

Evaluation of demand supply gap of agroforestry species in Vindhyan region of U. P., India

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Abstract

Agroforestry presents a viable solution for growing trees on available land through block or boundary plantations, thereby alleviating pressure on forests for tree-based resources needed in everyday life. In Uttar Pradesh, only 6.24 % area is covered with forests against national target of 33.0%. The present study aims to gather information regarding the demand-supply gap of important agroforestry timber tree species in Vindhyan region of Eastern Uttar Pradesh. It was depicted from results that, highest demand supply gap was found in Prayagraj, followed by Sonbhadra and Mirzapur districts in Vindhyan region. Out of total demand supply gap of nine assessed species in Vindhyan region, highest contribution was for *Mangifera indica* (26.42 %), followed by *Tectona grandis* (18.47 %), *Azadirachta indica* (14.13 %), *Dalbergia sissoo* (10.21%), *Eucalyptus sp.* (10.36 %) and *Madhuca indica* (8.43 %). For other three species, it was between 3-6 %. The results indicated that suitable species may be selected in afforestation programmes of respective districts of Vindhyan region for sustainable availability of species.

Keywords: Vindhyan region, timber, tree species, demand supply gap, afforestation

Introduction

As estimated 1.6 billion people, or 25% of the global population, rely on forests for their subsistence needs, livelihoods, employment, and income (UN General Assembly, 2017) [23]. Alternative energy sources have been developed, yet wood energy remains a primary source for domestic use. Agroforestry presents a viable solution for growing trees on available land through block or boundary plantations, thereby alleviating pressure on forests for tree-based resources needed in everyday life. Wood biomass contributes 14% to the world's energy supply and accounts for 38% in developing countries (Dagar *et al.*, 2014) [5]. According to the latest report from Forest Survey of India (FSI, 2023) [8], only 6.24 % area is covered with forests in Uttar Pradesh against national target of 33 %.

In India, the wood-based sector contributes significantly to the rural economy and offers both seasonal and long-term employment to the urban population (Kant and Nautiyal, 2021) [10]. It is estimated that over 90% of the total wood available for domestic and commercial use comes from non-forest areas, primarily from farmlands, with some wood sourced from imports (Dhiman, 2011) [6]. In Eastern Uttar Pradesh, however, the forest cover is minimal and mostly consists of small woodlots and plantations. The farmers in this area are mostly marginal and rely heavily on the market for their daily needs for wood, including timber and firewood. Unfortunately, important tree species are present in negligible numbers in the villages. Therefore, assessing the demand-supply gap for selected species and TOFs in rural areas is crucial for identifying species that are in

deficit (Kaur and Mittal 2020) [11]. The forest cover in the regions of Prayagraj, Mirzapur and Sonbhadra is 3.03%, 16.73% and 34.87% respectively (FSI, 2023) [8]. The present study aims to gather information regarding demand-supply gap of timber of important agroforestry tree species in rural region of three districts- Prayagraj, Mirzapur and Sonbhadra located in Vindhyan region of Eastern Uttar Pradesh.

Material and Methods

Study Area: Vindhyan region: The Vindhyan region of Uttar Pradesh lies between 22° 45' to 24° 34' North latitude and 82° E to 83° 23' East longitude. The forest of Vindhyan region consists of tropical dry deciduous type. The rainfall varies from 1200-3720 mm in July-August. The Vindhyan region consists of the Vindhyan plateau and hills in the state. The topography consists mainly of plateau lands but has lot of local variations too. The soil of this region has red lateritic soils with often-pronounced nodules locally called "Murrum". Vindhyan region was with dense forests, but now depletion of this resources is increasing very fast due to developmental activities, agricultural land expansion and, of course, spurt in forest offences, like-illicit felling, encroachment, poaching etc. Factors, like- abiotic and edaphic, have also played a key role in determining and also restraining the growth of plant species in this area.

The selective agroforestry tree species of timber and firewood value were screened which were also economically important for farmers, *viz.* *Dalbergia sissoo* (Shisham), *Acacia nilotica* (Babool), *Mangifera indica* (Mango), *Azadirachta indica* (Neem), *Madhuca indica* (Mahua),

Eucalyptus sp. (Safeda), *Poplar sp.* (Poplar), *Tectona grandis* (Teak) and *Artocarpus heterophyllus* (Kathal) were selected for the study.

