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Farmers' Use and Preferences of Trees in Southern Punjab, Pakistan

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Abstract: Forest trees are used for multiple purposes, including various products, fruits, timber, resins, windbreaks, shelter, and gums by farmers worldwide. The study aimed to identify the forest tree types chosen by the agrarians in the lower areas of Punjab, including districts Multan, Dera Ghazi Khan, Lodhran, Vehari Muzaffargarh, Khanewal, and Bahawalpur. Altogether, 124 of the respondents were interviewed according to the prescribed questionnaire. The results showed that the young people (48%) had more experience in agroforestry and were willing to adopt the systems on their lands. The research survey observed that most (55%) of the local communities were using wood as a fuel, due to which there is a dire need for the forest trees on the farmlands to overcome the lack of fuel wood sources and the local communities preferred to plant *acacia nilotica* species (48.3%) and *eucalyptus camaldulensis* (14.9%) on their farm for their benefits, including fuel, wood, and fodder. *Mangifera indica* (19.5%) and *citrus sinensis* (9.2%) are used as fruit trees in their farmland. These results show that farmers used the agroforestry system i.e. silvo-arable, agro-horticulture silvo-pastural and agrosilvo-pastural to increase revenue, hence the need to improve the agroforestry system in these areas.

Keywords: Agroforestry; Southern-Punjab trees; Trees preference; Utilization; Multipurpose trees

INTRODUCTION

Agroforestry is an arrangement of trees with agriculture crops or animals in the same land management system (Eneji et al., 2004). Kalinganire et al., (2008) described Agroforestry as a careful addition of trees to crops or pastoral processes on the same land management, and in such a way that both ecological and economic benefits are realized from this system. Agroforestry is the best substitute to fulfil the requirement of timber and fuel wood (Eneji et al., 2004). In tropics and subtropics areas, farmers grow multipurpose trees and shrubs to achieve their economic benefits, including fruits, timber, and fuelwood, however, some of the farmers rely on annual crops like rice, wheat, and maize for their livelihood (Batish et al., 2007). Trees also help in terms of fodder for animals and provide timber for house constructions on a national and local basis (Simons & Leakey, 2004).

The potential of soil improvement and soil quality is improved by the forest trees when they are grown in combination with crops. In addition, trees also improve soil organic matter content, microclimate, soil biological and enzymatic activity, physical properties, and decomposition processes (Nazari et al., 2023). The primary function of implementing agroforestry is multipurpose products (Tian et al., 2001). Additionally, Trees i.e., legumes enhance soil nitrogen accessibility trough the nitrogen fixation process (N'goran et al., 2002).

Agroforestry system measured as a profitable technique for climate change mitigation (Nair & Garrity, 2012). In the agroforestry system, trees store the carbon woody biomass and in soils , and they might decrease greenhouse gas productions from the soils (Verchot et al., 2007). According to Nodza et al., (2013), trees are an essential part of the agriculture system. Most developing countries in the world have faced soil erosion, forest degradation, deforestation, and environmental degradation, causing land degradation and minimum income generation (Von Carlowitz, 1987).

Furthermore, different benefits are easily available for the rural livelihood from the trees to get household income. These products include (medicine, fuel wood, fodder, food, and building furniture) (Shackleton et al., 2011). It also provides a high amount of employment resources. Trees in agroforestry also provide shading, and fertility, preventing degradation, desertification, and land erosion (Oyewole & Carsky, 2001). Agroforestry plays a good role in the maintenance of ecological processes and biodiversity

connected to traditional economic activities (P. Udawatta et al., 2019).

For the past two decades, the farmers have been practicing their own experience and knowledge, which has gained value in the market and from the scientific community (Rist, 1991). Pakistan's national economy is also dependent on the trees grown along the crops playing a good role in the livelihood of households (Essa, 2011; Zada et al., 2022). Most of the plants grown in agroforestry practices are used for timber production and fuel wood purposes. Due to the extreme need for the products in the previous two decades, the demand for wood has increased sharply (Nouman et al., 2006). Farmers primarily work in agroforestry to get forage for their livestock. During different agroforestry practices in Punjab, it was observed that the local communities preferred agroforestry because they were getting double revenue from planting conventional crops and forest tree plantations (Rahman et al., 2008). In Punjab, this indigenous knowledge of planting native trees along with the crops is useful and a high revenue generator for the farmers (Awan & Aslam, 2015).

