



8

Chapter

Bamboo Resources of the Country

8.1 INTRODUCTION

Bamboos are one of the fastest growing perennial plants in the world. They belong to the family Poaceae (Graminae) and are found in the in the tropical, sub-tropical and mild temperate regions of the world. Bamboos are distributed naturally in abundance in East and Southeast Asia and Islands of Pacific & Indian oceans. As per an FAO report (2007)¹, there are about 1,200 species in 90 genera worldwide. Distribution of bamboo is uneven and largely depends on climatic factors such as precipitation, temperature, altitude and soil conditions. Large tracts of natural bamboo forest are found in tropical Asian countries between 15° and 25° North latitudes. In India, bamboo grows naturally almost throughout the country except in Kashmir region.

¹ FAO (2007). World bamboo resources: A thematic study prepared in the framework of the Global Forest Resources Assessment. Non-wood forest products-18, Food and Agriculture Organization of the United Nations, Rome

Bamboo culms grow from the dense root rhizome system. There are two main types of rhizomes i.e. monopodial and sympodial. The former grows horizontally and the rhizome buds develop either upward, generating a culm, or horizontally with a new tract of the rhizomal net. Monopodial bamboos are non-clump forming with culms distant from each other and can be invasive. They are usually found in temperate regions and include the genera *Phyllostachys* and *Pleioblastus*. Sympodial rhizomes are short and thick, and the culms above ground are close together in a compact clump, which expands evenly around its circumference. Their natural habitat is tropical regions and they are not invasive. The main genus are *Arundinaria*, *Bambusa*, *Dendrocalamus*.

India is reportedly home to about 125 indigenous and 11 exotic species of bamboo from 23 genera. Bamboos occur in abundance in the deciduous and semi-evergreen forests of the North-eastern region of the country and the tropical moist deciduous forests of Northern and Southern India. The major bamboo genera found in India are *Arundinaria*, *Bambusa*, *Chimonobambusa*, *Dendrocalamus*, *Dinochola*, *Gigantochloa* etc. The North Eastern States and West Bengal account for more than 50 % of the bamboo resources of the country. Other bamboo rich areas of the country are the Andaman & Nicobar Islands, Chhattisgarh, Madhya Pradesh and the Western Ghats.

Bamboo contributes significantly to the social, economic & ecological development of any region. It is a universally used plant and contributes to subsistence needs of more than 2.5 billion people. Bamboos are an important component of the subsistence economy in providing livelihood to the tribals, forest dwellers and other communities. It is estimated that in India there are about 2 million traditional artisans whose livelihood depends almost entirely on harvesting, processing, value addition and selling of bamboo products such as baskets, mats, handicrafts etc. Major advantage of bamboo is its versatility in making variety of products by small entrepreneurs without any major initial investment.

FIGURE 8.1 Bamboo clump



Although, bamboo occurs in almost every State of the country, its distribution and concentration varies primarily due to the climatic and edaphic conditions. *Bambusa* and *Dendrocalamus* are the species found in tropical conditions, whereas *Arundinaria* and its associates occur in the temperate region and are common on high altitudes in the Western and Eastern Himalayas. *Dendrocalamus strictus* is the predominant species of the dry deciduous forests, while *Bambusa bambos* thrives in the moist deciduous forests. *Gigantochloa rostrata* is the most important bamboo species in the semi evergreen forests of Andaman Islands. The commercially important bamboo species of the Eastern & the north-eastern India are *Bambusa tulda*, *Dendrocalamus hamiltonii* and *Melocanna baccifera*.

Bamboo is capable of thriving in an extreme range of climatic and edaphic conditions. With its wide distribution, Bamboo also plays an important role in carbon sequestration, bio-diversity and soil moisture conservation. Their diversity in terms of size, being light yet strong, hard, straight and yet flexible, fast growth and abundance make them amenable to versatility of uses. The physical and environmental properties of bamboo make it an exceptional economic resource for a wide range of uses and for poverty alleviation. It is an important non-wood forest product used in making normal and fine quality paper, furniture, flooring, handicrafts, walking sticks, fishing poles etc. Young bamboo shoots are used as vegetables in many cuisines. Bamboo stems can be split up for use as pipes in channelling water. Raw leaves of many bamboo species are a source of fodder for cattle. The largest stems of bamboo are used as planks for houses and rafts, while both large and small stems are lashed together to form the scaffoldings at construction sites. Bamboo is therefore, called as green gold, poor man's timber, cradle to coffin timber etc.