The districts Mirzapur, Sonbhadra and Prayagraj, located in Vindhyaal Region (Zone-9) were in study area. List of villages in respective districts were compiled from population census records of U.P. One percent villages selected in each district- Prayagraj, Mirzapur and Sonbhadra, through purposive random sampling representing each block (with high population and tree growers). A total of 10 households of each selected village following stratified random sampling (Progressive - 04, Medium -03 and Lower -03) were taken. The demand and supply of selected species and socio-economic studies were conducted for villages of selected districts in their respective blocks.

The data were collected through structured questionnaire for demand supply gap of screened agroforestry species in selected villages. After preliminary field survey, the necessary changes were added to the questionnaire for collecting information on demand and supply position for selected tree species from the study sites. By Participatory Rural Appraisal (PRA) technique, villagers were asked questions regarding demand and supply position of selected species for their day-to-day timber needs.

The calculation of demand position was done for all selected species and supply position was assessed with availability of existing trees. The demand-supply gap of timber (cft) was assessed for each species. The fieldwork was carried out as per the questionnaire in the selected areas. The observations were grouped on the basis of the development blocks of the districts covering selected villages (Cochrein, 1977; Manhas *et al.*, 2006; Explorable.com, 2009; Kothri, 2012; National Statistical Office (NSO); Anand *et al.*, 2016) [1, 3, 7, 12, 15].

Results and Discussion

The Table 1, 2, 3 & 4 (i-ix) and Fig. 1 & 2 depicts blocks - district wise demand-supply gap status of timber for studied species in the selected villages of the respective districts *viz.* Prayagraj, Mirzapur and Sonbhadra. Table 4 (i) showed that for Teak, highest demand supply gap was in Prayagraj (785325 cft) followed by Sonbhadra (194650 cft) and Mirzapur (162800 cft). The demand of Teak was more in urban area as compared to the rural region. For Shisham (Table 4-ii), highest gap was depicted in Prayagraj with 333715 cft, followed by Mirzapur with 150420 cft and Sonbhadra with 147740 cft. Likewise, Table 4 (iii) showed that for Mango, the gap was again highest in Prayagraj (807404 cft) followed by Sonbhadra (450970 cft) and Mirzapur (376250 cft). In case of Neem (Table 4-iv.), highest demand supply gap was recorded in Prayagraj with 410720 cft followed by Sonbhadra 243910 cft, followed by Mirzapur 219300 cft. In case of Babool (Table 4-v), highest demand supply gap was in Prayagraj with 132975 cft, followed by Sonbhadra district with 129080 cft and Mirzapur with 78140 cft. For Kathal (Table 4-vi) highest demand supply was again in Prayagraj with 126538 cft,

followed by Mirzapur 48210 cft and Sonbhadra with 41930 cft. In case of Mahua (Table 4-vii) the demand supply gap was highest in Prayagraj with 316346 cft followed by Mirzapur 104350 cft and Sonbhadra 101140 cft. In case of Poplar (Table 4-viii) the demand supply gap was assessed in Prayagraj district with 184345 cft. In Mirzapur and Sonbhadra districts, this gap could not be assessed as farmers were not much aware about the uses and plantation techniques of this species. In case of Eucalyptus (Table 4-ix) this gap was highest in Prayagraj district with 340001 cft, followed by Mirzapur with 153400 cft and Sonbhadra with 147430 cft.

Out of total demand supply gap (3437369 cft) of timber for all nine species in Prayagraj district, it was assessed that highest gap was for Mango (23.49%) followed by Teak (22.85%), Neem (11.95%), Eucalyptus (9.89%), Shisham (9.71%), Mahua (9.20%) and others in range of 3-6% only. The data clearly shows that in Prayagraj district, Mango, Teak and Neem are highly demanded species. Similarly, in Mirzapur district, out of total gap of 1292870 cft, the maximum gap was for Mango (29.10%) followed by Neem (16.96%), Teak (12.59%), Eucalyptus (11.87%), Shisham (11.63%) and Mahua with 8.07%. In case of Sonbhadra, total demand supply gap was 1456850 cft for all nine species. The results depicted that highest gap was for Mango with 30.96% followed by Neem (16.74%), Teak (13.36%), Shisham (10.14%) and Eucalyptus (10.12%) (Table 4 & Fig. 3, 4).

