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Research article

Agroforestry systems in Sultanpur district, Uttar Pradesh, India: a gender perspective

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Abstract

This study investigates gender-specific roles in agroforestry across 700 randomly selected households in 14 blocks of Sultanpur district, Uttar Pradesh, from February 2024 to March 2025. Cultural and traditional biases often marginalize gender considerations in the agroforestry management. This study revealed that men favour *Tectona grandis* and *Eucalyptus* spp., while women prefer *Mangifera indica* and *Eucalyptus* spp. Males play a dominant role in agroforestry system. They enjoy the highest access to resources and have decision-making rights. Males view ten hindrances in adoption of agroforestry, the highest being limited availability of products and suggest five recommendations, the highest being training on production of value-added products to increase the adoption of agroforestry systems. The interventions suggested by the farmers have the potential to boost tree productivity and farmer's income, emphasizing the need for inclusive strategies to reinforce agroforestry systems in the region. This study revealed that male dominance in society still overshadows the needs and role of women in agroforestry. A societal change in mindset and strong policy intervention is the only hope for women empowerment.

Keywords: Access to resources, Agroforestry, Constraints, Practices and management, Recommendations, Tree preferences.

Introduction

Agroforestry is a technique of managing natural resources that integrates trees with crops or livestock in the same unit of land (Roy, 2016). Agroforestry practices increase food production and have a positive impact on the socio-economic conditions of people, leading towards sustainable development (Waldron *et al*., 2017). Agroforestry supports over 1.2 billion people globally (WB, FAO and IFAD, 2009) and is particularly reliant on the active participation of women, who play pivotal roles in managing home gardens, conserving tree genetic resources, and contributing to food security (Kiptot *et al*., 2014).

Gender dynamics significantly influence the adoption and outcomes of agroforestry practices. While women contribute substantially especially in the early stages of tree management, their access to land, resources, and decision-making remain constrained due to entrenched socio-cultural norms (Kiptot and Franzel, 2012). These disparities impact productivity and adoption rates, as household decisions are shaped by gender-based roles, education, and access to capital (Wiig, 2013). Studies indicate that women are more involved in low-value agroforestry activities, while men dominate commercial sectors such as timber production. Despite their contributions, women face barriers in accessing technology, information, and finance, which limits their participation in value-added enterprises (Degrande and Arinloye, 2014). Differences in species preference also reflect gendered priorities.

In India, women are crucial to the upkeep of family gardens. 78% of all women in regular employment are rural women who work in agriculture (Upasana, 2023). They assist in the cultivation of food crops, preserve the environment around them, and perform the household chores in the home gardens. They play crucial roles in the management and protection of sustainable ecosystems and put in more time and effort than men. To address the concerns of women's empowerment and rural development, the role of women in managing sustainable agroforestry must be certified and documented. It is important to remember that gender

roles and relationships are dynamic, evolving over time in response to shifting needs, interests, and situations. The scientific community has given gender, its role in development and gender inequality more attention over time (Kiptot *et al*., 2014). It is generally believed that addressing these gender disparities can result in a decline in food insecurity and poverty. Social norms, institutional regulations, gendered knowledge systems, gendered division of labour, gendered access to natural, physical, financial, and human capital, and gendered differences in decision-making processes are some of the factors that contribute to gender inequality (Kim, 2022). Gender judgments and choices are shaped by social standards. In comparison to their male counterparts, women are consistently viewed as a weaker segment of society. Understanding social relationships is crucial to addressing the gender disparities that exist in society between the sexes.

Many studies have been carried out in other countries on gender. Oloo (2013) reported that tree planting activities in western Kenya were dominated by men and women were denied tree ownership. Paudel *et al*. (2019) reported that in Nepal women participation was higher in establishment activities and males contributed more in activities like applying chemical fertilizer & pesticides and irrigation. FAO (2011) reported that in Rwanda the women were not allowed to plant trees except for fruit and medicinal trees. Degrande and Arinloye (2014) concluded that women have very little control over marketing decisions, except in Nigeria where women were found to control cash crop marketing (i.e. Millet, cowpea and sorghum). Kiptot and Franzel (2012) reported that women's participation is low in enterprises that are considered men's domain. Catacutan and Naz (2015) reported that in northwest Vietnam, the key constraint to agroforestry adoption is lack of technical knowledge on agroforestry technologies; however, women, predominantly ethnic minorities, have more constraints in adopting agroforestry compared to men. Nishad *et al.* (2024) found that family opposition and limited cash availability was seen as a hindrance by the females in adoption of agroforestry systems and they stressed on policy interventions to improve the adoption rate of agroforestry systems.

In India, particularly in Uttar Pradesh, women constitute a significant proportion of the agricultural workforce and are central to agroforestry practices. Yet, studies on gender aspects have been limited. Tewari *et al.* (2020) revealed that in Bundelkhand, Central India, despite women's active involvement in tree planting and maintenance, societal beliefs often limit their authority in decision-making and ownership. Though not focused on gender, two studies related to determinants influencing agroforestry adoption have been conducted in eastern Uttar Pradesh (Singh *et al*., 2018; Divya *et al*., 2022). So, it is clear that gender aspects of agroforestry in Uttar Pradesh are not well understood or documented except for one study conducted in Ayodhya district (Nishad *et al*., 2024). To address the above-stated knowledge gap and as gender disparities are crucial for improving agroforestry adoption and outcomes, this study aimed to assess gender roles, identify constraints, and suggest recommendations to enhance gender-inclusive agroforestry in the region.

Materials and Methods

Study site: The study was carried out in Sultanpur district of Uttar Pradesh, comprising 14 blocks and 5 tehsils, located at 26.2977° N and 82.1278° E on the right bank of the Gomti River (GoUP, 2025). It lies 95 m above mean sea level and experiences annual rainfall of approximately 1005.1 mm, with temperatures ranging from 6.3 to 41.6°C and average relative humidity of 68.7% (KVK, 2025). Soils are predominantly alluvial loam, sandy loam, and clay loam formed by deposits from the Ganga, Gomti, and their tributaries (KVK, 2025). Land use includes agroforestry systems, paddy fields, wetlands, ponds, reserve forests, and human settlements. The region hosts diverse flora and fauna, particularly along the Gomti River, which supports 41 fish species with the family Cyprinidae being dominant (Krishna, 2022). Agroforestry systems feature species like *Eucalyptus hybrid*, *Tectona grandis*, *Azadirachta indica*, *Mangifera indica*, and *Psidium guajava*, enhancing biodiversity and providing ecological habitats.