The primary objective of this research was to assess the specific utilization patterns, preferences, and practices of farmers regarding tree management on their farmlands in Southern Punjab, Pakistan. The study aimed to meticulously examine the agroforestry landscape, delineate the design strategies used by farmers, identify prevalent tree species, quantify their abundance on individual farms, the geographical locations of these farms. Through a detailed investigation, the current study insights into the intricate dynamics of agroforestry systems in the region, highlighting the deliberate choices made by farmers in terms of tree selection, placement, and overall farm design.

MATERIALS AND METHODS

Study Area

The study was conducted in seven districts of Punjab. The major cities included Multan, Dera Ghazi Khan, Lodhran, Vehari, Muzaffargarh, Khanewal, and Bahawalpur (see Figure 1). The Data was collected from seven different districts of Southern Punjab, Pakistan. The location of the districts is Multan (30.1575° N, 71.5249° E), Dera Ghazi Khan (30.0489° N, 70.6455° E), Lodhran (29.6869° N, 71.6673° E), Vehari (30.0442° N, 72.3441° E), Muzaffargarh (30.0736° N, 71.1805° E), Khanewal (30.2864° N, 71.9320° E), Bahawalpur (29.3544° N, 71.6911° E). The geophysical topography of the above-mentioned areas is very harsh. The climate of these terrains is relatively dry, having an average annual rainfall of about 150-250mm (Hamid et al. 2019). The summer season starts in March and ends in June when the temperature crosses 35 0C. In the monsoon season, there is scanty rainfall, and a small amount of precipitation occurs during winter. Summers are severely hot, and this combined with fewer rainfalls, results in more severe drought conditions (Aklibasinda et al., 2011).

Data Collection

The questionnaire was designed for the collection of data from the farmers of the village. Planned interviews were conducted along with the filling of a questionnaire having a set of ten questions. Snowballing techniques were used to get every single piece of information, either beneficial or detrimental. One hundred and twenty-four respondents were chosen randomly, and the snowballing technique helped find the leading farmers and professionals of agroforestry. The respondents were mainly farmers and experienced workers who knew their farmlands and tree plantations in between their farm fields. The study was conducted to understand the growing practices of the farmers, their status, and their preferences for the forest trees along with different crops. The data was collected from the area mentioned above by using the questionnaire and interviews with farmers. An interview implies an oral exchange of words between the interviewer and interviewee by inquire them about their overall opinion about agroforestry systems, their techniques to manage trees on their farmland, what and how much they achieve, and contribution to their overall economy. Different villages were selected to derive valid data from the survey questionnaire. The local communities and farmers were selected from these villages for the survey. Most of the respondents were from Dera Ghazi Khan (20). Secondly, the majority (19) of farmers were from Muzaffargarh. The farmer ratio from Bahawalpur, who was willing to participate in the survey, was about (18). Some of the respondents (19) were from Khanewal. About (17) of the farmers were from Lodhran, and a small amount of the respondents (15) were from Vehari, whereas; the remaining (16) farmers were from Multan (Table 1).

Table 1. Scales of Airveda Air quality monitor

Village	No. of Respondents
Bahawalpur	18
Muzaffargarh	19
Vehari	15
Dera ghazi khan	20
Multan	16
Lodhran	17
Khanewal	19
Total	**124**

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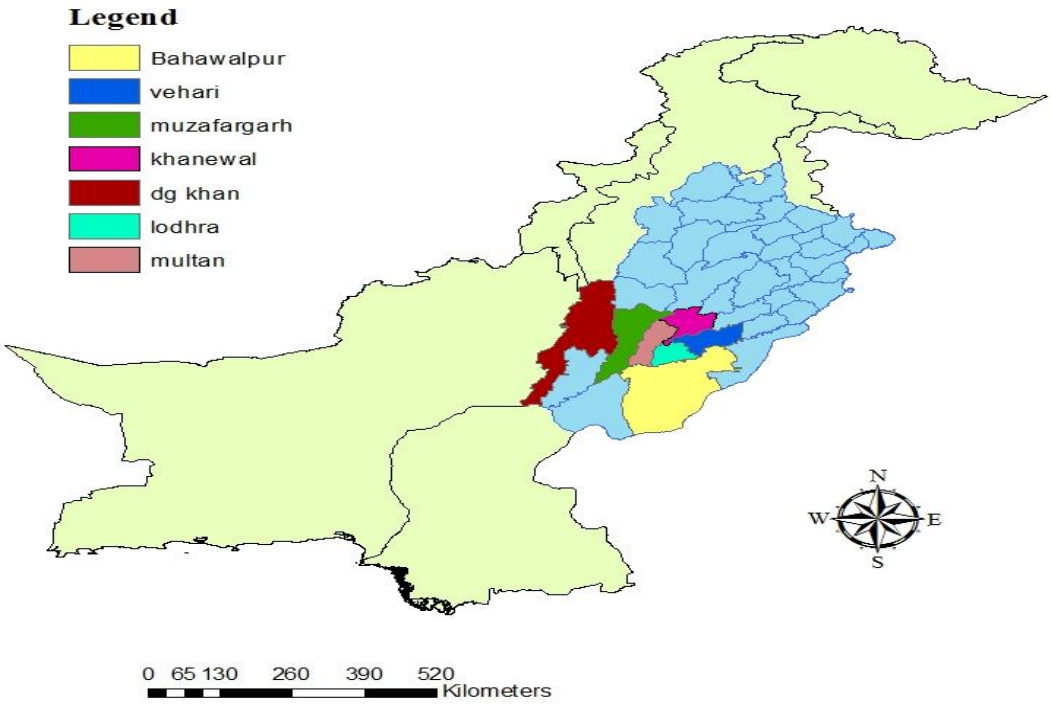

