50	8.49	11.83	24.37	57.19

RWE=roundwood equivalent

Table 2: India, roundwood demand forecasts by wood-based sector, 2021-2030 (million m³ RWE)

Year	Pulp and Paper	Furniture	Plywood and other wood-based industries	Construction	Total
2021	12.5	8.98	15.45	22.71	59.64
2022	12.5	9.47	17.88	21.79	61.64
2023	12.5	9.95	20.69	20.88	64.02
2024	12.5	10.44	23.94	19.96	66.84
2025	12.5	10.92	27.70	19.05	70.17
2026	12.5	11.40	32.06	18.14	74.10
2027	12.5	11.89	37.10	17.22	78.71
2028	12.5	12.37	42.93	16.31	84.11
2029	12.5	12.86	49.68	15.39	90.43
2030	12.5	13.34	57.49	14.48	97.81

RWE=roundwood equivalent

Roundwood demand by the pulp and paper industry remains constant or declines slightly in response to the decline in the number of firms producing wood-based paper, from 30 in 2010/11 to 18 in 2019/20. No increase in manufacture of wood-based paper is anticipated in the medium-term even though demand for paper, especially packing and other industrial paper, is projected to increase sharply in response to population growth and the 'Make in India' policy being promoted by the Government of India. This increase in demand, however, is likely to be supplied by a sharp increase in the use of recycled fibres, which is seeing a robust growth with government policies favouring reuse and recycling.

Roundwood demand by the furniture industry is projected to increase at a slower pace, from 9 million m³ in 2021 to about 13 million m³ in 2030. A large component of furniture, especially office furniture, is increasingly being made of non-wood material in response to the increasing cost and

maintenance of wooden furniture made of traditional furniture-making timber species such as teak, *Dalbergia* spp., etc.

Demand for wood by 'plywood and other wood-based industry' sharply increases from 15 million m³ in 2021 to more than 57 million m³ in 2030. A significant proportion of this is the demand arising from gradually shifting preference for plywood and board panels from solidwood in construction activities. Construction of housing units has increased significantly and this trend is likely to continue as the Government of India has aimed at providing houses for all Indians by 2022. Additions and improvements in existing houses are also projected to increase. Demand, however, is likely to be for cost-effective plywood rather than hardwood species such as teak, pine and *Dalbergia sissoo* (Sheesham). Timber used for construction, including that used for preparing scaffoldings, will also register changes with the increasing pace of construction, but the volume used may not necessarily rise because of

repeat use of wood for scaffoldings and increasing reliance on iron and steel for larger constructions. Demand for roundwood by the construction sector is expected to be around 15 million m³ in 2030, excluding plywood used in construction which has been assessed separately. Total timber demand by 2030 is therefore projected to rise to around 98 million m³ in these four sectors alone.

On the supply side, estimates of total domestic production, and exports and imports of various wood products are shown in Table 3. Roundwood produced from state forests has been obtained from reports by the state forest departments and has remained around 2 million m³ for almost a decade.

Roundwood from trees outside forests has been taken from India State of the Forest Reports² (ISFR) for various years but as it is only available biennially the missing values have been estimated from the preceding and succeeding years. It has also remained in the vicinity of 45 million m³ for a number of years.

All import and export data has been sourced from the Directorate General of Commercial Intelligence and Statistics³ (DGCIS) and the Indian Council of Forestry

Research and Education⁴ (ICFRE). Imports of roundwood logs have remained around 4 to 5 million m³ over the preceding decade while sawnwood imports have increased steadily from a low level (0.16 million m³ to 1.63 million m³) over the same period. Among value-added products, imports of veneer have increased multi-fold and that of fibreboard and sulphate pulp modestly while the import of plywood has remained low.

Imports of teak roundwood have doubled from about half a million m³ in 2009 to slightly more than a million m³ in 2019 while sawn teak has remained subdued due to high tariffs. On the export front, the volumes traded were consistently low with only veneer and fibreboard showing a marginal presence.

Owing to its excellent properties, teak is traditionally the most preferred species in India. The total area of teak plantations is about 1.7 million hectares. An

² India State of Forest Report is a biennial publication of Forest Survey of India (FSI), an organization under the Ministry of Environment Forest and Climate Change (<https://fsi.nic.in/forest-report-2019>).

³ <http://www.dgciskol.gov.in/>

⁴ <https://www.icfre.org/>

Table 3: Estimated domestic production and international trade of major wood products, by quantity, 2009-2019

Product	Units	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Roundwood from state-owned forests	million m ³	2.18	1.89	1.78	2.07	2.39	2.2	2.09	2.2	2.16	2.15	2.17
Roundwood from trees outside forests	million m ³	44.79	44.07	43.36	42.46	41.57	42.81	44.05	44.48	44.91	45.45	45.98
Roundwood imported	million m ³	5.09	4.79	5.82	6.39	6.23	6.23	5.69	5.2	4.62	4.56	4.37
Hoopwood imported	million kg	0.35	0.42	0.6	1.45	0.46	0.38	0.29	0.12	0.11	0.04	0.02
Sawnwood imported	million m ³	0.16	0.16	0.45	0.5	0.55	0.55	0.73	0.74	0.92	1.18	1.56
Veneer sheets imported	million kg	19.70	21.54	134.13	90.36	125.29	167.7	286.49	326.16	312.23	299.84	319.9
Fibreboard imported	million kg	94.06	165.52	183.15	192.26	203.70	168.16	180.00	210.71	268.33	296.38	266.62
Plywood and panels imported	million m ³	0.20	0.28	0.40	0.31	0.20	0.20	0.19	0.17	0.20	0.25	0.46
Sulphate pulp imported	million kg	456.22	518.45	645.11	646.93	689.47	666.82	706.83	777.46	746.77	680.46	735.44
Sulphite pulp imported	million kg	1.76	1.73	2.46	1.68	34.26	25.05	1.64	1.00	1.96	3.16	1.64
Round wood exported	million m ³	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Hoopwood exported	million kg	0.29	0.26	0.17	0.24	0.25	0.24	0.24	0.12	0.07	0.10	0.12
Sawnwood exported	million m ³	0.02	0.02	0.02	0.05	0.05	0.03	0.04	0.02	0.01	0.01	0.00
Veneer sheets exported	million kg	20.25	15.69	9.54	6.91	3.68	7.38	5.15	6.07	3.78	13.84	10.44
Fibreboard exported	million kg	11.47	12.78	13.36	16.54	15.52	13.41	15.19	15.79	11.84	16.37	24.82
Plywood and panels exported	million m ³	0.11	0.14	0.11	0.07	0.12	0.13	0.11	0.25	0.23	0.10	0.11
Sulphate pulp exported	million kg	≈0	≈0	≈0	≈0	≈0	5.47	14.74	8.35	1.66	1.49	2.04
Sulphite pulp exported	million kg	0	0	0	0	≈0	0	0	1.364	0.0015	0.0001	0.0017

insignificant volume of teak, about 50 000 m³, is harvested annually from domestic sources. Most of India's teak demand is met from roundwood imports which in recent years have exceeded 1 million m³. The quantity of sawn teak imported is relatively insignificant. Exports of teak, both round and sawn, have been negligible and are predominantly to neighbouring Nepal.

Estimates of India's production of industrial roundwood, sawnwood, veneer and plywood over the decade 2009 to 2019, the latest year for which data is available, are given in Table 5.

Plywood production increases sharply in 2017 due to technology upgrades in two of the major factories that account for more than half the plywood production in the organised sector, according to the Federation of Plywood and Panel Industries (FIPPI). The production figures for 2009 to 2014 are considered imprecise because the price differential between different qualities as well as inflation could not be accounted for, and only an average CAGR of 6.5% has been used for extrapolation.

Non-conifers such as eucalypts and poplars growing on lands outside forests mostly supply the plywood and pulp industry, all of which are located in the semi-tropical and tropical plains due to availability of land, cost-effective labour, raw material, and other needed amenities. After a ban was imposed on felling of trees more than 1000m above mean sea level, the removal of conifer logs has decreased considerably and at present constitutes a small proportion of total roundwood removals, currently estimated at

Table 4: India, international trade of teak, by volume, 2009-2019

Year	Imports of teak		Exports of teak	
	RW in rough (1000 m ³)	Sawn/Chipped (1000 m ³)	RW in rough (1000 m ³)	Sawn/Chipped (1000 m ³)
2009	583.35	29.84	0.363	15.606
2010	647.75	36.72	0.462	7.149
2011	934.27	94.1	0.137	8.451
2012	996.94	55.98	0.321	9.178
2013	1,003.05	43.61	0.237	30.229
2014	928.05	45.83	0.719	6.479
2015	842.7	69.82	0	5.714
2016	816.37	71.86	0.083	2.918
2017	833.93	123.09	0.33	1.153
2018	1,074.87	130.72	0.505	1.006
2019	1,019.05	195.65	0.301	0.760

RW= roundwood

about 8.5%. Coniferous harvests are mainly from five states — Meghalaya, Sikkim, Himachal Pradesh and the Union Territory of Jammu and Kashmir. Approximately half of the removals of roundwood in Uttarakhand are of conifers. The largest production of coniferous production has been in the state of Meghalaya, especially from areas outside forests. Removals from the rest of the country and almost all removals from trees outside forests are non-coniferous.

Table 5: India, estimated production of industrial roundwood, sawnwood, veneer and plywood, coniferous and non-coniferous, 2009-2019

Production (thousand m ³)											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Ind. round wood	46,968	45,962	45,136	44,534	43,961	45,012	46,144	46,683	47,072	47,598	48,154
Ind. round wood (C)	182	158	148	173	199	183	174	183	180	179	181
Ind. round wood (NC)	46,786	45,804	44,988	44,361	43,762	44,829	45,969	46,499	46,892	47,419	47,973
Sawnwood	26,438	25,229	25,783	25,322	24,856	25,313	25,782	25,920	25,573	23,635	23,975
Sawnwood (C)	162	157	134	137	156	147	145	154	286	258	190
Sawnwood (NC)	26,276	25,072	25,649	25,185	24,700	25,166	25,637	25,766	25,287	23,377	23,785
Veneer	3,676	3,908	3,996	4,323	4,545	4,793	4,950	5,270	8,043	8,616	9,058
Veneer (C)	0	0	0	0	0	0	0	0	0	0	0
Veneer (NC)	3,676	3,908	3,996	4,323	4,545	4,793	4,950	5,270	8,043	8,616	9,058
Plywood	3,869	4,122	4,394	4,676	4,967	5,286	5,634	6,029	8,930	9,500	10,000
Plywood (C)	0	0	0	0	0	0	0	0	0	0	0
Plywood (NC)	3,869	4,122	4,394	4,676	4,967	5,286	5,634	6,029	8,930	9,500	10,000

C= coniferous, NC = non coniferous

Establishment of plantations is a major activity of the state forest departments in degraded forest areas and of the village panchayats in the village common lands across the country. Agro-forestry is also popular in wheat growing areas in northern and central India, and over marginal agricultural lands in the rest of the country. The total number of seedlings planted across the country is given in Table 6.

A question often asked is whether India would be able to increase its wood output substantially in the coming decades. The area under forest cover has risen consistently since the 1990s and 1.5 to 2 million hectares of plantations are being established annually on private and public lands. The volume of timber produced, however, has remained static at around 47 million m³. The new forests raised are definitely meeting the ecological needs of the country but the country's forest policies, and the resulting management practices, are heavily oriented towards

Table 6: India, plantation establishment on private, community and forest lands, 2012/13 to 2016/17

Year	2012-13	2013-14	2014-15	2015-16	2016-17
Seedlings planted (millions)	1,303.48	1,197.09	1,224.41	973.82	1,404.29
National area covered (mill. ha)	2.01	1.84	1.88	1.50	2.16

Source: National Afforestation and Eco-restoration Board (NAEB) of the MoEFCC

conservation and discourage harvesting. It is therefore unlikely that there will be a substantial increase in wood production in India in the foreseeable future even as the demand keeps increasing with increase in population and prosperity. This would mean that demand for imports will rise at a faster pace in the coming years.

1) INDIAN FORESTS AND FOREST PRODUCTS, 2009-2019

The Forest Survey of India (FSI) has been estimating demand and supply of timber and fuelwood at district and group of districts levels from time to time. Using these estimates, Rai and Chakravarti⁵ (2001) projected timber and fuelwood demand to be 82 million m³ and 199 million tons respectively in 2006. Using more direct estimation methods, Maharaj Muthoo⁶ prepared a comprehensive report covering timber trends and prospects, including imports, exports, production and consumption, distribution channels, import tariffs and related trade practices. The study pointed out the lack of information on production, processing, trade and consumption of forest products in India and underscored the need to *“develop and deliver a system for timely, transparent, coherent and reliable statistical data collection and compilation regarding timber consumption, production, processing, marketing and trade, and consider taking measures for the further loosening of tariff and non-tariff barriers”*.

With an estimated growing stock of 2.7 billion m³ in 2005, the predominant product from Indian forests was fuelwood which, augmented by supplies from trees outside forests (TOF) and agricultural waste, met the country's fuelwood requirement. The TOF covered nearly 2% of the land area and played an important role in meeting the raw material needs for plywood, and the pulp and paper industries.

The overall annual production of industrial roundwood from forests and TOF was estimated at around 50 million m³, which was about 2 million m³ less than domestic demand requirements in 2005. Muthoo⁶ concluded that the volume of imports of industrial wood had grown threefold during the ten years preceding 2005, comprising mainly non-coniferous logs from ITTO tropical timber producers. Exports from these countries to India had grown 20% per annum since 2000, reaching over 2 million m³, but were still only 5% of the total national consumption of roundwood. Imports were overwhelmingly as logs with processed primary products (sawnwood, veneers and plywood) limited to small quantities in specific categories, a trend that was likely to continue in the coming years. Imported roundwood is mostly utilised in the manufacture of sawnwood, plywood, veneer, particleboard, medium density fibreboard, and

builder's joinery. Muthoo⁶ estimated consumption of roundwood in India to increase to 406.15 million m³ by 2010 of which industrial roundwood amounted to 49.96 million m³ with the rest being primarily fuelwood. India's domestic production of industrial roundwood by 2010 was projected at 46.94 million m³ with imports of 3.02 million m³ required to meet the balance. Exports of industrial roundwood were projected to be negligible at 2,000 m³ by 2010.

1.1 Forest Survey of India estimates in 2011

Another assessment of Indian supply and demand was made by FSI⁷ in 2009. Annual wood production was estimated to be 45.95 million m³, almost all of which (42.77 million m³) came from TOF with an insignificant volume (3.18 million m³) coming from forests. Of the total fuelwood consumed, that supplied through official channels from forests was only 1.23 million tons while that from TOF was 19.25 million tons. The annual consumption of wood in household construction and furniture, agricultural implements, industrial construction, and furniture was assessed at 33.61 million m³ which, assuming an average conversion factor of 30%, amounts to 48 million m³ of roundwood. FSI's estimate of India's annual consumption of fuelwood in 2011 was 216.42 million tons of which 58.75 million tons came from forests with about 23% of the population using fuelwood from forests.

The FSI used estimates of Growing Stock of Trees outside Forests by species for assessing potential production of timber and fuelwood for all states and union territories in the country. Species were separated into two groups trees — high value timber and trees for fuelwood production. The first group was further subdivided into short, medium, and long rotation subgroups and annual potential production was estimated for each state using von Mentel's formula⁸. In assessing fuelwood, 20% wastage from timber trees was also added to the potential production from the rest of the trees among the TOF. Total India potential production was estimated at 42.774 million m³ of timber and 19.25 million tons of fuelwood. Table 1.2 shows the potential production estimates from TOF.

⁵ Rai and Chakravarty. 2001. Demand and Supply of fuelwood and timber in India. *Indian Forester* 127(3): 263-279, 2001. Available at: <http://www.indianforester.co.in/index.php/indianforester/article/view/2786>

⁶ ITTO. 2005. Review of the Indian Timber Market. Completion report of the PPD 049/02 (M) completed by Maharaj K. Muthoo. Available at: https://www.itto.int/files/itto_project_db_input/2760/Competition/PPR-68-04.pdf?v=1394089018

⁷ Forest Survey of India (Ministry of Environment Forest and Climate Change). 2011. India State of Forest Report 2011. Available at: <https://www.fsi.nic.in/forest-report-2011>

⁸ Rose, D.W. and Burke, T.E. 1980. Development of a model for simulation of Forest Regulation Techniques. Agricultural Experiment Station, Univ. of Minnesota. pp 34.

Table 1.1: Annual estimated production of roundwood and fuelwood from forests by State/Union Territory, 2011

S.No.	State/Ut	Recorded Forest Area (km ²)	Estimated Production of roundwood (million m ³)	Estimated Production of Fuelwood (million tons)
1	Andhra Pradesh	63,814	0.138	0.002
2	Arunachal Pradesh	51,540	0.064	0.007
3	Assam	26,832	0.025	0.0004
4	Bihar	6,473	0.007	Negligible
5	Chhattisgarh	59,772	0.397	0.09
6	Gujarat	18,927	0.099	0.008
7	Haryana	1,559	0.108	0.002
8	Himachal Pradesh	37,033	0.231	0.00005
9	Jammu and Kashmir	20,230	0.055	0.02
10	Jharkhand	23,605	0.013	0.004
11	Karnataka	38,284	0.049	0.03
12	Kerala	11,265	0.068	0.009
13	Madhya Pradesh	94,689	0.397	0.017
14	Maharastra	61,939	0.203	0.07
15	Orissa	58,136	0.029	Negligible
16	Punjab	3,084	0.090	Negligible
17	Rajasthan	32,639	0.057	0.05
18	Tamilnadu	22,877	0.013	0.005
19	Uttar Pradesh	16,583	0.425	0.008
20	Uttarakhand	34,651	0.250	0.05
21	West Bengal	11,879	0.317	0.003
22	Other NE States	64,988	0.124	0.02
23	UTs	8,739	0.012	0.0005
	Total	769,538	3.175	1.232

Source: India State of Forest Report 2011

UT=Union Territory

Table 1.2: Potential production of timber (logs) and fuelwood from areas outside forests by State/Union Territory, 2011

S.No.	State/Ut	Growing stock of TOF (million m ³)	Annual potential production of timber (million m ³)	Annual availability of fuelwood (million tons)
1	Andhra Pradesh	115.683	1.939	1.024
2	Arunachal Pradesh	74.516	0.762	0.353
3	Assam	41.336	1.355	0.352
4	Bihar	47.195	1.209	0.945
5	Chhattisgarh	70.069	1.826	0.894
6	Delhi	1.040	Negligible	Negligible
7	Goa	3.895	0.019	0.009
8	Gujrat	117.993	3.099	2.137
9	Haryana	15.268	1.975	0.825
10	Himachal Pradesh	21.146	0.939	0.290
11	Jammu and Kashmir	147.745	0.830	0.365
12	Jharkhand	51.308	1.327	0.656
13	Karnataka	101.733	2.023	0.907
14	Kerala	49.059	1.628	0.439
15	Madhya Pradesh	85.106	3.168	1.164
16	Maharashtra	147.029	3.519	1.533
17	Manipur	10.691	0.220	0.087
18	Mizoram	9.392	0.289	0.134
19	Meghalaya	20.964	0.421	0.212
20	Nagaland	12.681	0.342	0.128
21	Odisha	73.624	1.418	0.743
22	Punjab	19.305	2.650	0.920
23	Rajasthan	81.560	3.463	1.541
24	Sikkim	2.017	0.025	0.014
25	Tamil Nadu	70.328	0.834	0.378
26	Tripura	7.391	0.256	0.114
27	Uttar Pradesh	81.683	5.082	2.253
28	Uttarakhand	20.917	0.697	0.297
28	West Bengal	45.693	1.436	0.529
29	A & N Islands	0.666	0.007	0.003
30	Chandigarh	0.084	Negligible	Negligible
31	Dadra & Nagar Haveli	0.833	0.014	0.006
32	Daman & Diu	0.108	Negligible	Negligible
33	Lakshadweep	0.049	Negligible	Negligible
34	Pondicherry	0.320	0.010	0.002
	Total	1548.427	42.774	19.254

Source: India State of Forest Report 2011

FSI also estimated the household use of wood including the wood used in agricultural tools by stratified random sampling of 40,074 households spread across the country (Table 1.3). The survey also assessed use of fuelwood by households across the country (Table 1.4). As expected, the hill and tribal states have the highest percentage of people depending upon fuelwood from forests for their household energy use.