Sampling method and sample size: The survey was carried out with the help of an interview schedule in Sultanpur district, Uttar Pradesh, employing a multi-stage random sampling technique. All the blocks of the district were surveyed. From each block, 10 villages were randomly selected, and 5 households per village were surveyed, resulting in a total sample size of 700 respondents. Villages were chosen to ensure spatial representation across blocks and tehsils. Sampling framework included 1 district, 14 blocks, 140 villages and 700 respondents.

Survey questions covered aspects such as gender-specific roles in agroforestry and tree management, species preferences, access to resources, participation in decision-making, barriers and suitable recommendations for adoption. The study focused on farmers practicing agroforestry, examining the diversity of systems in relation to agricultural integration and local resource management. Tree species preferences among farmers were assessed following the method of Ahire and Kumar (2006), wherein respondents assigned scores (1–10) to their preferred species. The most preferred species received the highest score and was ranked first, followed by others in descending order. Chi-square analysis was performed using SPSS (version 19.0), with statistical significance set at $p < 0.05$.

Results and Discussion

Gender roles in practices and management of agroforestry systems: In Sultanpur district, nine major agroforestry activities, ploughing, pit digging, tree planting, fertigation, irrigation, pruning, harvesting, transportation, and sales, exhibited significant gender-based participation disparities across blocks (Table 1). In the 14 blocks, ploughing (55%), pit digging (74%), fertigation (68%), irrigation (63%), transport (74%), and sales activity (64%) were performed mainly by males and the least by females (Table 1). Across all the blocks, there was a statistically significant difference for ploughing (p = 0.010), pit digging (p = 0.001), fertigation (p = 0.001), irrigation (p = 0.005), transport (p = 0.004) and sales (p= 0.01) (Table 1). This study conforms with the study of Catacutan and Naz (2015) and Nishad *et al.* (2024), where the majority of the males were involved in ploughing and transportation activities and with the study of Birhanu and Guye (2022) and Nishad *et al.* (2024) where males were primarily involved in fertigation, irrigation and sale activities. Across all the blocks, the tree planting (49%), pruning (54%) and harvesting activities (57%) were performed by both genders and least by females. There was a statistically significant difference across the blocks for tree planting (p= 0.0007), pruning (p= 0.030) and harvesting (p = 0.01). This contradicts the observations of Birhanu and Guye (2022), who revealed that the majority of the males were involved in tree planting and pruning activities.

Gender specific tree preferences: Across the studied blocks of Sultanpur district, gender-specific preferences for tree species were evident (Table 2). Among males, *Eucalyptus* spp. and *Tectona grandis* consistently emerged as the top choices, with *Prosopis cineraria* being the least preferred in most locations. Conversely, females predominantly favoured *Mangifera indica*, followed by *Psidium guajava* or *Tectona grandis*, with *Prosopis cineraria* or *Ailanthus excelsa* often least preferred. Notably, in Baldirai and Akhand Nagar, males preferred *Eucalyptus* spp., while females showed a marked preference for *Mangifera indica* and *Psidium guajava*. In Dostpur, Kurebhar, Lambhua, and Jaisinghpur, males leaned towards *Tectona grandis*, whereas females consistently preferred *Mangifera indica*. Similar patterns were observed in Dhanpatganj, Kamaicha, Kurwar, Pratappur, Bhadaiya, Kadipur, Motigarpur, and Dubeypur. These findings align partially with Yakob *et al.* (2014), who reported species preferences such as *Coffea arabica*, *Persea americana*, and *Mangifera indica* in southwest Ethiopia and contradicts with Gachuiri *et al.* (2022), who reported that in eastern Kenya, both men and women preferred exotic fruit trees.

Gender-wise access to resources of farmers: There was access to eight major farming resources in Sultanpur district, namely land ownership, transfer rights, loans, trainings, seeds, irrigation facilities, market and harvest (Table 3). The males had the highest access to land ownership (65%), land transfer rights (57%), training (65%), seeds (66%), irrigation facilities (76%), market (80%) and harvesting (54%) followed by both genders and the least by females. There was no statistically significant difference across the blocks for land ownership (p = 2.29), access to training (p = 0.09), seed access (p = 0.08), irrigation facilities (p = 0.25), market access (p = 0.053), and harvesting (p =0.98) but there was a statistically significant difference across the blocks for land transfer rights (p = 0.0009). In all the 14 blocks, both genders had the highest access to loans (58%), followed by males, and least by females and it was statistically significant (p = 0.20). This result contradicts the study of Catacutan and Naz (2015), who reported that males had higher access to loans and Nishad *et al.* (2024), who reported that females had higher access to seeds and Birhanu and Guye (2022), who found that females had greater access to the market and harvest.

Gender-wise participation in decision-making by farmers in maintaining agroforestry systems: In Sultanpur district, twelve significant gender-based farming decision-making processes were identified (Table 4). Across all blocks, decisions regarding the planting of species were most commonly made jointly by both genders (70%), followed by females (17%) and males (13%) and there was no statistically significant difference (p = 0.50) (Table 4). Across all blocks, decisions regarding the area to be planted (56%), how many numbers of plants to be planted (60%), season of planting (62%), financial management (59%), fertilizer application (61%), irrigation (62%), pruning (60%), harvesting (59%), sale of produce (74%), processing (75%) and tree ownership (75%) were primarily made by males followed by joint decisions by both genders and least by females. There was no statistically significant variation across the blocks regarding decision-making on planting areas (p = 1.04), number of plants to plant (p= 8.02), season of planting (p = 4.22), financial management (p= 1.64), fertigation (p= 5.97), irrigation (p = 4.51), pruning (p= 2.44), harvesting (p = 1.00), sales (p= 0.37), processing (p = 0.002), and tree ownership (p = 0.07). Birhanu and Guye (2022) observed that the decision on planting of species was taken by females which contradicts the present study, where both genders took decision on planting of species. This study conformed with the study conducted by Catacutan and Naz (2015) who concluded that decision on numbers of plants to plant, financial management, irrigation and sale were taken by males and contradicted the study of Nishad *et al.* (2024) who reported that decisions on season of planting, financial management, fertilizer application and processing were mostly taken by females in Ayodhya district of Uttar Pradesh.

