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CONSTRAINTS AND LIMITED RESOURCES AFFECTING AGROFORESTRY PRACTICES INTEGRATED WITH FOOD AND CASH CROPS IN JHANSI DISTRICT, UTTAR PRADESH, INDIA

Abhishek, Alka Shrivastava, Astha Gupta
Department of Agroforestry, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.) India.

ABSTRACT----------
Agroforestry methods and their limitations were investigated in this study among a subset of farmers in Jhansi District (U. P.) India. Data were gathered from a total of 120 respondents through observations, in-person interviews, and a well-structured questionnaire. To analyze the data gathered, descriptive statistics were employed. The average age and size of farming families were 41 years and 10 people, respectively, indicating that farming was dominated by men. With an average farming experience of 14 years, over half (69.2%) of the farmers were literate. The most prevalent trees in the farmlands were Azadirachta indica, poplar, eucalyptus, and mango. Due to conservation education (32.5%) and forest guards (20.0%), the majority of farmers (70.8%) were aware of agroforestry practices, which preserve valuable trees and enhance agricultural output. In the (98.3%), a source of revenue (81.7%), and a source of food (80.3%). In the study area, the following factors hindered agroforestry practices: restricted usage of farm equipment (75%), poor access to finance facilities (70.8%), trees' rapid growth (68.3%), land tenure (65.8%), marketing channel (62.5%), and population growth (56.7%). Therefore, the study suggested that public and non-governmental extension agents educate farmers about agroforestry through workshops and community awareness campaigns, and that farmers receive support in the form of credit facilities, improved seeds or varieties, and soft loans for increased production.
KEYWORDS: *Agroforestry, Awareness, Benefits, Constraints, Conservation, Economic trees----------*

INTRODUCTION

Traditional agroforestry is also referred to as indigenous agroforestry or ethno-agroforestry, terms that highlight its basis in local ecological knowledge and cultural heritage (Kumar & Nair, 2004). In prehistoric times, hunters and gatherers planted the seeds of valuable fruit trees around their campfires, either intentionally or accidentally. This practice is considered the origin of traditional agroforestry, where these seeds later sprouted and developed into edible fruits, often nurtured alongside timber trees and medicinal plants (Udofia, 2010).

Agroforestry is defined as the intentional integration of trees and shrubs with crops and/or livestock to create a diverse, productive, and sustainable land-use system that offers both ecological and economic benefits (Nair, 1993). It emphasizes the reciprocal advantages between trees and crops, aiming to enhance land productivity, farmer income, and ecological stability. As a land-use system, agroforestry has been practiced for centuries across continents, especially in tropical and sub-tropical regions (Leakey, 2017).

Over the last century, agroforestry has evolved into a scientific discipline, focusing on quantitative assessments of its impact on soil fertility, crop yield, biodiversity conservation, and economic returns (Garrity, 2004). It is now widely recognized as a sustainable land management practice, particularly suitable for smallholder farmers, as it integrates food and timber production, and can even support livestock rearing (Sanchez, 1995). Such systems are especially valuable in sub-humid and semi-arid regions, where they aid in the restoration of degraded lands and support the maintenance of life-supporting ecosystems (Adeola, 2015; FAO, 2013).

Agroforestry plays a significant role in the production of both domestic commodities (such as fuelwood, timber, fruits, and fodder) and international trade commodities (including coconut, coffee, tea, cocoa, rubber, and gum). Furthermore, agroforestry can strategically support many countries in achieving critical national development goals, especially in the areas of environmental sustainability, food security, and poverty alleviation (Nair, 1993; Leakey, 2017; FAO, 2013). It has a favorable impact on food, fuel wood, and watershed management in towns and villages, making the food system more robust (FAO, 2011). Agroforestry helps farmers become more resilient

and raise household income by harvesting a variety of products at different times of the year. Additionally, the processing of tree products creates employment opportunities, thereby enhancing the national economy and promoting economic growth in rural areas (Garrity, 2004; FAO, 2013). Agroforestry systems can be adapted to a wide range of settings, including farms, landscapes, and individual plots. For instance, at the plot level, farmers may grow cereal crops alongside nitrogen-fixing trees to improve soil fertility. At the landscape level, communities can rehabilitate degraded areas using trees and shrubs, while at the farm level, trees may be planted along boundaries or in designated woodlots (Jose, 2009). Successful agroforestry systems reduce the risks associated with crop failure and dependency on chemical inputs, and they maximize positive interactions among system components, ultimately yielding a more valuable and sustainable output than conventional monoculture practices (Nair, 1993; Leakey, 2017).

