# Assessment of Trees Outside Forests in Rural Region of Varanasi District in U.P.

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***Abstract—*** *A study has been undertaken to assess the number of important tree species outside forests in rural areas of district Varanasi. Varanasi is a commercial center and a consumption center for the tree based needs. The species selected were Teak, Mango, Shisham, Mahua, Neem, Aonla and Eucalyptus. These species are very common species as Trees outside Forests (ToF) in rural area of the district. Mango, Neem and Shisham are most demanded species of the region. The district Varanasi has 1277 villages, out of which 12 villages (1 %) were taken for the study. The number of trees on the basis of girth classes was recorded in selected villages of respective blocks. In case of Teak, a total of 272390 trees, in Mango species, a total of 86648 trees, a total of 53116 trees in Neem, in case of Shisham, a total of 23917trees, in Eucalyptus species, a total of 24851 trees, in case of Aonla, a total of 8795 and for Mahua, 16556 trees were enumerated in different girth classes. It was found that Mahua and Aonla trees were very less as compared to other species. Thus, introduction of these species in large areas / private land of farmer may be a viable option for minimizing demand supply gap as well as to increase the tree cover.*

***Keywords— Agroforestry, afforestation projects rural region, trees outside forests, timber and firewood species.***

## I. INTRODUCTION

In India, TOF is defined as all those trees, which has attained 10 cm or more diameter breast height, available on lands, which is not notified as forests. However, FAO defines TOF as trees available on lands which is not defined as 'forests' or 'other wooded land'. Trees outside forests (TOF) in India, mainly growing on private land, are the main source of wood in the country for industry and domestic wood-fuel[1]. These are attracting attention in view of pressure mounting on the existing forests due to increasing population and resource consumption[2]. Unlike forests, TOF are present on all non-forest lands in varying densities and configurations, which makes them a resource rather than an area category[3.] Agroforestry, one of the categorizations under trees outside forests, has immense potential in meeting day-to-day needs and food security of rural population. Trees outside forests are predicted to have a huge role in combating climate change. It is estimated that over 90% of total wood availability for domestic and industrial use now comes from non-forest areas especially from the farm land and some from imports[4.] Trees outside forests occur in natural and in cultivated landscapes and serve in a number of ecological and economic functions [5.] Trees and other woody plants in the landscape serve also important ecological functions, particularly for the conservation of biodiversity, offering shelter and food, and nesting sites [6]; other ecological functions are erosion control, water protection and carbon sequestration. India with its diverse bio-geographical zone and varied agro-climatic conditions presents a unique scenario for the growth of tree species in varying situations. The Trees Outside Forests (TOF) refers to trees on land not defined as forest or other wooded land and generally include trees on farmlands, in cities and human settlements, orchards, roadsides, pastures, banks of river, streams and canals and as shelterbelts which are less than 20m wide and 0.5 ha area [7.] It is now being increasingly argued that the role of TOF in providing food, wood and fuel to rural masses, carbon sequestration, prevention of soil erosion, biodiversity conservation, checking desertification, establishment of wildlife corridors and microclimatic stabilization, is quite substantial[8.] The share of wood energy from non-forest land used for cooking in rural India is 59% while that of biomass energy is 90%[9]. In another study[10], estimated that of the total fuel-wood requirement in India in 1996 (201 Mt), 51% (103 Mt) came from forestlands while the remaining 49% (98 Mt) came from non-forest lands.

Today, Indian agriculture faces diverse challenges and constraints due to growing demographic pressure, increasing food, feed and fodder needs, natural resource degradation and climate change[11]. TOF confined to agricultural lands include tree resources which grow in grasslands and meadows (windbreaks, scattered trees, woodlots, and other silvi- pastoral systems), in amalgamation with annual crops on agricultural fields (cocoa, coffee, and other systems), and trees grown in orchards or along water bodies and permanent crop systems[12]. Therefore, a management system needs to be devised that is capable of producing food from marginal agricultural land and is also capable of maintaining and improving quality of producing environment[13]. Agroforestry system is one of the best known traditional practices and has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risks[14], but there are several challenges that reap the benefits of agroforestry in India. The current area under agroforestry in India is estimated as 25.31 million hectares or 8.2 percent of the total reporting geographical area of the country by[11,15,16]. As the population of India is increasing at a very fast rate; the land-holding size of farmers shrink at a very fast rate and agroforestry is the only way to optimize the farm productivity (National Agroforestry Policy, 2014). It is generally well known that status of agroforestry in districts of Eastern plain region of Uttar Pradesh is in developing stage.

