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ORIGINAL RESEARCH

Farmer's Perception of and Factors Influencing Agroforestry Practices in the Indus River Basin, Pakistan

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Abstract

Agroforestry practices of farming communities are investigated in southern Punjab province, Pakistan. It is hypothesized that rural people of this areas are more inclined than elsewhere in the province to practice agroforestry due to greater profitability than cropping. A landholder survey revealed that the majority of farmers are inclined to plant trees on their land. Low accessibility of institutional credit is a constraint for both agroforestry farmers (AF) and non-agroforestry farmers. However, among AF respondents only 24% were found to need credit for agroforestry practice, as against nearly 76% for crop production. Mostly farmers were found to have positive perceptions regarding agroforestry practice, because they understand the multiple benefits from growing trees, compared with cropping where farmers face various constraints, including poor access to credit, natural hazards, and little support from local authorities. Further, effort to sensitize farmers that growing trees has multiple benefits compared to only cultivation of field crops can bring about change in farmer's perceptions and attitudes in the Indus River basin, resulting in motivation for agroforestry adoption.

Keywords Adoption of agroforestry · Agricultural credit · Barriers to tree planting · Farmer's attitudes · Community perceptions · Rural livelihoods

Introduction

Agroforestry is a land-use system that integrates trees and agricultural crops in various configurations. Agroforestry systems are an effective means of increasing productivity at the farm level. Tree planting amongst crops has great potential in

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terms of both livelihoods and productivity (Nair and Toth 2016). Tree growing is an important income generating practice for farmers in many rural areas of the world (Meijer et al. 2015). In developing countries, large portions of the steadily expanding populations still depend on agriculture and forest products for their livelihoods (Chao 2012). Tree growing as part of an agroforestry system is therefore a common practice among smallholder farmers in developing countries.

Agroforestry involves the combination of species for higher economic value and synergistic association and can provide benefits to smallholder farmers (Kessler et al.2012; Cerda et al. 2014). These plantations are a crucial resource for meeting smallholder farmer and community needs for timber, fuel-wood and various non-wood forest products (NWFPs) including cheiks (made from of *Sachrum munjah* and locally used for roof constructions), mates (made from the leaves of *Phonix dectilifera* and *P. typha* and used as carpets in villages), fruits, ropes and medicinal products, as well as environmental services, especially in developing countries (FAO 2006). Trees growing on farmland have economic advantages and contribute towards sustainable utilization of natural resources in terms of providing an opportunity for production of fodder, fuel-wood, timber, medicine and food, which otherwise might be taken from forest reserves (Udawatta and Jose 2012). Tree planting by smallholders may be integrated in various categories regularly recorded in land-use statistics for agricultural land, degraded land, urban areas (homestead forestry), forest land and land for other uses (e.g. canal and roadside plantings). While forest areas are declining, treed areas are increasing on farms (Richardson et al. 2012).

In order to understand the current and potential contributions of agroforestry to ecosystem services and rural development in developing countries, extensive research and sound statistical data are required. The latter are, however, absent from most official statistics (Rametsteiner and Whiteman 2014). It is reported by Belcher et al. (2005) that forest products make a substantial contribution in the life or shelter of 18% of the world's population or at least 1.3 billion people. Further, in Asia and Oceania, annual income generated through the production of NWFPs has a value of about 67.4 billion US$ (FAOSTAT 2016).

The characteristics of smallholders and their farms will influence their agroforestry adoption decision-making. It was observed by Ajayi et al. (2015) that farmers commonly show flexibility to adjust to technological advancements, and this can play a role in their adoption of agroforestry. Various studies have explored the impact of factors including social demography, technology adoption behavior and farmers' perceptions about tree planting. Further, positive perceptions of farmers about what they need for agroforestry adoption and level of risk associated with adoption can play a major role in tree planting decisions. Irshad et al.(2011) found that in Pakistan positive factors influencing tree planting in Swat district arise from farmers' perceptions of agroforestry as an income source and farmers' specific socio-economic characteristics, including age, education of household head, size of landholding and family size. Similar findings on factors determining tree planting decisions were found by Ndayambaje et al. (2012).

