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Agroforestry system adopted by farmers of Hoshangabad district of Madhya Pradesh

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Abstract

Present study was conducted in Hoshangabad district of Central Narmada Valley agro-climatic zone of Madhya Pradesh with an aim to document the Agroforestry system adopted by farmers in their fields. The information like choice of species, planting pattern, reason for adoption, challenges faced collected from farmer's by conducting interview with pre tested questionnaire during 2019-2020. Results revealed that farmers of Hoshangabad district preferred six types of Agroforestry system namely silvi - agri - horti system, silvi-agri system, horti-agri system, silvi-agri-horti-pasture, silvi-agri-oleri and silvi-agri-horti-oleri. The proclivity towards the adoption of Silvi-agri-horticulture system was higher (68.39%) than other systems. It was also reported that maximum farmers preferred *Tectona grandis* (33.87%), *Leucaena leucocephala* (16.77%) and *Vachellia nilotica* (11.94%) in tree based system like silvi - agri, silvi - agri - horti - oleri, silvi - agri - oleri, silvi - agri - horti and silvi - agri - horti system while *Mangifera indica* (38.71%), *Psidium guajava* (16.45%) and *Phyllanthus emblica* (13.55%) preferred in fruit based system viz. silvi - horti - agri, silvi - agri - horti - oleri, silvi - agri - horti - pasture and horti-agri systems. Majority of farmers prefers bund (33.87%) and Scattered (26.77%) planting in their field. Choice of tree-crop, tree planting pattern mainly depend on size of landholdings but less knowledge of agroforestry affects tree farming adoption.

Keywords: Agroforestry system adoption, Central Narmada Valley, *Tectona grandis*, *Mangifera indica*, Silvi-horti and Silvi-agri system

Introduction

Agroforestry system and practices that effectively integrate tree with agricultural crops assume greater importance particularly in the sensitive soils of the topics (Kumar and Nair, 2004) [17]. Agroforestry as a smart land use system has potential to support livelihood improvement by producing food, fodder and fuel as well as mitigation of the impact of climate change (Upadhyay *et al.*, 2005). Agroforestry practices are strongly dependent on land availability. Farmers who are not having ownership of land may not be able to take advantages of agroforestry interventions (Arunachalam *et al.*, 2002) [3] for livelihood improvement unless market regimes permit their inclusion through value addition.

As per the National Agroforestry Policy (NAP), (2014), tree cover can be increased only through agroforestry systems. Sub-Mission of Agroforestry (SMAF) Operational guideline (2016) reported that about 65% of the country's timber requirement is fulfill from the trees grown outside forests.

The area under agroforestry is 13.7 million ha FSI (2013) so far to extend the specified forest cover (33%), planting trees outside the forest (TOF) on farmlands can be viable option. Hence, it is important to create awareness among the farmers to adopt promising Agroforestry systems in their field to generate additional intermittent income.

The objective of the Sub-Mission of Agroforestry is to popularize various Agroforestry models suitable to different agro ecological regions and land use conditions. Various promising agroforestry systems like Babul+ rice based agroforestry system in Central India (Vishwanath *et al.*, 2000), Gmelina + Bach+ Paddy system (Sah *et al.*, 2002) [26], Babul + Paddy, Sagon + Musli (Berry, 2005) [5], Bamboo based agroforestry system (Berry *et al.*, 2008) [8], Flemingia based silvi-agri-lac system (Berry *et al.*, 2018) [6, 7] Gmelina + Pan (Berry *et al.*, 2018) [6, 7] Gmelina + Adarak (Berry *et al.*, 2021) [9] were developed by the TFRI and other institutions for tropical region of M.P. and Shukla (2014) [30] discussed the issues relating to adoption of teak under agroforestry by different landholders, technology packages suitable for small farmers, market access, information and viability.

Earlier some studies have been carried out and they reported that farmers preferred the species

which provides fuel wood, fodder, vegetable, fruit, and timber while moderate or low preferences for medicine, cottage industry/handicrafts, fibre/floss, oilseeds and animals/birds/insects etc. (Gupta *et al.*, 2017; Islam *et al.*, 2015 and Banyal *et al.* 2015) ^[14, 15]. While Sharma *et al.*, 2011 worked on adoption behavior of farmers practicing agroforestry in Jabalpur district, Madhya Pradesh, Mulukh *et al.*, 2017 ^[22] and Sarvade *et al.*, 2020 ^[27] worked on the adoption of agroforestry system in some parts of Maharashtra and Madhya Pradesh states of India respectively.