Figure 1. Study area map.

RESULTS AND DISCUSSION

Farmers Description

All (100%) of the respondents who participated in the survey and worked in the farmlands as agro foresters were male. The reason for involving total male respondents was that you cannot conduct interviews with the females. The respondents were of different age classes to determine the age correlation with experience and other variables. Descriptive analyses were done to show the preferences and interests of the local communities and farmers regarding agroforestry practices. Moreover, correlation tests were done to analyze the relation of various variables showing the agroforestry practices. The majority, (41.4%) of the respondents were of the age (of 51-60). Some (27.6%) of the respondents were of the age (61-70), and others (21.8%) were of the age (41-50), whereas the remaining (9.2 %) were of the age (30-40). During the survey, the respondents were asked about their education. The majority (50.8%) of the local communities were illiterate. The remaining (49.2%) of the respondents were literate, had primary education, and had a bit of know-how about agroforestry and the selection of tree species along with crops. Most of the respondents (39) stated that they have about (21-30) years of experience. Some (35) of the local communities involved in farming had (31-40) years of experience and some of the respondents (31) had less than 20 years of experience, while the remaining (19) respondents had a maximum (41-50) years' experience in crop growing (see Figure 2).

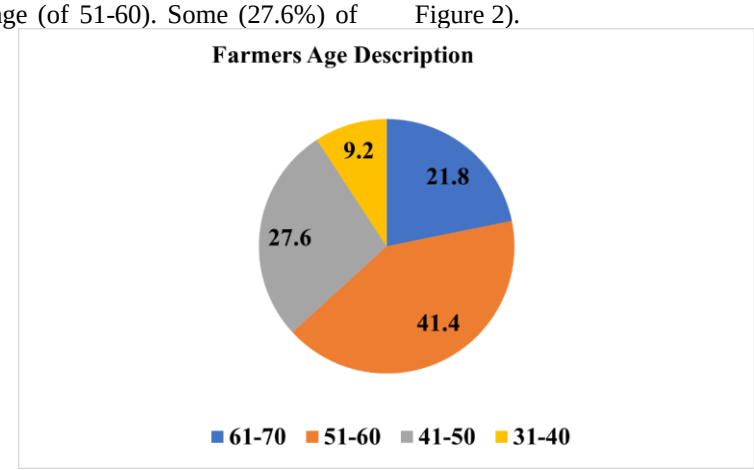

Figure 2. Age description of farmers included in the survey.

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Diversity of Tree Species

Table 2 shows the diversity of the tree species on the farmlands of the respondents. Twenty (20) different types of tree species were located on their farmlands. The *Acacia nilotica* tree species had the most diversity on their farmlands (71%), the second most cited species was *Eucalyptus camaldulensis* (55%). According to the respondent *Acacia nilotica* and *Eucalyptus camaldulensis* tree species are very common and easily grow in the southern area of Punjab and can survive in hot weather conditions. There were also other tree species diversity on the farmlands *Dalbergia sissoo* (55%), *Melia azedarach* (40%), *Azadirachta indica* (35%), *Albizia lebbeck* (31%), *Phoenix dactylifera* (30%), *Mangifera indica* (27%), *Citrus sinensis 24, and Ficus religiosa* had the lowest diversity (1%).

Most Preferred Tree Species

The farmers were asked about the important species present locally on agricultural lands. The majority (48.3%) of the respondents depicted that *Acacia nilotica* is the important tree species in the area to moderate climate change and survive in the mentioned study areas. Some (8%) of the people said that the most beneficial tree used for agroforestry systems is *Mangifera Indica*. Some (14.9%) of the locals stated that *Eucalyptus camaldulensis* is the species that is more beneficial. The respondents who were in favour of *Citrus sinensis* were about (19.5%), while the remaining (9.2%) stated that *Dalbergia sissoo* is the important tree species in the mentioned study areas (Table 3).