The Government of India, in a landmark initiative, has promulgated the Indian Forest (Amendment) Ordinance, 2017 to exempt bamboo grown in non-forest areas from the definition of tree, by amending the Section 2 (7) of the Indian Forest Act 1927 and thereby dispensing with the requirement of felling/transit permit for its transport and economic use. Before this amendment, the felling and transit of bamboo grown on forest as well non-forest land attracted the provisions of the Indian Forest Act, 1927. This was a major impediment for bamboo cultivation by farmers on non-forest land. Major objective of the amendment is to promote cultivation of bamboo in non-forest areas to achieve twin objectives of increasing the income of farmers and also increasing green cover of the country.

With this background and the importance of bamboo in our day-to-day life, its assessment has been an integral part of Forest Inventory and is presented as a separate chapter in ISFRs. The data on bamboo resources are collected while carrying out the inventory of forest and TOF. Further, a comparison of bamboo bearing areas and its growing stock as compared to ISFR 2017² has also been given in this chapter.

8.2 SAMPLING DESIGN

The two stage stratified sampling design which is used for inventory of forest and TOF is also employed for the assessment of bamboo resources. The design of the first stage is same as that of both forest and TOF inventory described in the chapter on Growing Stock of this report. The second stage comprises separate designs for the inventory of forests, TOF (Rural) and TOF (Urban) which are also described in the chapter dealing with Growing stock.

² India State of Forest Report (2017), Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India

For the forest inventory under the new design, a cluster of four-circular sub-plots is the sampling unit for enumeration of trees/bamboos. A circular plot of 60 m radius around the central sub-plot is used for recording data on plot description. In this form, data of trees and bamboo clumps is recorded from all sub-plots of 8 m radius. Plot Enumeration Form for each subplot of 8 m radius is maintained separately.

8.3 DATA COLLECTION

8.3.1 Forest inventory

The information on bamboo is collected on every sample plot of the forest inventory. The information such as bamboo density, quality, flowering and regeneration is observed by the field crew and recorded in the Plot Description Form (PDF). Bamboo density is classified into nine categories namely pure bamboo, very dense, dense, moderately dense, scattered, sparse, hacked, absent and regeneration for clump forming bamboo and for non-clump forming bamboo. For determining the bamboo production capacity of a site, bamboo areas are classified into bamboo-site quality classes **on the basis of average height of culms of different bamboo species. For each enumerated bamboo clump**, information is recorded on a number of parameters like species name, diameter and crown width of the clump.

8.3.2 Bamboo Clump Analysis for Clump forming Bamboo

The information regarding total number of bamboo clumps and their respective diameters occurring in each sub-plot is recorded in the Plot Enumeration Form. The data is also collected in a separate field form called as Bamboo Clump Analysis Form in which data of each individual culm, occurring in certain selected clumps in each subplot is recorded. For carrying out this analysis, it is first determined whether a culm is green sound, green damaged, dry or dry damaged; these are then further classified as current year's culms, one to two-year-old culms and over two years old culms. In case of dry and decayed culms (both sound as well as damaged), however, the age classification is not necessary. The culms, other than that of current year and decayed culms, both green and dry, are further grouped under **different diameter classes i.e. 1 cm to under 2 cm, 2 cm to under 5 cm, 5 cm to under 8 cm and 8 cm and above.**

All culms occurring in the clump selected for analysis are enumerated and each enumerated culm is recorded by 'dot-dash' method (*dots represents counts from 1 to 4, lines 5 to 8, and diagonal lines 9 and 10*) under its appropriate class. The total number of culms found under each class is recorded in two digits.

8.3.3 Bamboo Enumeration and Analysis for Non Clump Forming Bamboo

The information is collected for non-clump forming bamboos occurring in the sample subplot 2 i.e. western half of the subplot 2. For the purpose of counting the culms, the subplot 2 is dissected by taking a bearing of 360 from the center of subplot. A rope is put on this bearing upto the point where this bearing crosses the subplot circumference in North and South direction. All culms falling in western half of north subplot are counted and categorised in five classes viz. Green Sound, Green Damaged, Dry Sound, Dry Damaged & Decayed.

These are further classified as current year's culms, one to two year old culms, over two year old culms. In case of dry (both sound as well as damaged) and decayed culms, the age classification is not necessary. The culm, other than the current years and decayed culm, both green and dry are further

grouped under diameter at breast height classes, 1 cm to under 2 cm, 2 cm to under 5 cm, 5 cm to under 8 and 8 cm and over.