Though the agroforestry system is starting gaining its importance but needs to document region specific models existing in farmers field of Hoshangabad district of Madhya Pradesh which was not documented earlier with economically viable tree-crop combinations. The present study deals to document agroforestry practice adopted by farmers in Central Narmada Valley Zone of Madhya Pradesh. This study will

further helpful for promotion of promising agroforestry system in selected site and to educate farmers by demonstration of successful models.

Material & Methods

The study was conducted in different blocks of Hoshangabad district of Madhya Pradesh on the basis of adoption of agroforestry system by the farmers.

District Profile- Hoshangabad district is located between north latitudes 22° 15' and 23° 00' and east longitudes 77° 15' and 78°42' and has 6704 Sq. Km. of geographical area which supports 1,240,975 inhabitants as per census, 2011. The district is consisting with seven Blocks *viz.* Bankhedi, Pipariya, Sohagpur, Babai, Hoshangabad, Kesla (Itarsi Tehsil) and Seoni Malwa (Figure-1) including 424 and 926 gram panchayat and village respectively.

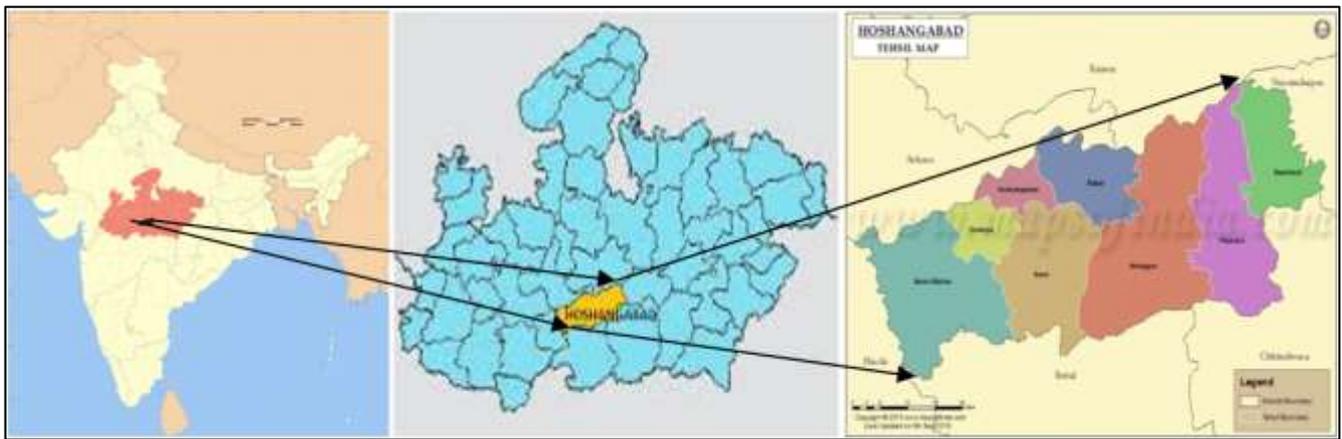


Fig 1: Location of Study Site (Hoshangabad district, MP)

The climatic condition of Hoshangabad district is tropical, rainfall received during the south west monsoon season. The normal rainfall average of the district is 1323.7 mm while maximum and minimum rainfall range is 2122mm-1302.3 mm. The normal annual means maximum and minimum temperature is 31.3°C and 18.9°C respectively. The district is broadly covered by Black soils and ferruginous red lateritic soils, Sandy clay loam, sandy loam and clay loam (Anon, 2013) ^[2]. (Source-Anon, 2013 ^[2] and <http://www.kvkbankhedi.org/Activity.aspx?Activityname=District%20Profile>).

Data collection: Survey have been widely used in India since past to collect information on forest resource use, joint forest management, social forestry adoption and psychological aspects of forest users. (Mahapatra, 1997, Glendinninge *et al.*, 2001, Sood, 2003, Sood and Mitchell, 2004) ^[19, 33, 32]. Primary data were collected on pre-structured schedule through face to face interviews by pretested questionnaire with the heads of households who knows traditional farming practices.

Multistage random sampling was adopted to select households. Village wise list was prepared for the study site. Hoshangabad district was selected purposely at first stage then five villages were selected from each block. This will give a realistic representation of the households. A list of households in each of the selected villages was prepared by employing data collectors. Ten households from each village were selected using simple random sampling. Above information was recorded during 2018-2020 and total 5 blocks and 31 villages were surveyed.

Results & Discussions

Results revealed that out of 5 blocks and 31 villages of Hoshangabad district, Hoshangabad block having maximum agroforestry adoption by the farmers with 36.13% followed by Bankhedi (20%) and Sohagpur (18.06%) while minimum agroforestry system adopted by farmers at Babai block with 5.81%.