Agroforestry is increasingly recognized as a core component of climate-smart agriculture, as noted by the Intergovernmental Panel on Climate Change (IPCC). Its potential for both climate change adaptation and mitigation was emphasized during the 2011 COP meetings in Durban (FAO, 2013). Additionally, its role in combating desertification and supporting ecosystem restoration has been acknowledged by the United Nations Convention to Combat Desertification (UNCCD). Despite these global endorsements, the adoption of agroforestry at the grassroots level remains uneven, particularly in semi-arid regions like Jhansi District in Uttar Pradesh, India, where agricultural productivity is constrained by land degradation, erratic rainfall, and limited livelihood diversification.

This study was conducted to understand the constraints and resource limitations faced by farmers in adopting agroforestry practices in Jhansi. The region was specifically chosen because it falls under the Bundelkhand zone—an area known for frequent droughts, soil erosion, and acute rural poverty, making it highly vulnerable to climate variability. Agroforestry holds great promise for this region by improving soil health, generating alternate income sources, and stabilizing ecosystems. However, despite its potential, the adoption of agroforestry remains low, often due to socio-economic, institutional, and technical barriers. Therefore, this study aims to explore the extent of awareness, adoption, and challenges in implementing agroforestry practices in Jhansi District, with the goal of informing policy and extension strategies tailored to local realities.

MATERIALS AND METHODS

Jhansi District, located in the Bundelkhand region of southern Uttar Pradesh, experiences a semi-arid to sub-humid tropical climate, characterized by hot summers, a monsoon season, and cool winters. The district lies between 24°11' and 25°57' North latitude and 78°10' and 79°25' East longitude, with an average elevation of around 285 meters above sea level.

Temperature

The region endures extreme temperatures, with summers (March to June) often exceeding 45°C, and winters (December to February) seeing minimum temperatures dropping to around 4–6°C.

Rainfall

Jhansi receives an average annual rainfall of about 850–1000 mm, the majority of which (approximately 90%) falls during the southwest monsoon season (June to September). The rainfall is highly variable, contributing to frequent droughts and agricultural uncertainty.

Vegetation

The natural vegetation of Jhansi falls under the tropical dry deciduous forest type. The landscape is dominated by sparse tree cover, scrub vegetation, and open grasslands, particularly on degraded or eroded soils. Common native and economic tree species include:
Azadirachta indica (Neem)
Butea monosperma (Palash)
Acacia nilotica (Babool)
Ziziphus mauritiana (Ber)
Anogeissus latifolia

Soil and Land Use

The soils are predominantly black soils (Vertisols) and red soils, moderately fertile but prone to erosion and nutrient depletion. The district is primarily agricultural, but land degradation due to deforestation, overgrazing,

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and poor rainfall management has encouraged interest in agroforestry and watershed development as sustainable land use options.