Table 2. Frequency of tree species cited by farmers, N= Native, I= Introduced, T = Timber, Fw= Fuelwood, S= Shade, M= Medicine, Hf= Human food, F= Fencing, Wb= Windbreak

Scientific Name	English Name	Local Name	Origin	Frequency (%)	Uses
Acacia nilotica	Acacia	Kikar	N	71	T
Eucalyptus camaldulensis	Eucalyptus	Safeda	I	55	FW
Dalbergia sissoo	Sheesham	Tali	N	55	T and Fw
Melia azedarach	Persian lilac	Bakain	N	40	M
Azadirachta indica	Neem	Neem	N	35	M
Albizia lebbeck	Lebbeck tree	Shareen	I	31	S
Phoenix dactylifera	Date palm	Khajoor	N	30	Hf
Mangifera indica	Mango Tree	Mango	I	27	Hf
Citrus sinensis	Orange Tree	Kino	I	24	Hf
Ziziphus mauritiana	Indian jujube	Ber	I	17	Hf
Cassia fistula	Indian laburnum	Amaltas	N	15	M
Psidium guajava	Guava	Amrood	I	13	Hf
Morus alba	Mulberry	Shehtoot	N	13	Hf
Syzygium cumini	Java plum	Jamun	N	13	Hf
Moringa oleifera	Drumstick tree	Soohajna	I	12	M
Conocarpus erectus	Conocarpus	Cono	I	9	F
Pongamia pinnata	Indian beech	Sukhchain	N	6	S
Grewia asiatica	Black currant	Falsa	I	1	Hf
Punica garantum	Pomegarante	Anar	I	1	Hf
Ficus religiosa	Peepal tree	Peepal	I	1	Wb

Table 3. Important tree species planted by farmers.

Species	Respondent Frequency	Percent
Acacia nilotica	60	48.39
Dalbergia sissoo	10	8.06
Eucalyptus camaldulensis	19	15.32
Mangifera Indica	24	19.35
Citrus Sinensis	11	8.87

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Use and Accessibility of Farmlands Trees

Trees are used in agroforestry land for different purposes and production of different products. These multi-products include fruit, nutrition fodder for livestock, timber, fuel wood for energy production, biomass, and medicines as a cure for diseases whereas daily-based benefits include: shelter from wind and sun, host to edible insects, bee habitats for pollination, nitrogen fixation, carbon capture, micro-climates modification, increment of soil carbon, control of erosion, groundwater recharge and better regulation of water among others (Farooq et al., 2018).

Utilization of Tree for Timber Production

Farmers were asked about the most important tree species present in their farmlands. Most of the farmers (48.3%) said that *Acacia nilotica* is the important species in the area to use for timber and survive in harsh weather conditions. The bark of this tree is also used for medicinal purposes. This tree species is also used as a religious perspective. The species is highly tolerant to water logging in some areas of these countries. It is also believed that the tree species enhances the growth of the rice fields by working as a fertilizer. The tree species is also used as a supplement for livestock during drought conditions (Rahim & Hasnain, 2010). These materials play an essential function in making the soil nutrients and richness. Trees also help in the carbon sequestration secreted by the industries and soil surface, which is (30%) in the above-ground biomass while (70%) is in below-ground biomass (Ramachandran Nair et al., 2010).

Use as Fuelwood and Fruit Production

Most farmers (22.8%) answered that they used *Dalbergia sissoo* and *Eucalyptus camaldulensis* as fuel-wood production on their agricultural lands. The majority of the (72%) fuel wood and timber requirements are fulfilled from the trees grown on private lands, based on agroforestry / social forestry/community forestry as compared with the state forests. Trees must be grown in conjunction with crops on private farmlands (Keenan et al., 2015).

The remaining (28.7%) of the local community used the agroforestry trees for fruit production on their farmlands and stated that *Mangifera indica* and *Citrus sinensis* are the most common tree species that are used for fruit production and generate extra revenue. However, most of the farmers denied answering questions about their annual/seasonal income, except for a few. Some of them mentioned that their income from fruit production is an average of four hundred thousand (PKR) per season, and they grow fruit trees. Additionally, those who do not grow fruit trees mentioned an average income of one hundred thousand (PKR) per season. In several countries, farmers prefer nuts and fruit-producing trees. The preference is mostly given in the home gardens and agroforestry systems in farms and other communal lands. The locals prefer indigenous trees which are beneficial regarding fruits balanced diet and adaptability to the environment along with the economic benefits. In rain-fed marginal soils, the agroforestry system is a viable enterprise. (Newaj & Rai, 2005).