The most recent studies of tree planting on farms have shown that this activity is associated with socio-psychological factors, including farmer's perceptions and attitudes (Rezaei et al. 2018). In Pakistan, Zubair and Garforth (2006) explored

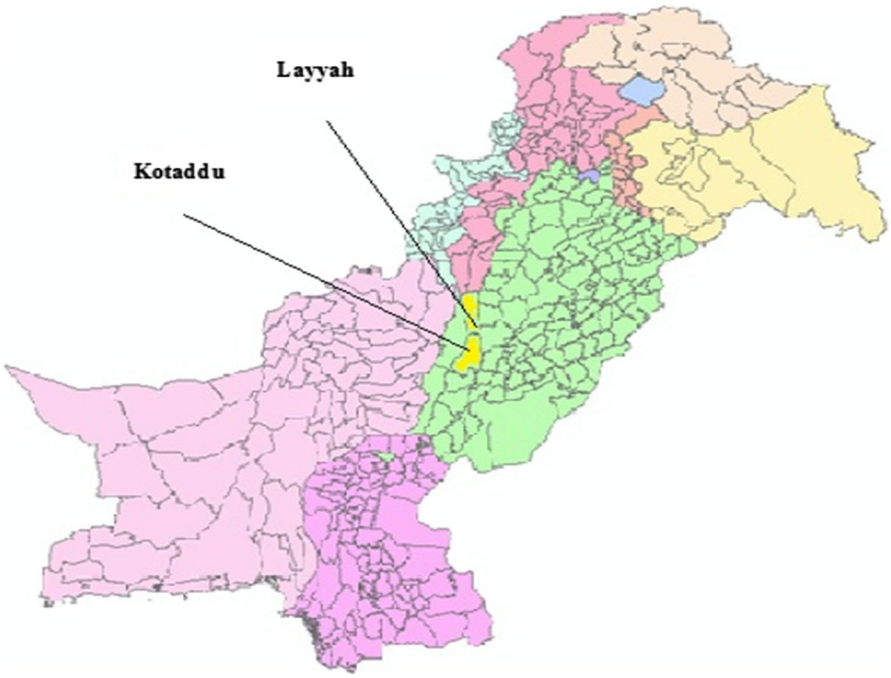

Fig. 1 Location of selected study site of Tehsil Layyah and Tehsil Kotaddu in Pakistan

farmers' perceptions and attitudes and found that they are willing to plant trees on their land because they believe there are multiple benefits of tree-planting, despite recognizing the various challenges to successful tree growing for agroforestry.

This study examines the role agroforestry plays in cash income generation, subsistence of rural people, and how farmers' perceptions and other factors influence their agroforestry participation. This study investigates the reasons why some farmers are inclined to adopt agroforestry in the Indus river basin. The study is ethnobotanical in that it examines the knowledge of indigenous people and explores the potential of agroforestry in the southern part of Punjab Province, Pakistan, with a view to providing a baseline for future comparison of agroforestry and non-agroforestry adopters in the study area and other areas of Punjab province.

The Study Area

The research was conducted in the Indus River Basin of southern Punjab Province (Fig. 1). Tehsil Layyah and Tehsil Kotaddu of districts Layyah and Muzaffargarh respectively were selected for the study because these districts are relatively underdeveloped, and the farmers have limited extension services, institutional credit availability, market access and other government services, with low adoption of modern technologies.

Geographically, Tehsil district Layyah is situated between 30°45′ and 31°24′ north latitude and 70°44′ and 71°50′ east longitude, while district Muzaffargarh lies between 28°57′ and 30°46′ north latitude and 70°30′ and 71°47′ east longitude. These districts are located between the Indus and Chanab Rivers in the western mountains of Koh Salaman. More specifically, the research is focused on four Union Councils[1] within the Tehsils of Layyah from district Layyah and Kotaddu from district Muzaffargagh. The UCs within Tehsil Layyah are Bakhri Ahmad Khan and Bait Wasawa Shumali, and the UCs within Tehsil Kotaddu are Biat Qaim Walla and Hunjrai.