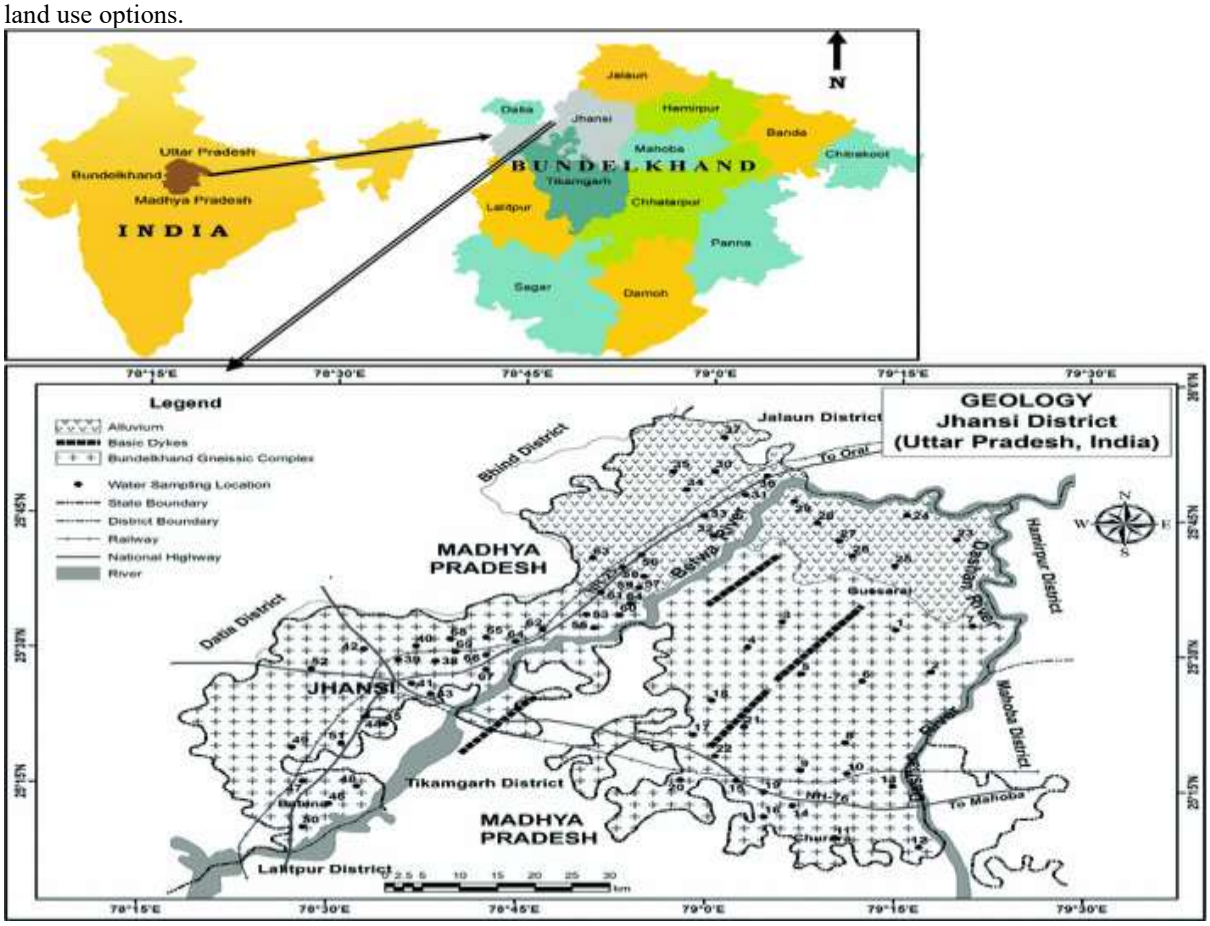


Fig 1: Map showing study location

Method of Data Collection

Data were collected through a structured questionnaire administered to selected farm producers in the study area. The questionnaire was designed to gather information on the types of crops and trees grown, land use patterns, socio-economic status, and awareness of agroforestry practices. Interviews were conducted in person, and data were cross-verified through field observations. Stratified random sampling was used to ensure representation from different villages and farming systems.

Plants Grown by Producers

The surveyed producers reported growing a variety of agricultural and agroforestry species. Common agricultural crops included:

- Cereals: Wheat (Triticum aestivum), Sorghum (Sorghum bicolor), and Maize (Zea mays)
- Pulses: Chickpea (Cicer arietinum) and Pigeonpea (Cajanus cajan)
- Oilseeds: Mustard (Brassica juncea)

Alongside these, several tree species were integrated into the farming systems, either on field boundaries or in woodlots. Frequently grown trees included:

- Neem (Azadirachta indica)
- Babul/Kikar (Vachellia nilotica)
- Subabul (Leucaena leucocephala)
- Ber (Ziziphus mauritiana)
- Mango (Mangifera indica)

These species were selected for their economic, ecological, and fuelwood value, as well as their compatibility with intercropping systems.

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RESULT AND DISCUSSION

Size of Field

The landholding size of the surveyed producers varied considerably, reflecting the diversity in socio-economic status and farming capacity within the study area. A majority of the farmers were smallholders, owning less than 2 hectares of cultivable land. Medium-scale farmers, with holdings between 2 to 5 hectares, constituted a significant portion, while a smaller group of respondents owned fields exceeding 5 hectares. Fragmentation of land due to generational division was commonly observed, which has contributed to reduced average land sizes over time. This variation in landholding size played a crucial role in influencing crop selection, agroforestry adoption, and overall farm productivity, with larger fields allowing for greater crop diversity and tree integration.