Out of 310 farmers, 44.52% farmers were comes under category of small farmers, 31.94% was medium farmers and 17.10% and 6.45% was Marginal and Large farmers categories respectively.

Generally, farmers of Hoshangabad were opting agroforestry system on bunds as well as block and also integrated farming model to get multiple products like fruits (34.52%), timber (28.39%), fuelwood (25.81%), fodder (7.10%) and others uses (4.19%) while medium and large farmers selling the agroforestry products for industrial purpose. Some of the farmers are very keen to adopt the agroforestry systems and even they procure Quality Planting Material of important tree species like Teak, Eucalyptus, Gmelina and Bamboo from Private nursery and Forest department. The success of any plantation mainly depends upon good silvicultural practices including genuine source of planting material, appropriate spacing, selection of species as per the soil type, irrigation method, canopy management and application of bio-fertilizer and insect pest disease management.

It was also observed that 55.16% farmers adopted agroforestry by self motivation, whereas 36.77% farmers adopted agroforestry by inheritance, 8.06% farmers guided by other agencies (Research institutions, Forest Department,

Horticulture department, Krishi Vigyan Kendra and private companies). The data indicates that farmers' adopted six major agroforestry systems namely silvi-agri-horti (68.39%), silvi-

agri (17.74%), horti-agri (5.16%), silvi-agri-horti-pasture (3.23%), silvi-agri-oleri (2.90%) and silvi-agri-horti-oleri (2.58%) systems on farm lands (Figure-2).

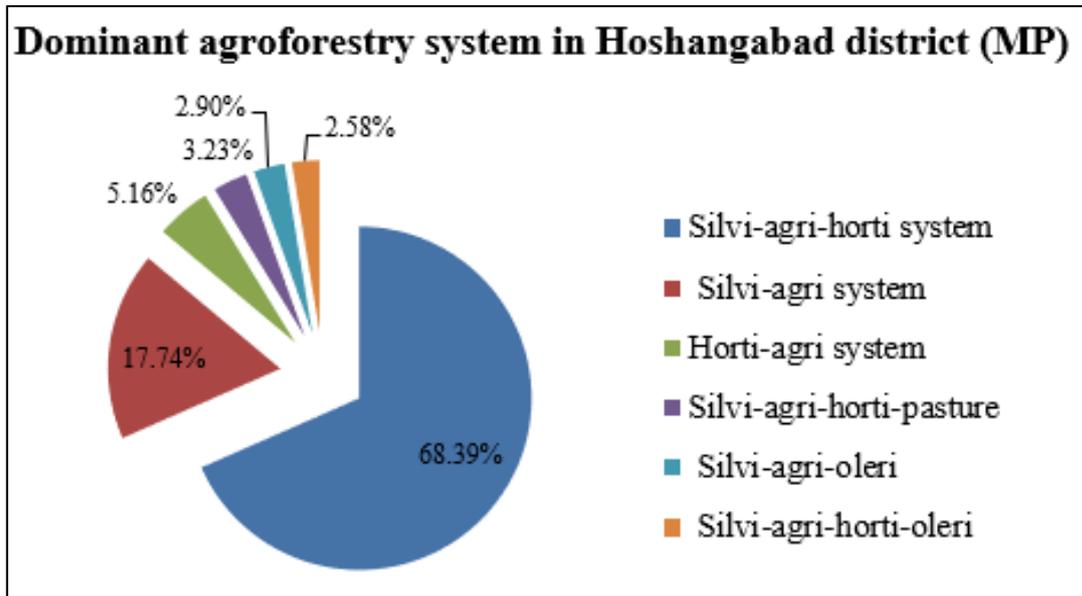


Fig 2: Dominant agroforestry system in Hoshangabad district (MP)

Usually farmers are cultivated Wheat, Paddy, Chickpea, Black gram, Soybean, Pigeon pea, Green gram and Maize and also diverted their fields by planting Horticulture species with

vegetable and fodder crop to fulfill family and livestock requirement regularly (Table-1).

Table 1: Tree -Crop combination detail on farmer's field in Hoshangabad district (MP)

