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*Full Length Research Paper*

# Identifying factors affecting agroforestry system in Swat, Pakistan

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**This study has identified factors that affect the adoption of agroforestry practices; these include farmers' perceptions towards agroforestry, socio-economic characters of farmers and constraints for the development of agroforestry. The analysis of data demonstrates that the factors affecting farmers' adoption of agroforestry practices have been varied depending on the type of factor. Growing of trees was observed as a function of social and economical characteristics of the farming community. On- farm trees were grown for fuel-wood, timber, fodder, income generation, environmental purpose and for controlling erosion. Poor crop-stand, lack of markets, lack of nurseries, damage by animals and humans and lack of incentives were the obvious constraints expressed by the farmers. Bigger size of the family positively influenced tree cultivation. Farmer's income has supported agroforestry. Education level encouraged trees. Farm trees species were distributed in the order of poplar > persimmon > peach > pear > walnut > apple > acacia > willow > plum. Further studies are suggested for the contribution of agroforestry to the household income, food security and sustainability of agriculture.**

**Key words:** Agroforestry, farmers' perceptions, constraints, socioeconomic factors, dry area.

## INTRODUCTION

Forests are an integral part of daily lives of the rural population in Pakistan. The current forest area is only 4.7% of the country's surface (GOP, 2003) which is too low to meet the environmental and socioeconomic needs of the country. Total forests area of different provinces and territories of Pakistan viz. Sindh, Baluchistan, Punjab, Khyber Pukhtun khawa (KPK), Azad Kashmir and Northern areas is 0.92, 0.33, 0.69, 1.21, 0.42 and 0.66 million ha respectively (GOP, 2003). This shows that most of the forest distribution is in the northern part of the country. Deforestation and environmental degradation are the major problems of Pakistan. It has a poor forestry resource and one of the lowest proportions of forest area in the world (Mcketta, 1990). The area under forest is depleting due to a number of threats including continuous commercial over-exploitation, indiscriminate cutting, overgrazing, poor management and man-made ecological changes. Moreover, for a number of financial, technical, administrative and political reasons, tree cutting in forests is in excess of replanting and regeneration rates (ERNP, 1999). Current output is not sufficient to fulfill the demand for timber and fuelwood, raw material for industries, energy requirements of the agricultural sector and fodder for livestock. The dependence on conventional fuels like firewood (which alone accounts for 50% of rural fuel needs (Sheikh, 1987), cow dung and agricultural residue highlights the importance of trees in solving energy needs of rural communities (Siddiqui, 1997).

Agroforestry is one of the options for reversing the prevalent land degradation. It is a collective name for land-use systems and technologies, involving the integration of multipurpose trees with crops and / or livestock in different spatial and temporal configurations (Eneji et al., 2004). Agroforestry is a dynamic, ecologically

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based, natural resource management system that, through the integration of trees in farm and rangeland, diversifies and sustains production for increased social, economic and environmental benefits. This is a land use system in which woody perennials are deliberately grown on the same piece of land as agricultural crops (Nair, 1993). The impact of agroforestry on sustainability arises primarily through the trees and their regenerative effect on soil fertility, shelter and fodder they provide for livestock and the range of tree products directly useful to people (Eneji et al., 2004). Huxley (1984) reported the aim of agroforestry systems as to optimize the positive outcomes in order to obtain diversified and more sustainable production systems from the limited resources than other systems of land use. Agroforestry gives land-use a multipurpose approach towards sustained agricultural production. The practice of agroforestry is not entirely new to farmers because they have long realized the efficiency of some trees in restoring soil fertility, and endeavored to give these plants selective advantages.

Socio-economic study of farmers and their relationship to the agroforestry is highly important. This would help to ascertain the opportunities for the development of agroforestry system in our country. Analyzing the household and farm characteristics can help the process of effective planning system for farm forestry. Sinclair and Walker (1999) indicated the lack of quantitative and predictive understanding about traditional agroforestry practices and its importance in making them more adoptable. Developing new strategies for encouraging farmers to grow trees and improvements in existing systems can be designed if characteristics of the farms and farmers in relation to tree growing in existing agroforestry systems are studied (Nair and Dagar, 1991). Pagdee et al. (2006) also reported various variables that influence community forestry, for instance tenure security, clear ownership, congruence between biophysical and socioeconomic boundaries of the resources, effective enforcement of rules and regulations, monitoring etc.