Age of producer

Farming in the Jhansi district was dominated by men. Men made up the majority of responders (65%), with women making up the remaining 35% (Table 1). this could be because of the energy requirements of farming, the unemployment rate, and government initiatives supporting agriculture. The mean age of the producer was 40.9 years, and 30% of them were in the economically active age range of 31–40 years. This is comparable to the mean age of 41.62 found among farmers in Kaduna State's Igabi Local Government Area (Ummuna et al., 2018). While the presence of a larger share of the economically active age group (typically 15–59 years) suggests a strong potential for increased agricultural productivity and food security, this result alone—indicating only the average age of producers—does not directly confirm an increase in food security. It simply reflects the demographic composition of the respondents. According to Asiabaka (2002), the economically active age group is inventive, driven, and receptive to advancements in agriculture—qualities that are essential for the adoption of improved farming technologies and practices. In the present study, the majority of respondents fell within this age group, with an average age indicating an active and potentially productive farming population. Furthermore, 67% of those surveyed were married, suggesting a level of social stability that can positively influence household labor availability and farm management. However, while these demographic characteristics are promising, they alone do not confirm an increase in food security in the country. The data presented reflect only the age and marital status of active producers, not actual food production, distribution, or access. To assess whether food security has improved, broader indicators—such as crop yield trends, food price stability, nutrition levels, and food accessibility—must be evaluated alongside demographic data.

Marital status and household size

About 20.8% of people were single, whereas 8.3% and 4.2%, respectively, were divorced or widowed. The results show that 67% of the surveyed producers were married, indicating that a majority of them have family responsibilities. This demographic detail highlights the potential socio-economic pressures on producers to ensure household food security and income stability. However, while it may be tempting to assume that such responsibilities would influence the adoption of agroforestry or other sustainable practices, this result alone does not provide direct evidence of the farming methods used. Further data would be needed to assess whether and how family structure influences the choice of agricultural practices, including agroforestry. The average household size was 10, indicating a medium family size, whereas 38.3% of farmers had 6–10 people living in their home. According to Nwaru (2004), a larger household would lessen the labor shortage in agricultural productivity.

Level of Education

The study revealed that 69.2% of the respondents were literate, having attained at least secondary education. Among them, 45.0% had completed secondary education, while 24.2% had pursued postsecondary education, including vocational training, diplomas, or higher degrees. The remaining 30.8% of respondents were either illiterate or had only primary-level education, indicating a notable divide in educational attainment among producers. This educational background may influence their ability to access, comprehend, and apply modern agricultural knowledge and technologies. According to a 2010 survey by the United States Agency for International Development (USAID), farmers are more likely to accept innovations if they have higher levels of education. This would make it easier for farmers to comprehend the idea of agroforestry.

Years of Experience

The average farming experience was roughly 14 years, with 4.2% of the farmers having 1–10 years, 22.5% having 11–20 years, and 33.3% having 21–30 years. This demonstrates that a sizable percentage of farmers were highly knowledgeable about farming.

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Table 1:- Personal Characteristics of the respondents

Variable	Chi-Square (χ^2)	p-value	Significance
Sex	10.80	0.0010	**Significant** ($p < 0.05$)
Age	4.00	0.2615	Not significant
Marital Status	118.33	1.76e-25	**Highly significant**
Household Size	28.47	2.90e-06	**Highly significant**
Education	22.60	4.89e-05	**Significant** ($p < 0.05$)
Experience	8.45	0.0146	**Significant** ($p < 0.05$)