Land holding Size (Ha.)	Agroforestry System	Agriculture Crop	Forestry species	Horticulture Species	Pattern of Planting	Knowledge of Agroforestry system
Marginal (0-1 hectare)	Silvi – Agri- Horti system and Agroforestry	Wheat, Chickpea, Paddy	<i>Tectona grandis</i> , <i>Azadirachta indica</i> , <i>Leucaena leucocephala</i> , <i>Eucalyptus</i> and <i>Melia azedarach</i>	<i>Mangifera indica</i> , <i>Ziziphus mauritiana</i> , <i>Syzygium cumini</i>	On bund and Scattered in field	Self and Inheritance
	Horti- Agri system	Wheat and Chick pea		<i>Ziziphus mauritiana</i> and <i>Citrus limon</i>	On bund and block	Self and Inheritance
	Silvi- Agri- horti-oleri system	Wheat, Rice & Vegetables	<i>Tectona grandis</i> and <i>Leucaena leucocephala</i>	<i>Phyllanthus emblica</i>	On bund	Inheritance
	Silvi- Agri system	Wheat, Mustard and paddy	<i>Eucalyptus Spp.</i> , <i>Leucaena leucocephala</i> and <i>Tectona grandis</i>	-	On the bunds ,On the bunds and block	Self and Inheritance
Small (1-2 hectare)	Silvi-Agri-Horti and Agroforestry	Wheat, Green Gram & Paddy	<i>Tectona grandis</i> ,and <i>Leucaena leucocephala</i>	-	On the bunds	Self and Inheritance
	Silvi-Agri-Oleri system system	Wheat, green gram & Vegetables	<i>Leucaena leucocephala</i>	-	On the bunds	Inheritance
	Agri-Silvi-Horti and Agroforestry	Wheat, Chickpea, Cajanas, Paddy and Green gram	<i>Tectona grandis</i> , <i>Vachellia nilotica</i> , <i>Azadirachta indica</i> , <i>Eucalyptus</i> , <i>Madhuca indica</i> , <i>Bamboo spp.</i> , <i>Terminalia arjuna</i>	<i>Mangifera indica</i> , <i>Psidium guajava</i> , <i>Tamarindus indica</i> , <i>Ziziphus mauritiana</i> , <i>Artocarpus heterophyllus</i>	Scattered, On Bund, On Bund and Scattered in field, On Bund and Block	Self and Inheritance
	Horti- Agri system	Wheat, Chickpea, Moong, Paddy & Sugarcane		<i>Mangifera indica</i> , <i>Punica granatum</i> , <i>Psidium guajava</i> , <i>Syzygium cumini</i> , <i>Kathal</i>	Scattered, On the bunds & Uniform	Other agencies (KVK)
	Silvi-Agri-Horti-Pasture system	Wheat, Rice & fodder	<i>Vachellia nilotica</i>	<i>Mangifera indica</i> , <i>Psidium guajava</i> , <i>Tamarindus indica</i>	Scattered	Self
Medium (4-10 hectare)	Silvi - Agri- Horti system and Agroforestry	Wheat, Chickpea, Cajanus, Sugarcane, Mustard , Green Gram, Paddy	<i>Tectona grandis</i> , <i>Leucaena leucocephala</i> , <i>Bamboo spp.</i> and <i>Azadirachta indica</i>	<i>Mangifera indica</i> , <i>Phyllanthus emblica</i> , <i>Psidium guajava</i> , <i>Tamarindus indica</i> , <i>Manilkara zapota</i> , <i>Citrus limon</i> , <i>Ziziphus mauritiana</i> and <i>Syzygium cumini</i>	On bund, Scattered, On the bunds and scattered in field and On the bunds and Block	Other agencies, Self and Inheritance
	Silvi- Agri system	Wheat & Rice	<i>Madhuca indica</i> , <i>Tectona grandis</i> and <i>Bamboo spp.</i>	-	On the bunds & Scattered in field	Self and Inheritance
	Silvi-Agri-Oleri system	Wheat & Vegetables	<i>Tectona grandis</i> , <i>Leucaena leucocephala</i>	<i>Mangifera indica</i>	On the bund and Block	Self

			,Bamboo			
Large (over 10 hectare)	Silvi – Agri- Horti system and Agroforestry	Wheat, Greengram, Blackgram, Chickpea & Paddy	<i>Tectona grandis</i>	<i>Phyllanthus emblica,</i> <i>Manilkara zapota and</i> <i>Mangifera indica</i>	On the bunds, On bund and Block, On bund and Scattered in field	Self
	Silvi- Agri system	Wheat and Paddy	<i>Tectona grandis</i> , <i>Bamboo</i> <i>spp. and Leucaena</i> <i>leucocephala</i>	-	On the bunds, On bund and Block, On bund and Scattered in field	Self

The pattern of tree planting mainly depends upon land holding category. Maximum farmers preferred bund plantation (33.89%) followed by scattered planting (26.77%), while Medium and large category of farmers preferred block

plantation. Farmers those have knowledge about tree farming from inheritance, they retained trees on their field bunds for fuel wood, fruits, fodder and other uses (Figure-3).