India's present forest policy envisages that one third of its geographical area should be covered under forest and plantation. In the state of Uttar Pradesh only 9.20 % (6.15 % forest and 3.05 % Tree cover outside forests) area is covered with trees. The sustainable availability of timber trees in the region of Eastern UP, especially in gangetic plain region is a challenging task. Only 1.11 % forest is in the Varanasi district including tree cover[17]. Thus, present study aims at collecting status of important tree species outside forests (TOFs) in rural areas of the Varanasi district of Eastern Uttar Pradesh with a view to assess the availability of these Trees Outside Forests (TOF) to promote and guide the selection of these species in afforestation programmes by various agencies as well as by local people. This information may be helpful in selection of species while formulating afforestation programmes of U.P. The careful selection of these species in plantations by local people and various agencies will lead to sustainable availability of these species on long term basis.

## II. EXPERIMENTAL METHODS

### 2.1 Study Area

Varanasi is situated in the agro- climatic zone of eastern plain region of Uttar Pradesh, bordering the districts of Jaunpur in the North, Ghazipur in the North East, Chandauli in the East, Mairzapur in the South and Sant Ravidasnagar in the West. The total area of the district is 1535 sq. km, supporting of population of 31.48 lakh persons. This district is densely populated, with 2063 persons per sq. km, as against the state average of 689 persons per sq. km. The urban agglomeration is stretched between 82° 56'E – 83° 03'E and 25° 14'N – 25° 23.5'N. It is located in the middle Ganges valley of North India, along the left crescent-shaped bank of the river Ganges. The river system consists of the mighty Ganga highly revered by Hindus since ages and Gomti, Varuna, Assi, Banganga, Chandra Prabha and Karmnasa are tributaries of the Ganga that drain the area. Being located in the Indo-gangetic plains of North India, the land is very fertile because low level floods in the Ganges continually replenish the soil. There are three main tahsil in Varanasi district. First one is Varanasi, second one is Pindra and another is Rajatalab. There are eight block in Varanasi district. Out of these, there are 03 blocks in Varanasi tahsil namely Chiraigaon, Cholapur and KashiVidyapeeth and partially Harhua and 03 blocks are in Rajatalab tahsil namely Sewapuri, Arajiline and partially Kashi Vidyapeeth and 03 blocks in Pindra tahsil namely Baragaon, Pindra and partially Harhua.