Research on factors that encourage and discourage farm forestry in Pakistan has generally focused on social and physical parameters, leading to the ranking of constraints and benefits by respondents (Dove, 1995). Little research has been done to characterize farmers and their farms for planting trees and the perceptions and attitudes which contribute towards their decision-making. Dove (1995) stated that “the most important variables in the development of (agro-forestry) in Pakistan are not physical but human”, interpreting the latter as cultural and socio-economic factors. The focus of research remained on the technical aspects (increasing biological and economic productivity) rather than on social and desirability criteria (Mercer and Miller, 1998). However, tree growing is very rarely a pure technical problem as people in various parts of world have grown trees in one form or another without any technical assistance (FAO, 1986). A review by Mercer and Miller (1998) of agroforestry studies revealed little attention to the social aspects of agroforestry. Moreover, many of the so-called social forestry programmes (agroforestry here considered as a type of social forestry) fail as they do not take into account social factors (Cernea, 1992). Keeping in view the above mentioned facts it is important to note that the future success of agro-forestry would largely depend on assessing and addressing farmers’ perceptions regarding factors affecting farm level tree planting. Therefore, study has been conducted to identify the local constraints and interventions which negate the productivity of agroforestry systems in Swat-Pakistan with following objectives.

## Objectives

This research was aimed at (1) to analyze some socio-economic characters of farmers and their impacts on agroforestry (2) to determine the primary reasons for planting and primary benefits derived from agroforestry, (3) to know farmers' perceptions towards economic and environmental importance of agroforestry, (4) to identify the constraints faced by forest developers for the development of agroforestry, and (5) to suggest recommendations for the improvement of agroforestry system in Swat-Pakistan.

## MATERIALS AND METHODS

For the identification of the socioeconomic factors that are affecting agroforestry system and for the investigation of the current pattern, magnitude, future trends and the problems / prospects of the agroforestry system in Swat areas of Pakistan, a field survey was conducted in three Union Councils of Swat district namely Khwazakhela, Miandam and Odigram during Dec, 2009 and Jan, 2010. Swat, a district of Khyber Pukhtunkhawa (KPK) province of Pakistan, covers an area of 8220 square km, with a population of 1.2 million. There is a great variety of species of agroforestry because of the physiographic and climatic variations. The issues of sustainable livelihoods and forest degradation are highly tangible in Swat. Agriculture is the leading profession of its people. The major land use in the area is subsistence farming. The cropping pattern has been followed by primitive methods of agriculture and insufficient implements. Different types of winter vegetables like tomato, onion, peas, turnip, spinach, cauliflower etc are grown. Among summer vegetables, tomato, potato, okra, pumpkin, tinda (round gourd), cucumber and eggplant, are prominent for domestic and commercial uses. Wheat, maize and rice are the common cultivated crops.

For the subjected study, a questionnaire was developed through a consultative process keeping in view the objectives of the study. The questionnaire developed was pre-tested so as to avoid the chances of duplication and biasness. Keeping in view the available financial resources, heterogeneity of the target villages, allotted time and other attributes 150 households out of the total population in 3 union councils (50 households in each) were taken for our targeted survey. Those interviewed were done from the male head of household.

Since the household is the decision-making unit regarding growing (retaining natural growing trees or planting) trees on their farmland, primary data were collected through a cross-sectional

**Table 1.** Distribution / abundance of farm trees in Swat (decreasing order).

| S. No | English name | Scientific name |
|---|---|---|
| 1. | Poplar | *Popolus nigra* |
| 2. | Persimmon | *Diosopyrus kaki* |
| 3. | Black persimmon | *Diosopyrus lotus* |
| 4. | Peach | *Prunus persica* |
| 5. | Chinese pear | *Pyrus sinensis* |
| 6. | Walnut | *Juglans regia* |
| 7. | Apple | *Malus pumila* |
| 8. | Acacia | *Robinia pseudoacacia* |
| 9. | Alnus | *Ulnus nitida* |
| 10. | Willow | *Salix babylonica /Salix tetrasperma* |
| 11. | Plum | *Prunus communus* |
| 12. | Apricot | *Prunus armaniaca* |
| 13. | Fig | *Ficus palmate* |
| 14. | Pinus | *Pinus wallichiana* |
| 15. | Cedar | *Melia azadarich* |
| 16. | Mulberry | *Morus nigra* |
| 17. | Bluejack oak | *Quercus incana* |
| 18. | Olea | *Olea ferruginea* |
| 19. | Oriental plane | *Platenus orientalis* |
| 20. | Pear | *Prunus communis* |
| 21. | Apricot | *Prunus armeniaca* |
| 22. | Loquat | *Morus* spp. |

survey of the heads of household in the study area on various aspects of agroforestry and its interrelation to the local people through questionnaire, by holding discussions and interviews with individuals and groups.