1.2 Evolution of the forest sector in India since 2011

In 2011, India's total forest and tree cover was 78.29 million ha, about 23.81% of the country's

geographical area. This represented a net decline of 36,700 ha compared to 2009, with most of the decline occurring in tribal and hill districts spread across the country and more specifically in the north-eastern states of Arunachal Pradesh, Manipur, Mizoram and Nagaland.

The largest forest and tree cover in the state was 7,770,000 ha in Madhya Pradesh followed by 6,741,000 ha in Arunachal Pradesh.

The highest percentage of forest cover in relation to total geographical area was 90.68% in Mizoram, followed by 84.56% in the relatively small Union Territory of Lakshadweep.

Table 1.3: Quantity of wood used in house construction, furniture and agricultural implements (million m³), 2011

S.No.	State/UT	House Construction	Furniture	Agricultural Implements
1	Andhra Pradesh	23.354	3.147	2.106
2	Arunachal Pradesh	0.709	0.071	0.009
3	Assam	7.663	2.829	0.483
4	Bihar	9.169	3.010	0.334
5	Chhattisgarh	12.012	0.912	0.903
6	Gujrat	27.469	2.417	0.320
7	Haryana	5.870	1.473	0.506
8	Himachal Pradesh	5.667	0.534	0.078
9	Jammu and Kashmir	5.312	1.066	0.050
10	Jharkhand	4.902	0.919	0.323
11	Karnataka	17.931	1.896	2.629
12	Kerala	15.214	3.31	Not Recorded
13	Madhya Pradesh	26.262	1.817	1.753
14	Maharashtra	55.61	4.602	5.101
15	Odisha	7.045	1.303	0.434
16	Punjab	9.2	3.372	0.084
17	Rajasthan	10.348	1.593	0.674
18	Tamil Nadu	18.447	2.476	0.186
19	Uttar Pradesh	42.018	15.107	4.255
20	Uttarakhand	4.781	0.503	0.072
21	West Bengal	14.577	4.079	0.522
22	Other NE states	4.969	1.079	0.024
23	UTs	11.643	0.905	0.022
	Total	340.172	58.42	21.588

Source: India State of Forest Report 2011
UT=Union Territory

Table 1.4: Annual fuelwood consumption, 2011

S.No.	State/UT	No of persons using fuelwood (millions)	No of persons using fuelwood from forests (millions)	Quantity of fuelwood used (million tons)	Quantity of fuelwood used from forests (million tons)	Percentage of fuelwood used from forests/ total fuelwood used
1	Andhra Pradesh	64.992	7.573	24.293	2.966	12.21
2	Arunachal Pradesh	0.882	0.698	0.402	0.325	80.93
3	Assam	23.373	5.812	11.421	2.494	21.83
4	Bihar	65.816	3.115	11.475	0.465	4.05
5	Chhattisgarh	20.078	7.818	4.366	1.378	31.56
6	Gujrat	40.092	7.497	9.731	2.225	22.87
7	Haryana	8.092	0.012	1.494	0.003	0.17
8	Himachal Pradesh	5.912	5.646	1.214	1.163	95.80
9	Jammu and Kashmir	8.375	4.540	1.394	1.015	72.80
10	Jharkhand	21.733	9.984	4.844	2.849	58.81
11	Karnataka	44.681	9.584	20.967	5.776	27.55
12	Kerala	29.504	4.429	14.543	2.183	15.01
13	Madhya Pradesh	51.007	24.839	13.665	7.191	52.63
14	Maharashtra	68.904	31.845	9.508	4.527	47.61
15	Odisha	33.029	11.110	8.894	2.971	33.40
16	Punjab	13.628	0.136	3.348	0.029	0.87
17	Rajasthan	57.992	11.414	18.782	3.698	19.69
18	Tamil Nadu	42.405	7.429	12.387	2.601	21.00
19	Uttar Pradesh	175.096	10.495	19.063	1.294	6.79
20	Uttarakhand	7.289	6.060	2.566	2.139	83.38
21	West Bengal	51.202	18.574	14.158	6.361	44.92
22	Other NE states	9.383	6.588	5.274	3.822	72.48
23	UTs	10.412	4.432	2.633	1.272	48.32
	Total	853.879	199.631	216.4211	58.747	27.14

Source: India State of Forest Report 2011

UT=Union Territory

Bamboo forests

The total area of bamboo forests is estimated to be 13.96 million ha. The largest area is in Arunachal Pradesh (1.6 million ha) followed by Madhya Pradesh (1.3 million ha), Maharashtra (1.1 million ha) and

Orissa (1.05 million ha). The total number of culms at national level is 169 million tonnes of which green sound bamboos contribute 73% and dry sound bamboos contribute the remaining 27%. In TOF areas, the total number of culms is estimated at 2,127 million with an equivalent weight of 10.20 million tonnes. The

physiographic zone of Eastern Plain contributes the maximum number of culms (943 million), followed by North East 289 million culms and East Deccan 212 million culms.

Growing stock in 2011

FSI estimated the total growing stock in India at 6,047.15 million m³ of which 4,498.73 million m³ was inside forests and 1,548.42 million m³ contained in Trees outside Forests. The total carbon stock in the forests was estimated at 6,663 Mt including the carbon contained in the forest soils.

Forests of India in 2019

The most recent forest assessment report⁹ estimated the total forest and tree cover at 80.73 million ha, which is about 24.56% of India's geographical area. Of this the forest cover alone is spread over 712,249 km² (21.67%) while the tree cover is about 95,027 km² (2.89%). The forest cover in hill districts is 284,006 km², in tribal districts 422,531 km² and in the North East region is 170,541 km². Bamboo forests cover about 160,037 km², a large part of which is in the North East region. Total carbon stock is 7,124.6 Mt of which 4,004 Mt, or about 56%, resides in the soil organic carbon pool.

Growing stock in 2019

Total growing stock in 2019 is estimated at 5,915.76 million m³, of which 4,273.47 million m³ is in forests while the remaining 1,642.29 million m³ is in TOF. Average growing stock in forests is about 55.69 m³/ha.

⁹ <https://fsi.nic.in/forest-report-2019>

Table 1.5: Change in forest and tree cover, growing stock and carbon stock, 2011-2019

	2011	2019	Change (2011-2019)
Total forest and tree cover (km ²)	782,871	807,276	24,405
Total forest cover (km²)	692,027	712,249	20,222
Very dense (km ²)	83,471	99,278	15,807
Moderately dense (km ²)	320,736	308,472	-12,264
Open forests (km ²)	287,820	304,499	16,679
Trees Outside Forests (km ²)	90,844	95,027	4,183
Forest cover in Hill districts (km ²)	281,295	284,006	2,711
Forest cover in tribal districts (km ²)	411,881	422,351	10,470
Forest cover in North East Region (km ²)	173,219	170,541	-2,678
Total Growing stock (Mm ³)	6,047.15	5,915.76	-131.39
Total Carbon stock (Mt)	6,288	7,124.6	836.6
Total bamboo area (km ²)	139,577	160,037	20,460

M = Million

Source: India State of Forest Report 2011, India State of Forest Report 2019

Table 1.6: Change in forest cover, by state (km²)

S. No	State/UT	2011	2013	Change	2015	Change	2017	Change	2019	Change
1	Andhra Pradesh	46,389	46,116	-273	24,424	-21,692	28,147	3,723	29,137	990
2	Arunachal Pradesh	67,410	67,321	-89	67,248	-73	66,964	-284	66,688	-276
3	Assam	27,673	27,671	-2	27,623	-48	28,105	482	28,327	222
4	Bihar	6,845	7,291	446	7,288	-3	7,299	11	7,306	7
5	Chhattisgarh	55,674	55,621	-53	55,586	-35	55,547	-39	55,611	64
6	Delhi	176	179.81	3.81	188.77	8.96	192.41	3.64	195.44	3.03
7	Goa	2,219	2,219	0	2,224	5	2,229	5	2,237	8
8	Gujrat	14,619	14,653	34	14,660	7	14,757	97	14,857	100
9	Haryana	1,608	1,586	-22	1,584	-2	1,588	4	1,602	14
10	Himachal Pradesh	14,679	14,683	4	14,694	11	15,100	406	15,434	334
11	Jammu & Kashmir	22,539	22,538	-1	22,988	450	23,241	253	23,612	371
12	Jharkhand	22,977	23,473	496	23,478	5	23,553	75	23,611	58
13	Karnataka	36,194	36,132	-62	36,421	289	37,550	1,129	38,575	1,025
14	Kerala	17,300	17,922	622	19,239	1,317	20,321	1,082	21,144	823
15	Madhya Pradesh	77,700	77,522	-178	77,462	-60	77,414	-48	77,482	68
16	Maharashtra	50,646	50,632	-14	50,628	-4	50,682	54	50,778	96
17	Manipur	17,090	16,990	-100	16,994	4	17,346	352	16,847	-499
18	Meghalaya	17,275	17,288	13	17,217	-71	17,146	-71	17,119	-27
19	Mizoram	19,117	19,054	-63	18,748	-306	18,186	-562	18,006	-180
20	Nagaland	13,318	13,044	-274	12,966	-78	12,489	-477	12,486	-3
21	Odisha	48,903	50,347	1,444	50,354	7	51,345	991	51,619	274
22	Punjab	1,764	1,772	8	1,771	-1	1,837	66	1,849	12
23	Rajasthan	16,087	16,086	-1	16,171	85	16,572	401	16,630	58
24	Sikkim	3,359	3,358	-1	3,357	-1	3,344	-13	3,342	-2
25	Tamil Nadu	23,625	23,844	219	26,345	2,501	26,281	-64	26,364	83
26	Telangana*	N/A	N/A		21,591		20,419	-1,172	20,582	163
27	Tripura	7,977	7,866	-111	7,811	-55	7,726	-85	7,726	0
28	Uttar Pradesh	14,338	14,349	11	14,461	112	14,679	218	14,806	127
29	Uttarakhand	24,496	24,508	12	24,240	-268	24,295	55	24,303	8
30	West Bengal	12,995	16,805	3,810	16,828	23	16,847	19	16,902	55
31	A & N Islands	6,724	6,711	-13	6,751	40	6,742	-9	6,743	1
32	Chandigarh	17	17.26	0.26	22.03	4.77	21.56	-0.47	22.03	0.47
33	Dadra and Nagar Haveli	211	213	2	206	-7	207	1	207	0
34	Daman & Diu	6	9.27	3.27	19.61	10.34	20.49	0.88	20.49	0
35	Lakshadweep	27	27.06	0.06	27.06	0	27.1	0.04	27.1	0
36	Puducherry	50	50.06	0.06	55.38	5.32	53.67	-1.71	52.41	-1.26
	Total	692,027	697,898		701,673		708,273		712,249	

Source: India State of Forest Report 2011 (FSI 2011), India State of Forest Report 2019 (FSI 2019).

* The state of Telangana did not exist during the years where N/A has been reported

Table 1.7: Change in growing stock, by state (million m³)

S. No	State/UT	2011	2013	Change	2015	Change	2017	Change	2019	Change
1	Andhra Pradesh	370.765	297.975	-72.79	212.393	-85.582	218.386	5.993	186.7	-31.686
2	Arunachal Pradesh	567.205	527.448	-39.757	502.22	-25.228	511.488	9.268	533.08	21.592
3	Assam	214.83	189.991	-24.839	176.69	-13.301	163.323	-13.367	138.36	-24.963
4	Bihar	82.381	70.988	-11.393	66.544	-4.444	65.991	-0.553	67.19	1.199
5	Chhattisgarh	404.45	423.419	18.969	444.955	21.536	410.008	-34.947	458.88	48.872
6	Delhi	2.745	1.517	-1.228	1.645	0.128	1.784	0.139	2.23	0.446
7	Goa	11.611	14.24	2.629	13.467	-0.773	13.348	-0.119	15.19	1.842
8	Gujarat	166.254	159.632	-6.622	164.905	5.273	166.022	1.117	130.91	-35.112
9	Haryana	20.161	19.582	-0.579	20.764	1.182	20.895	0.131	21.78	0.885
10	Himachal Pradesh	342.46	338.058	-4.402	338.579	0.521	338.779	0.2	372.26	33.481
11	Jammu and Kashmir	375.133	377.245	2.112	383.898	6.653	378.919	-4.979	416.77	37.851
12	Jharkhand	167.615	159.679	-7.936	183.826	24.147	181.476	-2.35	168.15	-13.326
13	Karnataka	416.889	384.162	-32.727	383.576	-0.586	417.245	33.669	437.11	19.865
14	Kerala	191.641	198.057	6.416	204.048	5.991	218.983	14.935	202.36	-16.623
15	Madhya Pradesh	334.767	333.982	-0.785	368.802	34.82	383.085	14.283	449.01	65.925
16	Maharashtra	440.698	348.199	-92.499	383.027	34.828	417.118	34.091	408.88	-8.238
17	Manipur	81.569	59.656	-21.913	60.398	0.742	60.95	0.552	48.1	-12.85
18	Meghalaya	66.375	59.929	-6.446	58.797	-1.132	55.974	-2.823	50.12	-5.854
19	Mizoram	77.434	67.524	-9.91	69.501	1.977	61.814	-7.687	65.41	3.596
20	Nagaland	53.636	48.966	-4.67	49.051	0.085	48.324	-0.727	43.24	-5.084
21	Odisha	358.815	310.262	-48.553	323.876	13.614	339.516	15.64	394.06	54.544
22	Punjab	35.015	30.079	-4.936	31.151	1.072	32.953	1.802	29.68	-3.273
23	Rajasthan	115.945	113.258	-2.687	123.24	9.982	128.139	4.899	113.46	-14.679
24	Sikkim	20.849	26.264	5.415	27.313	1.049	28.231	0.918	37.26	9.029
25	Tamil Nadu	214.732	178.181	-36.551	186.35	8.169	194.067	7.717	173.27	-20.797
26	Telangana*	N/A	N/A	N/A	94.982	94.982	100.122	5.14	122.41	22.288
27	Tripura	29.255	29.775	0.52	29.81	0.035	28.238	-1.572	26.5	-1.738
28	Uttar Pradesh	205.083	210.615	5.532	219.873	9.258	224.188	4.315	193.66	-30.528
29	Uttarakhand	481.006	492.419	11.413	460.278	-32.141	438.187	-22.091	425.21	-12.977
30	West Bengal	138.208	125.042	-13.166	122.012	-3.03	114.734	-7.278	87.5	-27.234
31	A&N islands	53.851	58.498	4.647	58.868	0.37	56.512	-2.356	93.57	37.058
32	Chandigarh	0.372	0.344	-0.028	0.425	0.081	0.424	-0.001	0.79	0.366
33	Dadar and Nagar Haveli	4.827	2.527	-2.3	2.556	0.029	2.635	0.079	1.9	-0.735
34	Daman and Diu	0.118	0.105	-0.013	0.115	0.01	0.116	0.001	0.24	0.124
35	Lakshadweep	0.049	0.052	0.003	0.058	0.006	0.06	0.002	0.07	0.01
36	Puducherry	0.413	0.377	-0.036	0.394	0.017	0.363	-0.031	0.45	0.087
	Total	6,047.158	5,658.046	-389.112	5,768.387	110.341	5,822.377	53.99	5,915.76	93.383

Source: India State of Forest Report 2011, India State of Forest Report 2019

* The state of Telangana did not exist during the years where N/A has been reported

Table 1.8: Percent change in growing stock (by volume) of the top ten species in forests

Plant Name	Change (2013-2011)	Plant Name	Change (2015-2013)	Plant name	Change (2017-2015)	Plant name	Change (2019-2017)
<i>Shorea robusta</i>	13.06	<i>Shorea robusta</i>	12.06	<i>Shorea robusta</i>	11.36	<i>Shorea robusta</i>	10.62
<i>Tectona grandis</i>	5.37	<i>Tectona grandis</i>	5.3	<i>Tectona grandis</i>	5.57	<i>Tectona grandis</i>	4.55
<i>Terminalia tomentosa</i>	3.4	<i>Pinus roxburghii</i>	4.02	<i>Pinus roxburghii</i>	3.97	<i>Terminalia tomentosa</i>	3.88
<i>Pinus roxburghii</i>	3.35	<i>Terminalia crenulata</i>	4.01	<i>Terminalia crenulata</i>	3.62	<i>Pinus roxburghii</i>	3.66
<i>Terminalia crenulata</i>	3.24	<i>Anogeissus latifolia</i>	3.13	<i>Anogeissus latifolia</i>	2.96	<i>Abies pindrow</i>	3.02
<i>Picea smithiana</i>	3.12	<i>Quercus semicarpifolia</i>	2.05	<i>Pinus excelsa</i>	1.98	<i>Anogeissus latifolia</i>	2.9
<i>Pinus excelsa</i>	1.86	<i>Lannea coromandelica</i>	2	<i>Quercus semicarpifolia</i>	1.97	<i>Pinus wallichiana</i>	2.79
<i>Lannea coromandelica</i>	1.84	<i>Pinus excelsa</i>	1.93	<i>Lannea coromandelica</i>	1.84	<i>Cedrus deodara</i>	2.78
<i>Quercus semicarpifolia</i>	1.81	<i>Quercus leucotrichophora</i>	1.75	<i>Maduca latifolia</i>	1.62	<i>Lannea coromandelica</i>	2.37
<i>Boswellia serrata</i>	1.71	<i>Boswellia serrata</i>	1.61	<i>Quercus spp.</i>	1.59	<i>Abies smithiana</i>	2.21

2) WOOD-BASED INDUSTRY IN INDIA, 2010-2019

2.1 Introduction

Wood products have always been in demand despite the availability of several substitutes such as iron, steel, and aluminium, etc., and increases in the price of wood. This may be attributed to the very high social acceptability of wood in India and its availability, even in remote localities. The market for timber in India is substantial as it caters to a wide variety of end-uses that include construction, paper, plywood and panels, furniture, agricultural implements, handicrafts, and toys. The current policy of encouraging “Make in India” is also likely to expand the demand for wood in the medium term.

The Indian timber market is very dependent on supplies from four main sources — harvest carried out by the state forest departments, forest development corporations, areas under the control of private tree growers collectively known as Trees Outside Forests (TOF), and imports. The wood-based industry in India is a significant contributor to the rural economy and provides employment to the urban population, both permanent and seasonal. This chapter reviews the wood-based industry in India, its economics, growth, production, consumption, and other indicators, and provides forecasts to 2030.

2.2 Methodology

This chapter uses information from a number of primary and secondary sources such as like annual reports and websites of state forest departments, Ministry of Statistics and Programme Implementation, Forest Survey of India, Indian Council of Forestry Research and Education, Indian Plywood and Panel Research and Training Institute, industry federations, etc. These include the reports of state forest departments, publications such as Forestry Statistics India (Indian Council of Forestry Research and Education), India State of Forest Report (published by the Forest Survey of India), and various papers and presentations by industry associations.

Data on production from forests was derived from the annual reports of state forest departments and corporations and publications on forest statistics by some states such as Uttarakhand, Andhra Pradesh, and Gujarat. Estimates of production from areas outside forests were obtained from the Indian State of Forest Report published by Forest Survey of India. Where data on production from outside forest areas were not available, imputations by rates and share has been undertaken.

Data on international trade has been obtained from the database of Directorate General, Commercial Intelligence and Statistics. The growth statistics of wood-based industries in terms of input, output and net value added have been collected from the website of Ministry of Statistics and Programme Implementation, Government of India. It is based on the Annual Survey of Industries undertaken by the Central Statistics Office of the Ministry.

Methodology for assessment of plywood production

The plywood industry in India is fragmented and it is reported by the Federation of Indian Panel and Plywood Industries (FIPPI) that 80% of the industry is in the unorganized sector. Only 20% is in the organized sector, of which 52% of the market share is controlled by just two of the largest plywood mills. Data on plywood production from the mills, especially in the unorganized sector, was minimal and current production data of only these two large plywood mills was able to be accessed. However, plywood production has been estimated on the basis of their known market share, and the industry CAGR of 6 to 7%, averaging 6.5%, over the past several years.