8.3.4 *Bamboo Weight*

For determining correlation between green and dry weights for utilizable bamboo culm length, data is collected in 'Bamboo Weight form'. This form is, however, to be filled up for plots, in which bamboo has actually been found in an area of 60 m radius from the center of subplot 1. One mature bamboo culm from each culm diameter class 1 cm to 2 cm, 2cm to 5 cm, 5 cm to 8 cm, and 8 cm and over, is to be selected for felling from the first clump enumerated in the plot. If, however, the required number of culms of any diameter class is not available in the first clump, the shortfall is to be made good from the clump next in the serial order of enumeration. Further, if the necessary numbers of culms are not available from any other clump of the plot, the required number of culms is to be obtained from the area in the immediate vicinity of the plot.

8.3.5 *Bamboo Assessment from TOF Inventory*

As bamboo is not very common in urban areas, bamboo data is collected only from the rural areas of TOF. The information on bamboo is recorded in Plot Enumeration Form. The name of the bamboo species, the diameter of clumps and number of culms in each clump are recorded from each plot of rural inventory.

8.4 DATA PROCESSING FOR ASSESSMENT OF BAMBOO

Data processing is carried out separately for forest and TOF inventory, which is described below.

8.4.1 *Bamboo Assessment from Forest Inventory*

The data collected from more than 9,628 points surveyed during 2016-17 & 2017-18 has been used for processing. Data from five field forms namely Plot Description Form, Plot Enumeration Form, Bamboo Enumeration Form (Clump and Non-clump forming separately) and Bamboo weight form are entered in the database using data entry module developed in house. The data is checked manually and also **through computer based software and cleaned wherever necessary. Once data is cleaned, it is processed at State level through the data processing software on the basis of an area factor (per plot area) which is determined for each State depending on the number of plots falling in the RFA. Thereafter, the bamboo plots surveyed in the States are listed according to bamboo density and quality. The bamboo plots when multiplied with area factor gives the species and quality wise bamboo bearing area for that State. The information on estimated culms is classified into three categories namely green sound, dry sound and decayed. The estimated number of culms is converted into equivalent green weight using appropriate weight factors. The national level estimates are obtained by adding the estimates of all the States.**

8.4.2 *Bamboo Assessment from TOF Inventory*

The area figures for block and linear strata are obtained by digital interpretation of remote sensing data, whereas the area of scattered stratum is obtained by subtracting the area of block and linear patches from rural culturable non-forest area. Species and size class wise number of clump/ha and culms/clump is obtained for each stratum. In several States, adequate number of TOF plots having bamboo could not be found during the period of current assessment i.e. 2016 to 2018 and therefore, the estimate of State wise bamboo could not be generated. However, the number of plots having bamboo have been found sufficient to generate national level estimate which are given at the end of this chapter.

8.5 RESULTS

Bamboo resource assessment has been done for forest as well as TOF using NFI data. The bamboo resource assessment at the national level and for the States & UTs is presented in this section.

8.5.1 Bamboo Resources in Recorded Forest Areas

TABLE 8.1 Number of culms at country level by Age and Soundness in Recorded Forest Area

(in million)

| Culm Size Class | Green Sound | Dry Sound | Decayed | Total no of culms 2019 | Total culms in ISFR 2017 | change with respect to ISFR 2017 |
|-----------------|---------------|--------------|--------------|------------------------|--------------------------|----------------------------------|
| Current year* | 4,917 | NA | NA | 4,917 | 5,034 | -117 |
| 1-2 cm** | 6,280 | 2,176 | NA | 8,456 | NA | NA |
| 2-5 cm | 11,842 | 3,416 | NA | 15,258 | 14,199 | 1,059 |
| 5-8 cm | 4,470 | 939 | NA | 5,409 | 5,016 | 393 |
| 8 cm + | 1,849 | 230 | NA | 2,079 | 1,836 | 243 |
| | | | 3,335 | 3,335 | 2,018 | 1,317 |
| Total | 29,358 | 6,761 | 3,335 | 39,454 | 28,103 | 11,351 |

* size class of culms of current year are not measured

**culms of size 1-2 cm are estimated first time for ISFR 2019

The total number of culms at the national level has been estimated 39,454 million out of which the percentage of green sound, dry sound and decayed culms has been observed as 74.41%, 17.14% and 8.45% respectively. Size class 2-5 cm has contributed maximum number of culms (38.67%). The total number of culms has increased by 11,351 million as compared to the estimates of ISFR 2017.