It was depicted from data (Fig. 4) that for most of the studied species, highest demand supply gap was found in Prayagraj, followed by Sonbhadra and Mirzapur districts in Vindhyan region. Out of total demand supply gap of nine assessed species in Vindhyan region, highest contribution was for Mango (26.42%), followed by Teak (18.47%), Neem (14.13%), Shisham (10.21%), Eucalyptus (10.36%) and Mahua (8.43%). For other three species, it was between 3-6%. It was assessed that villagers were unaware about tree planting techniques and efforts of implementing agency for agroforestry plantations were not encouraging. The reason behind over highest demand of Mango is, that it is affordable timber for all income groups. But now, availability of desi variety (for timber purpose) of Mango trees are reducing because farmers preferred planting of kalmi variety of Mango in their orchards. Thus, massive plantation of desi variety of Mango is urgent need of time. Shisham is preferred wood of farmers, but due to increased mortality and less planting have increased its demand. Likewise, Mahua is a slow growing species and is demanded by farmers for door and window making works but less plantation of this species has created its great demand. Teak, which is valuable timber is most demanded in the area for its quality and less availability in the region. The results indicated that suitable species may be selected in afforestation programmes of respective developmental blocks in the district for sustainable availability of species in the future.

Table 1: Annual demand supply gap of timber of selected species (cft) in district Prayagraj

S. No.	1	2	3	4	5	6	7	8	9	
Species	Teak	Shisham	Mango	Neem	Babool	Kathal	Mahua	Poplar	Eucalyptu	Total
Kaurihar	17260	13832	30150	20896	5892	3762	14024	7950	14794	128560
Holagarh	22550	17640	35400	19080	4830	6728	14710	10350	7332	138620
Mauaima	11400	9080	48120	18630	5580	1600	6950	15430	8740	125530
Soraon	17106	20738	28448	21896	5010	9168	11228	5005	12989	131588
Shringverpur Dham	6498	8308	33580	6902	2000	2958	6216	8000	15760	90222
Bhagwatpur	8908	11662	20402	6026	3018	1679	4696	6800	14954	78145
Bahariya	22220	16430	45400	21830	2110	1403	20160	7850	22540	159943
Phulpur	15074	13270	56888	6510	3090	1322	11812	9150	9766	126882
Bahadurpur	17882	15594	64312	15982	13000	7619	13672	9560	29212	186833
Sahson	16027	18916	14454	11409	3919	2882	27586	5500	8407	109100
Pratappur	7344	13424	22912	8128	3000	1478	5200	7830	8908	78224
Saidabad	19947	16465	56210	22858	7400	14471	13252	14290	23865	188758
Dhanupur	20085	23030	47460	26646	2000	6021	11900	10100	23455	170697
Handia	25362	19992	29788	21904	4000	5358	16424	7210	15286	145324
Jasra	15350	13300	24105	9775	2000	7912	13287	6790	14944	107463
Shankargah	6732	11562	13330	8196	2153	7450	6839	4800	14414	75476
Chaka	8994	6303	19093	8897	3073	5061	8510	2860	6665	69456
Karchhana	9074	7184	19712	7330	8000	4618	9310	6900	14065	86193
Kaundhiara	13110	5440	23440	10010	6000	1928	7000	7690	12320	86938
Uruwa	15002	5810	16380	11000	8000	3260	3230	6650	12380	81712
Meja	12000	9150	23250	9005	6000	6140	3160	3400	13115	85220
Manda	18000	12640	14620	11900	6000	9420	10600	5300	10020	98500
Koraon	19950	11535	27100	23840	9000	4600	9820	2300	10960	119105
Sadar	439450	32410	92850	82070	17900	9700	66760	12630	15110	768880
Total	785325	333715	807404	410720	132975	126538	316346	184345	340001	3437369
Mean	32721.88	13904.79	33641.83	17113.33	5540.63	5272.42	13181.08	7681.04	14166.71	143223.71
± SD	±86796.3	±6256.8	±19308.0	±15334.8	±3777.7	±3350.1	±12689.8	±3276.9	±5642.9	±137888.8