The method was used to gather needful information on household size, land holding composition, sources of income, and their quantitative aspects. Group discussions were useful to get general and historical information with regards to flora and fauna of the area, population trends, their past and current management practices and likely future scenario of agroforestry. Interviews and discussions were not enough to get all the necessary data. Sometime it happens that respondent does not respond clearly or precisely to the question being asked. To acquire broader perspective of the socio-economic aspects of the target villages, it was important to observe and closely participate in their day to day activities. So it was vital to collect some of the real information through our own observation and participation.

Information on household size, existing status of tree species, detail of trees distribution / abundance and other information regarding natural resources of the area were obtained from the target community also. An absolute care was taken in the collection of data to minimize the chances of error. Our questions were also focused on socio-economic conditions of the farmers and constraints on the adoptions of improved agroforestry management system.

Data was collected, analyzed and quantified to cover various aspects of socio-economic conditions of local communities, their correlation with the tree plantation, current trends and future prospects and identification of feasible ways and means through which sustained agroforestry system could be ensured. Farmers' perceptions were also considered to know the importance and reasons of their tree plantation on the farms and various suggestions were received by the farmers to improve the prevailing system of planting trees on farms.

**Statistical analysis**

The qualitative informations were gathered during the survey and were compiled, summarized and tabulated. The farmers were categorized into 4 groups on the basis of their land holdings, that is less than 1 acres, 1-2 acres, 2-5 acres and more than 5 acres. Data were statistically analyzed. Basic data were given as lists of trees species in the descending order of its abundance. The size of the farm with trees (dependent variable) has been correlated to the independent variables. The independent variables for the current study were: farmers' monthly income, members of household, education level of head of household, purpose of tree plantation, constraints perceived by the farmers and several others socio-economic characteristics of the farm and farmers. Households' variations were also correlated to the area of agroforestry. Important reasons for planting and farmers' perceptions regarding trees have also been listed.

## RESULTS AND DISCUSSION

In Swat-Pakistan, agrisilviculture (growing of trees with crops) and silvopastoral (growing of trees on pastures) are the main types of on-farm tree growing in the form of traditional agroforestry systems. The most frequent method of growing trees (except fruit trees) on the farms in the study area is through deliberate retention and management of naturally regenerating tree seedlings. The abundance of farm trees species were distributed in the order of poplar > persimmon > peach > pear > walnut > apple > acacia > willow > plum (Table 1). Raising of

**Table 2.** Distribution / abundance of fruit trees in Swat (decreasing order).

| S. No | English name | Scientific name |
|---|---|---|
| | ***WINTER FRUITS*** | |
| 1. | Pear | *Pyrus sp.* |
| 2. | Apple | *Eriobotrya japonica* |
| 3. | Mulberry | *Malus domestica* |
| 4. | Loquat | *Morus* spp. |
| 5. | Citrus | *Citrus* spp. |
| | ***SUMMER FRUITS*** | |
| 6. | Persimmon | *Diosopyrus* spp. |
| 7. | Peach | *Prunus persica* |
| 8. | Walnut | *Juglans regia* |
| 9. | Plum | *Prunus communus* |
| 10. | Apricot | *Prunus armeniaca* |
| 11. | Watermelon | *Citrullus lanatus* |
| 12. | Almond | *Prunus dulcis* |

**Table 3.** Farmers' perceptions / preference of tree plantation

| S. No | Purpose of plantation | Preference (opinion) (%) |
|---|---|---|
| 1. | Fuel-wood | 67 ± 7.3 |
| 2. | Fodder | 04 ± 1.2 |
| 3. | Timber | 14 ± 3.4 |
| 4. | Income increase | 12 ± 3.6 |
| 5. | Environmental purpose | 0 |
| 6. | Soil and water conservation | 03 ± 1.2 |

For this and subsequent table, ± indicates standard deviation.

fruit trees on the sides of agricultural fields and near the homes was a common practice. The top five winter fruits have been cultivated in the order of pear > apple > mulberry > loquat > citrus whereas the summer fruits have been ordered as: persimmon > peach > walnut > plum > apricot (Table 2).