Prior to 2017, the largest of these plywood manufacturing firms was producing 15,000 sheets per day. The representative size of the sheets is 8 feet by 4 feet and 1.5 cm thick. This amounts to around 670 m³ per day and constitutes 26% of the total plywood share in the organized sector. Using this information, estimates of plywood production by the organized sector and the unorganized sector (as 80% of the total production) were prepared. Introduction of new technology in 2017 saw the daily production in each of these large mills increase to 25,000 sheets per day. Production from 2017 onwards has been estimated at 8.93 million m³. These estimates are in general agreement with the production figures given by FIPPI for 2017 to 2019 (Pandey and Roy, 2020)¹⁰.

Methodology for assessment of veneer production

In order to estimate veneer production, the following conversion factors were used:

i Plywood is composed of core and face veneers, comprised of 95% veneer and the rest glue and other minor raw materials.

¹⁰ Pandey, C.N. and Roy, S. 2020. Plywood and Panel Industry in India. Current scenario and key issues. Wood is Good. Vol.1 (1). 15-17

ii Therefore, 95% of the total plywood being produced was taken as veneer (as informed by sources in plywood industry).

iii There are two sources of veneer sheets — imports and domestic production. Veneer sheets are also exported. Therefore, total exports and domestic consumption are equal to total imports plus the veneer produced domestically. Since import and export data are in kilograms, a weight to volume conversion factor of 700 kilograms per m³ of veneer was used.

Methodology for assessment of industrial roundwood production

Industrial roundwood removals are from two sources, namely, state-owned forests and areas outside forests. Roundwood production from state forests was derived from data by states, and estimations were made where data was not available. Coniferous roundwood production from state forests occurs in four states — Sikkim, Jammu & Kashmir, Himachal Pradesh and Uttarakhand. While the first three produce only conifers, 51% of the removal in Uttarakhand is non-coniferous. Coniferous roundwood production was estimated to comprise 8.34% of total removals from the 30 states that produce roundwood.

For assessment of round timber from areas outside forests we noted that roundwood production in a given year is about 2.8% of the growing stock of TOF for that year. The ISFRs for 2009, 2011, 2013, 2015, 2017 and 2019 have good quality estimates for growing stocks for those years and the intermediate gaps were estimated by taking the average of the two adjacent years.

The production of industrial roundwood includes all logs (for timber, pulp, veneer, etc.) removed from government-owned forests and areas outside forests. This does not include industrial roundwood imported.

Methodology for estimation of sawnwood

The roundwood from state-owned forests is mostly used in the production of sawnwood, which is 70% of the total roundwood after accounting for wastage, etc. From areas outside forests, wood is mainly used in the production of veneers, pulp, and sawnwood, which is then used for making furniture and other products. This, along with estimates of wood balance (given in section 2.8), has been used to estimate sawn timber production. Coniferous sawn timber from government forests is assumed to be 8.34% of the total roundwood removals from government forests, converted into sawn form using a conversion rate of 70%. From the

wood balance estimates, total roundwood used in manufacturing paper and veneers is deducted before estimating sawn timber. The roundwood used by the paper and veneer industries is estimated below.

Roundwood used in veneer production

For wood used in manufacturing veneer, the total roundwood used has been estimated from veneer production. As an approximation, wood yields about 85% veneer, accounting for wastage from the pith and bark.

Roundwood used in manufacturing wood-based paper

Paper production in India has been reported at 9.18 million tonnes per annum (mtpa)¹¹ in 2009 to 10.9 mtpa in 2011, according to estimates given in the 12th Five Year Plan, and 19 mtpa in 2017-18. About 32% of this 10 million tonnes of paper produced in India in 2010-11 was wood-based, the rest being from agricultural waste and recycling. According to discussions with pulp and paper industry experts, paper constitutes 95% pulp by weight, with the remainder being other additives. About 2.5 kg of roundwood produces around 1 kg of paper.

After removing lumber for producing veneers and pulp, the residual volume is sawn. The production of sawnwood from areas outside forests is therefore the difference between the total timber from areas outside forests and the total wood used for veneer and pulp production.

The sawnwood component also includes wood sawn from log imports (both coniferous and non-coniferous). Total sawnwood production has been estimated by removing 70% of the total volume available for sawing as wastage and also the logs that are used for producing pulp and veneer.

Sawnwood production estimates (by volume) can be expressed as:

- (1) **Total round logs available for sawing = (Total production from government forests) + (total production from areas outside forests) + (total imports of roundwood) – (total roundwood used for producing veneers and pulp).**
- (2) **Total sawn timber = 70% of the total logs available for sawing.**

¹¹ <https://www.indianmirror.com/indian-industries/2012/paper-2012.html>

Production of wood in India

The forests of India are the primary producers of timber. These are of two main types, namely, the traditional forests and the plantations raised specifically for the purpose of harvest. While the former come under the federal State Forest Departments, the latter are generally looked after by the state forest development corporations, business entities set up by state authorities to carry out commercial activities in forest products (timber and non-timber activities, consultancies, etc.). In addition to this, the **Trees outside Forests (ToF)** are also a major source of supply of timber. Such sources are either plantations raised by industries on their own land, or on farmers' land under buy-back arrangements, or agro-forestry practices in farmers' fields.

Imports of roundwood in the rough, in the form of painted wood, poles, pickets and other unclassified roundwood in the rough, has not been included in calculations of total roundwood available for sawing.

Trees outside forests and agro-forestry

In order to shift the focus from natural forests for raw material demand in the wood-based industries, tree growing has been encouraged in private plantations and farmers' fields. This forms a major source of wood for the industry. Plantations are also established by the industry on their own land or in farmers' fields with a buy-back arrangement. According to estimates, on average, nearly 45 million m³ of wood is produced annually by areas outside forests. Almost all the component of areas outside forests lies in the tropical region.

2.3 Timber harvested from state owned forests and areas outside forests

As the conservation of forests has become more important, timber production from state-owned forests has declined. Forest policy is now giving attention to conservation of forests and there is a complete ban on felling of green trees in hills where most of the forests are located. However, timber production takes place in government-owned forests based on a system of working plans.

Forest working plans are prepared according to a working plan code and approved by the central government. These plans give details about how a particular area of forest (generally known as a division) is to be sustainably managed, apart from felling operations to remove dead, decaying and drying trees and other activities such as harvesting of non-timber forest produce (NTFP).

Over the past four decades as the timber production from natural forests has declined sharply, Forest Development Corporations (FDCs) have been set up as business entities by the states to carry out business in forestry operations such as tree planting, harvesting, raising nurseries, tapping of non-timber forest products, providing consultancy in the field of forestry, etc. In their operations, some FDCs have started to

incur losses, and some are involved in production of processed wood products such as blockboard, flush doors, wood residues etc.

Table 2.3.1 presents total timber production by the state forest departments and the state forest development corporations.

Table 2.3.1: Production of roundwood in India (million m³ RWE)

Year*	Production from government-owned forests
2005-06	2.33
2006-07	2.39
2007-08	2.60
2008-09	2.31
2009-10	2.18
2010-11	1.89
2011-12	1.78
2012-13	2.07
2013-14	2.39
2014-15	2.20
2015-16	2.09
2016-17	2.20
2017-18	2.16**
2018-19	2.15**
2019-20	2.17**

* Accounting in India is for the financial year (1st April to 31st March)

** Based on three-year moving averages
RWE=roundwood equivalent

The total production of wood in India from state-owned forests has been around 2 million m³ on average while around 45 million m³ is produced from areas outside forests.

This trend is likely to continue as is evident from the near consistent production figures given in table 2.3.1.

Major species planted by State Forest Departments

Selection of species for plantation is also based on economic returns. The major species selected for plantations raised by the forest departments are teak, *Acacia catechu*, *Acacia nilotica*, *Eucalyptus* spp., *Dalbergia sissoo*, *Madhuca indica*, *Azadirachta indica* (Neem), chir pine, sal, gamar, emblica, oak, casuarina, zizyphus, ailanthus, etc. Annually, on average, 500,000 ha of plantations of these species are established. Plantations have also been established to compensate for deforestation carried out for developmental activities. Teak is the flagship species of the central and southern part of India. Known for its aesthetic quality, strength against insect pests, and nail holding properties, it is the most preferred timber for use in furniture, doors, and other end uses and is therefore of high value. The total area of teak plantations is around 1.7 million hectares with the states of Andhra Pradesh (along with present Telangana), Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Mizoram, Tripura and Uttar Pradesh having teak plantation areas of more than 100,000 ha. Annual plantings of teak have slowed and there are no major new plantations planned in most of the states.

Apart from this, the roundwood produced from outside forests, reported by FSI in various ISFRs, is given in Table 2.3.2.

Table 2.3.2: Production of roundwood in India from outside forests (million m³ RWE)

Year	Roundwood production from outside forests
2010	44.072
2011	43.356
2012	42.464
2013	41.571
2014	42.812
2015	44.054
2016	44.483
2017	44.912
2018	45.448
2019	45.984

RWE= roundwood equivalent

2.4 India's international trade in wood and wood products

The India's international trade statistics for wood and wood products are maintained by the Directorate

General of Commercial Intelligence and Statistics, Kolkata, under the Central Ministry of Commerce. The trade classification follows the system of Indian Trade Classification Harmonized System (ITC HS). In this report import and export data have been obtained from the website of the General of Commercial Intelligence and Statistics, Kolkata, and various reports of MoEFCC and ICFRE. The following products have been included:

Table 2.4.1: Wood and wood products included in the report

ITC HS Code	Product	Reporting Units
4403	Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared	m ³
4404	Hoopwood; split poles; piles, pickets and stakes of wood, pointed but not sawn lengthwise; wooden sticks, roughly trimmed but not turned, bent or otherwise worked, suitable for the manufacture of walking sticks, umbrellas, tool handles or the like; chipwood and the like	kg
4407	Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm	m ³
4408	Sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, sawn lengthwise, sliced or peeled, whether or not planed, sanded, spliced or end-jointed, of a thickness not exceeding 6 mm	kg
4411	Fibreboard of wood or other ligneous materials, whether or not bonded with resins or other organic substances	kg
4412	Plywood, veneered panels and similar laminated wood	m ³
4703	Chemical wood pulp, soda or sulphate, other than dissolving grades	kg
4704	Chemical wood pulp, sulphite, other than dissolving grades	kg

Source: Directorate General of Commercial Intelligence and Statistics, Kolkata (DGCIS)

The reporting units have been changed to million units and thousand units depending on the scale of values. The annual trade in eight wood and wood product categories, by quantity and value, are given in Tables 2.4.2 to 2.4.5. The value of exports increased considerably from 2015 onwards because of exports of high-value red sanders which was not permitted prior to this time.

Trade in wood in the rough (ITC HS 4403)

Timber in various forms (roundwood, sawnwood, poles, etc.) is imported for use by various industries.

According to the ITC HS code classification, wood in the rough includes wood stripped or not stripped of bark or sapwood, or roughly squared (as different from sawnwood). It includes wood that is treated with paint, stains, creosote or other preservatives in both classifications – coniferous and non-coniferous.

Sawlogs and veneer logs (meaning wood destined for sawing and veneering) is also included. The main species classifications include pine, fir, spruce, teak, meranti (red, light red and bakau), oak, beech, birch, poplar, eucalypts, padauk, dipterocarps, acacia, terminalia, etc.

Table 2.4.2: India imports of wood and wood-based products, 2009-2019

Year	ITC HS Code							
	4403 Wood in rough (million m ³)	4404 Hoop wood (million kg)	4407 Sawnwood (million m ³)	4408 Veneer sheets (million kg)	4411 Fibreboard (million kg)	4412 Plywood & panels (million m ³)	4703 Sulphate pulp (million kg)	4704 Sulphite Pulp (million kg)
2009	5.09	0.35	0.16	19.70	94.06	0.20	456.22	1.76
2010	4.79	0.42	0.16	21.54	165.52	0.28	518.45	1.73
2011	5.82	0.60	0.45	134.13	183.15	0.40	645.11	2.46
2012	6.39	1.45	0.50	90.36	192.26	0.31	646.93	1.68
2013	6.23	0.46	0.55	125.29	203.70	0.20	689.47	34.26
2014	6.23	0.38	0.55	167.70	168.16	0.20	666.82	25.05
2015	5.69	0.29	0.73	286.49	180.00	0.19	706.83	1.64
2016	5.20	0.12	0.74	326.16	210.71	0.17	777.46	1.00
2017	4.62	0.11	0.92	312.23	268.33	0.20	746.77	1.96
2018	4.56	0.04	1.18	299.84	296.38	0.25	680.46	3.16
2019	4.37	0.02	1.56	319.90	266.62	0.46	735.44	1.64

Table 2.4.3: India imports of wood and wood based by value (million USD), 2009-2019

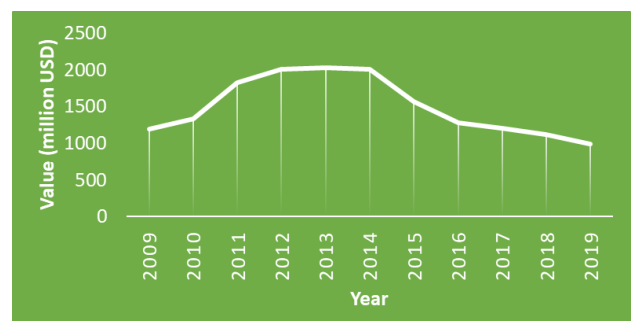
Year	ITC HS Code							
	4403 Wood in rough	4404 Hoop wood	4407 Sawnwood	4408 Veneer sheets	4411 Fibreboard	4412 Plywood & panels	4703 Sulphate pulp	4704 Sulphite Pulp
2009	1,191.77	0.39	42.16	19.95	40.60	36.71	238.86	1.33
2010	1,334.26	0.38	57.43	27.02	77.25	52.32	394.41	2.13
2011	1,828.94	0.51	130.96	45.74	84.31	112.42	463.55	1.81
2012	2,004.68	1.61	159.73	55.80	91.67	90.24	414.67	1.41
2013	2,033.64	0.50	184.31	65.73	96.32	80.63	451.56	22.29
2014	2,010.89	0.70	205.37	91.19	87.63	84.90	461.77	22.39
2015	1,564.88	0.47	283.64	174.01	87.18	85.78	466.92	1.11
2016	1,277.53	0.25	275.44	200.19	88.46	79.84	445.38	0.65
2017	1,206.09	0.03	367.73	219.53	106.12	97.80	484.09	1.54
2018	1,117.66	0.04	423.05	234.34	121.90	121.41	561.30	3.21
2019	993.63	0.02	466.28	280.84	103.34	107.63	507.94	2.05

Table 2.4.4: India exports of wood and wood-based products, 2009-2019

Year	ITC HS Code							
	4403 Wood in rough (million m ³)	4404 Hoop wood (million kg)	4407 Sawnwood (million m ³)	4408 Veneer sheets (million kg)	4411 Fibreboard (million kg)	4412 Plywood & panels (million m ³)	4703 Sulphate pulp (million kg)	4704 Sulphite Pulp (million kg)
2009	0.027796	0.28912	0.0236	20.247	11.469	0.1075	0.00099	0.0000
2010	0.020697	0.26145	0.0166	15.685	12.777	0.1404	0.00092	0.0000
2011	0.012694	0.17022	0.0166	9.5365	13.357	0.1059	0.00002	0.0000
2012	0.009482	0.23889	0.0457	6.909	16.541	0.0708	0.00048	0.0000
2013	0.005484	0.24502	0.0518	3.6832	15.521	0.1168	0.00017	0.0002
2014	0.008821	0.23773	0.0265	7.378	13.41	0.1295	5.47004	0.0000
2015	0.007285	0.24422	0.0403	5.1491	15.19	0.1129	14.7351	0.0000
2016	0.00156	0.11815	0.0242	6.0669	15.79	0.2499	8.34533	1.3640
2017	0.00675	0.07369	0.0143	3.7819	11.842	0.2329	1.66091	0.0015
2018	0.00571	0.09924	0.008	13.842	16.374	0.0986	1.49093	0.0001
2019	0.008022	0.11997	0.0039	10.436	24.824	0.1055	2.044	0.0017

Table 2.4.5: India exports of wood and wood-based products, by value (million USD), 2009-2019

Year	ITC HS Code							
	4403 Wood in rough	4404 Hoop wood	4407 Sawnwood	4408 Veneer sheets	4411 Fibreboard	4412 Plywood & panels	4703 Sulphate pulp	4704 Sulphite Pulp
2009	1.76	0.48	13.47	19.22	9.51	16.31	0.0185	0.0000
2010	1.67	0.42	17.60	16.66	9.72	14.20	0.0060	0.0000
2011	2.35	0.39	18.74	14.37	11.40	18.64	0.0001	0.0000
2012	1.97	0.44	28.85	15.78	11.18	17.93	0.0010	0.0000
2013	2.00	0.51	28.09	13.96	12.67	20.66	0.0004	0.0021
2014	4.58	0.43	30.22	14.46	12.31	31.36	4.3381	0.0000
2015	81.50	0.49	29.66	14.38	11.88	24.69	12.0610	0.0000
2016	19.99	0.28	18.00	16.82	14.85	43.10	6.1155	0.8914
2017	69.89	0.24	10.38	13.48	17.16	30.69	1.2159	0.0020
2018	53.33	0.24	5.44	22.65	20.53	32.39	1.1842	0.0002
2019	56.56	0.16	3.44	21.69	31.02	33.46	1.6266	0.0016

Fig. 2.4.1: Volume of imports of wood in the rough, 2009-2019**Fig. 2.4.2: Value of imports of wood in the rough, 2009-2019**

Imports of wood in the rough show an upward trend to 2012 before declining to 2019. The quantity imported in 2019 is less than that imported in 2009 probably due to the availability of substitutes and an increase in use of imported sawn timber and panels in the furniture and construction industries. Imports of wood in rough are likely to decline further, by quantity and value, although not significantly.

Exports of wood in the rough have declined steeply from 2009 to 2013 and have fluctuated from 2013 to 2019. Given the constant timber harvest of around 2 million m³ in recent years, and a high domestic demand, it is suggested that entrepot trade is practiced in the case of products that attract very less or no duty, and needs to be investigated.

[Trade in hoopwood \(ITC HS 4404\)](#)

This classification includes hoopwood, split poles, piles, pickets, and stakes of wood. They may be pointed but not sawn to length. It also includes wood sticks that may be roughly trimmed but not bent, turned or worked. These sticks are suitable for manufacturing of walking sticks, umbrellas, tool handles. Chip-wood and similar wood is also included in this classification. Both coniferous and non-coniferous wood is included but there is no classification by species.

Imports of this category of wood and wood products reached a peak in 2012 at 1.45 million kg and then steadily declined to a low in 2019 of 0.02 million kg. Apart from the peak in 2012, there has been a general declining trend in imports. Exports have also trended downwards from 2009 to 2017, although there has been a slight increase in 2018 and 2019.

[Trade in sawnwood \(ITC HS 4407\)](#)

This is the most important component of the timber trade and includes wood sawn or chipped lengthwise, sliced or peeled. The wood may be planed, sanded and end-jointed or not. The thickness should be more than 6 mm. The classification includes both coniferous and non-coniferous species. The major species included are pine, fir, spruce, Douglas fir, mahogany, meranti, teak, oak, beech, maple, cherry, birch, willow, fraxinus and poplar. Other species being traded are included in the 'Other' category.

Imports of sawnwood have increased year-on-year from 2009 to 2019, from less than 0.2 million m³ in 2009 to more than 1.5 million m³ in 2019. This trend is likely to continue due to the advantages of sawnwood imports compared with roundwood (wood in the rough). With a logging ban in place, and the obvious disadvantages of importing roundwood (handling,

Fig. 2.4.3: Volume of imports of sawnwood, 2009-2019

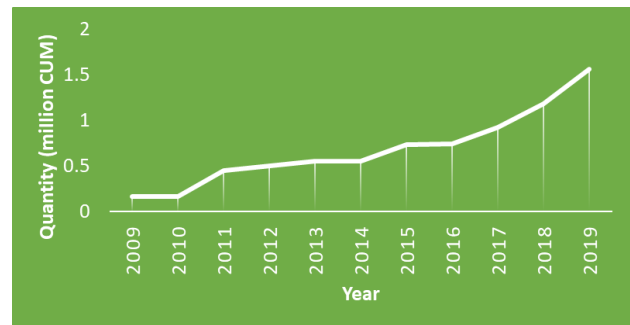


Fig. 2.4.4: Value of imports of sawnwood, 2009-2019



wastage of wood while sawing), imports of sawnwood are likely to continue to increase. Another possible reason for the increase in sawnwood imports may be the reduction in roundwood availability from exporting countries, where government policies favour employment generation and the provision of wood residues for local industry, indicating an increase in industries dependent on wood residues.