Educational Benefits

Over (49.2%) of farmers who had a primary education stated that through the education agroforestry system, management skills, knowledge, and extension management can be increased (see Figure 3). According to Amaza & Tashikalma, (2003), the level of education improves the skills, management system, and knowledge, and leads towards a better system. Most of the landowners were not educated and do not understand agroforestry system management and its practices well. They mentioned that if they were educated, they could manage their land using sustainable practices and in accordance with market demand, which would also help reduce management risks. However, they did not get a chance to receive education about the agroforestry system, and there is no proper management support to promote and assist them in managing their lands.

Enhancing Soil Fertility

Agroforestry helps in enhancing soil fertility, and it also helps in the control of erosion and maintenance of organic matter (Sharma et al., 2017). Some of the forest trees help in the maintenance of nutrients for crops (Aju 2014). In the current study we find out by the ferment perspective soil fertility, maintenance and enhancement are vital for food security and they optimize their practices to best support the enhancement of soil properties while maximizing the agricultural crop product. In their study, Manna et al., (2003) observed that different agroforestry systems, i.e., agro-horticultural, agro-pastoral and agro-silvopasture, are highly effective for the restoration of soil and organic matter (Muhaimeed et al., 2014). Samra & Singh, (2000) stated that the increase in soil organic matter is due to the intercropping of forest trees and crops.

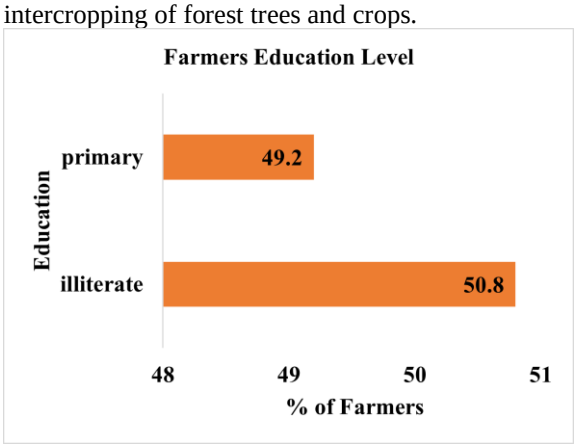

Figure 3. Education level of Farmers in the study area.

CONCLUSION

Agriculture is the main source of revenue for the people of the southern Punjab areas of Pakistan. Most farmers in these areas get their income from this source. However, nowadays, the local communities of Thal are focusing on agriculture and forestry as a primate source for their

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income. The study depicted that the cultivation of trees is more beneficial than the conventional cropping systems in which a single crop is grown for the entire year. Similarly, agroforestry is three times more profitable than conventional farming systems. Agroforestry is also more productive than just tree cropping. It was also observed that tree cropping is costly and time-consuming. Therefore, agroforestry is the primary choice for multipurpose trees and crops. An important outcome of this study is that it highlighted the local community's selection of different species in their lands. It is concluded that the young generation has significant experience in agroforestry systems and is willing to adopt these systems on their lands. The majority of the local communities are more reluctant about the answers regarding the annual income of their agroforestry because of the fairness of the tax implementation. The research survey observed that most of the local communities were using wood as a fuel, due to which there is a dire need for forest trees on the farmlands to overcome the lack of fuelwood sources. It was observed during the research survey that the local communities preferred Acacia species to plant on their farmlands to get more benefits, including fuel wood and fodder. Based on the findings, it is recommended that promoting agroforestry practices, particularly the cultivation of multipurpose tree species especially Fruit trees species, can significantly enhance income generation and address fuelwood scarcity in agricultural communities. Worldwide, policymakers and agricultural practitioners should consider integrating agroforestry into farming systems for sustainable economic and environmental benefits.

Author's contributions

All authors contributed to the conception and design of the study. Material preparation, NQ, MAA and MTI performed data collection and analysis. The first draft of the manuscript was written by NQ and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Statement and Declaration

We, the undersigned authors, declare that the submitted paper titled "Farmers' use and preferences of trees in Southern Punjab, Pakistan" is our original work. We affirm that this manuscript has not been previously published, is not currently under consideration for publication elsewhere, and does not contain any form of plagiarism. We confirm that the research presented in this paper complies with ethical standards and guidelines, including the proper treatment of human/animal subjects where applicable. The paper adheres to the submission guidelines and formatting requirements of Journal of Agroforestry System.

Conflict of Interest

There are no conflicts of interest declared by the authors.

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