The less developed southern part of Punjab province was purposively selected for this study because rural livelihoods are associated with tree growing and agriculture. The two study districts in southern Punjab province have most of their area within the Thal desert, and part within the Indus River basin. The Thal desert, which lies on the eastern side of the Indus River, is the third largest desert of Pakistan, and the western part of Thal desert faces frequent monsoon floods in the Indus River which result in major loss of crops and rural infrastructure. The annual rainfall is less than 300 mm, and climatic conditions generate risks to farming with adverse impacts on rural people's livelihoods and welfare (Bukhari and Rizvi 2015). The tree growing sites are located close (i.e. 5–16 km away) from the Indus Highway that runs along the Indus River basin in the western district of Dera Ghazi Khan and this offers the farming communities many possibilities for trade of various tree products.

The study area has very cold winters and is extremely hot in the summer. The 4 seasons are summer (May to July), autumn (August to October), winter (November to January) and spring (February to April). June has temperatures of up to 51 °C while December has minimums of about 2 °C. The region is arid, with an annual average rainfall of 300 mm (mostly during the monsoon season) and has high biodiversity values, particularly due to the presence of the Ramsar-listed Tuansa Barrage wetland. Monsoon rain occurs during June to September, and acts as a lifeline to the region and agrarian community. Variability of the summer monsoon rainfall is associated with the joys and sorrows of millions of people in Pakistan. However, heavy rainfall results in loss of life and severe damage to agriculture crops.

The region is facing increasing vulnerability to climate change, with damaging flash floods and hill torrents or *rodhkoki* becoming common during the monsoon season. The Indus has its source at an altitude of 5486 m in the Tibetan plateau of the northern part of the Himalayan Mountains and stretches to the Arabian Sea in Pakistan. The Indus is categorized as one of the largest rivers in the world in terms of its drainage area (960,000 km^2) and length (2880 km), with an average annual discharge of 7610 m^3/s (Khan et al. 2017).

[1] Administratively, Punjab province comprises 8 divisions, each of which has four districts that have 2 or more Tehsil councils, and there are 5–15 Union Councils (UCs) or small towns in a Tehsil council. This administrative hierarchy has been adopted in several countries of the Indian sub-continent since British colonization.

Research Method

This study was designed to examine the impact of age, education, classification of farmers (subsistence, economic and above economic farmers), and credit utilization by crop and agroforestry farmers. A survey of farmers was conducted in 16 villages, of four Union Councils, viz. Bakhri Ahmad Khan, Bait Wasawa Shumali, Biat Qaim Walla, and Hunjrai. In total, 82 farmers were selected from Bakhri Ahmad Khan and Bait Wasawa Shumali villages of Tehsil Layyah and 82 from Biat Qaim Walla and Hunjrai villages from Tehsil Kotaddu. Of these farmers, 82 were practicing agroforestry and 82 were practicing agricultural cropping. Due to missing information, because four respondents did not answer all questions, survey responses of 4 farmers were dropped, so the total sample size was 160 farmers.

Details of smallholder farmers were obtained from the *numberdar*, a key person present in each *mouza* who is nominated by their local authority as having ethno-botanical information of the *mouza*. The farmers were grouped based on their dominant land use (trees and crops versus just crops).

A questionnaire was designed for a landholder survey, to seek information about crops, tree growing and socioeconomic position of communities. The choice of data collected was designed to test hypotheses as to factors affecting adoption of agroforestry. These data concerned education, age, tenancy status, occupation, credit need and credit access through various sources, farm power (e.g. plough, tractor, tube-well), knowledge about agroforestry, farm income, and land-holding size.

Data were collected and analyzed to generate information about socio-economic and demographic variables. An attempt was made to keep questions simple and easy for farmers to understand. For the socio-demographic characteristics of the respondents the questionnaire included questions on education, gender, land-tenure, crops grown and use of credit.

Data regarding agroforestry and non-agroforestry practices, including their perceived advantages and disadvantages, were gathered through personal interview with the sampled farming households. Primary quantitative data were collected through structured, open-ended interviews of household heads if possible and otherwise another adult household member. As well, qualitative data were obtained through village meetings, eight focus group discussions (FGDs), key informant interviews (KII) and personal field observations. Both quantitative and qualitative data from field study sites were integrated and analysed, and often used to check the information obtained by quantitative analysis. The logic for conducting the focus group discussions was to obtain insights about how participant view tree planting as well as the variation and inconsistencies that prevail among the rural people in terms of their practices, experiences and beliefs.