Table 1. Gender roles in practices and management of agroforestry systems in Sultanpur district

Activities	G	OV (N=700) No.(%)	BD (n=50) No.(%)	AN (n=50) No.(%)	DO (n=50) No.(%)	DH (n=50) No.(%)	LB (n=50) No.(%)	KD (n=50) No.(%)	KM (n=50) No.%	BH (n=50) No.(%)	DB (n=50) No.%	KB (n=50) No.(%)	PT (n=50) No.(%)	JS (n=50) No.(%)	MO (n=50) No.(%)	KU (n=50) No.(%)	*p-value*
Ploughing	M	386(55)	29(58)	29(58)	29(58)	30(60)	29(58)	28(56)	23(46)	25(50)	27(54)	26(52)	28(56)	28(56)	27(54)	28(56)	0.01
	F	53(8)	7(14)	7(14)	0	0	0	3(6)	12(24)	4(8)	4(8)	6(12)	1(2)	2(4)	4(8)	3(6)	
	B	261(37)	14(28)	14(28)	21(42)	20(40)	21(42)	19(38)	15(30)	21(42)	19(38)	18(36)	21(42)	20(40)	19(38)	19(38)	
Pit digging	M	521(74)	40(80)	36(72)	39(78)	41(82)	39(78)	38(76)	29(58)	38(76)	35(70)	35(70)	40(80)	38(76)	37(74)	36(72)	0.001
	F	53(8)	7(14)	6(12)	0	0	0	3(6)	13(26)	5(10)	4(8)	5(10)	1(2)	2(4)	4(8)	3(6)	
	B	126(18)	3(6)	8(16)	11(22)	9(18)	11(22)	9(18)	8(16)	7(14)	11(22)	10(20)	9(18)	10(20)	9(18)	11(22)	
Tree planting	M	300(43)	25(50)	16(32)	22(44)	26(52)	23(46)	18(36)	20(40)	24(48)	20(40)	17(34)	25(50)	22(44)	19(38)	23(46)	0.0007
	F	56(8)	7(14)	7(14)	0	0	0	3(6)	13(26)	5(10)	5(10)	6(12)	1(2)	2(4)	4(8)	3(6)	
	B	344(49)	18(36)	27(54)	28(56)	24(48)	27(54)	29(58)	17(34)	21(42)	25(50)	27(54)	24(48)	26(52)	27(54)	24(48)	
Fertigation	M	473(68)	36(72)	36(72)	35(70)	36(72)	36(72)	33(66)	26(52)	32(64)	33(66)	34(68)	35(70)	33(66)	34(68)	34(68)	0.001
	F	54(8)	7(14)	7(14)	0	0	0	3(6)	13(26)	6(12)	4(8)	5(10)	1(2)	2(4)	3(6)	3(6)	
	B	173(25)	7(14)	7(14)	15(30)	14(28)	14(28)	14(28)	11(22)	12(24)	13(26)	11(22)	14(28)	15(30)	13(26)	13(26)	
Irrigation	M	441(63)	32(64)	28(56)	35(70)	35(70)	32(64)	30(60)	25(50)	34(68)	31(62)	31(62)	34(68)	33(66)	30(60)	31(62)	0.005
	F	54(8)	7(14)	6(12)	0	0	0	4(8)	13(26)	5(10)	4(8)	5(10)	1(2)	2(4)	4(8)	3(6)	
	B	205(29)	11(22)	16(32)	15(30)	15(30)	18(36)	16(32)	12(24)	11(22)	15(30)	14(28)	15(30)	15(30)	16(32)	16(32)	
Pruning	M	269(38)	19(38)	19(38)	20(40)	21(42)	20(40)	18(36)	18(36)	17(34)	19(38)	18(36)	22(44)	17(34)	20(40)	21(42)	0.03
	F	55(8)	7(14)	6(12)	0	0	0	5(10)	12(24)	4(8)	4(8)	6(12)	2(4)	2(4)	3(6)	4(8)	
	B	376(54)	24(48)	25(50)	30(60)	29(58)	30(60)	27(54)	20(40)	29(58)	27(54)	26(52)	26(52)	31(62)	27(54)	25(50)	
Harvesting	M	251(36)	18(36)	15(30)	19(38)	21(42)	18(36)	14(28)	19(38)	18(36)	17(34)	17(34)	22(44)	18(36)	16(32)	19(38)	0.01
	F	53(8)	7(14)	6(12)	0	0	0	4(8)	12(24)	4(8)	4(8)	5(10)	2(4)	2(4)	3(6)	4(8)	
	B	396(57)	25(50)	29(58)	31(62)	29(58)	32(64)	32(64)	19(38)	28(56)	29(58)	28(56)	26(52)	30(60)	31(62)	27(54)	
Transport	M	517(74)	41(82)	33(66)	40(80)	41(82)	40(80)	36(72)	29(58)	37(74)	35(70)	34(68)	40(80)	38(76)	36(72)	37(74)	0.004
	F	53(8)	7(14)	6(12)	0	0	0	4(8)	12(24)	4(8)	4(8)	6(12)	1(2)	2(4)	3(6)	4(8)	
	B	130(19)	2(4)	11(22)	10(20)	9(18)	10(20)	10(20)	9(18)	9(18)	11(22)	10(20)	9(18)	10(20)	11(22)	9(18)	
Sale	M	449(64)	33(66)	29(58)	36(72)	32(64)	34(68)	33(66)	24(48)	32(64)	32(64)	31(62)	32(64)	34(68)	32(64)	35(70)	0.01
	F	54(8)	7(14)	7(14)	0	0	0	4(8)	12(24)	4(8)	4(8)	5(10)	2(4)	2(4)	3(6)	4(8)	
	B	197(28)	10(20)	14(28)	14(28)	18(36)	16(32)	13(26)	14(28)	14(28)	14(28)	14(28)	16(32)	14(28)	15(30)	11(22)	

p-values represent the outcome of a chi-square test; G: Gender; M: Male; F: Female; B: Both. OV: Overall; BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