Recent terrorism and the war against it, has tremendously suffered the growth of this sector. Huge labour force has been fled away during the war and has not been returned. The people that have been interviewed were of the view that gradual reduction in different crops production has also been related to the fragmentation of land (the land has been divided and sub-divided) and small landholding and poor agricultural management practices. People are poor and can not afford to buy agricultural inputs for better crop production. Due to these reasons the community is losing interest in agricultural sectors and switching over to other jobs. Therefore, communities are compelled to search for other economic source through which they could better off their livelihood options.

Primary data were gathered on household size, average family income, existing status of tree species and detail of trees distribution / abundance. Our questions were also focused on socio-economic conditions of the farmers and constraints on the adoptions of improved agroforestry management system. The farmers have been categorized into 4 groups on the basis of their land holdings, which is less than 1 acre, 1-2 acres, 2-5 acres and more than 5 acres. Across the population surveyed, 28% of the farmers possessed less than 1 acre, 32% farmers have been keeping agoforested land between 1 to 2 acres, 24% farmers have forested land between 2 to 5 acres and 16% farmers got more than 5 acres forested land.

The farmers' willingness to grow trees on their farms was found as a function of their sociological, cultural and economical characteristics. Survey analysis of farmers' perceptions has showed a strong step for the positive outcomes of tree planting. The opinions of farmers towards agroforestry either encourage or discourage farm level tree plantation. Tree planting was perceived by the large number of the farmers either for fuel-wood, timber, fodder or income enhancement (Table 3). Fewer farmers

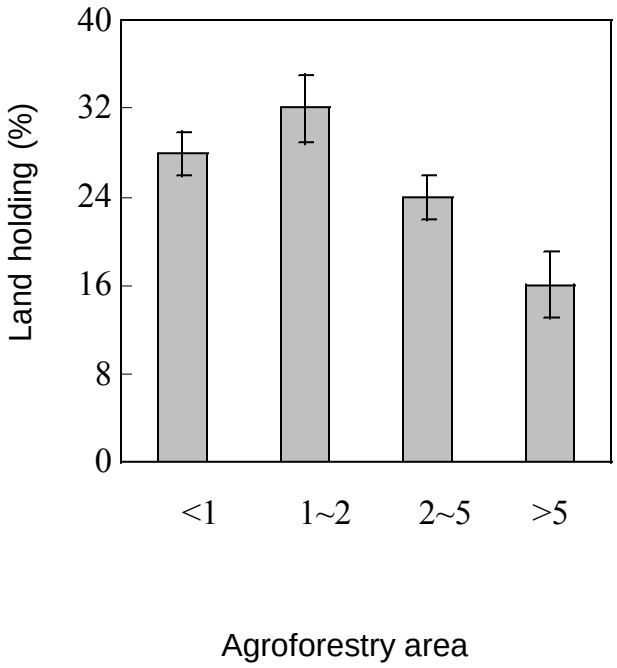


**Figure 1.** Distribution of landholdings under agroforestry.

opted on-farm plantation for environmental purpose, soil and water conservation (controlling erosion) and for other values. Trees contributed to economic development through their role in the protection of watersheds, maintenance of biodiversity and enhancement of environmental quality (Bukhari, 1997). Arnold and Dewees (1998) argued that strategies to encourage tree planting on farms need to be based on an understanding of farmers' tree management in the context of household livelihood strategies, pointing out that little is known about "farmers' perceptions of the value of trees" and about the constraints they face in developing tree resources.

During discussion, farmers favored importance of tree growing as an essential capital for future generations. Traditionally the head of household tends to retain or attain the best possible assets to be inherited by the children. On-farm tree growing is such an activity as it increases the value of the on-farm assets to be inherited. Thus the expansion and success of farm forestry would depend on the factors which underlie farmers' reasons for planting or not planting trees. Zubair and Garforth (2006) reported the level of tree plantation as function of farmers' perceptions and attitudes.