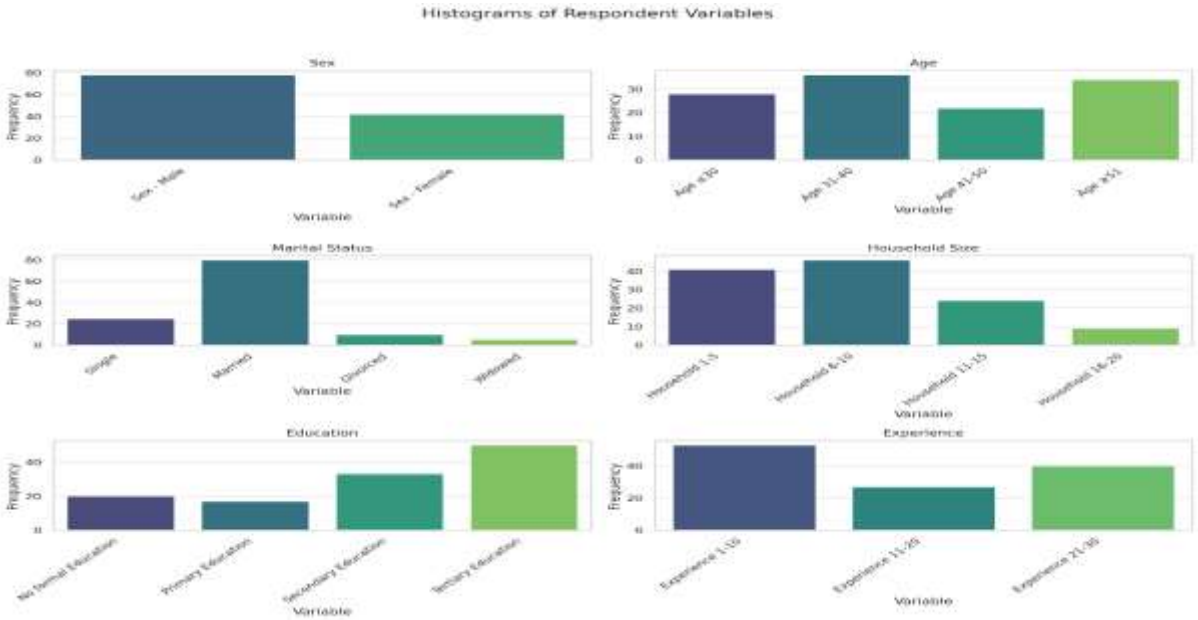


Fig 2: Histograms of respondent variables

Constraints to Agroforestry Practices

Limited use of machinery (75%), difficult access to credit (70%), trees' rapid growth (68.3%), land tenure (65.8%), and marketing channels (62.5%) were the main obstacles to agroforestry operations. The limited use of agricultural machinery among the surveyed producers appears to stem from multiple interrelated constraints. During interviews, many farmers cited the high cost of purchasing or renting equipment as a major barrier, particularly among smallholders with limited financial resources. Additionally, the presence of tree roots in agroforestry systems was reported to interfere with the efficient use of machinery, especially for ploughing and harvesting operations. Another commonly mentioned issue was the small and fragmented size of landholdings, often a result of traditional land tenure systems, which makes it impractical to operate large machinery. Several respondents also noted a lack of technical knowledge or training in the operation and maintenance of modern farm equipment.

These findings are consistent with earlier studies. For example, Akinbile (2007) noted that financial limitations and land fragmentation were significant barriers to mechanization among rural farmers in Nigeria. Similarly, Agwu et al. (2008) emphasized that limited access to extension services and training programs often results in low adoption of modern agricultural tools. In the context of agroforestry, Ajayi et al. (2003) observed that the physical layout of tree-crop interactions can limit mechanization options if not planned appropriately. These factors collectively illustrate the complexity of machinery use in small-scale, tree-integrated farming systems.

In the present study, only 22.5% of the producers reported being members of a cooperative or farmer group, while a significant 77.5% were not affiliated with any such organization. This lack of membership may partly explain the poor access to formal credit facilities and the limited bargaining power observed among respondents. Cooperative membership often enables farmers to pool resources, access subsidized inputs, receive training, and negotiate better prices for both inputs and produce. The absence of these advantages puts unaffiliated producers at a disadvantage, particularly in regions with weak rural financial infrastructure.