Table 2. Gender specific tree preferences for agroforestry systems in Sultanpur district

Tree species	BD (n=50)	AN (n=50)	DO (n=50)	DH (n=50)	LB (n=50)	KD (n=50)	KM (n=50)	BH (n=50)	DB (n=50)	KB (n=50)	PT (n=50)	JS (n=50)	MO (n=50)	KU (n=50)
	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)	M(F)
Ailanthus excelsa	7(7)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)	6(6)
Azadirachta indica	8(6)	8(7)	8(8)	8(8)	8(8)	8(8)	7(7)	8(7)	8(7)	8(7)	8(8)	8(8)	8(7)	8(7)
Dalbergia sissoo	5(4)	5(4)	5(5)	5(5)	5(5)	5(5)	5(4)	5(5)	5(5)	5(5)	5(5)	4(5)	4(5)	5(5)
Eucalyptus spp.	1(5)	2(5)	2(4)	1(4)	1(3)	2(4)	2(5)	2(4)	1(3)	1(4)	1(4)	2(4)	2(4)	2(4)
Madhuca indica	6(8)	7(8)	7(2)	7(7)	7(7)	7(7)	8(8)	7(8)	7(8)	7(8)	7(7)	7(7)	7(8)	7(8)
Mangifera indica	9(2)	10(2)	10(1)	10(1)	10(1)	10(2)	10(2)	10(1)	10(2)	10(2)	10(1)	10(1)	10(1)	10(1)
Prosopis cineraria	10(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)	9(9)
Psidium guajava	3(1)	4(1)	4(3)	3(2)	4(2)	3(1)	4(1)	3(2)	3(1)	2(1)	4(2)	5(2)	5(2)	4(2)
Swietenia macrophylla	4(3)	3(3)	3(7)	4(3)	3(4)	4(3)	3(3)	4(3)	4(4)	4(3)	3(3)	3(3)	3(3)	3(3)
Tectona grandis	2(10)	1(10)	1(10)	2(10)	2(10)	1(10)	1(10)	1(10)	2(10)	3(10)	2(10)	1(10)	1(10)	1(10)

M: Male; F: Female. BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

Gender-wise constraints faced by farmers in adoption of agroforestry systems: In Sultanpur district, ten key factors were identified as impeding the gender adoption of agroforestry (Table 5). The lack of transportation (66%), limited business and negotiation skills (69%), family opposition (74%), limited availability of products (79%), high initial investment (72%), lack of extension activity (74%), limited knowledge of tree management (64%), limited land availability (71%), limited cash availability (73%), and absence of a clear policy framework on agroforestry (70%) was seen as a hindrance the highest by males and least by females (Table 5). Lack of transportation (p= 0.10), limited business and negotiation skills (p= 0.08), family opposition (p= 0.14), high initial investment (p= 0.07), lack of extension activities (p= 0.08), poor understanding of tree management (p= 0.10), and limited land availability (p= 0.06) viewed as a hinderance in agroforestry system was not statistically significantly different across the blocks but limited product availability (p= 0.01), limited cash availability (p= 0.02) and absence of a guiding agroforestry policy (p= 0.03) was statistically significant. Similar to the findings of this study, Catacutan and Naz (2015) and Nishad *et al.* (2024) found that high initial investment and Birhanu and Guye (2022) found that limited product was seen as a major hindrance by males. Similar to the results of this study, the study conducted by Palsaniya *et al.* (2010) also revealed that lack of understanding on tree management, small land holding, marketing constraint and high investment were major hurdles in the adoption of agroforestry in Bundelkhand region. Similar constraints were also observed by Dogra *et al.* (2022) in Rajasthan.

Recommendations suggested by the farmers for adoption of agroforestry systems: In Sultanpur district, five key agroforestry interventions were identified: policy support, training in value-added product development, tree management training, access to microcredit, and improved transport and storage infrastructure (Table 6). Across all the blocks, development of infrastructure for transport and storage (69%), training on production of value-added products (76%), tree management (60%), provision of easy micro-credit arrangements (73%), and policy modifications (66%) were seen as interventions, the highest in males and least by females. There was no statistically significant difference across the blocks for development of infrastructure (p= 0.98) and policy interventions in agroforestry systems (p= 0.07) but training on value-added product development (p= 0.02), tree management (p= 0.01), and micro-credit arrangements (p= 0.01) were statistically significant. This study conforms to the study of Catacutan and Naz (2015) in Northwest Vietnam, who found that males recommended for better infrastructure for transport and storage in agroforestry systems as compared to

Table 3. Gender-wise farmers access to resources in agroforestry systems in Sultanpur district