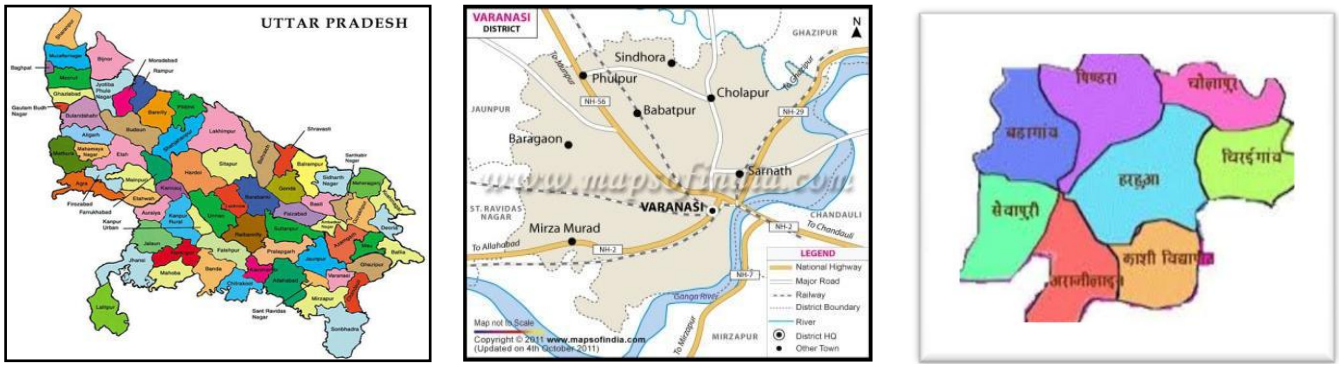



**FIGURE 1: Map of Uttar Pradesh and Varanasi district**

A study on assessment of important trees outside forests in villages of district Varanasi was conducted in the year 2018-2019. The species selected were Teak (*Tectona grandis*), Shisham (*Dalbergia sissoo*) Mango (*Mangifera indica*), Neem (*Azadirachta indica*), Eucalyptus (*Eucalyptus sp.*),Mahua (*Madhuca longifolia*) and Aonla (*Phyllanthus emblica*). There are 8 developmental blocks in the district and 1277 villages. A total of 1% villages were randomly selected for the study. The methodology adopted for conducting the survey was stratified random sampling to selected villages in respective tehsils. The species wise number of trees on the basis of girth class was recorded in selected villages of respective blocks.

### 2.2 Sampling Method, Tools And Techniques

1. A questionnaire was prepared and data sheets were field tested in a village. After the field-testing, the necessary changes were added and the data sheets were finalized for collecting information from the study sites. On structured questionnaire, girth class wise recording of trees has been done for selected species.
2. The villagers were assembled in a place as primary school, temple, panchayat etc. and they were asked questions regarding the selected trees that are existing in their village especially on farm bunds, village road side, pond side, homesteads and other locations too. By PRA technique, the villagers were asked to come along with the researchers using transect method for physical verification of species wise trees in the field. In large plantation patches, sampling method was done for recording of data.

### 2.3 Observations and Calculations

The fieldwork was carried out as per the questionnaire in the selected areas. The observations were grouped on the basis of the 8 block of the district covering 1% of the total villages. In all 8 block, species wise no. of trees were tabulated in respective girth classes *viz.* 0-30, 31-60, 61-90, 91-120, 121-150, 151-180, 181-210, 211-240, 241-270 and 271-300 cm. After combining data of all 8 blocks, the number of TOFs per unit village in rural area of district was assessed. On the basis of per unit village data, assessment for whole rural area of the district has been done for species wise total number of trees. The percent contribution of trees in each girth class was also estimated for respective species[18].

## III. RESULTS AND DISCUSSION

The tree species selected for the study were very common as Trees Outside Forests (TOFs) in rural area of Varanasi district. *Mangifera indica, Tectona grandis, Azadirachta indica* and *Dalbergia sissoo* were most demanded species of the region. The total enumerated tree species with respective girth classes in the district has been depicted in Table 1 and Fig. 2 & 3. The results clearly depicted complete picture of enumerated trees of selected species in the villages of different blocks of Varanasi district. The most common tree species of the district included Teak (272390), Mango (86648), Shisham (23917) and Neem (53116), Eucalyptus (24851), Mahua (16556) and Aonla (8795) in different girth classes (Fig. 2).

Maximum Teak trees were found 46.39 % in 31-60 cm girth class, 21.18 % are in 0-30 cm and 24.65 % tree were in 61-90 cm girth class which comes under immature category of timber. Only 7.42 % of the trees and 0.35 % of trees were found in mature category of 91-120 cm and 121-150 cm girth class respectively. It clearly shows that despite of huge demand of Teak wood, its supply position is very limited. Hence, it carries a premium on its price. In present scenario, though its plantation is popular among farmers under agroforestry but more attention is required to be paid to enhance its acceptability by farmers for undertaking extensive plantation. Shisham was found 12.41 % in 0-30 cm, 23.15 % are in 31-60 cm, 37.39 % in 61-90 cm, 20.85 % in 91-120 cm and 6.20 % in 121-150 cm girth class. The results clearly depicted that Shisham plantation is being taken up by the farmers on a regular basis during past years and its girth class distribution is a balanced one. It is second to Teak for timber value in popularity among farmers but farmers are not taking up its plantations in large numbers due to its mortality in water logged conditions.