On the other hand, exports of sawnwood have declined continuously from 2013 onwards, indicating a reliance on imports for the gap in supply resulting from increasing demand and stagnant domestic production at 2 million m³ from forests and 45 million m³ from areas outside forests. From outside forests the main species available are softwood species, primarily used in the plywood, pulp and panel industries.

[Trade in veneer sheets \(ITC HS 4408\)](#)

This classification includes sheets for veneering, including those obtained by slicing laminated wood, for plywood or for similar laminated wood and other wood. They may be sawn lengthwise, sliced or peeled and be planed, sanded, spliced or end-jointed or not.

The thickness does not exceed 6 mm. The wood included is both coniferous and non-coniferous and includes some important species such as oak and rosewood. However, the classification does not include

all the species used and gives an overall classification which includes several species.

Fig. 2.4.5: Quantity of imports of veneer sheets, 2009-2019

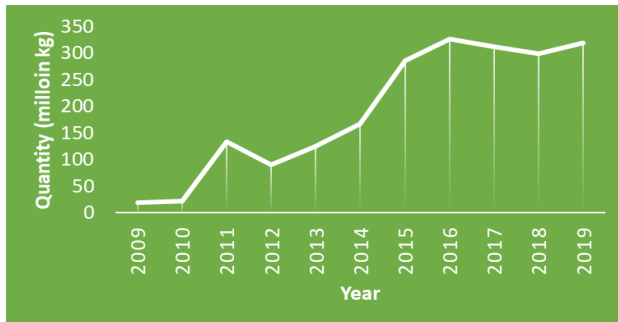
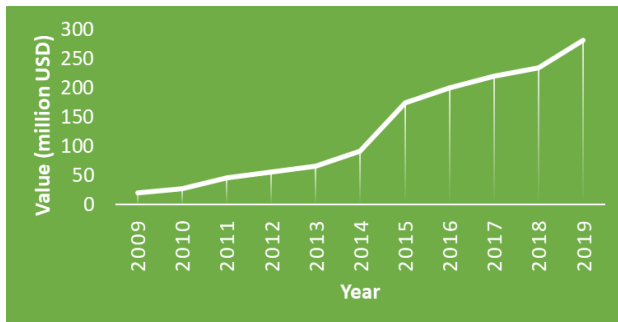


Fig. 2.4.6: Value of imports of veneer sheets, 2009-2019



Imports of veneer sheets have increased year-on-year from around 20 million kg in 2009 to almost 320 million kg in 2019. Veneer sheets are used by the plywood industry and the increase in imports indicates the increase in plywood production in the domestic plywood industry. A possible shortage of veneer production in India has led to a growing demand for imported veneer. The estimation of national plywood production may be improved if domestic production of veneers is also factored into the estimates.

[Trade in fibreboard \(ITC HS 4411\)](#)

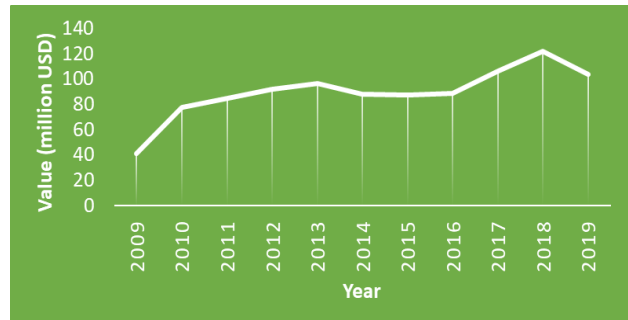
This classification comprises fibreboard of wood or other ligneous materials, whether or not bonded with resins or other organic substances. The species used in

Fig. 2.4.7: Quantity of imports of fibreboard, 2009-2019



fibreboard are not covered. The categories included are classified according to panel density and include medium-density-fibreboard, insulation boards and insulation boards made from coir and jute fibre.

Fig. 2.4.8: Value of imports of fibreboard, 2009-2019



Imports of fibreboard increased year-on-year to 2018 and then dropped sharply by around 30 million kg in 2019. The reason for this drop may be a decrease in domestic demand or increased production of fibreboard within the country that has led to a decrease in import of fibreboard. It is too early to say the drop will continue in the years to come. However, exports of fibreboard have been consistently rising from around 11.5 million kg in 2009 to a peak of nearly 25 million kg in 2019, with the trend expected to continue. Exports had, however, only increased slowly by value from 2009 to 2015 and then experienced a sharp rise after 2015. The increase in exports also suggests increasing domestic manufacture of fibreboard, thus indicating increased use of wood residues in India.

[Trade in plywood and veneered Panels \(ITC HS code 4412\)](#)

The category of plywood, veneered panels and similar laminated wood is classified by end use, including decorative plywood, tea chests, marine and aircraft plywood and thin plywood not exceeding 5 mm. The species (alder, ash, beech, birch, cherry, chestnut, elm, eucalypts, hickory, lime, maple, oak, poplar, walnut, etc.) used as the outer ply of the plywood are also included as a combined classification. Species used other than bamboo, and those mentioned above, constitute a separate classification. Classification also exists for plywood of coniferous wood.

Following a two-year period of decline, plywood imports increased sharply from 2016. Over the same period exports declined with the exception of 2016 and 2017, and in 2019 when exports increased slightly. With increasing imports and declining exports, the domestic consumption of plywood has increased in the last 10 years. Plywood is in high demand in the

construction sector and is a cost-effective alternative to higher priced solid timber species such as teak, sissoo, and sal, etc. which have become in short supply and in high demand. Domestic consumption is expected to increase in response to growth in population and household incomes. The domestic production of plywood is therefore expected to be supplemented with imports.

Fig. 2.4.9: Volume of imports of plywood and panels, 2009-2019



Fig. 2.4.10: Value of imports of plywood and panels, 2009-2019



Trade in pulp (ITC HS codes 4703 and 4704)

The trade in chemical wood pulp is carried out for two types of pulp, namely soda or sulphate, and sulphite, excluding dissolving grades. Pulp is an important component of wood-based products as, apart from bamboo, most of the short rotation tree species like casuarinas, eucalypts, etc. are pulped to manufacture paper. The further classifications comprise unbleached, semi-bleached or bleached, and coniferous and non-coniferous wood base.

Chemical wood pulp, soda or sulphate, other than dissolving grades (ITC HS code 4703)

Imports of sulphate-based wood pulp have increased over the period 2009-2019. This trend is likely to continue as the supply of wood for pulp is expected to be at the same level and demand for paper is expected to rise, leading to an increase in the size of the paper industry. Without a pulp mill of the scale required to cater to the demands of the industry, imports are

expected to increase. However, exports have been minimal, except for a quantum leap in 2015 when almost 15 million kg was exported, mostly to Iran. This compares with around 5.5 million kg in 2014 and 8.29 million kg in 2016.

Fig. 2.4.11: Quantity of imports of chemical wood pulp (sulphate), 2009-2019

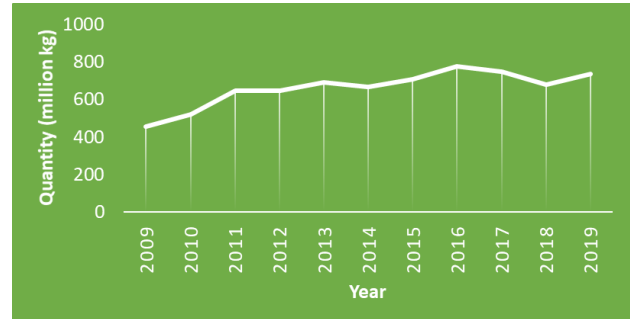


Fig. 2.4.12: Value of imports of chemical wood pulp (sulphate), 2009-2019



Chemical wood pulp, sulphite, other than dissolving grades (ITC HS code 4704)

This classification includes sulphite chemical wood pulp, both unbleached and semi-bleached, or bleached. The classification is the same as for sulphate pulp, i.e., coniferous and non-coniferous. The trade in sulphite bleached chemical wood pulp has generally been low with the exception of increases in imports in 2013 and 2014 and exports in 2016.

These imports have been from Malaysia, with imports totalling 29.25 million kg in 2013 and 24.07 million kg in 2014. Both are in the semi-bleached category. The exports, as usual, have been low except in 2016 when a marked jump is observed due to the export of 1.36 million kg to unspecified locations.

India imports of major wood and wood products by major suppliers

Table 2.4.6 gives the total quantity of imports of wood and major wood products from the top 10 countries from 2009 to 2019.

Table 2.4.6: India imports from top 10 countries, 2009-2019, by quantity

	4403 Wood in the rough		4404 Hoopwood		4407 Sawnwood		4408 Veneer		4411 Fibreboard		4412 Plywood and panels		4703 Sulphate bleached wood pulp		4704 Sulphite bleached wood pulp	
	Mm ³		MKg		Mm ³		MKg		MKg		Mm ³		Mkg		MKg	
Malaysia	17.41	China	2.57	Germany	1.97	Myanmar	659.34	Malaysia	432.66	China	1.50	Indonesia	2,274.31	Malaysia	53.58	
New Zealand	15.64	Vietnam	1.31	U.S.A.	0.84	Vietnam	413.49	Thailand	428.13	Indonesia	0.34	U.S.A.	1,304.23	Russia	4.46	
Myanmar	6.08	New Zealand	0.12	Malaysia	0.77	China	365.54	Vietnam	394.42	Malaysia	0.21	Chile	781.27	Indonesia	4.16	
Ghana	1.73	Belgium	0.03	Indonesia	0.38	Indonesia	203.86	Indonesia	249.57	Myanmar	0.18	Canada	537.29	Germany	2.41	
Ecuador	1.67	Malaysia	0.03	Brazil	0.36	Gabon	171.80	Sri Lanka	225.07	Nepal	0.13	Sweden	426.95	South Africa	2.39	
P.N.G.	1.49	Nigeria	0.02	Tanzania	0.35	Nepal	106.01	China	168.84	Vietnam	0.12	Finland	283.26	Iceland	2.23	
Solomon Is.	1.30	U.A.E.	0.02	Canada	0.31	Lao PDR	39.27	New Zealand	97.03	Russia	0.06	Estonia	252.10	Canada	1.57	
Costa Rica	1.24	Taiwan P.O.C.	0.02	Ukraine	0.26	Côte d'Ivoire	21.15	Germany	31.74	U.S.A.	0.05	Russia	235.08	U.S.A.	1.27	
Suriname	1.14	Ireland	0.02	Austria	0.19	Italy	17.43	Brazil	22.44	Germany	0.05	Brazil	227.37	New Zealand	1.14	
U.S.A.	1.03	Germany	0.02	U.K.	0.18	Malaysia	16.59	Romania	22.43	Spain	0.03	Malaysia	179.36	Sweden	0.74	

M = million

The major volume of **wood in the rough**, totalling 17.41 million m³, was imported from Malaysia in the period 2009 to 2019, followed by imports from New Zealand (15.64 million m³) and Myanmar (6.08 million m³). The major species imported from Malaysia have been mixed species classified as 'Others', along with meranti. New Zealand has supplied mainly mixed species and Myanmar has mainly supplied teak.

The country from which maximum **hoopwood and similar wood** was imported is China (61.8%) followed by Vietnam and New Zealand. Semi-finished hoopwood for manufacturing walking sticks and other general hoopwood were the main imports from China. Imports of hoopwood from other countries have been negligible.

Germany was the major supplier of **sawnwood** imported by India from 2009 to 2019, followed by the USA and Malaysia. Small quantities were also imported from Austria and the UK. Imports of sawnwood from Germany were predominantly pine, other coniferous species, beech, fir and spruce. From Malaysia, the major imports were of mixed tropical wood and meranti (dark red, light red, bakau, white and yellow). From the USA, major imports were of pine, conifers, Douglas fir, beech, and other tropical wood.

Myanmar was the major source of India's imports of **veneer sheets** during this period followed by Vietnam, China and Indonesia. Malaysia was the least important source of veneer sheets. The majority of the imports were used for veneering plywood.

The top five countries who exported **fibreboard** to India during the period were Malaysia (432.66 million kg) followed by Thailand (428.13 million kg), Vietnam (394.42 million kg), Indonesia (249.57 million kg) and Sri Lanka (225.07 million kg). In total, India's imports of fibreboard exceeding 9 mm amounted to about 728 million kg, fibreboard between 5 mm and 9 mm constituted 380 million kg while that of thickness less than 5 mm constituted 628 million kg.

The two main countries which exported **plywood and panels** to India during this 11-year period were China and Indonesia, with a share of 56% and 13% respectively. Malaysia and Myanmar have a relatively low share of around 8% and 7% respectively.

Indonesia, USA and Chile are the major exporters of **sulphate pulp** to India. Indonesia had a 35% share of the total quantity imported, while USA and Chile had shares of 20% and 12% respectively. The main country exporting **sulphite pulp** to India during this period was Malaysia with a significant share of 72.5%, followed by Russia and Indonesia, both with shares of 6%.

India exports of major wood and wood products to major destinations

India exported around 21% of its total **wood in the rough** to USA followed by China and Nepal. The main species imported by USA were Andaman padauk, laurel and rosewood. China mainly imported *Pterocarpus* spp. (red sanders and Andaman padauk) from India while Nepal imported mixed species classified as 'Other'.

India's **hoopwood** exports have been largely to USA, Nepal, UK and Germany out of eight countries to which hoopwood was exported. The maximum share was to USA (19.4%) followed by Nepal, UK and Germany with respective shares of about 13, 12 and 11%.

Although relatively small, India has been exporting **sawnwood** to U.A.E., Kuwait, Pakistan, Italy, Singapore, Qatar, Netherlands, Saudi Arabia and Oman, which are the top 10 destination countries. The main species exported to the top 10 importers are sawn/chipped teak and meranti.

Among the top 10 countries, India's major exports of **sheets for veneering** are to Nepal (50%), U.A.E. (15%) and Turkey (10%). Among the top 10, Saudi Arabia had the smallest share of 1.6%.

Among the top ten major importers of **plywood, veneered panels and laminated wood** from India during the last eleven years, Nepal accounted for almost 33% of India's total exports followed by U.A.E. and Turkey. Nepal imported mostly decorative plywood followed by plastic-laminated plywood. Nepal's international trade is likely to be through Indian ports, which may account for the significant imports of plastic-laminated plywood by both India and Nepal, with India importing from other countries and Nepal from India. However, this has not yet been validated by Nepal ports and customs authorities. U.A.E. mostly imports mixed plywood classified as 'others' apart from a large volume of bamboo-based plywood.

Exports of **sulphate pulp** from India have been in significant quantities to Iran, which absorbed 85% of total exports, followed by UAE with a share of 15%. The leap in exports to Iran is noticeable in 2014 and 2015 with a marked increase in the latter year.

Sulphite wood pulp was exported in large quantities during this period but most of the destination countries are not listed. A sizeable quantity of unbleached coniferous pulp was also exported to Nepal.

Table 2.4.7: India exports of wood and wood products to top 10 countries, 2009-2019

4403 Wood in the rough	4404 Hoopwood		4407 Sawnwood		4408 Veneer		4411 Fibreboard		4412 Plywood and panels		4703 Sulphate bleached wood pulp				
	000 m ³	000 Kg	000 m ³	000 m ³	000 m ³	MKg	MKg	MKg	Mm ³	Mkg	Mkg	000 Kg	000 Kg		
U.S.A.	21.35	U.S.A.	269.40	U.A.E.	73.56	Nepal	45.558	U.A.E.	48.532	Nepal	356.11	Iran	28.456	Un	1,348
China	17.69	Nepal	186.73	Kuwait	25.89	U.A.E.	14.061	Saudi Arabia	34.421	U.A.E.	207.37	U.A.E.	5.107	Nepal	16.76
Nepal	16.54	U.K.	170.57	Pakistan	19.11	Turkey	9.193	Qatar	18.399	Turkey	158.83	Nepal	0.05028	Egypt	1.50
U.A.E.	11.80	DE	163.84	Italy	18.82	BD	7.238	Kuwait	9.748	Saudi Arabia	62.95	Vietnam	0.049	Sri Lanka	1.02
NL	8.53	Qatar	117.55	Singapore	15.57	Sri Lanka	3.686	Bahrain	6.755	TH	59.98	Kenya	0.03266	Nigeria	0.10
H.K.	7.79	Saudi Arabia	104.43	Qatar	14.60	TH	3.496	U.S.A.	6.092	Un	56.42	China	0.02378	Thailand	0.09
U.K.	4.63	Myanmar	102.46	Un	14.23	U.S.A.	3.388	Sri Lanka	6.034	Sierra Leone	55.86	Bhutan	0.01568	Italy	0.05
AU	4.41	MY	101.57	NL	11.21	Qatar	2.686	Oman	5.139	Sri Lanka	44.20	South Africa	0.00353		
R.o.K.	4.12	Spain	96.67	Saudi Arabia	10.24	China	2.343	MY	4.317	MLDV	42.96	Sri Lanka	0.00295		
Qatar	3.20	China	77.20	Oman	7.96	Saudi Arabia	1.466	TZ	3.877	Egypt	36.21	TZ	0.00196		

M = million; AU = Australia; BD = Bangladesh; DE = Germany; MLDV = Maldives; MY = Malaysia; NL = Netherlands; R.o.K. = Rep. of Korea; TZ = Tanzania; Un = Unspecified

Trade in teak

Teak has been the most preferred timber in India owing to its favourable wood properties such as excellent nail-holding capacity and resistance to attack by diseases and insect pests. It is therefore the most preferred species for manufacture of furniture, handicrafts (apart from sissoo), doors and windows. With increasing prices due to low harvests in India (around 50,000 m³/annum) and significant demand, imports have been increasing. Teak is so important in the Indian context that it is also called the flagship species of the forest sector.

Imports of teak wood by India

From 2009 to 2019 about 10 million m³ of **teak wood in the rough** and 900,000 m³ of **sawn/chipped teak wood** has been imported. The main countries exporting teak to India are Ecuador, Ghana, Myanmar, Costa Rica, Panama, Brazil, Côte d'Ivoire and Benin.

Table 2.4.8: Imports of teak (wood in the rough and sawn/chipped form), 2009-2019

year	teak wood in the rough	teak wood in the rough	sawn/chipped teak wood	sawn/chipped teak wood
	1000 m ³	MUSD	1000 m ³	MUSD
2009	583.35	265.04	29.84	10.74
2010	647.75	318.85	36.72	13.38
2011	934.27	470.01	94.10	28.14
2012	996.94	527.78	55.98	21.32
2013	1,003.05	556.30	43.61	22.19
2014	928.05	524.35	45.83	25.87
2015	842.70	358.71	69.82	54.07
2016	816.37	339.84	71.86	52.03
2017	833.93	346.49	123.09	81.57
2018	1,074.87	370.17	130.72	87.73
2019	1,019.05	360.15	195.65	97.66
Total	9,680.33	4,437.69	897.22	494.7

M = Million

Imports of teak show an increasing trend with occasional fluctuations. Imports are expected to increase in response to increasing demand. However, the proportional increase may be low owing to cheaper substitutes available, both imported and domestic species.

Imports of **sawn teak** wood have been continuously on the rise with no fluctuations from 2013 onwards. The trends show that sawn teak is now being preferred over **teak wood in the rough**. The major countries exporting sawn teak wood to India (more than 50,000 m³) are Tanzania, Brazil, Benin, Myanmar and

Germany. Germany is not a teak producing country hence India's imports from Germany are mostly in the form of sawn/chipped teak wood with very small quantities in the form of logs, suggesting that Germany may have an entrepot system of trade in teak with India.