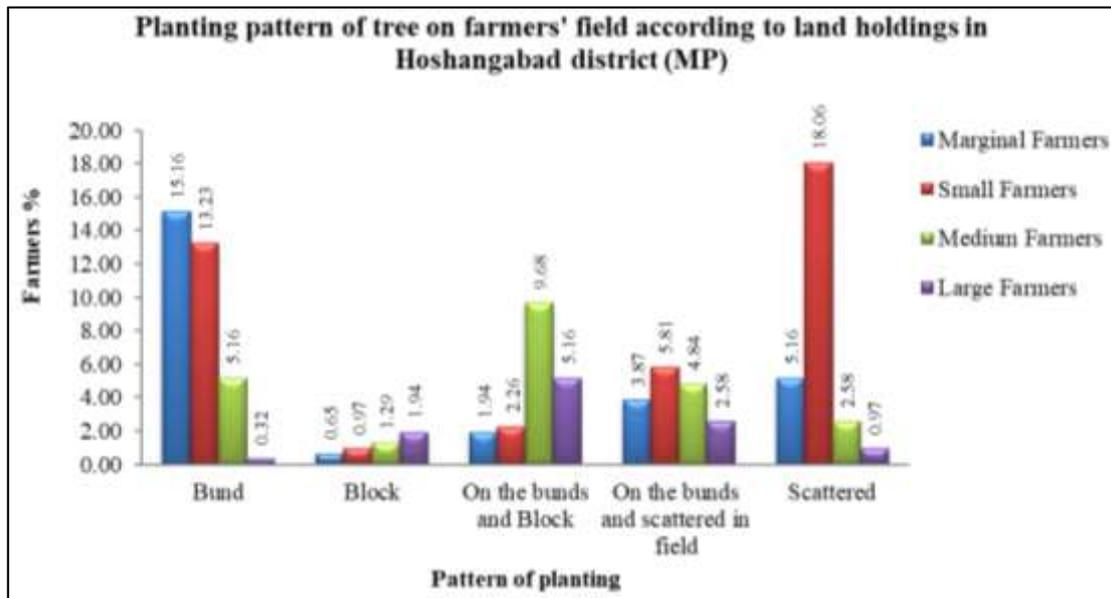


Fig 3: Planting pattern of tree on farmers' field according to land holdings in Hoshangabad district (MP)

Under tree based farming system, *Tectona grandis* (33.87%), *Leucaena leucocephala* (16.77%) and *Vachellia nilotica* (11.94%) preferred in silvi-agri, silvi – agri – horti - oleri, silvi – agri - oleri, silvi - agri – horti and silvi - agri - horti systems. Under Horti - agri system, silvi - horti - agri system, silvi - horti - agri - pasture system maximum farmers

preferred *Mangifera indica* (38.71%) followed by *Psidium guajava* (16.45%), *Phyllanthus emblica* (13.55%) while other species such as *Manilkara zapota*, *Tamarindus indica*, *Punica granatum*, *Citrus limon* and *Phoenix dactylifera* represents the 9.03% which was less preferred among the fruit yielding species (Figure-4 and Figure-5).

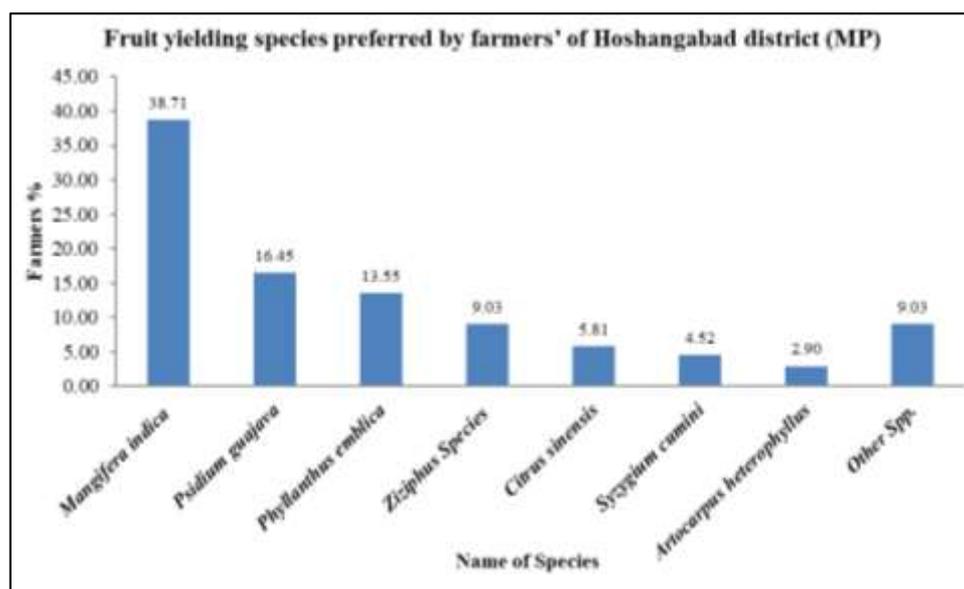


Fig 4: Fruit yielding species preferred by farmers' of Hoshangabad district (MP)