Table 8.1 shows that the estimated number of culms has increased in all the age classes and for all the soundness classes. On an average, there is an increase of 40.39% in number of culms at country level as compared to 2017 assessment.

TABLE 8.2 Equivalent Green Weight of Bamboo at the country level by Age and Soundness in Recorded Forest Area (in '000 tonnes)

(in '000 tonnes)

| Culm Size Class | Green sound | Dry Sound | Total Green weight | Total Green weight as per ISFR 2017 | Changes w.r.t. ISFR 2017 |
|-----------------|-----------------|---------------|--------------------|-------------------------------------|--------------------------|
| 1-2 cm* | 34,391 | 26,956 | 61,347 | NA | NA |
| 2 - 5 cm | 63,658 | 38,596 | 1,02,254 | 65,947 | 36,307 |
| 5 - 8 cm | 57,823 | 22,289 | 80,112 | 69,039 | 11,073 |
| 8 + cm | 25,774 | 8,100 | 33,874 | 53,773 | -19,899 |
| Total | 1,81,646 | 95,941 | 2,77,587 | 1,88,759 | 88,828** |

*culms of size 1-2 cm are estimated first time for ISFR 2019

** it includes 61.35 million tonnes green weight of 1-2 cm culm size

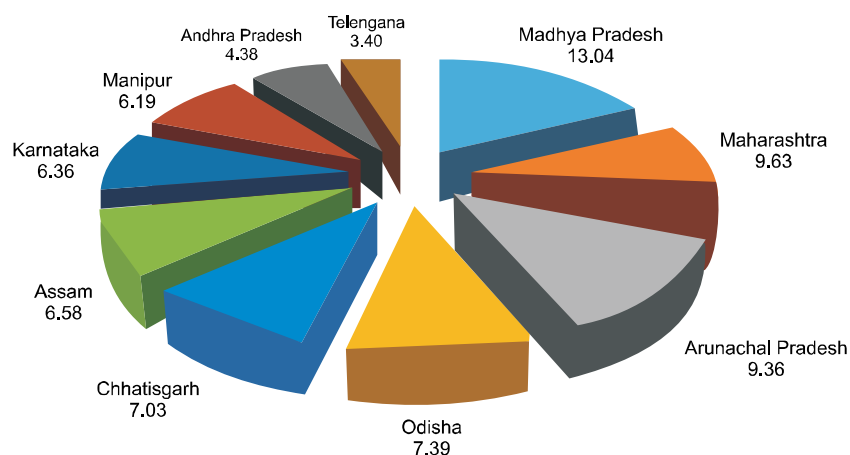
The total estimated green weight of bamboo culms at the national level is 278 million tonnes of which green sound bamboos contribute 65 % and dry sound bamboos contribute remaining 35 %. As compared to the estimate of ISFR 2017, there is an increase of about 88 million tonnes equivalent green weight of bamboo has been observed in the present assessment.

TABLE 8.3 State/UT wise Distribution of Bamboo Area in Recorded Forest Area

(in sq km)

| S. No. | State/UTs | Bamboo bearing area | Bamboo bearing area as per ISFR 2017 | Change in area with respect to ISFR 2017 |
|--------------|-------------------|---------------------|--------------------------------------|--|
| 1. | Andhra Pradesh | 7,003 | 7,578 | -575 |
| 2. | Arunachal Pradesh | 14,981 | 15,125 | -144 |
| 3. | Assam | 10,525 | 8,955 | 1,570 |
| 4. | Bihar | 1,136 | 1,004 | 132 |
| 5. | Chhattisgarh | 11,255 | 11,060 | 195 |
| 6. | Goa | 418 | 382 | 36 |
| 7. | Gujarat | 3,393 | 3,544 | -151 |
| 8. | Haryana | 72 | 21 | 51 |
| 9. | Himachal Pradesh | 650 | 540 | 110 |
| 10. | Jharkhand | 4,123 | 4,470 | -347 |
| 11. | Karnataka | 10,181 | 10,442 | -261 |
| 12. | Kerala | 2,849 | 3,484 | -635 |
| 13. | Madhya Pradesh | 20,867 | 18,167 | 2,700 |
| 14. | Maharashtra | 15,408 | 15,927 | -519 |
| 15. | Manipur | 9,903 | 10,687 | -784 |
| 16. | Meghalaya | 5,410 | 5,943 | -533 |
| 17. | Mizoram | 3,476 | 3,267 | 209 |
| 18. | Nagaland | 4,284 | 6,025 | -1,741 |
| 19. | Odisha | 11,827 | 12,109 | -282 |
| 20. | Punjab | 255 | 44 | 211 |
| 21. | Rajasthan | 1,874 | 1,976 | -102 |
| 22. | Sikkim | 1,176 | 553 | 623 |
| 23. | Tamil Nadu | 4,357 | 4,154 | 203 |
| 24. | Telangana | 5,438 | 4,778 | 660 |
| 25. | Tripura | 3,783 | 3,617 | 166 |
| 26. | Uttar Pradesh | 1,235 | 936 | 299 |
| 27. | Uttarakhand | 1,489 | 1,078 | 411 |
| 28. | West Bengal | 855 | 942 | -87 |
| 29. | A & N Islands | 1,814 | 0 | 1,814 |
| Total | | 1,60,037 | 1,56,808 | 3,229 |