Exports of teak wood from India

India has also been exporting teak wood (both in the rough and in sawn/chipped state) and teak is mostly exported in **sawn form** than as **round logs**, both in terms of quantity and value. From 2009 to 2019, India has exported around 3,500 m³ of teak wood in rough and 89,000 m³ of sawn and chipped teak wood. Exports of teak wood in the rough have been mostly to Australia, U.A.E. and USA with imports of 894, 635 and 626 m³ respectively over the period. Exports of sawn/chipped teak wood have been predominantly to U.A.E., Italy and the Netherlands with 26, 17 and 11 thousand m³ respectively.

Table 2.4.9: Exports of teak (wood in the rough and sawn/chipped form), 2009-2019

year	teak wood in	teak wood in the	sawn/chipped	sawn/chipped
	1000 m ³	MUSD	1000 m ³	MUSD
2009	0.363	0.368	15.606	9.900
2010	0.462	0.579	7.149	12.988
2011	0.137	0.069	8.451	14.645
2012	0.321	0.058	9.178	16.295
2013	0.237	0.349	30.229	15.641
2014	0.719	1.425	6.479	19.363
2015	0	0	5.714	18.154
2016	0.083	0.140	2.918	7.780
2017	0.33	0.0242	1.153	3.117
2018	0.505	0.006	1.006	1.908
2019	0.301	0.135	0.76	1.330
Total	3.458	3.1532	88.643	121.121

M = Million

2.5 Utilization of wood and wood products in India

The sectors that consume wood primarily comprise the following:

1. Panels and Plywood
2. Paper
3. Furniture
4. Handicrafts
5. Agricultural implements
6. Construction

The main species used in the above industries are the following:

1. Teak
2. Sheesham
3. Sal
4. Chir pine
5. Poplar
6. Eucalypts
7. Casuarina
8. Mango
9. Acacia

The supply chain of timber consists of four main components, namely, state forest departments, Forest Development Corporations, imports, and Trees Outside Forests (including agro-forestry). In most cases, particularly in the construction sector where timber is used, sawmills play a major role in supplying processed timber in the form of desired sizes.

Status of wood-based industries in India

Table 2.5.1.: Present status of wood-based industries

Code	Industry	Estimated number of
1610	Sawmilling and planing of wood	27,680
1621	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels and board	47,403
1622	Manufacture of builders' carpentry and joinery	2,599
1623 1629	Manufacture of wooden containers	16,580
1701	Manufacture of pulp, paper and paperboard	24,880
1702	Manufacture of corrugated paper and paperboard and containers of	92,871
1709	Manufacture of other articles of paper and paperboard	26,894
	Total	238,907

Wood-based industry discussion

A. Sawmills

Although the sawmilling and planing industry is the smallest sector, it is the largest consumer of timber, mostly in the form of roundwood. The estimated annual consumption of wood by sawmills is about 29 million m³ with about 62% of production used by the construction sector (mainly housing), 8% sleepers, 6% packing, 7% furniture, 7% vehicle industry, 4% ship building, 2% mining and the rest used in other miscellaneous uses such as stationery (mainly the pencil industry), sports goods, toys, handicrafts and agricultural implements. Although these estimates are from 2005 to 2008, they are considered reasonable given the growth of these sectors. Total numbers of units engaged in saw milling and wood-planing in the country are estimated to be 27,680 (Table 2.5.1) that includes all units irrespective of people employed, formal and informal sectors, and registration status. Of these, 5,311 units are reported registered with states including 1,748 registered as industries employing more than 10 persons. Sawmills add value to the roundwood extracted from forests, or imported as roundwood, by manufacturing and selling sawnwood. It is an intermediary in the processing and supply of wood to the final consumption sector, thus not playing a major role in estimating demand.

B. Wood based plywood and panels industry in India

The plywood and panel industry is an important component of the wood-based industry in India and is estimated to be valued at around INR 28,000 crore (approximately USD 3.8 billion). At present it is estimated to be growing in value at an annual rate of 10% to 12%. Historically, this rate of growth (Cumulative Annual Growth Rate – CAGR) has been 6% to 7%. Wood panels, especially for the construction sector, constitute the bulk of demand (90%), with the remaining 10% used for renovations and substitutes. The most important component of the panel industry is plywood with a total value of INR 19,000 crore (approximately USD 2.44 billion) constituting almost 70% of the share of wood-based panels.

Taken together with the laminate industry the share is about 78% with the laminate industry accounting for USD 460 million. New technology, improved adhesives, absence of properties like twisting, warping, etc. and cost have made it the preferred material to replace lumber. The plywood industry alone is witnessing an annual growth rate of 7%. However, the plywood industry of India is highly fragmented and a large part, almost 80%, is under the control of the unorganized

sector comprising middle- and small-sized firms. There are many small firms that operate locally to produce plywood. These firms employ a smaller number of people and also do not meet the minimum requirements (such as electricity consumption, area covered, output, etc.) to enable registration. The rest of the industry comprises other panels such as MDF and particleboard. In 2004-05, the contribution of this sector was only USD 5.5 billion which increased to USD 15.7 billion in 2010-11¹².

The interior industry, specifically the housing interiors industry, is heavily dependent on plywood with 60% market share, despite competition from products such as MDF and particleboard. The Federation of Plywood and Panel Industries (FIPPI), an industry association, has estimated the total output of plywood and panel sector to be around 220 million m² with an annual turnover of USD 585 million. Presently, due to shortage of raw materials, skilled labour and capital, the industry is operating at less than 33% of its total capacity.

In addition, some large firms in the organized sector have also established enterprises outside India. However, this segment, forming only an estimated 20% of the total production, is not likely to have an impact on domestic production of plywood. Estimates of plywood production by enterprises abroad have not been included in the report.

From 2008 to 2018, the plywood market in India grew at an annual rate of 4.8% from USD 4.4 billion in 2008. In addition to this, the size of laminate industry, an ancillary to plywood, is also estimated at INR 7,000 crore, roughly USD 950 million. This trend is likely to continue due to increases in income, urbanisation, investment in real estate, and changing tastes and habits. There may be some variation due to the effects of COVID-19 but the averages are expected to remain more or less the same as the demand for housing is likely to increase. By 2024, the plywood market is expected to reach a value of USD 5.7 billion.

The major products produced by the plywood industry are shuttering plywood, packaging plywood, plywood drums, flush doors, commercial and decorative plywood, blockboard, moulded plywood furniture, laminated picking sticks, decorative veneers of walnut, teak and rosewood, compregnated wood veneers for the heavy chemical industry, and electrified railways.

¹² American Hardwood Export Council. 2016. *Indian Wood Sector Market Study, 2016*. Available at: <https://www.scribd.com/document/365112741/ahec-india-wood-sector-market-study-2016reduced-550865-7>

The primary raw material of the plywood and panel industry is wood and the most preferred species is poplar which is distributed widely across Punjab, Uttar Pradesh, Haryana and Uttarakhand. Other preferred species are *Casuarina equisetifolia*, *Dalbergia latifolia*, *Salix* spp., *Ochroma pyramidale*, *Shorea robusta*, *Eucalyptus* spp., *Acacia catechu*, and *Anogeissus latifolia*. The details of species used are given in table 2.5.2.

The main sources of logs for the plywood and panel industry are plantations and agro-forestry while the supply from natural or state-owned forests is very limited. The industry is also establishing its own plantations of eucalypts, poplars, casuarina and acacia. This has reduced the pressure on state-owned forests that are mostly natural apart from unrecorded felling. The plywood and panel sector provides direct employment to around 4% of the population and indirect employment to around 8%. Starting with only 10 units, an enormous change occurred when rubberwood was abundantly available due to fluctuating rubber prices.

C. Wood-based pulp and paper industry in India

The paper industry plays a vital role in the overall industrial growth of the country in addition to providing direct and indirect employment. It is estimated that the industry provides direct employment to 0.6 million people and indirect employment to 1.6 million. About 4 million tonnes of total paper production, including paper board and newsprint, is estimated to be wood-based which implies that the industry supports the agro-forestry and farm forestry programmes in the country as most of the raw material for the wood-based industry is sourced from this sector. At present the annual turnover of the industry (including all sources – wood, agriculture by-products, and other recycled fibres) is estimated to be INR 67,000 crore (about USD 8.90 billion) contributing about INR 8,000 crore (USD 1.07 billion) to the national exchequer.

The paper industry is one of the fastest growing industries in the country. India's industry now accounts for more than 4% of the world's paper production (including newsprint), compared with around 1.6% before 2000. The growth of the industry was estimated to be 6% CAGR in 2018-19. India ranks 20th in production of paper with an estimated production of 10.9 million tonnes per annum in 2010-11, which rose to almost 19 million tonnes in 2018-19. The domestic demand for paper consumption is on the rise due to increasing population, literacy rate, and growth in GDP.

Table 2.5.2: List of species used in the plywood industry

S.No	Scientific Name	Common name	Geographical Distribution	Uses
1.	<i>Toona ciliata</i>	Tooni	In India it is found throughout the sub-Himalayan tract and valleys of outer Himalayas from Jammu eastwards throughout the plains of Bihar, Assam, West Bengal, Khasi Hills and the valleys of Eastern Ghats in moist localities	Manufacture of Grade I commercial plywood and Grade I moisture proof plywood
2.	<i>Albizia lebbeck</i>	Siris	It is found throughout the Indian peninsula and the Andamans. In the western Himalayas it ascends up to 1500m	Manufacture of Grade 1 plywood.
3.	<i>Albizia chinensis</i>		The tree is found throughout sub-Himalayan tract and Himalayan valleys. It is also found in moister parts of Deccan and Peninsula and Andaman and Nicobar islands	
4.	<i>Chukrasia tabularis</i>		In India it is mainly found in Indian Peninsula and Western Ghats up to 1400 m elevation	Manufacture of plywood
5.	<i>Kydia calycina</i>		It occurs up to 1200 m in the eastern Himalayas and up to 500 m in the western Himalayas	Manufacture of Grade III commercial plywood
6.	<i>Ailanthes triphysa</i>	Ferntop Ash	It is found in western ghats up to 1500 m elevation	Manufacture of Grade III commercial plywood and Grade IV moisture proof-plywood
7.	<i>Acer caesium</i>		It is found throughout the north-west Himalayas between 1800-2500 m elevation.	Manufacture of both Grade I commercial plywood and Grade I moisture proof plywood.
8.	<i>Melia azadirach</i>	Persian lilac	It is found in Himalayas up to 1800 m elevation	Plywood industry
9.	<i>Calophyllum elatum</i>	Poon	Found in forests of Western Ghats	Manufacture of plywood
10.	<i>Michelia champaca</i>	Champak	It is found in eastern Himalayan zone up to 900m elevation also found in the Western Ghats	Manufacture of Grade I commercial moisture proof plywood

The paper industry grew rather slowly in the first three decades after independence. In the 1970s excise concessions were given to small agro-based mills, which resulted in a rapid increase in small mills and capacity. In the late 1980s the industry was in a severe oversupply situation with capacity utilisation rates being around 60%. In the early 1990s the government reversed the policy, making large units more competitive (e.g., by removing excise concessions from agro-based mills). After the economic reform in 1991 the paper industry was de-licensed, and this boosted further growth of the industry. This move resulted in an increase in the total size of the industry from a little over 650 paper mills in the country to around 860 paper mills at present producing different types of paper.

The industry uses various raw materials with the raw material base changing significantly over the years. The input consumption in the pulp and paper industry is high and the output low compared to other industries. Currently the input-output ratio is around 8:1. There is a wide variation in the quantity of major inputs in the

Indian paper mills. The power consumption varies between 1,200 kWh and 1,700 kWh, steam from 10 tonnes to 16 tonnes, coal from 1.5 to 3.0 tonnes, water 60 to 125 m³, and cooking chemicals 60 to 400 kg per tonne of paper produced.

Although the most suitable raw material for pulp and paper manufacturing is derived from softwoods and some hardwood species, the Indian pulp and paper industry are largely dependent on bamboo and mixed hardwoods. This assists in conservation of the already dwindling natural forest resources. Along with farm plantations and trees outside forests, the industry also uses alternative raw material to a large extent. Fibrous raw material is a significantly large component, influencing the manufacturing cost of paper.

For sustained supply of raw materials, the industry has to use renewable sources to the maximum extent. The fibre resources used by the Indian pulp and paper industry come from the following three basic sources:

- Forest-based raw materials which include bamboo and mixed hardwoods from forest felling, and *Eucalyptus* wood from plantations (both organised plantations and farmers' fields/agro-forestry plots).
- Agricultural residues: This includes bagasse, rice and wheat straws, and cotton stalks.
- Waste paper and other recycled fibres: This includes domestic and imported waste paper.

Table 2.5.3: Status of the Indian Paper Industry (2010-11)

Number of mills	759
Installed capacity, Mt	12.7
Capacity utilization, %	90
Production of Paper, Paperboard and Newsprint, Mtpa	10.9
Per capita Consumption (kg)	9.3
Annual Turnover, INR Crore	30,000
Contribution to Exchequer, INR Crore	3,000
Employment Direct, million people	0.37
Indirect Employment, million people	1.2
India Share in World's Production, %	2.6

Source: Working Group report of 12th FYP¹³

The change in the structure of the industry with respect to raw material use from 2010-11 to 2017-18 is given in table 2.5.4.

The industry is largely fragmented with the capacity of mills ranging from 5 million tonnes per annum to almost 1,700 million tonnes per annum. The major raw materials used are wood, agro residues and recycled wastepaper. Newsprint grade paper is produced by mills utilizing mainly recycled wastepaper as well as agro-residues as major raw material.

The total paper production from wood and agro-based raw material has been almost constant from 2010/11 to 2017/18, at about 2 million tonnes in 2010/11 to about 1.7 million tonnes in 2017/18 from agro-based raw material; and from around 3.4 million tonnes in 2010/2011 to 3.5 million tonnes in 2017/2018 from wood. However, that from other recycled fibres rose exponentially from less than 0.5 million tonnes in 2010/11 to 13.7 million tonnes in 2017/18¹⁵.

Of the total paper production in India in 2010/11, 31% was wood-based raw material, 22% agricultural residue and the remaining 47% based on paper waste and other recycled fibres. However, due to a sudden rise in paper production using recycled fibrous material as raw material, the share in terms of percentage of paper from wood and agro-based raw material fell from 31% to 18%, and from 22% to slightly less than 2% respectively over the period.

The total installed capacity of the paper and paperboard industry in the late 1990s was around 5 million tonnes per annum which rose to a little over 6 million tonnes in early 2000s. During 2010/11, the total installed capacity was 12 million tonnes per annum (Mtpa) and around 10 Mtpa was being produced. By 2013/14, the total installed capacity rose to 14 Mtpa and production estimates were around 13 Mtpa. Out of the total production, around 75% is produced by the top 9 paper mills and the rest by small mills which are largely RCF (Refractory Ceramic Fibre) based. The paper industry's wood demand is expected to reach 33 million m³ in roundwood equivalent or 16 million tonnes by 2020, representing a significant deficit of around 4 million tonnes from available sources. The average production of wood-based paper remains at around 3.5 Mtpa with a large amount of capacity lying idle. The number of wood-based paper

Table 2.5.4: Structure of the Indian paper industry by raw material, 2010-11 and 2017-18

Type of mill	2010-11*			2017-18**		
	No. of Mills	Production Mtpa	Production Share (%)	No. of Mills	Production Mtpa	Production Share (%)
Wood-based (large integrated)	30	3.40	31	18	3.46	18.3
Agro-based (medium-scale)	150	2.42	22	37	1.73	9.15
Recycled fibre-based (medium and small-scale)	579	5.10	47	442	13.72	72.55
Total	759	10.92	100	497	18.91	100
Idle capacity				364	4.71	

*Source: Working Group report of 12th FYP¹³

** Source: Annual Report of CPPRI, Saharanpur¹⁴

¹³ NITI 2019, Working Groups / Steering Committees for the Twelfth Five Year Plan (2012-2017). Available at:

<https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/index.php?about=12strindx.htm#enf>

¹⁴ CPPRI 2018. Annual Reports 2017-18. Central Paper and Pulp Research Institute. Available at: <https://www.cppri.res.in/annual-reports>

¹⁵ Annual reports of Central Pulp and Paper Research Institute, Saharanpur. 2014-15 to 2017-18. Available at: <https://cppri.res.in/annual-reports>

mills has also reduced considerably from 30 in 2010, to 18 in 2017 and it may see a further decline.

Increasing global paper prices have provided an umbrella for raising domestic prices, even as backward integration for wood pulp locally, through farm forestry, has been highly successful. With international pulp prices being strong, and a more disciplined global industry, an expected upswing is likely to be sustainable in the medium term.

India is also the fastest growing major paper market in the world, registering a cumulative annual growth rate of around 8% from 2011 to 2016 compared to 1% for the entire global paper industry. The flip side of the Indian market is that it is highly fragmented with the top 3 players accounting for only 9% market share compared with 68% in USA, 72% in Indonesia, and 21% in China.

Species used in the paper and pulp industry

Hardwood and softwood:

- The present consumption of wood as a raw material for papermaking is around 12 million tonnes. Species like bamboo, eucalypts, poplar (mostly planted), acacia, tectona, some coniferous trees such as pine and some hardwoods are mostly preferred. It is estimated that around 75% of wood demand is being met through farm/social forestry sources. An additional 12 Mtpa of wood will be required to meet the projected production targets by the year 2025. In most parts of the country the tree species favoured by the pulp and paper industry are eucalypts, casuarina, subabul and poplar.

Other raw materials used in the Indian paper industry:

- **Agro-residues:** Due to lack of forest resources and advancement of new processing technologies, non-wood, agro-based material is being used in developing countries. Agro-based

fibres are well suited for small-scale industry, because of the low capital investment required. Usually, three categories of non-wood fibres are used namely, crops (such as hemp, kenaf, flax, jute), agricultural residues (wheat, corn or rice straw, bagasse, sisal) and wild plants (grasses, bamboo and seaweed). Bagasse and wheat straw are also being used by the paper industry in India. However, both these raw materials, though readily available, are not available to the paper industry due to diversion for other end-uses. The agro-residues contain lower lignin content, higher silica and ash. Fibre from bagasse and straw generally results in low grade pulp, whereas hemp, kenaf, cotton and flax are often used in higher quality and specialty papers such as banknote and cigarette papers. By 2025, the capacity of agro-residue-based enterprises is expected to be doubled from its present capacity of 2.1 Mt.

- **Recycled fibre (RCF)/Waste Paper:** Recycled waste comprises both pre-consumer and post-consumer wastes. The pre-consumer wastes are the shavings and trimmings from the paper machine such as printers, rejects etc. The post-consumer waste is usually old wastepaper collected from consumers. The requirements of raw material are sourced both domestically as well as through imports. These wastes are best suited for end products such as newsprint, duplex board, Kraft paper etc.

Recycled fibre accounts for the largest share (64%) of all the required fibre source for the industry. Wood-based material accounts for 26% of the total production while the share of agro-based material is 10%. Newsprint production relies predominantly on recycled paper as a source of fibre, contributing nearly 99% of the fibre source for the total 22 newsprint production firms, and the rest of the fibre source is wood. Most of the writing and printing paper production is based on wood and accounts for 51%, while recycled fibre accounts for 38% of total writing and printing paper production and about 10% comes

The challenges to the paper industry in India

The most significant challenge to the Indian pulp and paper industry is shortages of raw materials*. The industry is heavily dependent on mixed sources of raw material, including wood, agro-residues and waste paper. With domestic supply falling short of demand, increasing quantities of pulp, wood chips and waste paper are being imported. Since natural forests are protected in India, only bamboo and hardwood are available for industrial use. The Indian paper industry was using about 8.7 million tonnes of wood as a raw material in 2015 and preceding years. About 315,000 hectares of land is covered under pulpwood production from which about 75% is run by private farmers. Therefore, the importance of farm forestry in paper production is significant.

*cf. CPPRI 2018. Annual Reports 2017-18. Central Paper and Pulp Research Institute. Available at <https://www.cppri.res.in/annual-reports>

from agro-residuals. In packaging paper, recycled fibre is again the most common source accounting for nearly 77% of the share of total packaging paper production whereas wood and agro-based material contribute about 10% and 13% respectively.