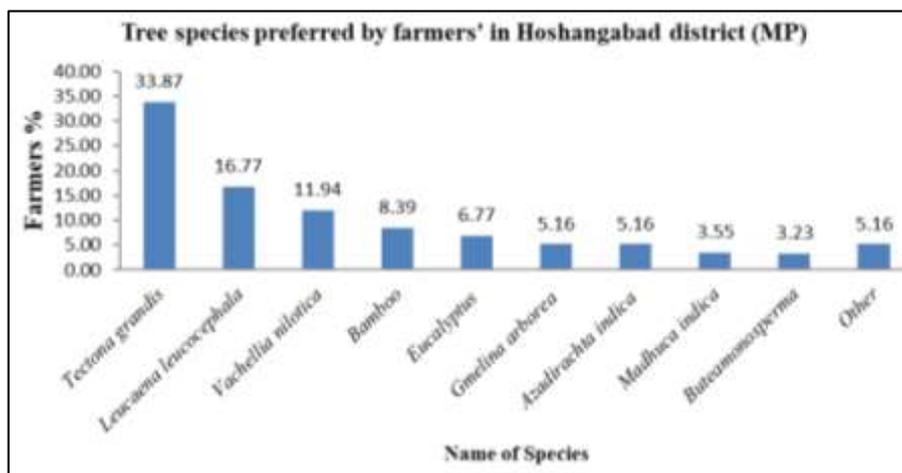


Fig 5: Tree species preferred by farmers' in Hoshangabad district (MP)

During field survey reasons for adoption of agroforestry and challenges constraints faced by farmers after adoption of agroforestry was also inventoried. Reasons for adoption of agroforestry system by the farmers in different blocks of Hoshangabad district are shown in (Figure-6) and it describes that Majority of the farmers of Hoshangabad (33.87%), Sohagpur (38.71%), Piparia (33.87), Bankhedi (33.87%) and Babai (27.42%) block adopted agroforestry because tree farming required less attention. Second main reason was higher income from tree farming told by farmers of different blocks Hoshangabad (16.13%), Sohagpur (19.35%), Piparia

(27.42%), Bankhedi (12.90%) and Babai block (29.03%). Due to shortage of skilled labor, maximum farmers of Hoshangabad (19.35%), Pipariya (12.90%), Bankhedi (4.84%) and Sohagpur (3.23%) inclined towards to agroforestry system.

Majority of farmers of Hoshangabad district preferred tree farming because of less attention (33.55%), less inputs (23.23%), higher income (20.97%), shortage of skilled labor (8.06%) and environmental benefits (14.19%) are main reasons for adoption of agroforestry by them (Figure-6).

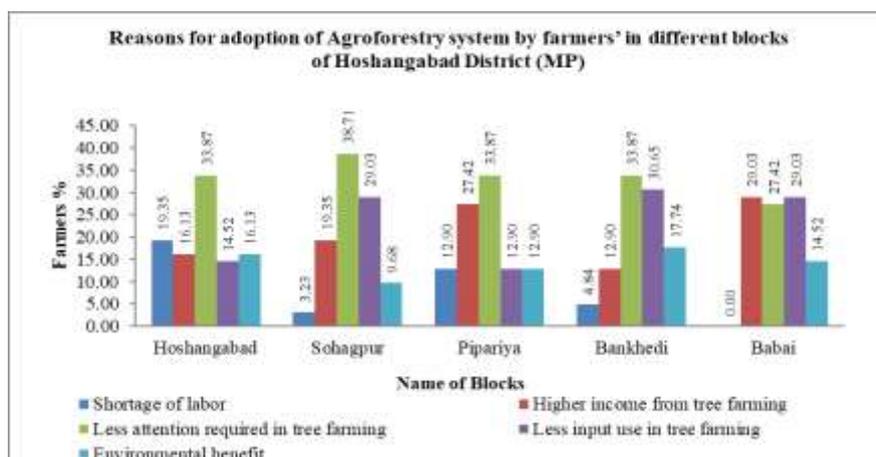


Fig 6: Reasons for adoption of Agroforestry system by farmers' in different blocks of Hoshangabad District (MP)