In case of Mango, 5.80 % trees are in 0-30 cm girth class, 11.32 % are in 31-60 cm, 12.98 % in 61-90 cm, 11.90 % in 91-120 cm, 8.23 % in 121-150 cm, 16.20 % in 151-180 cm, 9.75 % in 181-210 cm, 6.16 % in 211-240 cm, 11.73 % in 241-270 cm and 4.93 % in 271-300 cm girth class. The girth class distribution of Mango is very much wide and villagers are not taking up its plantations in large numbers. The young plantations are of mostly ‘Kalmi’ varieties which cater to the fruit value for

commercial purposes while 'Biju' variety catered to the more fruit value for down trodden, timber, firewood and other intangible benefits. Out of total Neem trees, 21.57 % trees were in 0-30 cm girth class, 19.14 % in 31-60 cm, 26.44 % in 61-90 cm, 19.54 % in 91-120 cm, 9.48 % in 121-150 cm, 0.69% in 151-180 cm girth class. It is clear from the data that young plantations of Neem are not being adopted by the farmers. Out of total Neem trees, 9.54 % trees were in 0-30 cm girth class, 20.49 % in 31-60 cm, 18.46 % in 61-90 cm, 20.81 % in 91-120 cm, 14.28 % in 121-150 cm, 7.11% in 151-180 cm girth classes and other girth classes were in less than 4 % range. It is clear from the data that young plantations of Neem are not being adopted by the farmers.

For Eucalyptus, 18.19 % are found in 0-30 cm girth class, merely 14.63 % in 31-60 cm, 24.15 % in 61-90 cm, 25.54 % in 91-120 cm, 9.78 % in 121-150 cm, 4.41 % in 151-180 cm and 3.30 % in 181-210 cm. girth class. The status of Eucalyptus is very critical in the district. Thus, to maintain sustainable availability of the species in future, its young plantation should be taken up. Likewise, in case of Aonla, 26.10 % trees are in 0-30 cm girth class, 40.04 % in 31-60 cm, 31.39 % in 61-90 cm, and 2.47 % in 91-120 cm. This has created more pressure for fuel wood on timber and fruit species. Its large scale plantation should be taken up.

For Mahua, 0.86 % trees are found in 0-30 cm. girth class, 10.65 % are in 31-60 cm, 9.89 % trees are in 61-90 cm, 11.27 % are in 91-120 cm, 3.66 % trees are in 121-150 cm, 13.95 % in 151-180 cm, 9.31 % in 181-210 cm, 9.65 % in 211-240 cm, 15.51 % in 241-270 cm and 15.25 % in 271- 300 cm. girth class. The girth class distribution of Mahua is very much wide and young plantations are not taking up by the villagers. Mostly trees of Mahua were in old age results also an important species of timber found rare in villages. Majority of the farmers have adopted Teak on their farm bunds as agroforestry species. Most of the Teak trees are too young to be harvested. It is clear from tree enumeration studies that young plantations of Mango, Neem, Mahua and Shisham were less.

In other species category, assessed tree species were Jamun (*Syzygium cumini*), Babool (*Acacia nilotica*), Pani gambhar (*Gmelina arborea*), Kathal (*Artocarpus heterophyllus*), Arjun (*Terminalia arjuna*), Ashok (*Saraca asoka*), and Karanj (*Pongamia pinnata*). These species were not able to fulfill the requirement of wood, but somewhere the amount of firewood used in the daily life of the people was reducing. These species were scattered on the village fallow land and roadside. The total no. of trees come in this category were 65170 and farmers have not adopted such trees with agricultural crops or under agroforestry. A total of 22.40 % plants of this category were under 0-30 cm girth class and 15.15% under 31-60 cm girth class, 17.33% trees in 61-90 cm and 15.77% trees in 91-120 cm. girth class and other girth classes were in less than 15 % range.