Access to	G	OV (N=700) No.(%)	BD (n=50) No.(%)	AN (n=50) No.(%)	DO (n=50) No.(%)	DH (n=50) No.(%)	LB (n=50) No.(%)	KD (n=50) No.(%)	KM (n=50) No.%	BH (n=50) No.(%)	DB (n=50) No.(%)	KB (n=50) No.(%)	PT (n=50) No.(%)	JS (n=50) No.(%)	MO (n=50) No.(%)	KU (n=50) No.(%)	*p-value*
Land ownership	M	457(65)	23(46)	19(38)	28(56)	28(56)	34(68)	43(86)	36(72)	45(90)	46(92)	32(64)	32(64)	27(54)	34(68)	30(60)	2.29
	F	40(6)	7(14)	7(14)	3(6)	2(4)	3(6)	1(2)	1(2)	0	1(2)	4(8)	2(4)	3(6)	3(6)	3(6)	
	B	203(29)	20(40)	24(48)	19(38)	20(40)	13(26)	6(12)	13(26)	5(10)	3(6)	14(28)	16(32)	20(40)	13(26)	17(34)	
Land transfer rights	M	399(57)	26(52)	23(46)	26(52)	25(50)	26(52)	25(50)	31(62)	32(64)	46(92)	31(62)	35(70)	25(50)	25(50)	23(46)	0.0009
	F	43(6)	7(14)	2(4)	4(8)	5(10)	2(4)	3(6)	4(8)	2(4)	1(2)	4(8)	2(4)	1(2)	4(8)	2(4)	
	B	258(37)	17(34)	25(50)	20(40)	20(40)	22(44)	22(44)	15(30)	16(32)	3(6)	15(30)	13(26)	24(48)	21(42)	25(50)	
Loans	M	224(32)	13(26)	29(58)	14(28)	13(26)	17(34)	11(22)	20(40)	15(30)	15(30)	19(38)	14(28)	14(28)	17(34)	13(26)	0.2
	F	71(10)	6(12)	6(12)	5(10)	5(10)	6(12)	4(8)	1(2)	5(10)	6(12)	7(14)	5(10)	5(10)	5(10)	5(10)	
	B	405(58)	31(62)	15(30)	31(62)	32(64)	27(54)	35(70)	29(58)	30(60)	29(58)	24(48)	31(62)	31(62)	28(56)	32(64)	
Trainings	M	455(65)	33(66)	34(68)	30(60)	34(68)	34(68)	36(72)	34(68)	30(60)	33(66)	33(66)	29(58)	28(56)	33(66)	34(68)	0.09
	F	32(5)	7(14)	3(6)	0	4(8)	2(4)	1(2)	1(2)	1(2)	1(2)	3(6)	1(2)	0	4(8)	4(8)	
	B	213(30)	10(20)	13(26)	20(40)	12(24)	14(28)	13(26)	15(30)	19(38)	16(32)	14(28)	20(40)	22(44)	13(26)	12(24)	
Seeds	M	461(66)	36(72)	32(64)	32(64)	29(58)	35(70)	36(72)	33(66)	29(58)	32(64)	32(64)	36(72)	34(68)	30(60)	35(70)	0.08
	F	41(6)	7(14)	4(8)	2(4)	0	3(6)	7(14)	2(4)	3(6)	2(4)	0	3(6)	2(4)	3(6)	3(6)	
	B	198(28)	7(14)	14(28)	16(32)	21(42)	12(24)	7(14)	15(30)	18(36)	16(32)	18(36)	11(22)	14(28)	17(34)	12(24)	
Irrigation facilities	M	534(76)	40(80)	37(74)	39(78)	39(78)	39(78)	37(74)	35(70)	36(72)	39(78)	39(78)	40(80)	36(72)	39(78)	39(78)	0.25
	F	26(4)	7(14)	3(6)	2(4)	2(4)	2(4)	2(4)	2(4)	1(2)	1(2)	0	1(2)	0	1(2)	2(4)	
	B	140(20)	3(6)	10(20)	9(18)	9(18)	9(18)	11(22)	13(26)	13(26)	10(20)	11(22)	9(18)	14(28)	10(20)	9(18)	
Market	M	558(80)	40(80)	39(78)	39(78)	40(80)	39(78)	42(84)	36(72)	41(82)	46(92)	41(82)	39(78)	40(80)	39(78)	37(74)	0.053
	F	24(3)	7(14)	2(4)	2(4)	3(6)	0	1(2)	1(2)	0	1(2)	2(4)	2(4)	0	2(4)	1(2)	
	B	118(17)	3(6)	9(18)	9(18)	7(14)	11(22)	7(14)	13(26)	9(18)	3(6)	7(14)	9(18)	10(20)	9(18)	12(24)	
Harvest	M	375(54)	26(52)	29(58)	25(50)	28(56)	25(50)	25(50)	27(54)	27(54)	26(52)	25(50)	27(54)	29(58)	31(62)	25(50)	0.98
	F	45(6)	7(14)	3(6)	2(4)	2(4)	3(6)	3(6)	3(6)	4(8)	3(6)	3(6)	3(6)	2(4)	5(10)	2(4)	
	B	280(40)	17(34)	18(36)	23(46)	20(40)	22(44)	22(44)	20(40)	19(38)	21(42)	22(44)	20(40)	19(38)	14(28)	23(46)	

p-values represent the outcome of a chi-square test; G: Gender; M: Male; F: Female; B: Both. OV: Overall; BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

Table 4. Gender-wise participation in decision making by farmers in maintaining agroforestry systems in Sultanpur district