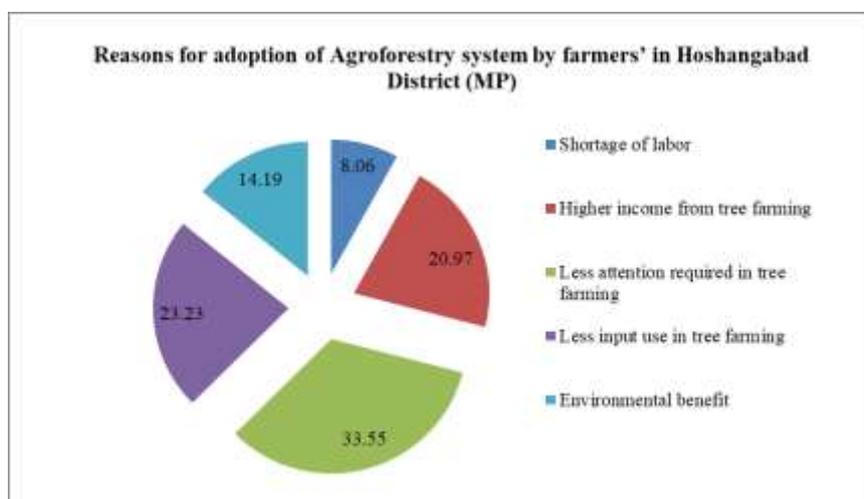


Fig 7: Reasons for adoption of Agroforestry system by farmers' in Hoshangabad District (MP)

Also recorded major constraints after adoption of agroforestry system faced by farmers at different blocks of Hoshangabad District are shown in Figure-8. Maximum farmers of Hoshangabad and Sohagpur block facing constraints like tree shade affecting the crop production 45.35% and 74.19% respectively while farmers of Hoshangabad, Pipariya, Bankhedi and Babai blocks expressed that due to rigid rule of tree harvesting they are not able to harvest the tree when they need urgent financial help. Farmers of Hoshangabad block

told about the problem of non-availability of skilled labor for tree farming (16.13%) and lack of knowledge of agroforestry (17.74%), farmers retained tree on their farm but they have lack of technical knowledge of agroforestry like pruning and thinning of trees. Farmers of Sohagpur, Pipariya, Bankhedi and Babai facing the challenges like new insect and disease occurs in crop from tree 25.81%, 33.87%, 19.35% and 50% respectively.

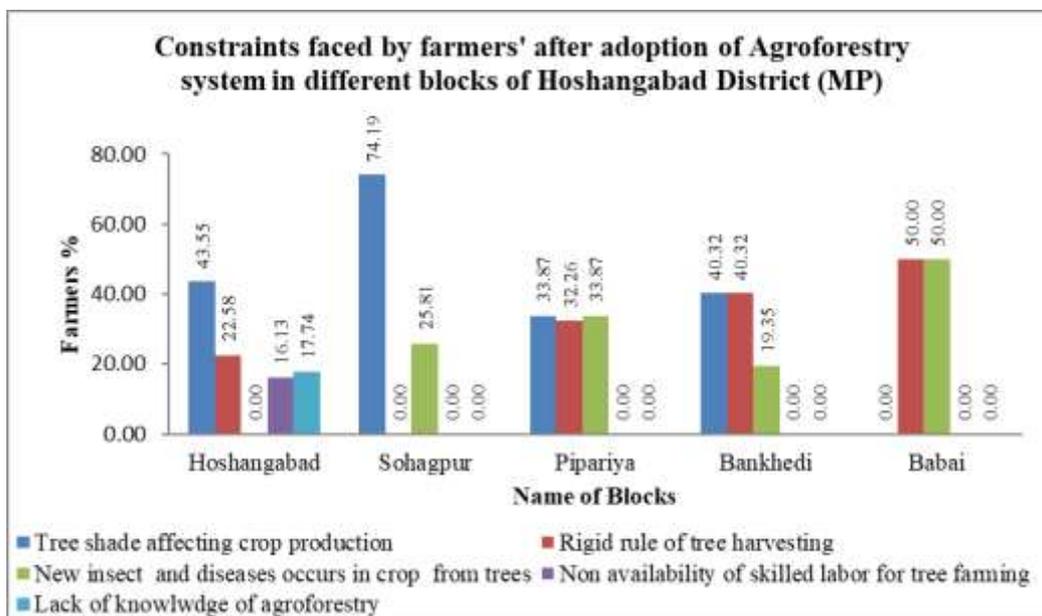


Fig 8: Constraints faced by farmers' after adoption of Agroforestry system in different blocks of Hoshangabad District (MP)