**TABLE 1**
**GIRTH CLASS-WISE NUMBER OF TREE SPECIES IN VARANASI DISTRICT**

| S. No. | Girth class (cm) | Teak | Shisham | Mahua | Eucalyptus | Aonla | Mango | Neem | Others |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0-30 | 57679 | 2968 | 143 | 4521 | 2296 | 5031 | 5066 | 14604 |
| 2 | 31-60 | 126335 | 5537 | 1762 | 3635 | 3522 | 11548 | 10882 | 9879 |
| 3 | 61-90 | 67168 | 8941 | 1638 | 6002 | 2760 | 11243 | 9809 | 11296 |
| 4 | 91-120 | 20228 | 4986 | 1866 | 6346 | 217 | 9438 | 11048 | 10279 |
| 5 | 121-150 | 980 | 1485 | 605 | 2429 | 0 | 7134 | 7586 | 3260 |
| 6 | 151-180 | 0 | 00 | 2308 | 1096 | 0 | 14043 | 3781 | 3680 |
| 7 | 181-210 | 0 | 00 | 1542 | 822 | 0 | 8447 | 1642 | 8187 |
| 8 | 211-240 | 0 | 0 | 1597 | 0 | 0 | 5340 | 515 | 2707 |
| 9 | 241-270 | 0 | 0 | 2569 | 0 | 0 | 10165 | 2117 | 1190 |
| 10 | 271-300 | 0 | 0 | 2526 | 0 | 0 | 4259 | 670 | 88 |
| **Total no. of trees** | | 272390 | 23917 | 16556 | 24851 | 8795 | 86648 | 53116 | 65170 |

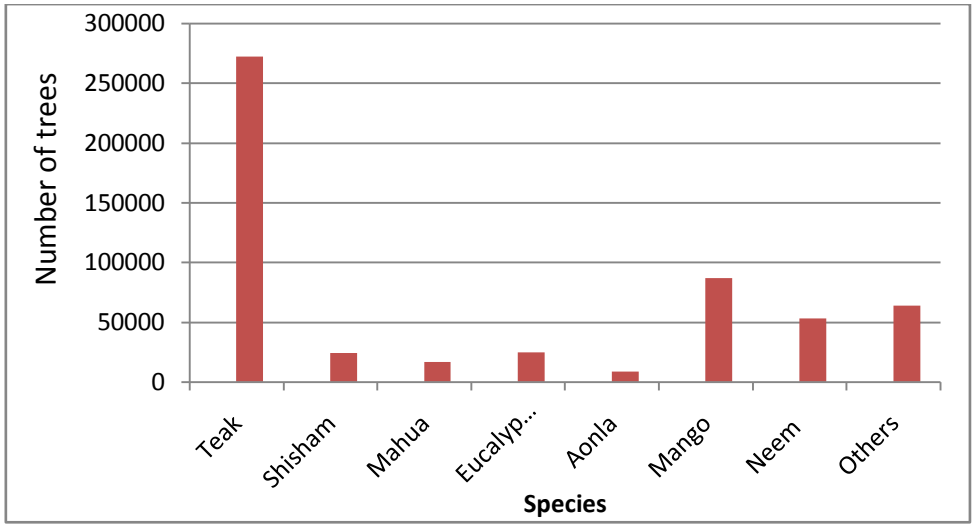
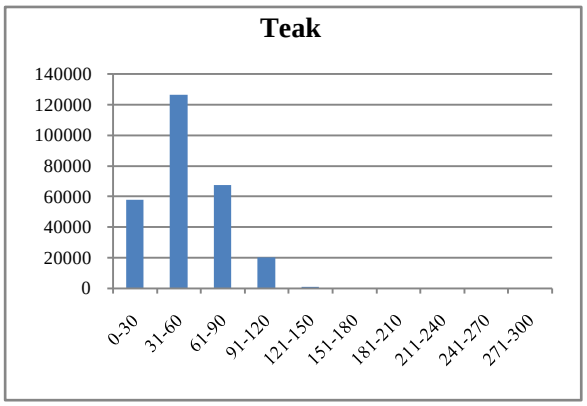
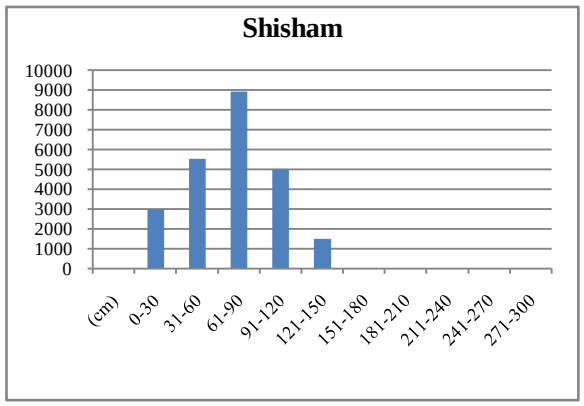
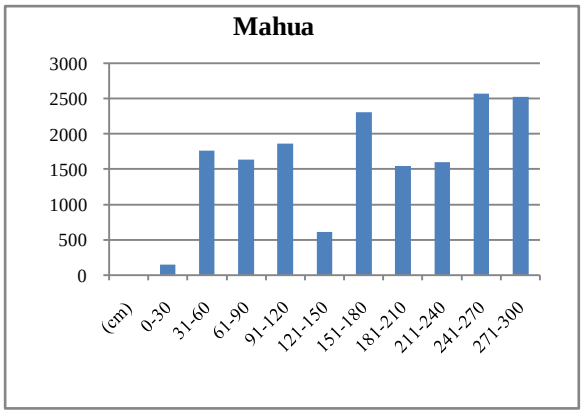
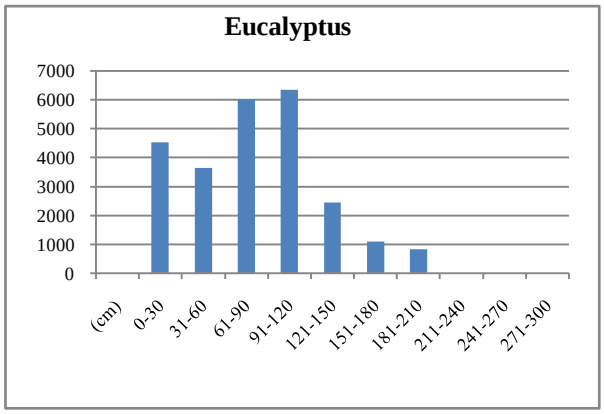