Note: Information of bamboo bearing area for Chandigarh, Dadra Nagar Haveli, Daman & Diu, Delhi, Lakshadweep, J & K and Puduchery is not given due to inadequate data

FIGURE 8.2 Top ten States in terms of bamboo bearing area (%)

The total bamboo bearing area of the country has been estimated to be 16.0 m ha. Madhya Pradesh has maximum bamboo bearing area of 2.0 m ha followed by Maharashtra (1.54 m ha), Arunachal Pradesh (1.49 m ha) and Odisha (1.18 m ha). As compared to the estimates of ISFR 2017, the total bamboo bearing area in the country has increased by 0.32 m ha. Comparing change in bamboo bearing area of assessment with ISFR 2017, it has been observed that bamboo bearing area in Madhya Pradesh has shown highest increase of 0.27 m ha followed by Assam (0.16 m ha). Similarly, Nagaland has shown highest decrease of 0.17 m ha in the bamboo bearing area followed by Kerala (0.06 m ha).

TABLE 8.4 State/UT wise bamboo bearing area under different classes in Recorded Forest Area

(area in sq km)

| S. No | State/UTs | Pure Bamboo | Dense | Scattered | Bamboo present but clumps completely hacked | Regeneration crop |
|-------------------------------|-------------------|--------------|---------------|-----------------|---|-------------------|
| 1. | Andhra Pradesh | 424 | 3,180 | 2,975 | 71 | 353 |
| 2. | Arunachal Pradesh | 417 | 3,389 | 10,904 | 0 | 271 |
| 3. | Assam | 204 | 2,350 | 7,664 | 0 | 307 |
| 4. | Bihar | 0 | 121 | 975 | 40 | 0 |
| 5. | Chhattisgarh | 637 | 1,698 | 6,056 | 531 | 2,333 |
| 6. | Goa | 0 | 197 | 112 | 11 | 98 |
| 7. | Gujarat | 69 | 891 | 2,124 | 69 | 240 |
| 8. | Haryana | 0 | 24 | 48 | 0 | 0 |
| 9. | Himachal Pradesh | 150 | 200 | 250 | 0 | 50 |
| 10. | Jharkhand | 0 | 103 | 2,601 | 550 | 869 |
| 11. | Karnataka | 196 | 1,304 | 6,008 | 0 | 2,673 |
| 12. | Kerala | 141 | 563 | 1,958 | 0 | 187 |
| 13. | Madhya Pradesh | 700 | 4,358 | 12,539 | 1,167 | 2,103 |
| 14. | Maharashtra | 810 | 2,543 | 8,261 | 1,762 | 2,032 |
| 15. | Manipur | 0 | 1,383 | 6,862 | 995 | 663 |
| 16. | Meghalaya | 140 | 467 | 4,803 | 0 | 0 |
| 17. | Mizoram | 0 | 1,370 | 2,106 | 0 | 0 |
| 18. | Nagaland | 227 | 1,137 | 2,730 | 75 | 115 |
| 19. | Odisha | 56 | 1,351 | 9,788 | 407 | 225 |
| 20. | Punjab | 0 | 113 | 142 | 0 | 0 |
| 21. | Rajasthan | 0 | 215 | 547 | 550 | 562 |
| 22. | Sikkim | 141 | 94 | 894 | 0 | 47 |
| 23. | Tamil Nadu | 0 | 551 | 2,024 | 740 | 1,042 |
| 24. | Telangana | 0 | 1,683 | 2,463 | 1,292 | 0 |
| 25. | Tripura | 20 | 617 | 3,146 | 0 | 0 |
| 26. | Uttar Pradesh | 0 | 309 | 926 | 0 | 0 |
| 27. | Uttarakhand | 0 | 271 | 1,151 | 0 | 67 |
| 28. | West Bengal | 0 | 0 | 816 | 0 | 39 |
| 29. | A & N Islands | 0 | 93 | 1,266 | 0 | 455 |
| Total (2019) | | 4,332 | 30,575 | 1,02,139 | 8,260 | 14,731 |
| Total as per ISFR 2017 | | 638 | 40,503 | 91,411 | 6,485 | 17,829 |
| Changes w.r.t. ISFR 2017 | | 3,694 | -9,928 | 10,728 | 1,775 | -3,098 |