D. Furniture industry in India

The entire Indian furniture industry (using all materials including woods, metals, plastics, and the rest) is estimated to be valued at about INR 3,500 billion (around USD 47 billion), eighty-five percent of which falls in the unorganized sector. The Indian furniture market is anticipated to register a CAGR of 13.38% during the forecast period 2018 to 2023 and is projected to achieve a year-on-year growth rate of 14.30% in 2023. Advances in technology, such as availability of high-speed internet networks, are boosting the e-retail sector in India. Customers are now finding it easy to buy furniture online through various start-ups and retailers. With the rising number of smart-phone users across the country and online shopping, furniture industry players are encouraged to introduce their products through online channels. This is likely to boost demand for furniture, particularly wood-based furniture which has traditional acceptance.

The India furniture market can broadly be classified into residential and commercial. The residential segment accounts for around USD 21 billion and is expected to grow at a CAGR of 14.16% over the forecast period (2018 to 2023). Furthermore, the residential market sector is expected to achieve year-on-year growth of 15.08% in 2023.

The Indian furniture industry is considered "non-organized" with handicraft production, which does not have a significant export demand, accounting for about 85% of furniture production. In the year 2000, India ranked 48th among furniture exporters worldwide and 49th among importers.

The domestic furniture market in India has a favourable outlook and the furniture industry is expected to grow in the medium term. Two important reasons for this are India's large population and Indian consumer preferences which have become more refined, as evidenced by people demanding more western-styled furniture.

Species used in the Indian furniture industry

The key raw materials in furniture making in India include wood, metal and plastic, with bamboo and cane also being used in some cases. Wood accounts for nearly 65% of all furniture made in India. The furniture

industry of India prefers solidwood (both hardwood and softwood) for most of the furniture because of its high endurance and artistic values. In India several types of indigenous wood species, as well as imported wood species, are used for furniture.

The species preferred by the furniture industry in India vary widely by geographic location. There are some selected species which are preferred throughout the country, as listed in table 2.5.5.

Despite the availability of indigenous timber, India imports wood species from various Southeast Asian countries such as Indonesia, Malaysia and Myanmar. It also imports MDF from Europe. Popular wood species used in India include walnut, sandalwood, teak, sheesham, deodar, ebony, redwood, rosewood, red cedar and sal.

Teak accounts for almost 50% of the total wooden furniture produced, sal and deodar account for about 20% and the balance includes mahogany, cedar and other tree types. Bamboo Material Boards (BMB) are increasingly being used in place of plywood. India also has abundant rubberwood supply. Natural rubber plantations cover 520,000 ha with an additional 6,000 ha being replanted almost every year since 1994.

The state of Kerala produces 95% of the total supply of rubberwood in India. Although furniture production occurs throughout India, a few centres have become famous for their exquisite carving, inlaying, turning and lacquering. Indian states well known for woodwork include Gujarat, Jammu and Kashmir, Punjab, Uttar Pradesh and Kerala. India is one of the largest consumers of wood in Southeast Asia. The country has sufficiently available tropical wood.

However, in recent years, growing concerns about the environment and the need for conservation of forests have led to a reduction in the supply of wood. India imports wood from various countries such as Malaysia, Indonesia, Myanmar, and Ivory Coast, etc.

Types of products produced by the furniture industry

With a growing economy and increased household and institutional spending, the market is growing steadily. There are as many as 12,000 companies listed in the online furniture directory in India.

The core product categories include brass furniture, metal furniture, glass/fibreglass furniture, care furniture, plastic furniture, rattan furniture, wooden furniture, bamboo furniture and leather furniture. Furniture products can also be classified on the basis of end-use sectors (table 2.5.6).

Table 2.5.5: Plant species used in the furniture industry in India

Species	Density	Distribution	General use
<i>Lagerstroemia flos-reginae</i>	640 kg/m ³	Assam, Bengal, Maharashtra	Hard and durable, easily worked and with good finishing properties. Used for house construction, boat building, railway carriages, cart making and scaffolding.
<i>Mangifera caesia</i>	595 kg/m ³	Karnataka, Maharashtra, Tamil Nadu, Kerala	Compact and even grained, moderately strong and easy to work. Good finishing properties and maintains its shape well. It has many uses including plain furniture, boat construction, well curbs, door panels, cabinet making and musical instruments.
<i>Artocarpus heterophyllus</i>	800 kg/m ³	Karnataka, Andhra Pradesh, Kerala, Maharashtra, Tamil Nadu	Heavy and hard, durable under water and in damp conditions although it cracks if exposed to direct sun. White ants do not attack it. Used for piles, platforms of wooden bridges, door and window panels.
<i>Lauraceae</i>	880 kg/m ³	Karnataka, Andhra Pradesh, Bihar, Orissa, Madhya Pradesh, Kerala, Tamil Nadu	Strong, hard and tough. It is subject to cracking and attack by dry rot. White ants do not attack it. Good surface smoothness. Used for such purposes as house construction, boat construction, railway sleepers and structural work.
<i>Swietenia spp.</i>	720 kg/m ³	Kerala, Tamil Nadu, Karnataka, Andhra, Bengal	Good finishing properties and is easily worked. Durable under water. Most commonly used for furniture, pattern making and cabinet work.
<i>Mangifera spp.</i>	560–720 kg/m ³	Throughout India	The mango tree is well known for its fruits. Easy to work and maintains its shape well. Moderately strong. It is most often used for cheap furniture, toys, packing boxes, cabinet work, and panels for doors and for windows.
<i>Morus spp.</i>	650 kg/m ³	Punjab	Strong, tough and elastic. Good finishing properties and can be seasoned well. Turns and carves easily. Mulberry is typically used for baskets and sports goods like hockey sticks, tennis rackets and cricket bats.
<i>Quercus spp.</i>	865 kg/m ³		Oak is strong and durable, with straight silvery grain. It is used for preparing sporting goods.
<i>Dalbergia latifolia</i>	850 kg/m ³	Kerala, Karnataka, Maharashtra, Madhya Pradesh, Tamil Nadu, Orissa	Strong, tough and close-grained. Good aesthetics and is easily finished. It maintains its shape well and is available in large sizes. It is used for furniture of superior quality, cabinet work, and ornamental carvings. IUCN listed vulnerable species.
<i>Shorea robusta</i>	880–1,050 kg/m ³	Karnataka, Andhra Pradesh, Maharashtra, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa	Hard, fibrous and close-grained. It does not polish easily and requires slow and careful seasoning. It is durable underground and in water. It is used for railway sleepers, shipbuilding, and bridges.
<i>Bombax spp.</i>	450 kg/m ³	All over India	Loose grained, inferior quality wood. Light in weight. Used for packing cases, the match industry, well curbs, and for cheap furniture.
<i>Albizia spp.</i>		North India	Hard and durable, Siris wood is difficult to work. It is used for well curbs in salty water, beams, posts, and furniture.
<i>Dalbergia sissoo</i>	770 kg/m ³	Mysore, Maharashtra, Assam, Bengal, Uttar Pradesh, Orissa	Also known as shisham or tali, this wood is strong and tough. Durable and aesthetically pleasing. Maintains its shape well. It can be easily seasoned. It is difficult to work but it takes a fine polish. It is used for high quality furniture, plywood, bridge piles, sport goods, and railway sleepers. It is a very good material for decorative works and carvings.
<i>Tectona grandis</i>	639 kg/m ³	Central India and Southern India	Moderately hard, teak is durable and fire-resistant. Easily seasoned and worked. It takes up a good polish and is not attacked by white ants and dry rot. It does not corrode iron fastenings and it shrinks little. It is among the most valuable timber trees of the world and its use is limited to superior work only.

Table 2.5.6: Furniture products by end-use sector

Residential	Dining and living, bedroom, kitchen, storage
Office	Desk operatives, storage, lounge
Hotels	Beds, dressers, wardrobes, bars, tables, panelling blinds, bed treatments, lighting
Hospital/Nursing homes	Beds, chairs, tables, lighting, bed treatment
Educational Institutes	Classroom panelling, boards, tables, chairs, sports complex (preparation of indoor stadiums etc)
Retail	Shelves, counters, tables, chairs, desks, lighting
Restaurant and Public Houses	Bar stools, tables, chairs etc.

Employment generation

Almost 50% of total employment in the furniture industry is distributed among seven states alone, as detailed in table 2.5.7.

Table 2.5.7: Employment by the Indian furniture industry

States	Employment
West Bengal	3,55,124
Uttar Pradesh	2,38,544
Maharashtra	2,03,124
Bihar	1,50,996
Gujarat	1,38,213
Kerala	1,37,156
Odisha	1,22,181

Source: National Sample Survey Office (NSSO)¹⁶

NSSO employment data provides total employment figures for the sector, including the unorganised sector. According to its 68th Round, 50% of the total employment in furniture manufacturing is concentrated in the five states of West Bengal, Uttar Pradesh, Maharashtra, Bihar and Gujarat. West Bengal, Uttar Pradesh and Maharashtra alone account for nearly 38% of the workforce. About 97% of the workforce involved in the furniture sector is unskilled,

of which 88% have an education qualification of secondary education or less. In the organized furniture segment, unskilled workers account for more than half of the total workforce. Managers and supervisors account for 10% of the total workforce and contract workers account for nearly 25% of the total workforce.

With the Indian population almost equal to that of China, India is one of the fastest growing major world economies and therefore, its middle-class consumer market is booming. This inevitably gives an impetus to the domestic furniture and homeware sector. Along with a strong domestic market, India is a signatory to 42 trade agreements with various countries, making it a viable choice for both market access and exports.

E. Handicrafts

The wooden handicrafts industry in India has registered significant growth in the last few years. The industry reflects the rural traditional style and beauty of India and the spirit of the rural craftsmanship of the country.

Wooden handicrafts are items that are made out of wood which carry an artistic and functional value. In India they are made by hand with the help of simple tools thus requiring low capital investment and various other resources. The industry is mainly based in rural areas and small towns and falls in the group of traditional rural small-scale industry. It provides significant employment opportunities to the people of the rural areas as it is highly labour intensive. The sector is the second largest employment provider in the country, employing more than six million artisans who are mainly reside in villages, providing financial independence for rural workers.

Wooden handicrafts are mainly produced in the states where raw material for their manufacture is easily available, such as Kashmir, Himachal Pradesh, Uttar Pradesh and southern states of India. The industry has grown very rapidly in the last few years due to increase in the export of wooden handicrafts. This has given a major boost to the industry and has also helped to further improve the condition of the rural people. The main countries where Indian wooden handicrafts are exported are USA, UK, Sweden, Singapore, Canada, Greece, and Portugal.

Industry overview

The skills for producing wooden handicrafts are specialized and are passed from one generation to the next. Indian wooden handicrafts reflect unmatched workmanship, fine designs, and subtle elegance. This

¹⁶ NSSO, Ministry of Statistics and Programme Implementation, 2014. 68th round Nutritional intake in India 2011-2012. pp 778. Available at: http://www.mospi.nic.in/sites/default/files/publication_reports/nss_report_560_19dec14.pdf

makes India one of the chief exporters of wooden handicrafts in the world market. The industry requires low capital investment and other resources and provides a high ratio of value addition and has emerged as one of the major sources of foreign exchange earnings for India.

Indian wooden handicrafts are in global demand and form an important export commodity for India. Although India's handicraft exports show a consistent increase of 16% per annum, its share in the international market is less than 2%.

2.6 Growth trends in the wood-based industry since 2000-01

The Central Statistics Office of the Ministry of Statistics and Programme Implementation, Government of India, regularly collects industry data and publishes it in its Annual Survey of India series¹⁷. Within the wood and timber sector, three industries are covered in the survey, namely, paper and paper products, furniture and the wood-based industry. The former two are partially dependent on wood while the third is fully dependent on wood.

The growth of the industry in terms of number of factories, input, output and Net Value Added (NVA) in absolute terms and percentage of the preceding year have been determined to assist in 10-year forecasts. The output has been determined by adjusting values by the estimated percentage of wood used in the industry, as given in the preceding sections.

Pulp and Paper Industry

Fig 2.6.1: Growth in output of the pulp and paper industry, 2000/01-2017/18 (%)



The paper industry has shown a slow but consistent growth with volatility in the percentage growth from 2001-02 onwards.

¹⁷ Ministry of Statistics and Programme Implementation, <http://mospi.nic.in/annual-survey-industries>

Table 2.6.1: Pulp and paper. Estimated Input – Output and NVA (100,000 INR)

Year	Input	Output	NVA
2000-01	1,412,353	1,871,242	374,807
2001-02	1,347,570	1,715,410	275,554
2002-03	1,579,563	2,017,863	332,657
2003-04	1,624,236	2,053,396	332,106
2004-05	1,824,963	2,269,677	338,770
2005-06	1,949,193	2,488,761	430,345
2006-07	2,164,050	2,766,359	481,690
2007-08	2,831,126	3,586,386	605,727
2008-09	3,252,867	4,107,717	677,914
2009-10	3,671,174	4,430,336	159,617
2010-11	4,828,703	5,960,453	869,755
2011-12	5,637,240	6,758,856	818,328
2012-13	5,789,656	6,859,629	750,561
2013-14	6,974,739	8,421,688	1,097,447
2014-15	7,767,585	9,241,817	1,090,733
2015-16	7,885,543	9,489,224	1,243,335
2016-17	8,162,190	9,837,344	1,261,676
2017-18	9,172,796	11,338,867	1,728,626

Table 2.6.2: Pulp and paper. Estimated Input – Output and NVA (%)

Year	Input	Output	NVA
2000-01	0	0	0.00
2001-02	-4.59	-8.33	-26.48
2002-03	17.22	17.63	20.72
2003-04	2.83	1.76	-0.17
2004-05	12.36	10.53	2.01
2005-06	6.81	9.65	27.03
2006-07	11.02	11.15	11.93
2007-08	30.83	29.64	25.75
2008-09	14.90	14.54	11.92
2009-10	12.86	7.85	-20.13
2010-11	31.53	34.54	60.64
2011-12	16.74	13.40	-5.91
2012-13	2.70	1.49	-8.28
2013-14	20.47	22.77	46.22
2014-15	11.37	9.74	-0.61
2015-16	1.52	2.68	13.99
2016-17	3.51	3.67	1.48
2017-18	12.38	15.26	37.01

Furniture Industry

Table 2.6.3: Furniture. Estimated Input–Output and NVA (100,000 INR)

Year	Input	Output	NVA
2000-01	977,718	1,198,446	196,321
2001-02	1,719,594	2,027,984	261,794
2002-03	1,573,228	1,830,137	222,117
2003-04	2,147,987	2,456,656	272,294
2004-05	2,802,014	3,226,210	381,707
2005-06	4,019,391	4,483,306	417,204
2006-07	4,764,174	5,383,060	568,050
2007-08	5,418,803	6,127,938	658,102
2008-09	486,298	609,152	106,387
2009-10	742,332	922,207	159,167
2010-11	926,988	1,186,379	236,730
2011-12	925,255	1,093,775	142,102
2012-13	1,180,793	1,474,061	263,943
2013-14	1,259,702	1,528,330	241,181
2014-15	1,244,208	1,577,526	290,290
2015-16	970,829	1,301,352	298,760
2016-17	1,547,605	1,868,546	273,003
2017-18	1,717,257	2,122,355	356,103

Table 2.6.4: Furniture. Estimated Input–Output and NVA (%)

Year	Input	Output	NVA
2000-01	0	0	0
2001-02	75.88	69.22	33.35
2002-03	-8.51	-9.76	-15.16
2003-04	36.53	34.23	22.59
2004-05	30.45	31.33	40.18
2005-06	43.45	38.97	9.30
2006-07	18.53	20.07	36.16
2007-08	13.74	13.84	15.85
2008-09	-91.03	-90.06	-83.83
2009-10	52.65	51.39	49.61
2010-11	24.88	28.65	48.73
2011-12	-0.19	-7.81	-39.97
2012-13	27.62	34.77	85.74
2013-14	6.68	3.68	-8.62
2014-15	-1.23	3.22	20.36
2015-16	-21.97	-17.51	2.92
2016-17	59.41	43.58	-8.62
2017-18	10.96	13.58	30.44

Fig. 2.6.2: Growth in output of the furniture industry, 2000/01-2017/18 (%)



The furniture industry has shown stability with occasional oscillations and a severe dip in 2008/09.

Other wood-based industries

Table 2.6.5: Other wood-based industries. Estimated Input–Output and NVA (100,000 INR)

Year	Input	Output	NVA
2000-01	185,460	223,405	29,791
2001-02	298,472	343,377	35,141
2002-03	244,315	294,245	38,902
2003-04	309,595	361,596	41,418
2004-05	368,879	481,736	39,015
2005-06	404,021	491,907	76,364
2006-07	506,738	573,136	52,402
2007-08	610,834	719,221	92,780
2008-09	748,395	849,542	77,965
2009-10	907,532	1,061,144	126,800
2010-11	1,440,660	1,592,612	113,924
2011-12	1,382,434	1,630,581	206,691
2012-13	1,601,012	1,863,203	220,863
2013-14	1,831,508	2,124,023	240,576
2014-15	1,675,940	2,042,772	306,971
2015-16	1,665,000	2,091,337	357,749
2016-17	1,887,446	2,350,437	397,347
2017-18	1,800,687	2,229,374	368,650

Fig. 2.6.3: Growth in output of other wood-based industries, 2000/01-2017/18 (%)

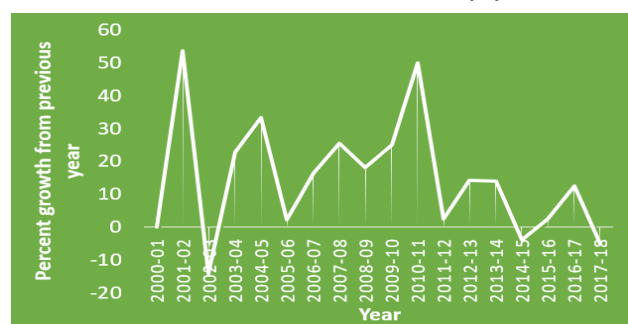


Table 2.6.6: Other wood-based industries. Estimated Input–Output and NVA (%)

Year	Input	Output	NVA
2000-01	0	0	0
2001-02	60.94	53.70	17.96
2002-03	-18.14	-14.31	10.70
2003-04	26.72	22.89	6.47
2004-05	19.15	33.22	-5.80
2005-06	9.53	2.11	95.73
2006-07	25.42	16.51	-31.38
2007-08	20.54	25.49	77.05
2008-09	22.52	18.12	-15.97
2009-10	21.26	24.91	62.64
2010-11	58.74	50.08	-10.15
2011-12	-4.04	2.38	81.43
2012-13	15.81	14.27	6.86
2013-14	14.40	14.00	8.93
2014-15	-8.49	-3.83	27.60
2015-16	-0.65	2.38	16.54
2016-17	13.36	12.39	11.07
2017-18	-4.60	-5.15	-7.22

The overall growth has decreased with major oscillations in the percentage output in successive years.

2.7 Current roundwood demand estimates

The input values of the three broad categories of wood-based industries are used to estimate the current demand for wood in India. The basis for estimating the demand is as follows:

1. For pulp and paper, the current demand for roundwood has been estimated using production of wood-based paper under the assumption that the operating capacity will meet its demand by importing wood-based pulp if not supplied by domestic roundwood
2. For furniture, 80% of input is wood and the cost of roundwood is INR 18,000/m³
3. For plywood, panels and other wood-based industries, 90% input is wood and the cost of roundwood is INR 18,000/m³
4. For the construction sector, the demand has been estimated as the difference between sawn timber expressed in RWE and roundwood used by the furniture industry.

The input has been estimated for all three categories using the model developed and given in section 3. Roundwood demand for 2016 to 2020 is given in tables 2.7.1 to 2.7.3.