In a second stage of sampling, two revenue villages or *mouzas* within each of the study's four Union Councils were selected, giving a total of 8 *mouzas* from the study area. These villages were purposively targeted because their farming communities have high dependence on agroforestry, NWFPs and agriculture for their

livelihoods. Large-scale timber and NWFP production has traditionally been a top income earner for these communities during the last decade. However, changing climatic conditions are creating serious risks for forestry, agricultural practices and water resource security, and are thereby affecting the livelihoods of the rural community. The sample size was 25–30% of the total number of households in each *mouza*. Selected households were interviewed with the Poverty Environment Network (PEN) prototype household questionnaire (described by CIFOR 2010) in combination with a supplementary NWFP-related household questionnaire. The PEN household questionnaires was used in two annual household surveys, one at the beginning of the survey year and one at the end, and two further household surveys were conducted to obtain a total survey year income depiction of households from diverse income derived from NWFPs and other forest wood products.

Data Analysis

The survey data were analyzed by calculating basic descriptive statistics including means and standard deviations and carrying out Chi square (χ^2) tests. Further, t-tests were performed to identify significant differences between the two study sites, in terms of barriers to tree growing and socio-demographic variables for agroforestry adopters and non-adopters. The analysis sought to determine if there are any significant differences between characteristics of the AF and NAF farmers and their farms, and how these characteristics may influence farmers' adoption of agroforestry. The outcomes of the focus group discussions were determined with the use of descriptive statistics and cross tabulation, using SPSS version 20.

Results

Tree plantations in the study area were found to have the advantage of both generating cash income and producing goods to support the livelihoods of the farming households. The most commonly adopted plantation systems were growing trees around the boundaries of the field crops and homesteads and in river basin areas. In the study area 7 trees species were found to be frequently grown, as well as various crops but particularly wheat, cotton, rice and sugarcane (Table 2). The AF farmers were found to often integrate their tree growing with the field crops. These farmers were found to be more inclined to grow trees due to their belief of the various benefits trees provide to them. The most common benefit perceived is future revenue from commercial timber sales. Other perceived benefits reported include the potential for the trees to provide forage for livestock, and to be a source of emergency income during natural disasters such as when flashfloods occur which destroy crops, this being frequent on farms in the Indus River basin.

Table 1 Socio-demographic characteristics variables of the AF and NAF farmers

Variable	AF	NAF	t-statistic	Sig (%)
Household head age (years)	42.4	46.7	− 3.761	1
Household head education (years)	4.45	2.88	3.631	1
Household family members	6.42	6.41	0.038	ns
Monthly income (US$)	95.54	78.29	1.932	10
Total landholding size (ha)	7.54	8.91	− 1.625	10
Farm to market distance (km)	6.28	6.93	− 1.875	10

Table 2 Characteristics of agroforestry species commonly planted to support farmer's livelihoods

Local common name	Scientific name	Use frequency	Performance	Price (PKR)
Grasses				
Munjah	*Saccharum munjah*	Frequently	+++	30/sqft
Vangrass	*Saccharum spontaneum*	Frequently	+++	350/kg
Timber trees				
Sufeda	*Eucalyptus camaldulensis*,	Frequently	+++	500/sqft
Shisham	*Dalbergia sissoo*	Occasionally	++	1200/sqft
Tamrix	*Tamarix dioica*	Frequently	+++	50/basket
Forage plants				
Sirris	*Albizia lebbeck*	Occasionally	++	300/tree
Fruits				
Khajoor, *Am*, *Beri*	*Phoenix dactylifera*, *Mangifera indica*, *Ziziphus mauritiana*	Frequently	+++	80/kg
Medicinal plants				
Dhmaan	*Datura fastuosa*, *Fagonia bruguieri*	Rarely	+	150/kg

*Performance was ranked by respondents as: +++—very good, ++—satisfactory, +—poor

Socio-demographic Characteristics Variables

The AF farmers had a mean average age of 42.3 years, which was lower than that of NAF farmers. They also had a larger landholding size, larger household and greater monthly income than the NAF farmers, and were located a greater distance from a sealed road and local market. AF farmers also had more years of education than NAF farmers. Their number of family members and monthly income averaged 6.4 individuals and US $95.54 (Table 1).