Activities	G	OV (N=700) No.(%)	BD (n=50) No.(%)	AN (n=50) No.(%)	DO (n=50) No.(%)	DH (n=50) No.(%)	LB (n=50) No.(%)	KD (n=50) No.(%)	KM (n=50) No.%	BH (n=50) No.(%)	DB (n=50) No.(%)	KB (n=50) No.(%)	PT (n=50) No.(%)	JS (n=50) No.(%)	MO (n=50) No.(%)	KU (n=50) No.(%)	*p-value*
Planting of species	M	88(13)	8(16)	4(8)	6(12)	7(14)	7(14)	8(16)	6(12)	6(12)	6(12)	5(10)	6(12)	8(16)	7(14)	4(8)	
	F	119(17)	8(16)	12(24)	6(12)	5(10)	6(12)	8(16)	17(34)	8(16)	12(24)	8(16)	7(14)	9(18)	9(18)	4(8)	
	B	493(70)	34(68)	34(68)	38(76)	38(76)	37(74)	34(68)	27(54)	36(72)	32(64)	37(74)	37(74)	33(66)	34(68)	42(84)	
Which area to plant	M	395(56)	19(38)	39(78)	22(44)	30(60)	29(58)	24(48)	33(66)	19(38)	29(58)	38(76)	37(74)	19(38)	28(56)	29(58)	1.04
	F	61(9)	7(14)	7(14)	2(4)	5(10)	4(8)	6(12)	6(12)	8(16)	0	3(6)	2(4)	2(4)	5(10)	4(8)	
	B	244(35)	24(48)	4(8)	26(52)	15(30)	17(34)	20(40)	11(22)	23(46)	21(42)	9(18)	11(22)	29(58)	17(34)	17(34)	
How many numbers to plant	M	420(60)	19(38)	39(78)	21(42)	30(60)	30(60)	23(46)	29(58)	19(38)	28(56)	36(72)	35(70)	37(74)	38(76)	36(72)	8.02
	F	61(9)	7(14)	7(14)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	0	4(8)	7(14)	1(2)	4(8)	1(2)	
	B	219(31)	24(48)	4(8)	27(54)	15(30)	16(32)	22(44)	15(30)	23(46)	22(44)	10(20)	8(16)	12(24)	8(16)	13(26)	
Season of planting	M	432(62)	22(44)	39(78)	20(40)	30(60)	30(60)	24(48)	29(58)	19(38)	30(60)	38(76)	36(72)	38(76)	39(78)	38(76)	4.22
	F	62(9)	7(14)	7(14)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	0	3(6)	9(18)	2(4)	3(6)	1(2)	
	B	206(29)	21(42)	4(8)	28(56)	15(30)	16(32)	21(42)	15(30)	23(46)	20(40)	9(18)	5(10)	10(20)	8(16)	11(22)	
Financial management	M	416(59)	19(38)	27(54)	20(40)	30(60)	30(60)	23(46)	29(58)	19(38)	29(58)	36(72)	39(78)	38(76)	39(78)	38(76)	1.64
	F	54(8)	7(14)	8(16)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	0	1(2)	2(4)	1(2)	4(8)	1(2)	
	B	230(33)	24(48)	15(30)	28(56)	15(30)	16(32)	22(44)	15(30)	23(46)	21(42)	13(26)	9(18)	11(22)	7(14)	11(22)	
Fertigation	M	427(61)	29(58)	27(54)	20(40)	30(60)	30(60)	23(46)	29(58)	19(38)	31(62)	37(74)	39(78)	36(72)	39(78)	38(76)	5.97
	F	58(8)	7(14)	8(16)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	0	3(6)	2(4)	2(4)	5(10)	1(2)	
	B	215(31)	14(28)	15(30)	28(56)	15(30)	16(32)	22(44)	15(30)	23(46)	19(38)	10(20)	9(18)	12(24)	6(12)	11(22)	
Irrigation	M	437(62)	30(60)	36(72)	20(40)	30(60)	30(60)	24(48)	29(58)	19(38)	33(66)	37(74)	39(78)	35(70)	37(74)	38(76)	4.51
	F	61(9)	7(14)	7(14)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	6(12)	3(6)	2(4)	2(4)	3(6)	1(2)	
	B	202(29)	13(26)	7(14)	28(56)	15(30)	16(32)	21(42)	15(30)	23(46)	11(22)	10(20)	9(18)	13(26)	10(20)	11(22)	
Pruning	M	422(60)	16(32)	30(60)	21(42)	30(60)	30(60)	24(48)	33(66)	19(38)	32(64)	38(76)	39(78)	36(72)	37(74)	37(74)	2.44
	F	61(9)	7(14)	7(14)	2(4)	5(10)	4(8)	5(10)	5(10)	8(16)	7(14)	2(4)	2(4)	2(4)	3(6)	2(4)	
	B	217(31)	27(54)	13(26)	27(54)	15(30)	16(32)	21(42)	12(24)	23(46)	11(22)	10(20)	9(18)	12(24)	10(20)	11(22)	
Harvesting	M	412(59)	14(28)	30(60)	22(44)	30(60)	30(60)	24(48)	30(60)	19(38)	32(64)	36(72)	35(70)	35(70)	36(72)	39(78)	1
	F	63(9)	7(14)	6(12)	2(4)	5(10)	4(8)	5(10)	6(12)	8(16)	7(14)	2(4)	2(4)	1(2)	1(2)	7(14)	
	B	225(32)	29(58)	14(28)	26(52)	15(30)	16(32)	21(42)	14(28)	23(46)	11(22)	12(24)	13(26)	14(28)	13(26)	4(8)	
Sale	M	515(74)	33(66)	36(72)	42(84)	37(74)	43(86)	35(70)	38(76)	36(72)	38(76)	32(64)	35(70)	36(72)	37(74)	37(74)	0.37
	F	59(8)	6(12)	7(14)	1(2)	4(8)	3(6)	4(8)	5(10)	5(10)	7(14)	5(10)	2(4)	3(6)	6(12)	1(2)	
	B	126(18)	11(22)	7(14)	7(14)	9(18)	4(8)	11(22)	7(14)	9(18)	5(10)	13(26)	13(26)	11(22)	7(14)	12(24)	
Processing	M	528(75)	38(76)	37(74)	36(72)	38(76)	36(72)	34(68)	37(74)	43(86)	44(88)	32(64)	38(76)	39(78)	37(74)	39(78)	0.002
	F	43(6)	7(14)	5(10)	2(4)	1(2)	0	1(2)	4(8)	4(8)	5(10)	1(2)	4(8)	5(10)	3(6)	1(2)	
	B	129(18)	5(10)	8(16)	12(24)	11(22)	14(28)	15(30)	9(18)	3(6)	1(2)	17(34)	8(16)	6(12)	10(20)	10(20)	
Owner of trees	M	527(75)	39(78)	37(74)	35(70)	37(74)	38(76)	39(78)	36(72)	39(78)	38(76)	39(78)	37(74)	39(78)	37(74)	37(74)	0.07
	F	66(9)	7(14)	4(8)	2(4)	6(12)	3(6)	3(6)	13(26)	4(8)	4(8)	6(12)	3(6)	5(10)	3(6)	3(6)	
	B	107(15)	4(8)	9(18)	13(26)	7(14)	9(18)	8(16)	1(2)	7(14)	8(16)	5(10)	10(20)	6(12)	10(20)	10(20)	

p-values represent the outcome of a chi-square test. G: Gender; M: Male, F: Female; B: Both. OV: Overall; BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