Note: Information of bamboo density for Chandigarh, Dadar Nagar Haveli, Daman & Diu, Delhi, Lakshadweep, J & K and Puducherry is not given due to inadequate data. The different classes of bamboo are defined in glossary.

Table 8.4 reveals that pure bamboo area has increased and dense bamboo area has reduced from the earlier estimates published in ISFR 2017.

On analysing the forest area of different States according to bamboo density, it has been observed that the pure bamboo brakes are found in less than 1%, dense bamboo in about 4% and scattered bamboo in about 14% of the RFA. In about 1% of the bamboo area, bamboo was present but clumps has been found completely hacked. Regeneration crop of bamboo was observed in only 2% of forest area.

Maximum occurrence of pure bamboo has been observed in Maharashtra (810 sq km) followed by Madhya Pradesh (700 sq km) and Chhattisgarh (637sq km). The area under dense bamboo has been found highest in Madhya Pradesh (4358 sq km) followed by Arunachal Pradesh (3389 sq km) and Andhra Pradesh (3180 sq km). The area with hacked bamboo clumps has been found highest in Maharashtra (1762 sq km) followed by Telangana (1292 sq km) and Madhya Pradesh (1167 sq km). Bamboo regeneration is maximum in Karnataka (2673 sq km) followed by Chhattisgarh (2333 sq km) and Madhya Pradesh (2103 sq km)

TABLE 8.5 State/UT wise number of estimated culms in Recorded Forest Area

(in million)

| S. No | State/UTs | Green Culms | Dry Culms | Decayed | Total | Total as per ISFR 2017 | Changes w.r.t. 2017 |
|--------------|-------------------|---------------|--------------|--------------|---------------|------------------------|---------------------|
| 1. | Andhra Pradesh | 1,237 | 424 | 159 | 1,820 | 1,076 | 744 |
| 2. | Arunachal Pradesh | 4,869 | 512 | 388 | 5,769 | 4,048 | 1,721 |
| 3. | Assam | 3,082 | 466 | 281 | 3,829 | 2,452 | 1,377 |
| 4. | Bihar | 221 | 25 | 1 | 247 | 353 | -106 |
| 5. | Chhattisgarh | 1,175 | 660 | 279 | 2,114 | 1,075 | 1,039 |
| 6. | Goa | 3 | 17 | 10 | 30 | 26 | 4 |
| 7. | Gujarat | 513 | 117 | 47 | 677 | 485 | 192 |
| 8. | Himachal Pradesh | 356 | 113 | 16 | 485 | 321 | 164 |
| 9. | Jharkhand | 569 | 146 | 161 | 876 | 666 | 210 |
| 10. | Karnataka | 1,305 | 454 | 151 | 1,910 | 1,166 | 744 |
| 11. | Kerala | 780 | 207 | 43 | 1,030 | 834 | 196 |
| 12. | Madhya Pradesh | 2,406 | 828 | 361 | 3,595 | 2,406 | 1,189 |
| 13. | Maharashtra | 1,979 | 718 | 274 | 2,971 | 1,816 | 1,155 |
| 14. | Manipur | 843 | 205 | 78 | 1,126 | 2,340 | -1,214 |
| 15. | Meghalaya | 1,148 | 188 | 185 | 1,521 | 1,323 | 198 |
| 16. | Mizoram | 863 | 134 | 77 | 1,074 | 716 | 358 |
| 17. | Nagaland | 2,289 | 98 | 157 | 2,544 | 1,301 | 1,243 |
| 18. | Odisha | 1,563 | 426 | 302 | 2,291 | 1,585 | 706 |
| 19. | Punjab | 9 | 1 | 1 | 11 | 6 | 5 |
| 20. | Rajasthan | 465 | 60 | 2 | 527 | 831 | -304 |
| 21. | Sikkim | 197 | 12 | 9 | 218 | 135 | 83 |
| 22. | Tamil Nadu | 575 | 283 | 88 | 946 | 777 | 169 |
| 23. | Telangana | 615 | 211 | 100 | 926 | 651 | 275 |
| 24. | Tripura | 963 | 88 | 59 | 1,110 | 797 | 313 |
| 25. | Uttar Pradesh | 155 | 75 | 6 | 236 | 175 | 61 |
| 26. | Uttarakhand | 210 | 115 | 59 | 384 | 267 | 117 |
| 27. | West Bengal | 352 | 20 | 12 | 384 | 464 | -80 |
| 28. | A & N Islands | 616 | 158 | 29 | 803 | 0 | 803 |
| Total | | 29,358 | 6,761 | 3,335 | 39,454 | 28,092 | 11,362 |