Species Commonly Planted to Support Farmer Livelihoods

Characteristics of the tree species commonly planted to support the livelihoods of the participating farmers are listed in Table 2. This includes details of the perceived

Table 3 Characteristics of agroforestry (AF) and non-agroforestry (NAF) farmers in the Indus River basin

Characteristic	Categories	Frequency			χ^2 statistic
		AF	NAF	Total	
Age	Young < 35	36	14	25	8.14*
	Middle-aged (35–50)	51	37	44	
	Old (≥ 50)	12	46	29	
Education	Illiterate	16	41	24	8.29*
	Primary	20	32	31	
	Above primary	64	27	45	
Landholding type	Subsistence	54	52	53	2.62
	Economic	31	21	19	
	Above economic	15	27	27	
Credit requirement	Agroforestry	24	20	27	11.30**
	Agricultural crops	76	80	73	
Access to credit	Formal credit	2	24	11	2.21
	Informal credit	5	76	38	

**Highly significance; *significance

performance of the species and market prices (in PKR) which are normally received for local sales of the tree products. Overall, it is evident that the AF farmers perceived there to be more benefits from tree planting than did NAF farmers.

Farmer Age

Farmers were classified into three age categories, viz. young (below 35 years), medium (35–60 years) and old (above 60 years). The AF farmers are distributed among the young and middle-aged groups, with a much lower percentage in the old category, but the NAF group is dominated by older farmers. The data suggest that farmer age has a critical influence on agroforestry adoption. The middle-aged and younger farmers are more inclined to adopt agroforestry. The old AF farmers were less interested in agroforestry (12%) compared to the NAF farmers (25%) ($\chi^2 = 8.141$, $p < 0.05$).Sharmin and Rabbi (2016) reported that younger farmers are more innovative and show more interest in adoption of new technologies such as agroforestry.

Farmer Education

Farmer education levels (Table 3) are categorized as illiterate and primary level or above (farmers having less than 5 years education, and those having more than 5 year's education respectively). For the AF farmers, 16% were illiterate (cannot read or write) compared to 41% of the NAF farmers. A high proportion of AF farmers had above primary-level education (64%) compared to the NAF farmers (27%).

Table 4 AF and NAF farmers' perceptions regarding tree planting

Perception statement	AF		NAF	
	Mean	SD	Mean	SD
Increase and complement household income	0.735	0.024	0.513	0.123
Provide timber, fuel-wood and NWFPs	0.641	0.168	0.591	0.191
Control erosion	0.194	0.081	0.287	0.087
Provide shade for animals and humans	0.753	0.121	0.579	0.089
Control pollution	0.124	0.042	0.323	0.101
Create problems in agricultural operations	0.398	0.121	0.848	0.152
Incur higher costs	0.325	0.115	0.425	0.084
Reduce crop production	0.372	0.072	0.796	0.163
Harbor insect sand pests that damage crops	0.282	0.082	0.246	0.046
Agroforestry has higher level of resilience against flooding	0.415	0.075	0.230	0.055
Future intention to increase tree planting	0.987	0.141	0.163	0.04

About 84% of the overall farming community of the study area are literate (primary-level or above education), while the national literacy rate reported by GOP (2015) is 58%. This is due to availability of primary school facilities in the study area, and the farmer's awareness of this access to education. It appears that the learning facilitated through education generated a favorable attitude towards agroforestry. Various studies reported by Toth et al. (2017) have identified the direct influence of education on the adoption of new technologies and decision-making processes at farm level.

Landholding Type

The farmer's landholdings are categorized in the survey as subsistence (up to 12.5 ac), economic (12.6–50 ac) and above economic (above 50 ac) in Table 3. For the AF farmers, 54% have a subsistence landholding compared to 52% for the NAF farmers. Similar proportions of the AF and NAF farmers had an economic landholding (54% and 21%, respectively), while 15% of AF farmers had an above economic landholding compared to just 27% for the NAF farmers.