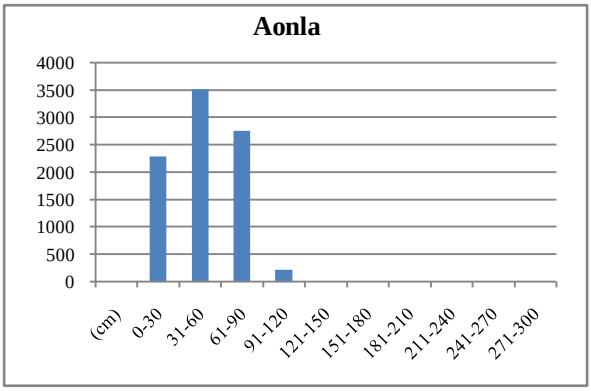

**FIGURE 2: Species wise total no. of trees in Varanasi district**

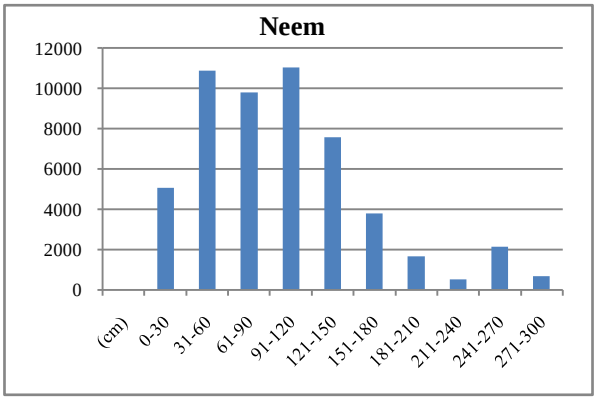


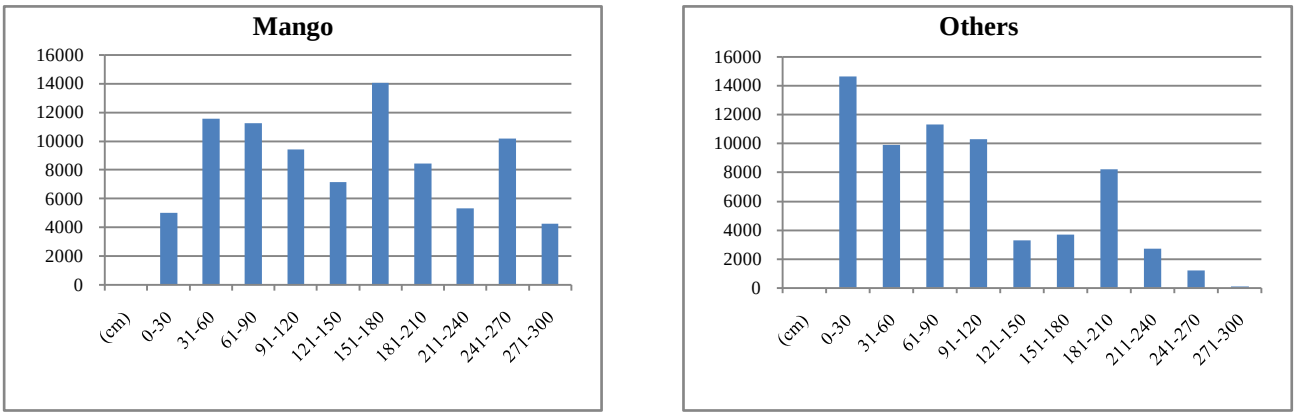



**FIGURE 3: Girth - class wise availability of different tree species in Varanasi district**

As discussed, the living condition of the surveyed area was very poor. People only consume need based requirements of timber as well as fire wood. They prefer to buy readymade timber articles from the market. In case of consumption of own trees, people sell these trees through contractor or middlemen. Firewood requirement is also in good quantity because alternative sources of energy as gas, stove, cow dung cakes, heater etc. are limited up to a specific class of people. People prefer to buy firewood, kerosene etc. For firewood mostly availability in the market is for mango, Shisham, Neem and Babool. Thinning of trees and market purchase fulfills day to day needs of farmers for firewood.

Mango, Mahua, Teak and Neem were most demanded species for timber. In Varanasi district, demand supply gap is high. The existing trees in 0-30 cm girth class are less for most of the species and needs to be planted in agroforestry and other afforestation programmes. The scenario in Varanasi district has improved much in last ten years. The matured trees of demanded species are also very less in the district. The tree harvesting and sale methods of timber were not much known to villagers and needed to be extended during future extension and trainings. At present, Teak is most demanded timber species besides Mango and Neem. Actually, deshi trees of Mango are very less in villages and for timber it is demanded but for fruits, purposes, kalmi variety is in more demand. The systematic planting of trees on bunds / blocks were less. In district Varanasi, great demand supply gap exists for most of the tree species. The availability of quality planting material, maintenance and management of plantations and sale of timber produce with good returns were major hurdles in the way of success in adoption of agroforestry in Varanasi district.