Table 2.7.1: Pulp and paper roundwood demand, 2016-2020

Year	Wood-based paper (Mtpa)	Roundwood equivalent (million m ³)
2016	3.45	12.32
2017	3.46	12.36
2018	3.5	12.50
2019	3.5	12.50
2020	3.5	12.50

Table 2.7.2: Furniture roundwood demand, 2016-2020

Year	Input (billion INR)	Value of input of wood (billion INR)	Roundwood equivalent (million m ³)
2016	154.76	123.81	6.88
2017	171.73	137.38	7.63
2018	169.24	135.39	7.52
2019	180.13	144.10	8.01
2020	191.02	152.82	8.49

Table 2.7.3: Other wood-based industry roundwood demand, 2016-2020

Year	Input (billion INR)	Value of input of wood (billion INR)	Roundwood equivalent (million m ³)
2016	188.74	169.87	9.44
2017	180.07	162.06	9.00
2018	213.12	191.81	10.66
2019	224.82	202.34	11.24
2020	236.52	212.87	11.83

Table 2.7.4: Construction sector roundwood demand, 2016-2020

Year	Sawnwood demand (million m ³)	Sawnwood demand (million m ³ RWE)	Furniture demand (million m ³ RWE)	Demand by construction sector (million m ³ RWE) (1) - (2)
2016	25.92	37.03	6.88	30.15
2017	25.57	36.53	7.63	28.90
2018	23.64	33.77	7.52	26.25
2019	23.98	34.26	8.01	26.25
2020	23.00	32.86	8.49	24.37

Table 2.7.5: Estimated current total demand for roundwood, 2016-2020 (million m³ RWE)

Year	Pulp and paper	Furniture	Panels and plywood	Construction	Total
2016	12.32	6.88	9.44	30.15	58.79
2017	12.36	7.63	9.00	28.90	57.89
2018	12.50	7.52	10.66	26.25	56.93
2019	12.50	8.01	11.24	26.25	58.00
2020	12.50	8.49	11.83	24.37	57.19

Total demand for roundwood is estimated to be about 55 to 57 million m³ out of which 47 million m³ is supplied by domestic sources and the rest by imports or use of substitutes.

Although many assumptions have been used in the generation of these demand estimates, their accuracy will be able to be validated and improved through field surveys.

2.8 Wood Balance estimates

In order to arrive at a relatively precise and accurate picture of availability and utilization of roundwood, it is important to look at the estimates of wood balance from certain major sectors of the country.

The sectors considered here are those that consume large volumes of wood and their consumption for the period 2010 to 2019 is estimated in terms of roundwood equivalents. All figures in the tables below are in million m³.

Total availability of roundwood

The following sources of roundwood have been included in the roundwood inflow:

1. Total production of roundwood from government forests
2. Total production of roundwood from areas outside forests
3. Total imports of roundwood
4. Total imports of sawnwood converted into RWE using a conversion factor 1 m³ of roundwood = 0.7 m³ of sawnwood (70% yield)
5. Total imports of pulp in RWE with a conversion factor of 1 kg of wood = 0.5 kg of pulp
6. Total imports of veneer in RWE with a conversion factor of 1 m³ of roundwood = 700 kg of veneer

Table 2.8.2: Total imports of sawnwood, 2010-2019 (million m³ sawn and RWE)

Year	Sawnwood	Sawnwood
2010	0.16	0.23
2011	0.45	0.64
2012	0.50	0.71
2013	0.55	0.78
2014	0.55	0.79
2015	0.73	1.05
2016	0.74	1.06
2017	0.92	1.31
2018	1.18	1.68
2019	1.56	2.23

Table 2.8.1 Production and imports of roundwood, 2010-2019 (million m³)

Year	Production of roundwood from government forests	Production of roundwood from areas outside forests	Imports of roundwood
2010	1.890	44.072	4.791
2011	1.780	43.356	5.820
2012	2.070	42.464	6.392
2013	2.390	41.571	6.233
2014	2.200	42.812	6.235
2015	2.090	44.054	5.694
2016	2.200	44.483	5.197
2017	2.160	44.912	4.617
2018	2.150	45.448	4.558
2019	2.170	45.984	4.372

**Table 2.8.3: Total imports of pulp (sulphate and sulphite), 2010-2019
(million kg, million m³ RWE)**

Year	Sulphate mill. kg	Sulphite mill. kg	Total mill. kg	Total million m ³ RWE
2010	518.45	1.73	520.18	1.49
2011	645.11	2.46	647.57	1.85
2012	646.93	1.68	648.61	1.85
2013	689.47	34.26	723.73	2.07
2014	666.82	25.05	691.87	1.98
2015	706.83	1.64	708.47	2.02
2016	777.46	1	778.46	2.22
2017	746.77	1.96	748.73	2.14
2018	680.46	3.16	683.62	1.95
2019	735.44	1.64	737.08	2.11

**Table 2.8.4: Total imports of veneer, 2010-2019
(million kg, million m³ RWE)**

Year	Veneer (million kg)	Veneer (million m ³ RWE)
2010	21.54	0.04
2011	134.13	0.23
2012	90.36	0.15
2013	125.29	0.21
2014	167.7	0.28
2015	286.49	0.48
2016	326.16	0.55
2017	312.23	0.52
2018	299.84	0.50
2019	319.9	0.54

Table 2.8.5: Roundwood consumed by paper industry (million tonnes, million m³)

Year	Total paper produced (million tonnes)	(million m ³ RWE)
2010	3.4	12.143
2011	3.41	12.179
2012	3.49	12.464
2013	3.48	12.429
2014	3.5	12.500
2015	3.51	12.536
2016	3.45	12.321
2017	3.46	12.357
2018	3.5	12.500
2019	3.5	12.500

Total utilization of roundwood

The following sources of roundwood have been included in the outflow of roundwood:

- Pulp and paper:** the total production of wood-based paper has been converted to RWE by using a conversion factor of 2.5 kg of roundwood = 1 kg of paper, 700 kg of roundwood = 1 m³ of paper (paper mostly being manufactured from short rotation tree crops or pulpwood).
- Veneer for making plywood** uses the assumption that 95% of plywood is veneer and 1 m³ of roundwood produces 0.85 m³ (85%) of veneer.
- Total roundwood exports.**
- Total sawnwood exports** converted to RWE using a conversion factor of 70%. (1 m³ of roundwood = 0.7 m³ of sawnwood)
- Total veneer exports** converted to RWE using a conversion factor of 700 kg. of veneer = 1 m³ of roundwood.
- Exports of pulp, both sulphate and sulphite,** assuming that 1 kg of roundwood produces 0.5 kg of pulp, and 700 kg of roundwood = 1 m³ of roundwood
- Total roundwood available for sawing:** Total roundwood (from government forests and areas outside forests) - total wood not sawn (that used in production of veneer and pulp), 90% of pulp is from roundwood from TOF while 10% of pulp is from roundwood from state forests
- The difference between total wood available and total used** is the wood used in miscellaneous sectors that may include sawing of wood, fillings, carvings, etc.

2.9 Production of timber and wood products in India

Industrial roundwood produced in India includes all logs (including those utilized for producing pulp, veneers, etc.) produced from the government-owned forests as well as areas outside forests. This does not include imported round logs. Sawnwood, on the other hand, includes all sawnwood produced by sawing roundwood obtained from three sources, namely, government-owned forests, areas outside forests and imported round logs, excluding those round logs used for producing pulp and veneer.

Plywood and veneer production was estimated based on the raw material being coniferous or non-coniferous. Discussions with industry and also according to information in table 2.5.2, established that almost no coniferous wood is used to produce plywood or veneer. In the case of thick plywood (more than 1,200 mm in thickness), the inner plies are usually

Table 2.8.6: Total inflow of roundwood (million m³)

Year	Roundwood from state forests	Roundwood from TOF	Roundwood imports	Sawnwood imports RWE	Veneer imports RWE	Pulp imports RWE	India total wood availability RWE
	1	2	3	4	5	6	7 (1+2+3+4+5+6)
2010	1.89	44.07	4.79	0.23	0.04	1.49	52.51
2011	1.78	43.36	5.82	0.64	0.23	1.85	53.67
2012	2.07	42.46	6.39	0.71	0.15	1.85	53.64
2013	2.39	41.57	6.23	0.78	0.21	2.07	53.25
2014	2.20	42.81	6.23	0.79	0.28	1.98	54.29
2015	2.09	44.05	5.69	1.05	0.48	2.02	55.39
2016	2.20	44.48	5.20	1.06	0.55	2.22	55.71
2017	2.16	44.91	4.62	1.31	0.52	2.14	55.66
2018	2.15	45.45	4.56	1.68	0.50	1.95	56.30
2019	2.17	45.98	4.37	2.23	0.54	2.11	57.40

Table 2.8.7: Total outflow (utilization) of roundwood (million m³)

Year	RW used by paper	RW used for producing veneers to manufacture plywood	Export of RW	RWE Sawn export	RWE Veneer export	Pulp RWE export	RW available for sawing	Total RW as estimated from RW inflow
2010	12.143	4.247	0.02	0.029	0.026	2.63E-06	36.041	52.51
2011	12.179	4.607	0.01	0.029	0.016	5.71E-08	36.833	53.67
2012	12.464	4.911	0.01	0.071	0.012	1.37E-06	36.174	53.64
2013	12.429	5.226	0.01	0.071	0.006	1.06E-06	35.509	53.25
2014	12.500	5.551	0.01	0.043	0.012	0.015629	36.161	54.29
2015	12.536	5.908	0.01	0.057	0.009	0.042114	36.831	55.39
2016	12.321	6.297	0	0.029	0.010	0.027754	37.028	55.71
2017	12.357	6.738	0.01	0.014	0.006	0.004747	36.533	55.66
2018	12.500	9.981	0.01	0.014	0.023	0.004257	33.764	56.30
2019	12.500	10.618	0.01	0.000	0.018	0.005833	34.25	57.40

RW=roundwood

RWE=roundwood equivalent

of mixed species and classifying them as purely coniferous plywood may not be correct. Similarly for veneers, no evidence has been found that coniferous logs, comprised mainly of pine, are converted into veneers. Thus, the production of coniferous veneers and plywood can be taken as nil. There may be instances of very low production of coniferous logs in 4 to 5 states but this is difficult to estimate. Furthermore, there are severe restrictions on felling of

trees in areas above 1,000 metres, thus limiting the availability of raw material for coniferous plywood and veneer. Most of the negligible volume of coniferous logs removed from forests or areas outside forests are used as timber. The final estimates of roundwood, sawnwood, veneer and plywood produced in India during the last decade is given in table 2.9.1.

From 2009 to 2019, plywood production in India increased from around 3.8 million m³ to 10 million m³. A similar trend was also observed in imports of veneer, as shown in table 2.9.2.

Table 2.9.1: Estimated production of roundwood, sawnwood, veneer and plywood in India, 2009-2019

Production (000m ³)											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Ind. roundwood	46,968	45,962	45,136	44,534	43,961	45,012	46,144	46,683	47,072	47,598	48,154
Ind. Roundwood (C)	182	158	148	173	199	183	174	183	180	179	181
Ind. roundwood(NC)	46,786	45,804	44,988	44,361	43,762	44,829	45,969	46,499	46,892	47,419	47,973
Sawnwood	26,438	25,229	25,783	25,322	24,856	25,313	25,782	25,920	25,573	23,635	23,975
Sawnwood (C)	162	157	134	137	156	147	145	154	286	258	190
Sawnwood(NC)	26,276	25,072	25,649	25,185	24,700	25,166	25,637	25,766	25,287	23,377	23,785
Veneer	3,676*	3,908*	3,996*	4,323*	4,545*	4,793*	4,950	5,270	8,043	8,616	9,058
Veneer (C)	0	0	0	0	0	0	0	0	0	0	0
Veneer (NC)	3,676*	3,908*	3,996*	4,323*	4,545*	4,793*	4,950	5,270	8,043	8,616	9,058
Plywood	3,869*	4,122*	4,394*	4,676*	4,967*	5,286*	5,634**	6,029**	8,930^a	9,500^a	10,000^a
Plywood (C)	0	0	0	0	0	0	0	0	0	0	0
Plywood (NC)	3,869*	4,122*	4,394*	4,676*	4,967*	5,286*	5,634**	6,029**	8,930 ^a	9,500 ^a	10,000 ^a

* The figures reported for the years 2009 to 2014 are tentative as the price differential (difference in price of products of different sizes) and inflation cannot be accounted for. An average CAGR of 6.5% has been assumed.

** Estimated

^a Quoted from an article prepared by Technical Advisor, Federation of Plywood and Panel Industries¹⁸.

A high correlation ($r = 0.81$, where r is the Pearson's correlation coefficient) was found between the quantity of imports of veneer and quantity of production of plywood.

Both are strongly linearly related. Plywood production in India mainly depends on imported veneers and imports of veneer have substantially increased due to an increase in demand for plywood leading to a marked increase in production.

Table 2.9.2: Comparative trends in production of plywood in India and imports of veneer by India, 2009-2019

Year	Import of veneers (million kg)	Plywood production (000 m ³)
2009	19.7	3,869
2010	21.54	4,122
2011	134.13	4,394
2012	90.36	4,676
2013	125.29	4,967
2014	167.7	5,286
2015	286.49	5,634
2016	326.16	6,029
2017	312.23	8,930
2018	299.84	9,500
2019	319.9	10,000

¹⁸ Pandey, C.N. and Roy, S. 2020. Plywood and Panel Industry in India. Current scenario and key issues. Wood is Good. Vol.1 (1). 15-17

3) PROJECTED DEMAND TO 2030

Demand for timber and wood in India arises mainly from the construction sector, furniture industry, pulp and paper industry, and handicraft industry and is provided by domestic timber species and imports. There are a significant number of sawmills which provide sawn timber for further use in the end-use sectors mentioned above, primarily being construction, furniture and handicrafts. The pulp and paper sector uses roundwood directly for pulping. Wood substitutes also play a role in determining demand and have become more prominent in these sectors, mainly in construction and furniture.

With fast-paced developments in technologies, changing consumer preferences, and rising prices of wood, many substitutes, both wood-based and metal, are replacing wood, especially in low-cost and mass-scale construction. Timber demand has reduced marginally due to an increase in use of aluminium, iron and plastics in the construction sector. However, use of low-cost timber such as poplar and eucalypts has increased in response to changing preferences in the plywood and other panels industry. There has been a rise in use of low-cost timber as well as a reduction in demand for high value timber such as teak.

Gross output plays a major role in growth of industry assuming that increased outputs are directly related to an increase in demand for raw material, which is wood in the case of these industries. Input and output estimates of all industry are prepared by the Ministry of Statistics and Programme Implementation, Government of India by undertaking surveys in the entire industrial sector of India (MoSPI). These statistics are useful to estimate the Gross Domestic Product of the country. The values are in monetary terms for comparative purposes. These values have been converted into roundwood equivalents by using correction factors as detailed in the text.

3.1 Roundwood demand in the pulp and paper industry

The growth of the pulp and paper industry has been on a constant rise and recycled fibres have played an important role in the growth of the paper industry. The total input (including all factors of production) increased more than six-fold, from INR 141.24 billion in 2000/01 to INR 917.28 billion in 2017/18.

At present the total wood demand by these firms is around 13 million tons. An increase in wood demand is likely to be more a response to utilisation of idle capacity rather than establishment of new firms.

Production of wood-based paper has more or less been constant, pivoting around 3.5 million tonnes per annum with a similar trend for agriculture waste-based paper. The use of recycled fibres has contributed immensely to increased paper production and it is highly unlikely in the coming years that production of wood-based paper will grow substantially.

For the purpose of estimation of demand of wood for this purpose, 3.5 million tonnes per annum of wood-based paper would require around 1.5 million tonnes of roundwood with an average of 2.5 kg of roundwood producing 1 kg of paper.

The growth in value of input in the pulp and paper industry is given in figure 3.1.1. Growth of the industry as a whole is exponential. The input has grown exponentially from 2000 to 2017. The trend is best explained by an exponential model as follows:

$$\text{Input (in billion INR)} = Ae^{bt}$$

where $A=4.98E-109$; $b = 0.127$; $t = \text{time (years)}$

The coefficient of determination (R^2) for the above model is 0.98 indicating a strong relationship.

Fig. 3.1.1: Growth of the pulp and paper industry in terms of input



Fig. 3.1.2: Growth of the pulp and paper industry in terms of output



The paper industry has seen almost exponential growth from 2000/01 to 2017/18. Assuming 5% annual inflation, growth still maintains an increasing trend.

The present per capita annual demand for paper is 4 kg. Assuming it to be constant (factoring increased reliance on online paperless procedures), the demand for paper will increase owing to an increase in population projected to reach 1.5 billion in 2030. However, the increase in demand is likely to be met by non-wood sources.

A dozen wood-based mills have shut down or are lying idle at present compared to 2010. Table 3.1.1 gives the estimated production of wood-based paper from 2010 to 2019.

Table 3.1.1: Production of wood-based paper and utilization of wood, 2010-2019

Year	Quantity of paper produced (Mtpa)	Roundwood equivalent (million m ³)
2010	3.4	12.143
2011	3.41	12.179
2012	3.49	12.464
2013	3.48	12.429
2014	3.5	12.500
2015	3.51	12.536
2016	3.45	12.321
2017	3.46	12.357
2018	3.50	12.500
2019	3.50	12.500

3.2 Estimated demand for roundwood by the furniture and handicrafts industries

With increases in income and housing demand, the demand for furniture is likely to increase over the next 10 years. However, with alternatives being available in suitable non-wood substitutes, the increase in demand for wood for furniture manufacture may not be proportionate to the increase in demand for furniture. In addition, the demand for hardwoods is likely to be absorbed in the increased demand for plywood and panels. Growth in value of input in the furniture industry is given in figure 3.2.1.

There is a sudden fall in the input to the industry from 2007 to 2008 for which no reasonable explanation could be found. Owing to this, the model for growth of furniture industry has been taken from 2008 onwards when linear growth had resumed after a steep decline from 2007.

Fig. 3.2.1: Growth of the furniture industry in terms of input



The trend is best explained by a linear relationship as follows:

$$\text{Input (in billion INR)} = C + Mt$$

where $C = -21808.7$; $M = 10.891$; $t = \text{time (years)}$

The adjusted R^2 for the model is 0.78 which indicates a high degree of linearity.

The growth of the furniture industry in terms of output is depicted in figure 3.2.2. The same plunge in industrial output can be seen with no plausible explanation.

Fig. 3.2.2: Growth of the furniture industry in terms of output



The furniture industry is in recovery following the steep decline in output in 2008/09 and is not expected to reach INR 612 billion by 2030. Alternative furniture (moulded plastic, aluminium and other metals, etc.) has reduced demand for wood in this sector. As per estimates, the wood-based furniture industry, which constituted almost 65% of the total furniture industry of India, is mostly in the unorganized sector. There has been a noticeable shift in the types of material used in manufacturing, particularly in office furniture where aluminium, steel, plastic and other non-wood material are now being used.

Almost all wood-based furniture manufacturing in India is by small- and medium-sized enterprises with large manufacturers using mechanized systems with steel, aluminium, plywood, MDF and other non-wood material as raw material. It is estimated that 80% of

the total input of the furniture industry is wood, mostly in sawn form. A wide range of species, from mango (*Mangifera indica*) to teak (*Tectona grandis*), is used in furniture making. More recently, even selected species of eucalypts, acacias, and other non-traditional timber are being used for manufacturing furniture.

Total demand estimates for roundwood for furniture making from 2021 to 2020 have been based on the assumptions that 80% of the total input is wood-based and the price of roundwood is INR 18,000/m³, considering a mix of species used for furniture making ranging from mango to teak, including poplar, eucalypts and other softwood used in manufacturing plywood and other panels. These assumptions, however, require validation through field surveys using primary data.

Table 3.2.1 provides the predicted input for the furniture industry for 2021 to 2030.

Table 3.2.1: Demand for timber for the furniture industry, 2021-2030

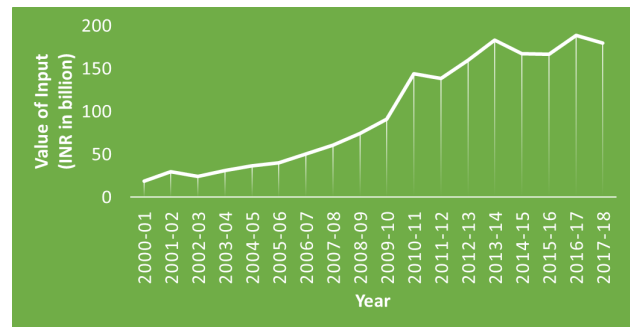
Year	Predicted input (INR billion)	Adjusted input for 80% of use of wood (INR billion)	Roundwood equivalent (million m ³)
2021	202.141	161.71	8.98
2022	213.032	170.43	9.47
2023	223.923	179.14	9.95
2024	234.814	187.85	10.44
2025	245.705	196.56	10.92
2026	256.596	205.28	11.40
2027	267.487	213.99	11.89
2028	278.378	222.70	12.37
2029	289.269	231.42	12.86
2030	300.16	240.13	13.34

3.3 Estimated demand for roundwood by the plywood, wood-based panels and other wood-based industry

Figure 3.1.1 presents the growth in the value of input in the plywood, wood-based panels and other wood-based industry.