Table 5. Gender-wise constraints faced by farmers in adoption of agroforestry systems in Sultanpur district

Factors	G	OV (N=700) No.(%)	BD (n=50) No.(%)	AN (n=50) No.(%)	DO (n=50) No.(%)	DH (n=50) No.(%)	LB (n=50) No.(%)	KD (n=50)	KM (n=50) No.%	BH (n=50) No.(%)	DB (n=50) No.(%)	KB (n=50) No.(%)	PT (n=50) No.(%)	JS (n=50) No.(%)	MO (n=50) No.(%)	KU (n=50) No.(%)	*p-value*
Lack of transportation	M	464(66)	34(68)	32(64)	36(72)	34(68)	34(68)	34(68)	25(50)	32(64)	33(66)	33(66)	34(68)	34(68)	35(70)	34(68)	0.1
	F	71(10)	7(14)	8(16)	0	1(2)	2(4)	4(8)	12(24)	8(16)	5(10)	8(16)	2(4)	6(12)	4(8)	4(8)	
	B	165(24)	9(18)	10(20)	14(28)	15(30)	14(28)	12(24)	13(26)	10(20)	12(24)	9(18)	14(28)	10(20)	11(22)	12(24)	
Limited business and negotiation skills	M	484(69)	34(68)	32(64)	39(78)	36(72)	37(74)	36(72)	28(56)	33(66)	34(68)	34(68)	35(70)	35(70)	35(70)	36(72)	0.08
	F	73(10)	7(14)	7(14)	1(2)	1(2)	0	5(10)	13(26)	9(18)	5(10)	8(16)	4(8)	6(12)	4(8)	3(6)	
	B	143(20)	9(18)	11(22)	10(20)	13(26)	13(26)	9(18)	9(18)	8(16)	11(22)	8(16)	11(22)	9(18)	11(22)	11(22)	
Family opposition	M	519(74)	38(76)	34(68)	41(82)	39(78)	40(80)	37(74)	30(60)	36(72)	36(72)	36(72)	39(78)	38(76)	38(76)	37(74)	0.14
	F	73(10)	7(14)	10(20)	4(8)	4(8)	0	5(10)	13(26)	5(10)	4(8)	7(14)	2(4)	3(6)	4(8)	5(10)	
	B	108(15)	5(10)	6(12)	5(10)	7(14)	10(20)	8(16)	7(14)	9(18)	10(20)	7(14)	9(18)	9(18)	8(16)	8(16)	
Limited products	M	553(79)	42(84)	36(72)	43(86)	43(86)	42(84)	39(78)	32(64)	39(78)	38(76)	37(74)	42(84)	40(80)	39(78)	41(82)	0.01
	F	62(9)	7(14)	6(12)	0	1(2)	1(2)	4(8)	12(24)	7(14)	5(10)	8(16)	1(2)	4(8)	3(6)	3(6)	
	B	85(12)	1(2)	8(16)	7(14)	6(12)	7(14)	7(14)	6(12)	4(8)	7(14)	5(10)	7(14)	6(12)	8(16)	6(12)	
High initial investment	M	504(72)	38(76)	31(62)	40(80)	40(80)	36(72)	36(72)	32(64)	36(72)	33(66)	35(70)	39(78)	34(68)	36(72)	38(76)	0.07
	F	70(10)	7(14)	7(14)	1(2)	1(2)	1(2)	5(10)	12(24)	7(14)	6(12)	8(16)	2(4)	6(12)	4(8)	3(6)	
	B	126(18)	5(10)	12(24)	9(18)	9(18)	13(26)	9(18)	6(12)	7(14)	11(22)	7(14)	9(18)	10(20)	10(20)	9(18)	
Lack of extension activities	M	519(74)	39(78)	33(66)	41(82)	41(82)	38(76)	37(74)	32(64)	36(72)	35(70)	35(70)	40(80)	36(72)	37(74)	39(78)	0.08
	F	68(10)	7(14)	6(12)	1(2)	1(2)	1(2)	5(10)	12(24)	8(16)	5(10)	8(16)	2(4)	5(10)	4(8)	3(6)	
	B	113(16)	4(8)	11(22)	8(16)	8(16)	11(22)	8(16)	6(12)	6(12)	10(20)	7(14)	8(16)	9(18)	9(18)	8(16)	
Poor understanding of tree management	M	450(64)	33(66)	27(54)	37(74)	36(72)	32(64)	31(62)	29(58)	31(62)	30(60)	29(58)	36(72)	30(60)	33(66)	36(72)	0.1
	F	74(11)	7(14)	6(12)	2(4)	1(2)	1(2)	5(10)	12(24)	8(16)	7(14)	9(18)	4(8)	5(10)	3(6)	4(8)	
	B	176(25)	10(20)	17(34)	11(22)	13(26)	17(34)	14(28)	9(18)	11(22)	13(26)	12(24)	10(20)	15(30)	14(28)	10(20)	
Limited land availability	M	497(71)	37(74)	34(68)	40(80)	40(80)	35(70)	35(70)	30(60)	34(68)	33(66)	33(66)	39(78)	33(66)	35(70)	39(78)	0.06
	F	67(10)	7(14)	6(12)	1(2)	1(2)	1(2)	5(10)	12(24)	8(16)	5(10)	8(16)	2(4)	4(8)	3(6)	4(8)	
	B	137(20)	6(12)	10(20)	9(18)	9(18)	14(28)	10(20)	8(16)	8(16)	12(24)	9(18)	9(18)	13(26)	12(24)	8(16)	
Limited cash availability	M	508(73)	38(76)	32(64)	38(76)	40(80)	37(74)	36(72)	31(62)	35(70)	36(72)	34(68)	40(80)	36(72)	37(74)	38(76)	0.02
	F	64(9)	7(14)	6(12)	0	1(2)	1(2)	5(10)	12(24)	8(16)	5(10)	8(16)	1(2)	4(8)	3(6)	3(6)	
	B	128(18)	5(10)	12(24)	12(24)	9(18)	12(24)	9(18)	7(14)	7(14)	9(18)	8(16)	9(18)	10(20)	10(20)	9(18)	
Absence of a guiding policy on agroforestry	M	490(70)	39(78)	29(58)	36(72)	38(76)	37(74)	35(70)	30(60)	36(72)	31(62)	33(66)	38(76)	35(70)	35(70)	38(76)	
	F	67(10)	7(14)	6(12)	1(2)	2(4)	1(2)	4(8)	12(24)	7(14)	6(12)	8(16)	2(4)	5(10)	3(6)	3(6)	0.03
	B	143(20)	4(8)	15(30)	13(26)	10(20)	12(24)	11(22)	8(16)	7(14)	13(26)	9(18)	10(20)	10(20)	12(24)	9(18)	

p-values represent the outcome of a chi-square test; G: Gender; M: Male; F: Female; B: Both. OV: Overall; BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