It is clear that Farmers have common practice to integrate crops, trees, and livestock to solve the problem of acute shortage of fuel, fodder and other goods[19]. The farmers have little opportunities to select the tree species, and therefore, they accept whatever is available on their land [20]. The various problems and constraints of agroforestry can be overcome through policy and institutional reforms[21]. Moreover, there is deficiency in the understanding of biophysical concerns correlated with productivity, water-resource sharing, soil productivity, and plant interactions in agroforestry systems, since most of the research is site-specific, observational in nature, and not process-oriented[22.] The promotion of sustainable agroforestry practices on a large scale in future is only possible through amalgamation of proactive farmer policies of government, involvement of the industries, support services from NGOs and willingness of farmers[23] for improvement in status of TOFs. Extension services are important for smooth dissemination of research results on the different aspect of agroforestry but research results on agroforestry, available in the public and private domain do not regularly reach the farmers due to lack of a proper or dedicated extension system. Also, Farmers with major land holdings will get more benefit by the agroforestry related schemes than the small and marginal farmers. So there is need to introduce special programs on agroforestry models for marginal and small farmers because 2/3rd farmers of Indian farmers are small and marginal farmers[24].

## IV. CONCLUSION

The systematic pattern in tree planting needs to be improved for the region. The extension and training programmes regarding selection of species, tree planting pattern, nursery raising, quality planting material, maintenance and management of plantations and most importantly, the marketing of trees as end produce. In marketing or sale of trees, transit and felling permit to be issued by forest department is very important. The unawareness of rules and fear of administration discourages farmers for adopting agroforestry widely at large level in this region. It is now urgent need of time to adopt tree plantations in massive way in districts of Eastern Plain zone to achieve our national target of forest policy. Agroforestry adoption with suitable species of economic value will improve country's forest and tree cover to the 33%. The foresters, researches, NGOs

and tree growers & traders are needed to be coordinated on a common platform for successful implementation of agroforestry programme on massive level. Further, to enhance the efforts of farmers, sale of end products should be strengthened with the involvement of project planners and wood based industries.

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