Growth has been exponential and explains the increase in plywood production in India which is increasingly being used for furniture and construction.

Fig. 3.3.1: Growth of other wood-based industry in terms of input



Input values were approximated by means of an increasing exponential model as follows:

$$\text{Input (in billion INR)} = Ae^{bt}$$

Where $A = 2.21E-126$; $b = 0.146$; $t = \text{time (years)}$

The coefficient of determination (R^2) for the above model is 0.92 indicating a strong relationship.

The growth of output of the plywood and wood-based panel industry is presented in figure 3.2.2.

Fig. 3.3.2: Growth of other wood-based industry in terms of output



The output of other wood-based industry shows an increasing overall trend from 2000/01 to 2017/18 with a small decline at the end of the period. Output is likely to continue to increase, particularly due to the 'Make-In-India' policy to encourage domestic production. The wood component in 'other wood-based industry' is large, as furniture and pulp and paper have alternate raw material options but other wood-based industries do not. Other industries constitute plywood, panels, particleboard, etc.

The use of wood residues (chips, shavings and sawdust) in manufacturing of particleboard, continues to be significant. The trend in output has been almost linear with time and, with minor fluctuations, this trend is expected to continue.

Estimates of wood demand assume a 90% input of roundwood at a price of INR 18,000/m³ considering all

types of wood. Demand estimates may be amended when more accurate roundwood inputs and prices have been determined through a sample survey in the concerned industry.

Table 3.3.1: Predicted input and demand for timber by the plywood and panel industry

Year	Predicted input (INR billion)	Input assuming 90% roundwood (INR billion)	Estimated demand for roundwood (million m ³)
2021	308.98	278.08	15.45
2022	357.55	321.79	17.88
2023	413.75	372.38	20.69
2024	478.79	430.91	23.94
2025	554.06	498.65	27.70
2026	641.15	577.04	32.06
2027	741.94	667.75	37.10
2028	858.57	772.71	42.93
2029	993.54	894.18	49.68
2030	1149.72	1034.74	57.49

3.4 Estimated demand for roundwood in the construction sector

With the 'houses for all' policy of the Government of India there has been a sharp increase in construction of affordable houses which is likely to continue over the next decade. Although this should, in normal course, lead to a sharp increase in demand for wood and wood products, the trend towards increased use of alternatives such as metal (aluminium and steel), glass and wood composites may dampen demand for timber, particularly teak, pine and *Dalbergia* spp. However, with plywood being a major constituent in the construction sector, demand for poplar and eucalypts is likely to increase, which has been captured by the demand estimates for the plywood and panel sector. The demand for sawnwood and wood products in this sector is mostly provided by sawmills.

The demand for roundwood by the construction sector has been estimated using the assumption that the sector uses the residual sawnwood that has not been utilised by the furniture industry. Alternative materials are used when wood is unavailable. Most of the products used in the construction sector are covered by the plywood and panel industry. There is a trend in use of roundwood for making doors, windows, and other products. Roundwood demand for the construction sector has been estimated from production rather than consumption data due to the

inability to undertake a primary survey during the study period. A general linear increase in sawnwood availability was observed over the past decade. The trend is best explained by a linear relationship as follows:

$$\text{Input (in billion INR)} = C + Mt$$

where C= 340.155 ; M= -0.156; t = time (years)

The coefficient of determination (R²) for the model is 0.39.

Estimates of demand for sawnwood and its roundwood equivalent in the construction sector is given in table 3.4.1.

Table 3.4.1: Estimates of demand for wood by the construction sector, 2021-2030 (million m³ sawn and RWE)

Year	Demand for sawn timber in construction	Demand for sawn timber in construction (RWE)
2021	15.899	22.71
2022	15.253	21.79
2023	14.617	20.88
2024	13.971	19.96
2025	13.335	19.05
2026	12.699	18.14
2027	12.053	17.22
2028	11.417	16.31
2029	10.771	15.39
2030	10.135	14.48

The decline in demand for sawn timber (in roundwood equivalent) by the construction sector is due to an anticipated increase in demand for substitutes and plywood. Much of the plywood, panels and fibreboard produced is utilized by the construction sector, reducing demand for sawn timber (in roundwood equivalent).

Roundwood availability, especially of species that are traditionally used in construction, such as teak, pine, *Dalbergia* spp., *Shorea robusta*, etc. may not be at prices afforded by middle income groups.

Thus, a marked shift is projected from traditional timber species to products like panels and plywood as well as other material such as aluminium, iron, steel and, in some cases, plastic (PVC windows, panels, etc.).

Total demand for roundwood across all sectors is given in table 3.5.1. The other wood-based industry also includes the sources of supply of wood and wood products to the construction industry.

3.5 Estimated total demand for roundwood

Based on the previous estimates, the total estimated demand for wood (in roundwood equivalents) is summarised in table 3.5.1.

Table 3.5.1: Total estimated demand for roundwood in India's wood-based industries (million m³)

Year	Pulp and Paper	Furniture	Plywood, panels and other wood-based industry	Construction	Total
2021	12.5	8.98	15.45	22.71	59.64
2022	12.5	9.47	17.88	21.79	61.64
2023	12.5	9.95	20.69	20.88	64.02
2024	12.5	10.44	23.94	19.96	66.84
2025	12.5	10.92	27.7	19.05	70.17
2026	12.5	11.4	32.06	18.14	74.10
2027	12.5	11.89	37.1	17.22	78.71
2028	12.5	12.37	42.93	16.31	84.11
2029	12.5	12.86	49.68	15.39	90.43
2030	12.5	13.34	57.49	14.48	97.81

Demand for roundwood by the pulp and paper industry is expected to remain constant or is likely to decline in response to a reduction in the number of firms producing wood-based paper. Production has remained almost constant despite the number of wood-based paper mills dropping to 18 presently from about 30 during 2010/11. Demand for paper, especially packaging and other industrial paper, is likely to increase due to the anticipated increase in population and the impacts of the Indian government's 'Make-in-India' policy. This sharp increase in demand is likely to be met by paper manufactured from recycled fibres, as the trend has already shown.

Demand for timber by the furniture industry increases at a regular pace, starting from about 9 million m³ in 2021 to around 13 million m³ in 2030. This seems reasonable as a significant proportion of furniture production, especially office furniture, is being increasingly made of material other than wood owing

to the increasing cost and maintenance of wooden furniture.

Demand for wood by the plywood, panels and other wood-based industries increases sharply from 15 million m³ in 2021 to 57 million m³ in 2030. The construction of housing units under the welfare schemes of the Government has seen a sharp increase and is likely to continue further. However, with low-cost housing, a larger share of demand will be for more cost-effective solutions such as plywood.

Timber used for preparing scaffoldings will also register a sharp increase with the increasing pace of construction. Overall, total timber demand is likely to reach about 98 million m³ by 2030 in order to supply the demands of the paper, furniture and other wood-based industries including construction. However, the role of substitutes and their effects on demand needs to be considered. The estimates of demand in the longer term are not considered as accurate as those for the earlier part of the decade due to the inherent nature of quantitative methods.

Total production of roundwood in India is around 47 million m³, of which 2 million m³ is from state-owned forests and 45 million m³ from areas outside forests. The remainder is expected to be sourced from imports. Demand in the next decade is set to increase significantly and is likely to be met by imports of roundwood, sawnwood, primary processed wood products and secondary processed wood products.

Total demand projections have been estimated for the four sectors that are major consumers of wood and wood products. The construction sector largely depends upon sawnwood and imports (including secondary processed goods and substitutes). At present around 24 million m³ of sawn wood is available for the construction and other sectors. The rest is provided by imports.

It must be noted that due to the COVID-19 pandemic this study has used secondary sources and personal interviews to obtain data estimates for these projections. Their accuracy will be improved by conducting field surveys in the wood industry and wood consuming sectors to obtain primary data.

Demand for imports of wood and selected wood products

The patterns of trade in wood and wood products (primarily eight commodities) have been given in section 2 and indicate the trade scenario over the next ten years.

Imports of wood in the rough are on a declining trend and are likely to decline further in the coming years although they are unlikely to be completely replaced by sawnwood. In 2009, India imported almost 5 million m³ of roundwood in the rough, with imports increasing for the next three years but then declining year-on-year to the present. The average decline since 2012 has been 0.2 million m³ annually. If the same trend continues, imports of roundwood are expected to decline steadily to around 2.7 million m³ per annum by the end of the decade.

Imports of hoopwood have declined to almost 0.02 million m³ in 2019. Sawnwood imports, although less than wood in the rough, have risen steadily from 0.16 million m³ in 2009 to 1.56 million m³ in 2019, increasing by more than 88% in a period of 11 years. With increasing domestic production and a static supply of wood from the forests and non-forest areas of India, imports of sawnwood are expected to increase substantially in the coming decade.

Veneer sheets are important for the plywood and panel industry. The increase in imports of veneer sheets is an indication of increased production of plywood and panels. Domestic production of veneer is not expected to meet the overall demand for veneer in the plywood and panel industry. Imports of veneer are therefore expected to increase in the coming decade, and have already reached 0.32 million tonnes in 2019, up from 0.02 million tonnes in 2009.

Imports of fibreboard increased from 2008 with a small drop in 2019. It is uncertain whether imports will continue to decline although domestic production of fibreboard is increasing which suggests that imports may not increase significantly over the forecast period. The use of MDF in home and office furniture has increased recently. The increase in use of fibreboard to replace plywood signals an increased utilization of woodchips, particles and sawdust which were earlier considered residues and waste. It is uncertain whether particleboard can completely replace plywood, especially in the interior industry, but the increase in its use has led to a drop in plywood's market share. The limited availability of wood residues that can be compressed to manufacture fibreboard is also a factor

supporting plywood demand. Wood residues are in demand for energy purposes in rural areas but with the Government ensuring LPG connections in village households and better electricity networks, the use of wood residues for energy needs is expected to reduce, increasing its availability to the panel industry to manufacture particleboard.

Imports of plywood and panels increased from 2009 to 2011 and then declined to a low of 0.17 million m³ in 2017. Imports then increased sharply to an historic high of 0.46 million m³ in 2019. The steep incline is expected to continue over the next decade to meet demand created by a booming construction industry where the utilisation of plywood and panels is dominant. The increased use of plywood and panels in the furniture industry is also expected to support growth in imports.

3.6 Future Road map for improving the report

The preparation of this report has been impaired by limitations caused by the pandemic, such as the inability to conduct field surveys, lack of access to non-digitalized data from important sources across the country, and the impossibility of carrying out field visits to the industries for assessing production, waste and technologies in use, among others. These limitations resulted in reliance on the use of many assumptions (noted in sections 2 and 3) based on discussions with industry experts.

As the pandemic ends it is recommended that the validity of these assumptions be re-evaluated by undertaking field surveys, and investigating other information sources to confirm trends. Specifically, the following steps are recommended:

1. Estimation and incorporation of annual trade with respect to countries
2. Validation of model output estimates (for furniture and other wood-based industry) through field surveys.
3. Constructing demand estimates for imports using the results of survey and timber harvest in the country.

SOURCES CONSULTED

Plywood and Panels

- [1] <http://www.madehow.com/Volume-4/Plywood.html> (Accessed on 3rd August, 2020)
- [2] <https://www.ucp.org/igi3s/7ssnlf.php?tag=how-plywood-is-made-028b5b> (Accessed on 3rd August, 2020)
- [3] https://www.michigan.gov/documents/mdard/AHECIndia_Wood_Sector_Market_Study-2016reduced_550865_7.pdf (Accessed on 3rd August, 2020)
- [4] <https://www.televisory.com/blogs/-/blogs/indian-wood-panel-industry-growth-drivers-and-present-trends> (Accessed on 3rd August, 2020)
- [5] https://www.michigan.gov/documents/mdard/AHECIndia_Wood_Sector_Market_Study-2016reduced_550865_7.pdf (Accessed on 3rd August, 2020)
- [6] <https://www.researchnester.com/reports/india-plywood-and-laminates-market/2366> (Accessed on 3rd August, 2020)
- [7] https://www.business-standard.com/article/economy-policy/plywood-laminate-industry-in-doldrums-high-gst-chemicals-prices-hurt-117110900222_1.html#:~:text=The%20size%20of%20India's%20plywood,lamination%20when%20used%20for%20furniture (Accessed on 4th August, 2020)
- [8] <https://www.businesswire.com/news/home/20190826005448/en/India-Plywood-Market-Trends-Share-Size-Growth> (Accessed on 4th August, 2020)
- [9] <https://www.slideshare.net/studsplanet/western-india-plywood-project-27105510> (Accessed on 4th August, 2020)
- [10] <https://www.scribd.com/doc/23278755/The-History-of-Plywood-Industry-in-India-is-Old> (Accessed on 4th August, 2020)
- [11] [https://www.slideshare.net/atulthakur007/lesser-known-forest-tree-species-used-for-commercial-purposes#:~:text=Well%20known%2FPopular%20forest%20Trees,\(Chirpine\)%20E2%80%A2%20Eucalyptus%20spp.&text=Populus%20spp.&text=Casuarina%20equisetifolia%20E2%80%A2%20Dalbergia%20sissoo,\(Rosewood\)%20E2%80%A2%20Salix%20spp](https://www.slideshare.net/atulthakur007/lesser-known-forest-tree-species-used-for-commercial-purposes#:~:text=Well%20known%2FPopular%20forest%20Trees,(Chirpine)%20E2%80%A2%20Eucalyptus%20spp.&text=Populus%20spp.&text=Casuarina%20equisetifolia%20E2%80%A2%20Dalbergia%20sissoo,(Rosewood)%20E2%80%A2%20Salix%20spp) (Accessed on 4th August, 2020)
- [12] https://en.wikipedia.org/wiki/List_of_Indian_timber_trees (Accessed on 4th August, 2020)
- [13] <https://www.downtoearth.org.in/coverage/industries-eye-forest-land-for-plantations-30894> (Accessed on 4th August, 2020)
- [14] <http://www.indiaenvironmentportal.org.in/files/file/wood-is-good.pdf> (Accessed on 4th August, 2020)
- [15] <https://www.newindianexpress.com/cities/kochi/2014/jun/16/Plywood-Industry-a-Boost-for-Economy-625293.html#:~:text=in%20Perumbavoor%20municipality.-,The%20plywood%20sector%20provides%20employment%20to%20around%20one%20lakh%20people,but%20veneer%20and%20resaw%20bandsaw> (Accessed on 4th August, 2020)
- [16] <https://www.businesswire.com/news/home/20190826005448/en/India-Plywood-Market-Trends-Share-Size-Growth#:~:text=The%20Indian%20plywood%20market%20reached,bonded%20together%20using%20powerful%20adhesives.&text=Owing%20to%20this%2C%20the%20market,US%24%205.7%20Billion%20by%202024> (Accessed on 5th August, 2020)

[17] <https://www.plyreporter.com/article/20197/Indian-Plywood-Industry-Battling-for-Market-Sruggling-for-Margins-Test-of-Petience-Begins> (Accessed on 5th August, 2020)

Wood based paper

[1] Annual reports of Central Pulp and Paper Research Institute, Saharanpur. 2014-15 to 2017-18. Available at: <https://www.cppri.res.in/annual-reports>

[2] <https://beeindia.gov.in/sites/default/files/Pulp-and-Paper-1-44.pdf> (accessed on 8th July, 2020)

[3] <https://www.printweek.in/news/indian-paper-industry-moving-woods-29617> (accessed on 8th July, 2020)

[4] http://www.gcpcenvs.nic.in/Thesis/Report_on_Opportunities_for_Green_Chemistry_Initiatives_in_Pulp_Paper_Industry_India.pdf (accessed on 8th July, 2020)

[5] http://www.gcpcenvs.nic.in/Thesis/Report_on_Opportunities_for_Green_Chemistry_Initiatives_in_Pulp_Paper_Industry_India.pdf (accessed on 8th July, 2020)

[6] <http://www.frienvs.nic.in/WriteReadData/UserFiles/file/ContentPage/Books/Eucalypts/Eucalypts-in-Pulp-and-Paper.pdf> (accessed on 9th July, 2020)

[7] http://www.gcpcenvs.nic.in/Thesis/Report_on_Opportunities_for_Green_Chemistry_Initiatives_in_Pulp_Paper_Industry_India.pdf (accessed on 9th July, 2020)

[8] A Report on Opportunities for Green Industry Initiatives: Pulp and Paper Industry. 2014. Published by Principal Scientific Advisor to Government of India, Vigyan Bhawan Annexe, New Delhi. Available at: http://www.gcpcenvs.nic.in/Thesis/Report_on_Opportunities_for_Green_Chemistry_Initiatives_in_Pulp_Paper_Industry_India.pdf

Furniture

[1] <https://www.businesswire.com/news/home/20190503005195/en/Indian-Furniture-Market-2019-Analysis-Outlook-2018-2023> (accessed on 15th June 2020)

[2] <https://www.indianmirror.com/indian-industries/furniture.html> (accessed on 15th June, 2020)

[3] <https://www.indianmirror.com/indian-industries/furniture.html> (accessed on 15th June 2020)

[4] https://www.ibef.org/download/Furniture_170708.pdf (accessed on 16th June, 2020)

[5] <https://stylesatlife.com/articles/wood-types-in-india-and-their-properties-and-uses/> (accessed on 17th June, 2020)

[6] https://en.wikipedia.org/wiki/List_of_Indian_timber_trees (accessed on 17th June, 2020)

[7] https://www.ibef.org/download/Furniture_170708.pdf (accessed on 16th June, 2020)

[8] <https://www.globenewswire.com/news-release/2019/06/26/1874483/0/en/India-Furniture-Market-Report-2019-2023-Un-organized-Segment-is-Dominating-the-Market.html> (accessed on 17th June, 2020)

[9] <http://www.icssrdataservice.in/datarepository/index.php/catalog/91> (accessed on 17th June, 2020)

[10] <https://www.researchandmarkets.com/reports/4326520/india-furniture-market-size-demand-opportunity> (accessed on 17th June, 2020)

- [11] <https://www.statista.com/outlook/17000000/119/furniture/india> (accessed on 18th June 2020)
- [12] <https://m.facebook.com/furniturenewsind/photos/a.117404073107484/157847882396436/?type=3> (accessed on 18th June, 2020)
- [13] <http://ficci.in/spdocument/20706/skill-Repor1.pdf> (accessed on 18th June,2020)

Handicraft

- [1] <http://www.wooden-handicrafts.com/industry-overview.htm> (accessed on 29th July, 2020)
- [2] <https://www.ibef.org/exports/handicrafts-industry-india.aspx> (accessed on 29th July,2020)
- [3] <https://business.mapsofindia.com/rural-economy/handicraft-industries/wooden.html> (accessed on 29th July,2020)
- [4] http://awsassets.wvfindia.org/downloads/report_on_survey_of_woodbased_handicraft_industry_jodhpur__rajasthan_.pdf (accessed on 29th July, 2020)
- [6] <http://www.wooden-handicrafts.com/manufacturing-regions.html> (accessed on 30th July,2020)
- [7] <https://www.indianmirror.com/crafts/cra2.html> (accessed on 30th July,2020)
- [8] https://www.business-standard.com/article/news-cm/indian-textile-handicrafts-industry-is-the-largest-employment-generator-after-agri-ajay-tamta-117110900180_1.html (accessed on 30th July, 2020)
- [9] <https://www.exhibitions Showcase.com/indian-textile-handicrafts-industry-largest-employment-generator-agri-ajay-tamta/> (accessed on 30th July, 2020)
- [10] <https://business.mapsofindia.com/rural-economy/handicraft-industries/wooden.html> (accessed on 1st August 2020)