Table 2: Annual demand supply gap of timber of selected species (cft) in district Mirzapur

S. No.	1	2	3	4	5	6	7	8	
Species	Teak	Shisham	Mango	Neem	Babool	Kathal	Mahua	Eucalyptus	Total
Chhanbey	11180	13910	28530	15380	6210	1800	6940	13640	97590
Kon	5010	6540	21140	10640	4030	2440	2960	7360	60120
Majhgawan	9130	9520	24090	16320	4500	1230	4760	6830	76380
City	14670	17090	45050	29250	5000	8080	10300	15540	144980
Pahari	7550	10210	28420	9000	5250	1730	7180	10740	80080
Patehra	5510	8400	26280	6870	3100	2620	6200	7530	66510
Hallia	17410	14470	34170	21660	7050	2790	6960	9590	114100
Lalganj	4400	7170	23180	12670	6210	2000	8130	10860	74620
Jamalpur	6400	10970	32600	18010	8600	3560	8640	12070	100850
Narayanpur	5870	8100	33030	21650	9000	4960	13240	14330	110180
Rajgarh	4930	13440	29750	14230	6100	2870	10470	12190	93980
Shikhar	4590	5160	14470	6570	4290	1540	3670	6690	46980
Sadar	66150	25440	35540	37050	8800	12590	14900	26030	226500
Total	162800	150420	376250	219300	78140	48210	104350	153400	1292870
Mean	12523.08	11570.77	28942.31	16869.23	6010.77	3708.46	8026.92	11800.00	99451.54
± SD	±16624	±5435	±7613	±8857	±1911	±3230	±3507	±5181	±46087

Table 3: Annual demand supply gap of timber of selected species (cft) in district Sonbhadra

S. No.	1	2	3	4	5	6	7	8	
Species	Teak	Shisham	Mango	Neem	Babool	Kathal	Mahua	Eucalyptus	Total
Robertsganj	17900	16800	60300	35200	15400	5500	10750	22400	184250
Nagwan	6300	7560	12800	7800	2400	4300	9670	20450	71280
Chatra	5600	8540	23500	10890	9700	2900	5650	11600	78380
Chopan	20450	20800	87460	49100	19320	6400	18800	25760	248090
Ghorawal	25430	18760	99870	42500	17600	7000	15600	20890	247650
Babhni	5400	7050	19800	11600	8700	2980	4090	12120	71740
Myorpur	15600	14500	70890	31760	17500	7560	11340	20530	189680
Dudhi	7300	8650	29800	15460	7080	2150	7750	12070	90260
Sadar	90670	45080	38900	34600	25980	5040	22860	12390	275520
Total	194650	147740	450970	243910	129080	41930	101140	147430	1456850
Mean	21627	16415	50107	27101	14342	4658	11237	16381	161872
± SD	±26910	±11930	±30519	±14610	±6430	±2094	±6653	±5940	±84713

Table 4: Annual demand supply gap of timber (cft) of selected species contribution (%) in Vindhyan region

S. No.	Species	Prayagraj	Contribution (%)	Mirzapur	Contribution (%)	Sonbhadra	Contribution (%)	Vindhyan region	Contribution (%)
i	Teak	785325	22.85	162800	12.59	194650	13.36	1142775	18.47
ii	Shisham	333715	9.71	150420	11.63	147740	10.14	631875	10.21
iii	Mango	807404	23.49	376250	29.10	450970	30.96	1634624	26.42
iv	Neem	410720	11.95	219300	16.96	243910	16.74	873930	14.13
v	Babool	132975	3.87	78140	6.05	129080	8.86	340195	5.50
vi	Kathal	126538	3.68	48210	3.73	41930	2.88	216678	3.50
vii	Mahua	316346	9.20	104350	8.07	101140	6.94	521836	8.43
viii	Poplar	184345	5.36	0	0.00	0	0.00	184345	2.98
ix	Eucalyptus	340001	9.89	153400	11.87	147430	10.12	640831	10.36
	Total	3437369	100.00	1292870	100.00	1456850	100.00	6187089	100.00