Note:1. The difference in the total number of culms from ISFR 2017 is due to that the culms of Dadar Nagar & Haveli is not included in ISFR 2019 due to inadequate area.

As per current assessment maximum number of green culms are found in Arunachal Pradesh (4869 million) followed by Assam (3082 million) and Madhya Pradesh (2406 million). Dry culms are found maximum in Madhya Pradesh (828 million) followed by Maharashtra (718 million) and Chhattisgarh (660 million). As compared to the estimates given in ISFR 2017, maximum increase in number of culms by soundness has been observed in Arunachal Pradesh (1721 million) followed by Assam (1377 million) and Nagaland (1243 million).

FIGURE 8.3 Top ten States in terms of bamboo culms (%)

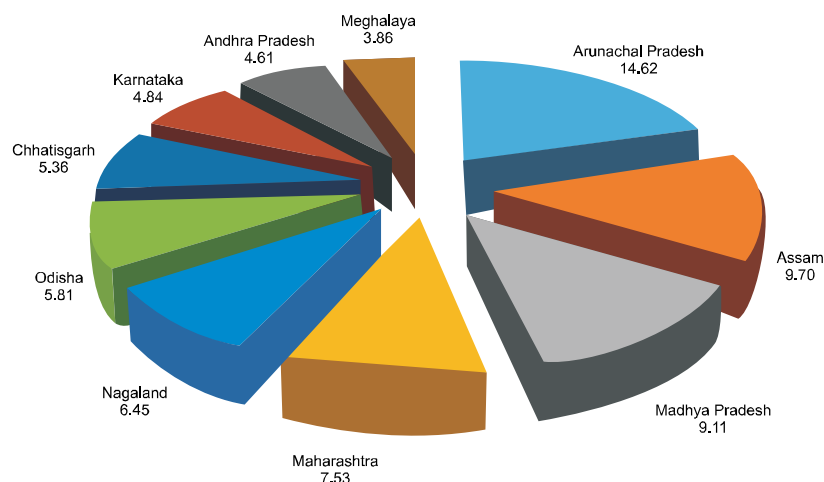


TABLE 8.6 State/UT wise Equivalent Green Weight of culms in Recorded Forest Area

(in '000 tonnes)

| S. No. | State/UTs | Green Culms | Dry Culms | Total | Total as per ISFR 2017 | Change w.r.t. ISFR 2017 |
|--------|-------------------|-------------|-----------|--------|------------------------|-------------------------|
| 1. | Andhra Pradesh | 9,702 | 6,455 | 16,157 | 9,903 | 6,254 |
| 2. | Arunachal Pradesh | 22,601 | 5,331 | 27,932 | 18,863 | 9,069 |
| 3. | Assam | 17,226 | 6,838 | 24,064 | 14,912 | 9,152 |
| 4. | Bihar | 1,544 | 278 | 1,822 | 1,692 | 130 |
| 5. | Chhattisgarh | 5,400 | 6,343 | 11,743 | 5,942 | 5,801 |
| 6. | Goa | 14 | 188 | 202 | 148 | 54 |
| 7. | Gujarat | 6,008 | 2,869 | 8,877 | 6,035 | 2,842 |
| 8. | Himachal Pradesh | 1,146 | 829 | 1,975 | 1,156 | 819 |
| 9. | Jharkhand | 2,880 | 1,693 | 4,573 | 2,520 | 2,053 |
| 10. | Karnataka | 15,423 | 11,033 | 26,456 | 16,538 | 9,918 |
| 11. | Kerala | 8,718 | 4,374 | 13,092 | 7,220 | 5,872 |
| 12. | Madhya Pradesh | 7,887 | 6,201 | 14,088 | 9,073 | 5,015 |
| 13. | Maharashtra | 13,842 | 12,673 | 26,515 | 15,879 | 10,636 |
| 14. | Manipur | 4,664 | 3,090 | 7,754 | 15,469 | -7,715 |
| 15. | Meghalaya | 8,770 | 3,553 | 12,323 | 11,462 | 861 |
| 16. | Mizoram | 6,475 | 2,337 | 8,812 | 6,217 | 2,595 |
| 17. | Nagaland | 18,678 | 1,869 | 20,547 | 11,269 | 9,278 |
| 18. | Odisha | 9,675 | 6,456 | 16,131 | 9,864 | 6,267 |
| 19. | Punjab | 34 | 13 | 47 | 27 | 20 |
| 20. | Rajasthan | 1,288 | 1,232 | 2,520 | 3,661 | -1,141 |
| 21. | Sikkim | 365 | 64 | 429 | 305 | 124 |
| 22. | Tamil Nadu | 3,068 | 4,711 | 7,779 | 6,470 | 1,309 |