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These findings are supported by earlier research. According to Adejobi and Kormawa (2002), cooperative societies in rural Nigeria significantly improved farmers' access to credit and agricultural inputs. Likewise, Barrett (2008) highlights the role of collective action in enhancing smallholder market access and reducing transaction costs. The low level of participation in cooperatives, as revealed in this study, underscores a missed opportunity for empowering small-scale producers economically and institutionally. Fast-growing tree species were frequently reported by farmers as a constraint in the study area, primarily due to their tendency to develop large canopies that shade underlying arable crops, leading to reduced light penetration, lower yields, and suppressed crop growth. This aligns with the observation that unmanaged or densely spaced tree stands can outcompete crops for sunlight, water, and nutrients, especially in smallholder systems with limited spacing.

However, the study found that farmers do not always actively manage the types of trees on their farms. While some planted fruit or timber trees deliberately—such as mango (*Mangifera indica*), neem (*Azadirachta indica*), and eucalyptus (Eucalyptus spp.)—a large proportion of trees were naturally occurring woody recruits or native species left to grow along farm boundaries or within plots. These included species used for fuelwood, fodder, and traditional medicine, highlighting the multifunctionality of agroforestry species in the local rural economy. Another issue facing farmers in our culture is the land tenure system. Sometimes landowners are hesitant to fully lease their property for farming; when they do, strict terms may be imposed, making it challenging for farmers to get land. For farmers, marketing agricultural and forestry products can occasionally be challenging. Farmers have a number of marketing hurdles, including the distance between their farms and markets, transportation issues, poor road systems, customer attitudes that aim to defraud them, and processing and storage issues. It occasionally results in the waste of agricultural products, which lowers the income earned by long-term farmers. This outcome is comparable to the FAO's (2013) list of obstacles to agroforestry development.

Additional limitations include insufficient money (58.3%), which may have an impact on farm inputs, low or poor yield and a lower standard of living for farmers. Population growth (56.7%) raises demand for land, which fuels industrialization, competition, and agroforestry land scarcity. Another limitation is the lack of labor (50.8%), which means that well-educated and wealthy people that require hired labor to cultivate vast tracts of land are unable to obtain it. The high prevalence of illnesses and pests (50.8%) may be brought on by climate change and the related issues of drought and excessive rainfall. Poor yield, low quality or market value, and a poor return to households could arise from this (Mabel, 2015). According to the respondents, low soil fertility (32.5%), short growing season, poor yield and theft (46.7%), and limited access to extension services (41.7%) were the main obstacles to agroforestry. According to Mabel (2015), poor production and theft are equally significant restrictions, particularly when the soil is unfertile and the stands are situated in dangerous areas. However, because farmers are denied essential technologies that could increase their output, ineffective government extension services help to maintain Nigeria's low production yields. The findings above support Ibrahim et al. (2018).

Table 2:- Constraints to Agroforestry Practices

Constraint	Frequency	Percentage (%)	Ranking
Limited use of Machineries	90	75.0%	1st
Poor access to credit	85	70.8%	2nd
Fast growing nature of trees	82	68.3%	3rd
Land tenure	79	65.8%	4th
Marketing channel	75	62.5%	5th
Inadequate capital	70	58.3%	6th
Increase in population	68	56.7%	7th
Unavailability of labour	61	50.8%	8th
High incidence of pests and diseases	60	50.0%	9th
Poor yield and theft	56	46.7%	10th
Poor access to extension services	50	41.7%	11th
Poor soil fertility	39	32.5%	12th
Short growing season	33	27.5%	13th

CONCLUSION

The study revealed that conservation education was the primary source of farmers' awareness of agroforestry, playing a significant role in shaping their perception and understanding of sustainable land use. While a portion of the respondents had adopted agroforestry practices, the majority relied on naturally occurring trees and shrubs

rather than actively integrating tree species into their farming systems. This suggests a limited but emerging adoption of agroforestry, largely shaped by traditional knowledge and passive management.

Socio-economic and structural constraints—such as land fragmentation due to the prevailing land tenure system, restricted access to capital and machinery, and limited extension services—were major obstacles limiting broader adoption and optimization of agroforestry. Moreover, a lack of cooperative involvement among farmers further reduced their ability to access financial services and market linkages. These factors collectively hindered the full realization of agroforestry's potential benefits in enhancing livelihoods, ensuring sustainability, and contributing to rural development.

To foster wider adoption and impact, the study recommends targeted interventions, including strengthening farmer cooperatives, improving extension outreach, and providing financial and technical support to farmers interested in adopting agroforestry more actively.

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