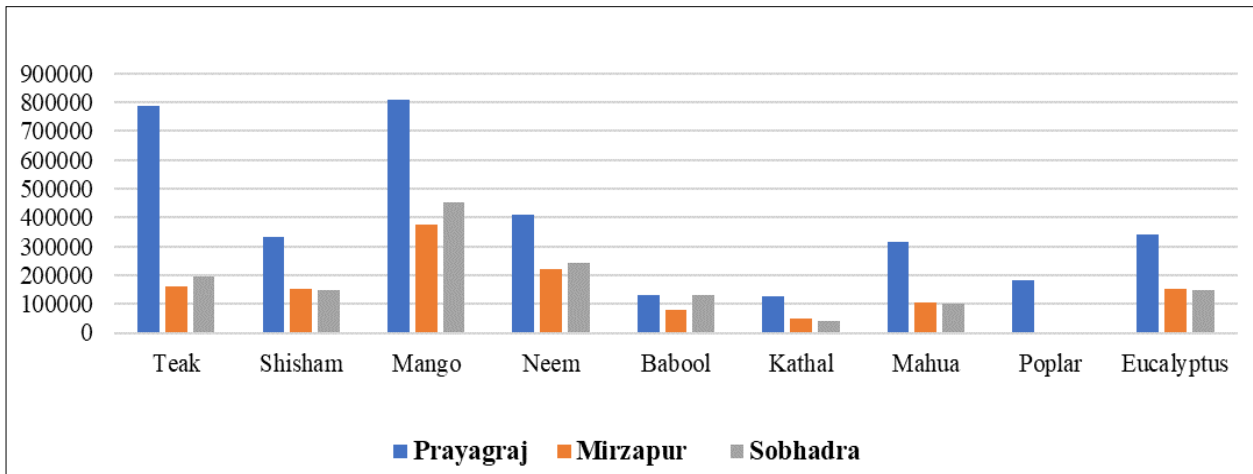


Fig 1: Demand supply gap of timber (cft) in districts of Vindhyan region

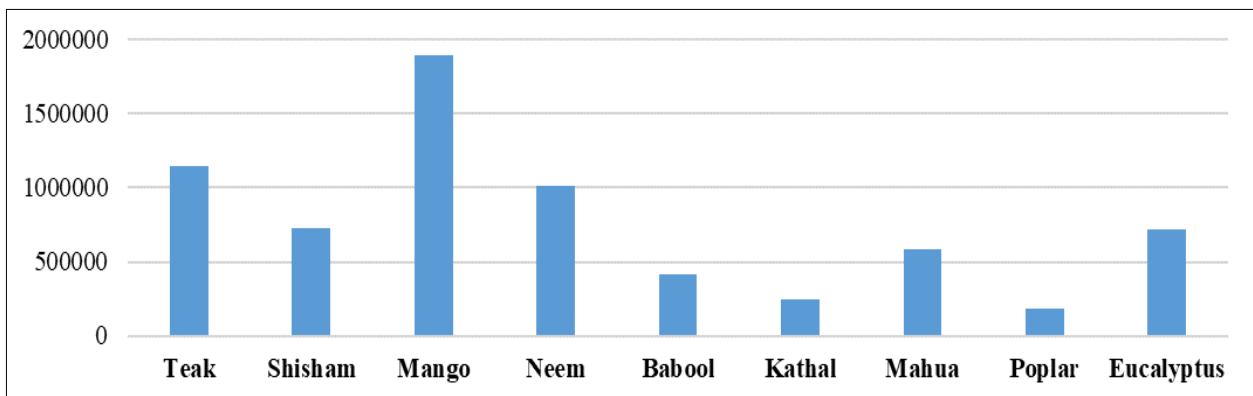


Fig 2: Demand supply gap of timber (cft) in Vindhyan region

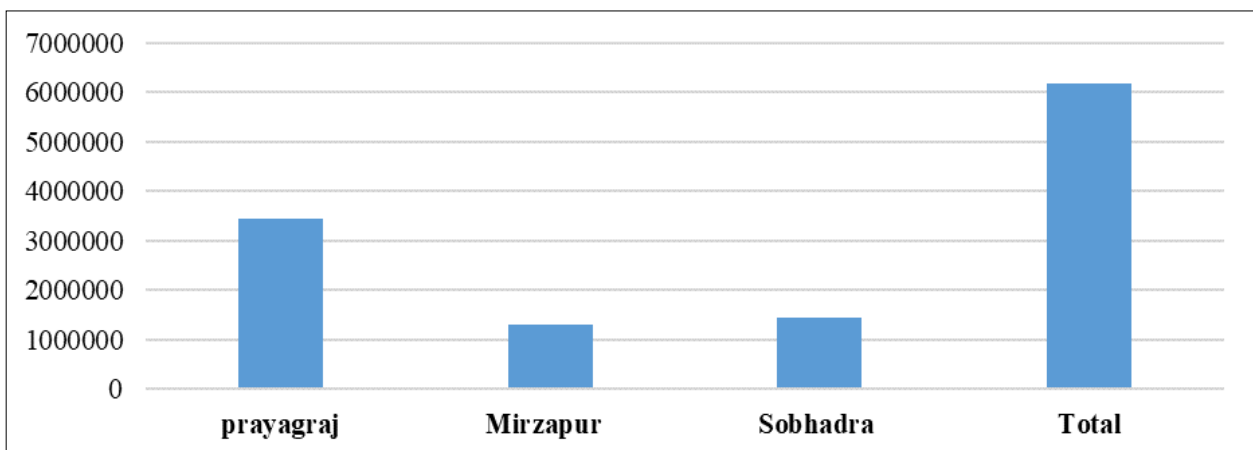


Fig 3: Total demand supply gap of timber (cft) in districts of Vindhyan region

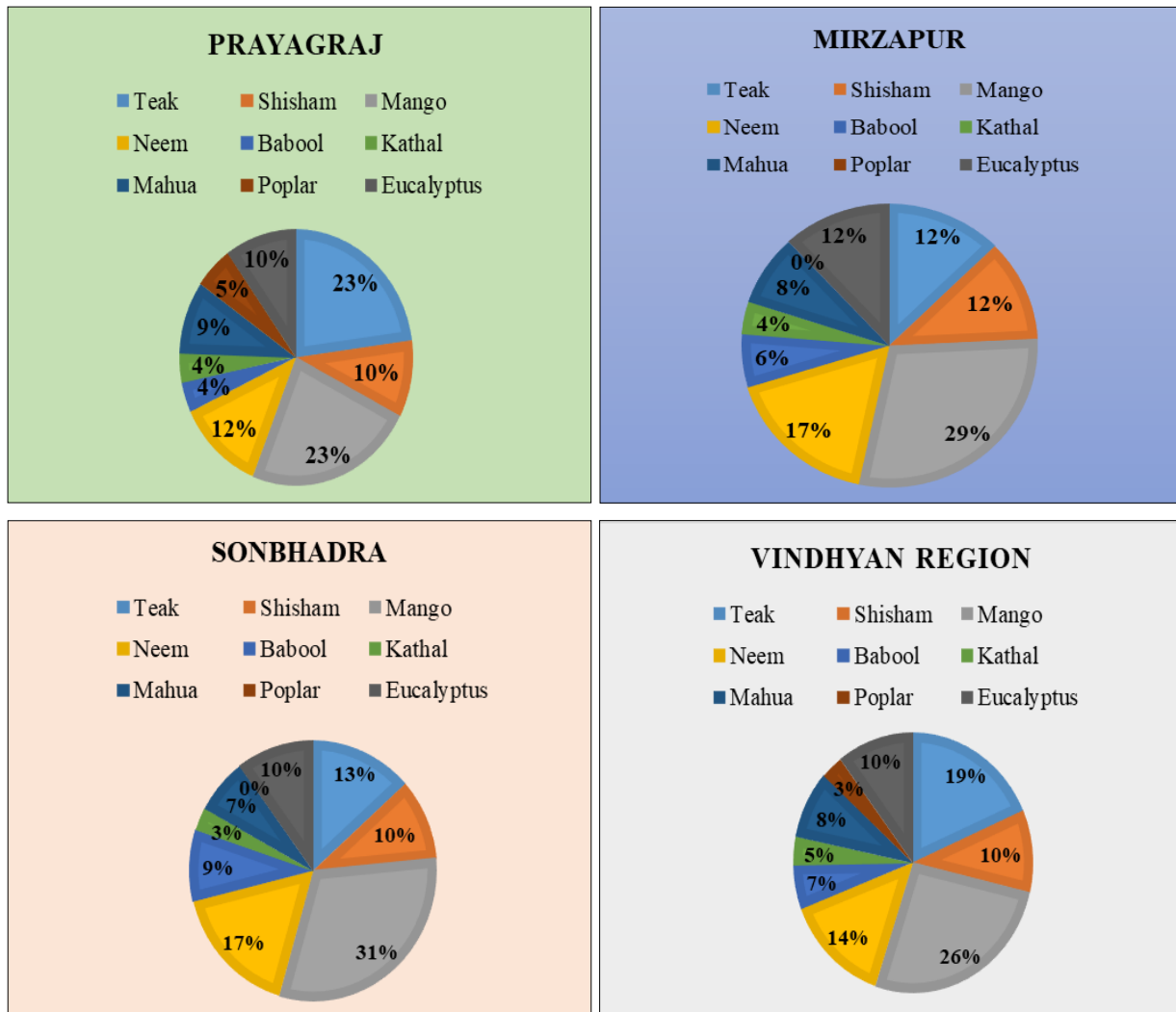


Fig 4: Assessment of demand supply gap of tree species contribution (%)

The farmers have little opportunities to select the tree species and therefore, they accept whatever is available on their land. Bhatt *et al.*, (2010) [2]; Dadhwal *et al.*, (1989) [4] and Toky *et al.*, (1989) [21] have recognized three agroforestry systems with their multifarious benefits. The various problems and constraints of agroforestry can be overcome through policy and institutional reforms (Smith *et al.*, 1998) [20]. 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 (Puri and Nair, 2004) [18]. In almost all tropical and subtropical eco zones, agroforestry is represented by the homestead farming, essentially the mixed cropping of annual and perennial crops around the farmer’s dwelling houses. Home gardens are recognized worldwide as an epitome of sustainable agroforestry