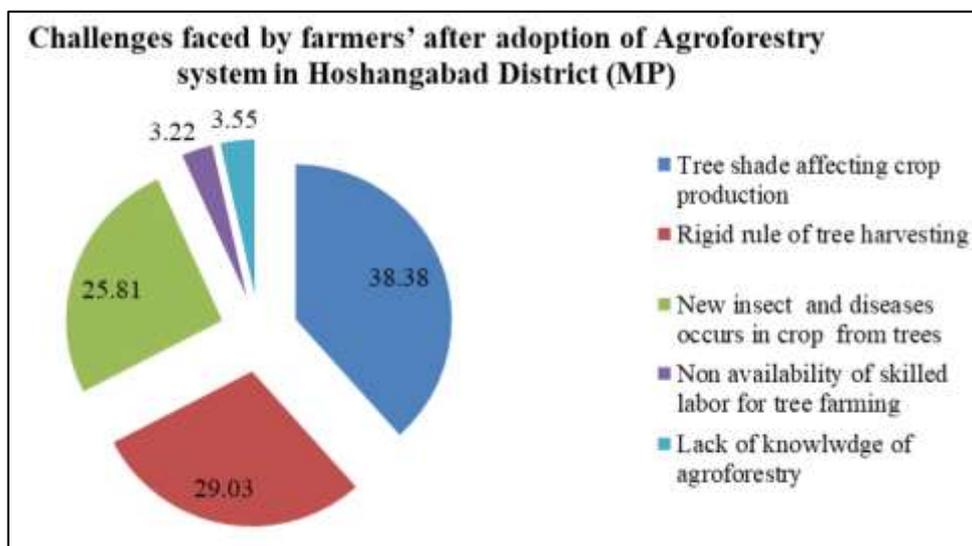


Figure-9 Challenges faced by farmers' after adoption of Agroforestry system in Hoshangabad District (MP)

Majority of farmers of Hoshangabad district expressed that due the tree shade affecting crop production (38.38%), rigid rule of tree harvesting (29.03%), new insect and disease occurs in crop from tree (25.81%), non availability of skilled labor for tree farming (3.22%) and lack of knowledge of agroforestry (3.55%) were major challenges (Figure-9). Several studies have been carried out and reported that costly and rigid rules and legislation in respect of tree felling tree, its transportation, processing, marketing (Planning Commission, 2001) [24] and lack of manpower (Pilote *et al.*, 2017 and William, 2019), damage of crop due to shade, birds and land

limitations (Parsad, 1994) were the major constraints faced by the farmers.

Sharma *et al.*, (2005) [29] noticed that maximum (40%) farmers of central India prefer agri-silvi-horticulture system. Majority of farmers of Ratnagiri district of Maharastra adopted five types of system i.e. agri-silvicultural system (75.5%), agri-silvipastoral (37.03%) and horti-silvicultural (37.03%), agri-horti-silviculture (17.70%) and apiculture with trees (15.50%) and Majority of the farmers (14.07%) planted combination of mango and cashew nut plants on their agriculture land (Mullukh *et al.*, 2017) [22]. Similarly

Mangifera indica, *Embilica officinalis*, *Psidium guajava* and *Artocarpus heterophyllus* were adopted under different agroforestry system in some Villages of Baldirai Block in Sultanpur District (Maurya *et al.*, 2018) [21]. William, (2019) [37] also studied in Chhattisgarh and reported that farmers adopted different agroforestry systems like Boundary plantation, Agri-silviculture system, Horti-silviculture, silvi-pasture, vegetable patch and Block plantation. Bijlawan *et al.*, 2019 [10] also reported that Shisham, Khamer, Palash, Bamboo, Mahua, Babul, Subabul, Bamboo and Mango, Jamun, Ber, Guava, Pomegranate, Aonla, Ber, Lemon, Mandarin, Papaya are major tree species Central Narmada Valley Zone, Subabul + wheat, Babul + sugarcane, Khamer +wheat, Bamboo + soybean are the most common tree-crop combinations practiced by farmers.

Conclusion

In Hoshangabad district, Wheat, Paddy and Maize are major cultivated crops while Mahua, Teak, Arjun, Pipal, Palash, Babul, Neem, Mahaneem are retained on farmer's field which shows that the farmers of Hoshangabad district aware about agroforestry practices but still some farmers are facing challenges like management of tree shade, tree pruning, root spread, thinning, soil management towards adoption of agroforestry. The study also noticed that the farmers are aware about benefits of agroforestry system but they are facing challenges like know how of the timber yielding species, selection of site specific agroforestry models, quality planting material, Certified plant nursery, management of tree canopy, insect pest disease management, nutrient management, appropriate age of tree harvesting, its marketing hesitate them to adopt agroforestry. These problems can be rectified through field demonstration and technical training to popularize above mentioned models in other agro-climatic zones of Madhya Pradesh. However farmers are keen to adopt economically viable agroforestry system for higher income.

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