Credit Requirements and Execution

As indicated in Table 3, agroforestry farmers had much lower use of credit than non-agroforestry farmers, and both groups accessed informal credit more frequently than formal credit. Various constraints were experienced in the credit execution process.

Positive and Negative Perceptions About Tree Growing

Table 4 reports AF and NAF farmers' perceptions of various positive and negative statements regarding planting trees. A greater proportion of the farmers

Table 5 Ranking of tree planting barriers by district

Barriers	Frequency	Ranking score	District	
			Layyah N = 4	Muzaffargarh N = 4
Farmer laziness	7	2.25	1.65	2.95
Land size and scarcity	6	1.84	1.81	1.81
No availability of planting materials	5	1.72	1.51	1.54
No extension services and farmer training	5	1.15	1.00	1.00
Not aware of benefits from trees	5	1.10	0.72	0.82
Poor soil health	3	0.16	0	0
Deforestation	3	0.75	0.24	0.21
Lack of equipment	2	0.18	0.11	0.11
Less water availability	3	0.12	0	0.12
Long time required to obtain tangible benefits	3	0.10	0.50	0.36
Perception that tree growing is a difficult task	1	0.01	0	0.10
People do not like to grow trees	1	0.13	0	0.12
Tree seed mortality	2	0.06	0	0
Government removes trees	3	0.14	0.15	0.17
Population pressure	2	0.08	0.12	0.13

practicing AF felt that planting trees increases farm income, i.e. 0.735 for AF, compared to 0.513 for NAF. The perception that tree planting enhances resilience against natural hazards (notably floods) was higher among the AF farmers (0.415) compared to the NAF farmers (0.230). Little difference was found concerning attitudes to timber, fuel-wood and NWFPs. With regard to future intentions, AF farmers expressed a desire to increase tree planting while NAF farmers had much less interest in planting trees. In terms of crop production, NAF farmers perceived this activity to be more costly (0.796) compared to 0.372 for AF farmers. However, the cost required for tree planting was perceived to be higher for the NAF farmers (0.425) compared to the AF farmers (0.325).

Tree Growing Barriers

In 8 focus group discussions (FGDs), totals of 15 barriers to tree growing were identified (Table 5). The most frequently mentioned barriers among the discussions were land scarcity, laziness, lack of tree seeds or seedlings, lack of extension services, inadequate farmer training, and poverty. Amongst these barriers laziness, land scarcity and lack of tree seeds were the highest ranked. Particularly in Muzaffargarh and Layyah, laziness was identified as the most common barrier to tree growing. Nevertheless, between the two districts there were no major differences in the ranking scores for the barriers to tree planting.

Table 6 Correlation coefficients between agroforestry adoption variables

Variable	Livelihood activities	Education	Socio-demography	Landholding type	Age	Credit
Livelihood activities	–					
Education	0.77	–				
Socio-demography	0.71	0.57	–			
Landholding type	0.75	0.71	0.59	–		
Age	0.78	0.64	0.78	0.64	–	
Credit execution	0.86	0.83	0.65	0.70	0.73	–

Correlation Analysis Amongst Various Variables for Adoption of Tree Growing

As revealed in Table 6, the education level of farmers is positively correlated with their livelihood activities (r = 0.77), and socio-demography strongly positively correlated with the farmer livelihoods (r = 0.71). Similarly landholding type is strongly positive correlated with livelihood (r = 0.75) and education (r = 0.71). The medium age of the farmers showed strong positive correlation with livelihood (r = 78), education (r = 64), socio-demography and land holding type (r = 64). Credit requirements are found to be strongly and positively correlated with livelihood (r = 0.86), education (r = 0.83), land holding type (r = 0.70), and age (r = 0.73).

Discussion

The results of this study suggest that younger farmers are more inclined to adopt agroforestry. Young and middle-aged farmers are both apparently greater risk-takers and this is consistent with the findings of Boateng (2018). This study also provides support for the hypothesis that rural people of the study area are more inclined to practice agroforestry in their agriculture landscape. It has also been found that agroforestry helps to improve forest protection by creating a buffer zone.