systems (Torquebiau, 1992; Kumar & Nair, 2004) [13, 22]. Thus, agroforestry practices can be an important tool to get four per cent sustainable growth in agriculture (National Agroforestry Policy, 2014) [16]. The upgradation of agroforestry is possible through agroforestry policy, industries, NGOs and participation of different stakeholders (Verma *et al.*, 2017) [24]. The Farmers with major land holdings will get more benefit by the agroforestry related schemes than other

category of farmers. So, there is need to introduce special programmes on agroforestry models for marginal and small farmers (Verma *et al.*, 2017) [24] because 2/3rd of them are small and marginal (Kumar *et al.*, 2017; Singh & Pandey, 2011) [14, 19]. It is needed to strengthen the agroforestry practices by identifying successful models that can be adopted by the farmers on a wide scale. Advancement of contemporary agricultural technology would also be helpful in increasing the yield of sole crops as well as intercrops (Jain & Singh, 2000) [9].

Conclusion

The systematic pattern in tree planting needs to be improved for the region. It is well known that western part of U.P. is more flourished than Eastern part for adoption of agroforestry. It is now urgent need of time to adopt tree plantations in massive way in districts of Vindhyan zone to increase green cover in the region and decrease pressure on forests. Agroforestry is the only way for progress of farmers and rural people, leading to sustainable development, food and nutritional security. Agroforestry adoption with suitable recommended species of economic value will improve state/country forest and tree cover to the 33 % as desired in national forest policy. The foresters, researches, NGOs, tree growers and traders are needed to coordinate for successful implementation of tree plantation in agroforestry at large 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. 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 should be promoted for different stakeholders. 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 adoption of agroforestry widely at large level in this region. Tree plantation techniques should be introduced at school level, training and tree plantation services and plants should be available to tree growers and expansion of market-oriented woodlots on marginal lands is expected to improve farmers' financial income and thus increases access to modern farm inputs.

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