Table 6. Recommendations suggested by the farmers for adoption of agroforestry systems in Sultanpur district

Recommendations	G	OV (N=700) No.(%)	BD (n=50) No.(%)	AN (n=50) No.(%)	DO (n=50) No.(%)	DH (n=50) No.(%)	LB (n=50) No.(%)	KD (n=50) No.(%)	KM (n=50) No.%	BH (n=50) No.(%)	DB (n=50) No.(%)	KB (n=50) No.(%)	PT (n=50) No.(%)	JS (n=50) No.(%)	MO (n=50) No.(%)	KU (n=50) No.(%)	*p-value*
Develop infrastructure for transport and storage	M	485(69)	38(76)	36(72)	36(72)	34(68)	34(68)	36(72)	34(68)	31(62)	32(64)	33(66)	36(72)	33(66)	36(72)	36(72)	0.98
	F	23(3)	0	1(2)	2(4)	3(6)	2(4)	0	1(2)	2(4)	1(2)	2(4)	3(6)	3(6)	2(4)	1(2)	
	B	192(27)	12(24)	13(26)	12(24)	13(26)	14(28)	14(28)	15(30)	17(34)	17(34)	15(30)	11(22)	14(28)	12(24)	13(26)	
Training on production of value-added products	M	529(76)	40(80)	34(68)	41(82)	41(82)	41(82)	37(74)	30(60)	37(74)	38(76)	33(66)	41(82)	38(76)	39(78)	39(78)	0.02
	F	67(10)	7(14)	6(12)	1(2)	1(2)	1(2)	3(6)	13(26)	8(16)	5(10)	8(16)	2(4)	4(8)	4(8)	4(8)	
	B	104(15)	3(6)	10(20)	8(16)	8(16)	8(16)	10(20)	7(14)	5(10)	7(14)	9(18)	7(14)	8(16)	7(14)	7(14)	
Training in tree management	M	418(60)	32(64)	24(48)	30(60)	33(66)	30(60)	30(60)	27(54)	30(60)	30(60)	27(54)	32(64)	30(60)	30(60)	33(66)	0.01
	F	77(11)	7(14)	7(14)	0	1(2)	1(2)	6(12)	13(26)	9(18)	8(16)	9(18)	3(6)	6(12)	4(8)	3(6)	
	B	205(29)	11(22)	19(38)	20(40)	16(32)	19(38)	14(28)	10(20)	11(22)	12(24)	14(28)	15(30)	14(28)	16(32)	14(28)	
Easy micro-credit arrangement	M	513(73)	40(80)	32(64)	40(80)	41(82)	39(78)	37(74)	29(58)	36(72)	35(70)	32(64)	40(80)	37(74)	37(74)	38(76)	0.01
	F	68(10)	7(14)	6(12)	0	1(2)	2(4)	4(8)	13(26)	8(16)	6(12)	8(16)	1(2)	4(8)	5(10)	3(6)	
	B	119(17)	3(6)	12(24)	10(20)	8(16)	9(18)	9(18)	8(16)	6(12)	9(18)	10(20)	9(18)	9(18)	8(16)	9(18)	
Policy interventions	M	462(66)	36(72)	30(60)	35(70)	37(74)	34(68)	33(66)	27(54)	32(64)	31(62)	31(62)	35(70)	31(62)	34(68)	36(72)	0.07
	F	72(10)	7(14)	6(12)	1(2)	1(2)	1(2)	4(8)	13(26)	8(16)	7(14)	8(16)	3(6)	6(12)	4(8)	3(6)	
	B	166(24)	7(14)	14(28)	14(28)	12(24)	15(30)	13(26)	10(20)	10(20)	12(24)	11(22)	12(24)	13(26)	12(24)	11(22)	

p-values represent the outcome of a chi-square test; G: Gender; M: Male; F: Female; B: Both. OV: Overall; BD: Baldirai; AN: Akhand Nagar; DO: Dostpur; DH: Dhanpatganj; LB: Lambhua; KD: Kadipur; KM: Kamaicha; BH: Bhadaiya; DB: Dubeypur; KB: Kurebhar; PT: Pratappur; JS: Jaisinghpur; MO: Motigarpur; KU: Kurwar

that of females but contradicts the study of Birhanu and Guye (2022) and Nishad *et al.* (2024) who concluded that females and both the genders respectively perceived training on production of value-added products as a major intervention.

Conclusion

Men play a very dominant role in the agroforestry practices in Sultanpur district. Out of the nine farming activities, the highest involvement of males was in six activities and both the genders were involved the highest in rest of the activities such as tree planting, pruning and harvesting. Males had the highest access to land ownership, land transfer rights, training, seeds, irrigation facilities, market and harvesting and both the genders had access to loans. The males decided on matters such as the area to be planted, numbers of plants to be planted, season of planting, financial management, fertigation, irrigation, pruning, harvesting, sale of produce, processing and tree ownership. The decision on planting of species was taken by both the genders. Males viewed ten hindrances in adoption of agroforestry the highest being limited availability of products and suggested five interventions the highest being training on production of value-added products to increase the adoption of agroforestry systems. Females chose fruit trees whereas, men favoured economic trees. This study revealed that the male dominance in society still overshadows the needs and role of women in agroforestry. A societal change in mindset and strong policy intervention is the only hope for women empowerment.

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