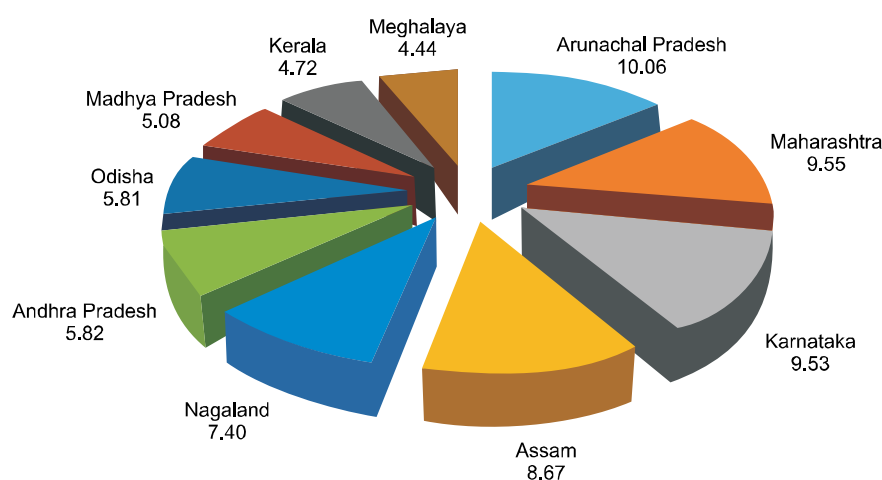
| S. No. | State/UTs | Green Culms | Dry Culms | Total | Total as per ISFR 2017 | Change w.r.t. ISFR 2017 |
|--------------|---------------|----------------|---------------|-----------------|------------------------|-------------------------|
| 23. | Telangana | 4,250 | 2,531 | 6,781 | 5,009 | 1,772 |
| 24. | Tripura | 5,053 | 1,242 | 6,295 | 6,494 | -199 |
| 25. | Uttar Pradesh | 483 | 491 | 974 | 641 | 333 |
| 26. | Uttarakhand | 580 | 810 | 1,390 | 963 | 427 |
| 27. | West Bengal | 943 | 167 | 1,110 | 948 | 162 |
| 28. | A & N Islands | 4,929 | 2,270 | 7,199 | 0 | 7,199 |
| Total | | 181,646 | 95,941 | 2,77,587 | 1,88,680 | 88,907 |

Note: The difference in the total equivalent green weight is due to that the weight of Dadra Nagar & Haveli is not included in ISFR 2019 due to inadequate data.

The table shows that weight of green culms is maximum in Arunachal Pradesh (22.6 m tonnes) followed by Nagaland (18.6 m tonnes) and Assam (17.2 m tonnes). The weight of dry culms is maximum in Maharashtra (12.67 m tonnes) followed by Karnataka (11.03 m tonnes) and Assam (6.8 m tonnes).

Maharashtra has shown maximum increase of 10.6 million tonnes in equivalent green weight as compared to the assessment given in ISFR 2017 followed by Karnataka (9.9 million tonnes) and Nagaland (9.2 million tonnes).

FIGURE 8.4 Top ten States in terms of bamboo bearing weight (%)



8.5.2 Bamboo Resources in TOF

In TOF areas, the total number of culms estimated at national level are 3,046 million with an equivalent green weight of 19.73 million tonnes. As compared to the assessment of 2017, it is observed that there is an increase of 178 million number of culms. The increase in equivalent green weight as compared to 2017 has been observed as 2.32 million tonnes. The State wise number of culms and their equivalent green weight could not be estimated due to inadequate number of sample plots with presence of bamboo in the two years period of the inventory with the new NFI design.