It is evident that the farmers' education level increases their willingness to plant trees. Research elsewhere has also found that farmers with higher education levels are more active participants in tree planting and agroforestry (Mbwiga 2016). Lockheed (1990) reported that the development of human capital, in the form of farming production skills and knowledge, is accumulated through education. Educated farmers also commonly earn higher profit from their farming activities than farmers with low education (Davis and Humphrey 2012). It has been found that the higher the education level of the head of a household the greater the chance of positive decision-making about agroforestry adoption (Akankwasa et al. 2013). In the Swat region of Pakistan, studies have highlighted that education has a strong influence on the way agroforestry is carried out, with educated farmers having greater numbers of trees on their land compared to illiterate farmers (Irshad et al. 2011).

The size of a landholding commonly influences the adoption of agroforestry. Despite often being well-aware of the potential benefits of agroforestry, landholders with relatively small land areas are more likely to adopt the practice (Hogarth et al. 2013; Ashraf et al. 2015). Such landholders value their agricultural land highly for subsistence purposes. Their land is their lifeline; it provides critical sustenance for their households and so they will be less inclined to convert farming land to tree crops and prefer agroforestry. This is also clearly evident among smallholding farmers in the Indus River basin. If a landholding is small, there is less likelihood the farmer will pursue tree-planting only and be more inclined towards agroforestry adoption. In contrast, larger-scale landholders have a greater opportunity to commit parts of their land to tree planting because they realize that trees are like money in the bank and could be cashed in at any time (Zhang and Owiredu 2007; Akhalkatsi 2015). In this study, farmers with larger landholdings were more likely to adopt tree-planting. This is consistent with the findings of Duffy (2016), that larger-scale landholders are more motivated to plant trees than small-scale landholders.

Farmer access to farm credit (rural finance) is recognized as of cardinal importance for the global economy (SBP 2015). The availability of such credit is critical to support farm productivity enhancements and entrepreneur development in rural areas (Petrick et al. 2013). In the study area, two types of credit are available to farmers to help them finance their agricultural practices, these being institutional credit (banks, microfinance institutions and NGOs) and non-institutional credit (private money lender, 'arthi' who provide credit to farmers and also buy their produce, middlemen and relatives). Both institutional and informal money lenders are active in Pakistan's rural credit markets (Anonymous 2015; Hussain and Thapa 2016). However, as evident in developing countries worldwide, there is a decreasing trend of credit availability for both agricultural and non-agricultural purposes in Pakistan (SBP 2015).

According to one estimate, the institutional requirement to meet Pakistan's need for agricultural credit for the country's 6.6 million farmers for the year 2014–2015 was about 500 billion PKR (Pak Rupees) (http://www.finance.gov.pk 2015). However, as reported by the State Bank of Pakistan, the amount of formal or institutional credit (available from commercial banks, microfinance banks, NGOs and other lending agencies) for agriculture in that year was only 326 billion rupees (Anonymous 2015). The main reason for farmers' low level of accessing credit from banks is the complicated process involved. Further, private banks are reluctant to provide credit because of difficulties they often face in loan recovery. For these reasons, farmers more often obtain the easily-available but high-cost credit for agriculture through non-institutional sources. It is evident that farm credit finances farmers and entrepreneurs to help in adopting new technologies and to undertake fresh investments (Zuberi 1989; Drollette 2009). Nevertheless, some of this study's farmers obtained loans from their relatives for tree plantations, being motivated by the potentially greater economic benefits of tree plantations compared to their traditional agricultural crops.

In the study area, farmers had a lower propensity to access institutional credit due to a lack of awareness and procedural complications. Therefore, awareness of

credit access procedures and efficient information could result in improved access of formal credit for farmers. Less procedural complications to formal sources of credit can positively motivate farmers to meet their credit requirements for agricultural and other purposes. Muchara et al. (2014) found that farmer age, access to credit, farm size, information sharing at the farm level and extension services can have a positive impact for credit execution including borrowing from relatives. However, the research in this study indicated that farmers have a lower level of information about formal credit sources compared to informal credit sources.

Factors notably affecting borrowing for agricultural practices were found to be farmer age, farm size, farming experience, heavy rains and associated fear of flashfloods, and access to formal and informal credit sources. It is observed that older and more experienced farmers are more inclined to access credit, as compared to their less experienced and younger counterparts.

This study identifies poverty as a significant limiting factor for tree planting. Various other studies also support this finding. It was reported that agroforestry adoption fails to be practiced among the poorest of the poor, who have priority on obtaining food and cannot afford too much investment risk, even though this would have sustainable financial benefits in the long term. In contrast, farmers with higher food security are more inclined to practice agroforestry (Jerneck and Olsson 2013).Adepoju and Obayelu (2013) also found a positive correlation between farmers' education and livelihood, socio-demographic characteristics livelihood activities and credit use, as well as age. Ali and Deininger (2015) observed positive correlation between education, livelihood associated with forest resources and landholding type. Overall, results from this study are in line with findings in the literature.

The main barriers to tree planting that were identified through farmers themselves during focus group discussions, and include laziness, land scarcity and lack of tree planting material. Poverty was identified as a barrier to tree planting, but only by two out of 8 focus groups. Negative perceptions of farmers were recognized as barriers by the focus groups and resulted in reducing tree planting. Such barriers highlight the factors that farmers perceive to be major disincentives which deter farmer communities from planting trees. Surprisingly laziness was recognized as a main reason why other farmers are not willing to plant trees. Focus group discussions elucidated that while some farmers might have been given the opportunity to grow trees they have been discouraged because of their previous experience of low survival rates of tree seedlings. The information gathered through focus group discussions assists to identify the perceived barriers to tree growing and reinforces the information obtained in the landholder surveys.

There is a possibility that farmers may have overstated their positive attitudes towards tree growing to present them as favorable to this practice. This is associated with assent bias where respondents try to agree with statements. An effort was made to reduce such biases through considering them in the questionnaire design and phrasing, and by giving a meticulous introduction to farmers prior to commencement of interviewing, also explaining the research importance for them and requesting them to be honest during interviews.

Concluding Comments and Policy Implications

This work underlines the importance of economic and social factors such as access to credit, motivations and social barriers in tree growing and effective design and implementation of agroforestry projects. Despite apparent benefits of agroforestry in the Indus River basin a high proportion of farmers had adopted traditional non-agroforestry farming in the southern part of Punjab province. However, this study has demonstrated the various factors influencing the adoption of agroforestry among farmers in this area. Factors such as farmer age, education, farm size, perceptions of the advantages and disadvantages of tree plantations and their forest product generation, credit availability and execution, and distance from local markets were found to influence the adoption of agroforestry in this area.

It was found that agroforestry is more likely to be adopted by farmers who have more experience of tree planting, are willing to make long-term investments (5–15 years) with an expected large profit margin, and are aware of the multipurpose benefits of agroforestry. However, agroforestry practice is not adopted by the farmers whose incomes or subsistence are entirely dependent on agricultural crops. Such farmers have less experience with and awareness of the benefits of agroforestry, cannot afford the agroforestry establishment costs, and have an interest in shorter-term agricultural investments. This study provides information to understand the factors hampering or positively facilitating the adoption of agroforestry in developing countries such as Pakistan.

There is a dire need to bring about a change in farmers' attitudes in favour of tree planting by provision of information through extension services. This effort could generate a willingness by more farmers in the Indus River basin to adopt agroforestry. Further, a solid advocacy network is required to support farmers to adopt innovative agroforestry practices on their farms. Adoption of agroforestry could be fostered by providing farmers with financial support and facilitating easier access to formal sources of credit. The vital measure for successful adoption of agroforestry is to follow a participatory approach, as a means to actively involve farmers and rural communities in agroforestry programs. The people in southern Punjab have immense potential for tree growing, and would actively participate in the needs identification process resulting in sustainable income generation opportunities with an outcome of lasting prosperity. The outcome of the study provides support and guidance for government policy-makers and administrators, local authorities, progressive farmers, NGOs, researchers and farmers about ways for prudent adoption of agroforestry.

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