The agroforestry has its own constraints to adoption in the area. Farmers saw poor crop-stand, lack of market, protection of plants from livestock / humans, hindrance in agricultural operations, and the harboring of insects, pests and diseases as negative impacts of tree planting (Figure 1). Some tree species compete with crops for water and nutrients, causing crop yield reduction. Other constraints for adoption of agroforestry have been noted as lack of awareness by small farmers and unavailability of tree seedlings. However, these were outweighed by their perceptions of positive impacts as discussed above. Among the factors, availability of land, lack of markets, lack of nurseries and damage caused by animals and humans were significantly predicted farm level tree planting. Farmers do not have their own nurseries to generate planting stock and hence they have to rely on nurseries operated by the forest department and private owners.

Tree growing decisions of farmers were influenced by the household conditions of farming communities. Education level of the head of the family has been recorded as an effective factor to encourage on-farm growing of trees. The influence of education (literacy) on agroforestry system was highly correlated (Figure 2). The educated farmers have allocated more size of the farms for trees as compared to illiterate farmers. This could be associated to the higher incomes of the educated class due to more off-farm employment opportunities and of course to the higher level of awareness / understanding for the importance of tree cultivation.

The bigger family size was reported to have more forested area (Figure 3). This may be related to the greater availability of labour for growing woody perennials and more requirements of woody perennials for fuel wood, fodder, timber and fruits for household utilization and to generate extra income to sustain their livelihoods. Hence, the size of the family can be considered to have a positive association with tree growing. Hartter (2010) also reported the role of population density for the existence and the use of forest fragments.

Higher monthly income of the farmers was found positively associated to the presence of trees on their farms (Figure 4). Among surveyed farmers, 28% have less than 1 acres trees planted land and had monthly average income less than Rs. 8300 per household, 32% farmers were having 1-2 acres possess average income of Rs. 10900. The farmers with greater area of agroforestry (that is more than 5 acres) have greater income (> Rs. 21500 per month). Income data revealed that major portion of the entire community could hardly meet their basic needs from their meager income. To maintain their livelihood, local people have adopted different professions to augment their daily requirements. 60 to 70% of the total population is engaged in agriculture and livestock rearing, while 30 to 40% is engaged in jobs in government and non-governmental sectors, local business (shop keeping, tourism, transport etc) and jobs in other cities. Our experience indicated that farmers most often cite socio-economic factors when asked about their adoption of farm forestry. Majority of the farmers often emphasize the issues of money and other resources for the establishment of farm trees. They cited lack of resources as the major external factor limiting their land use decisions. Our survey has provided preliminary information and has foreseen social variables

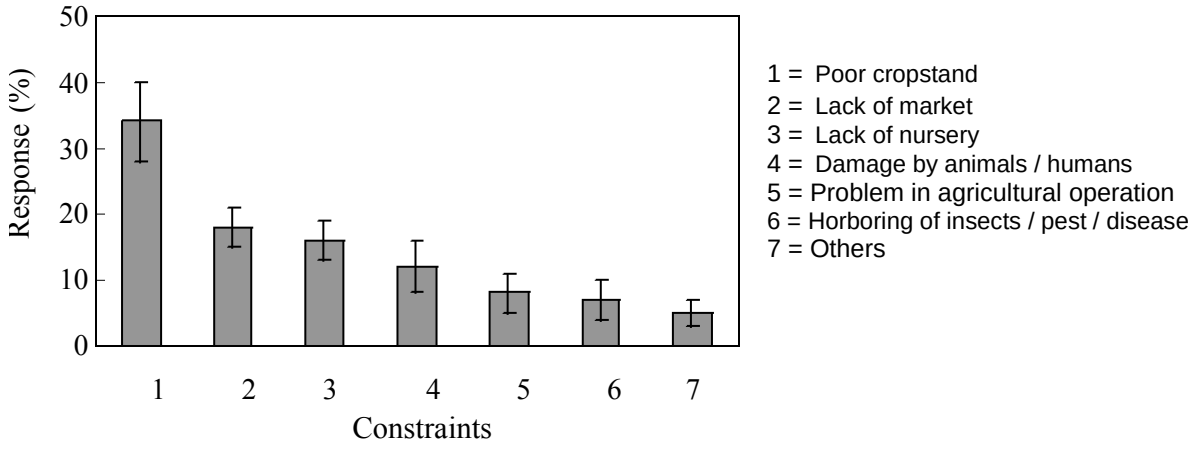


**Figure 2.** Constraints perceived by the farmers for agroforestry adoption.

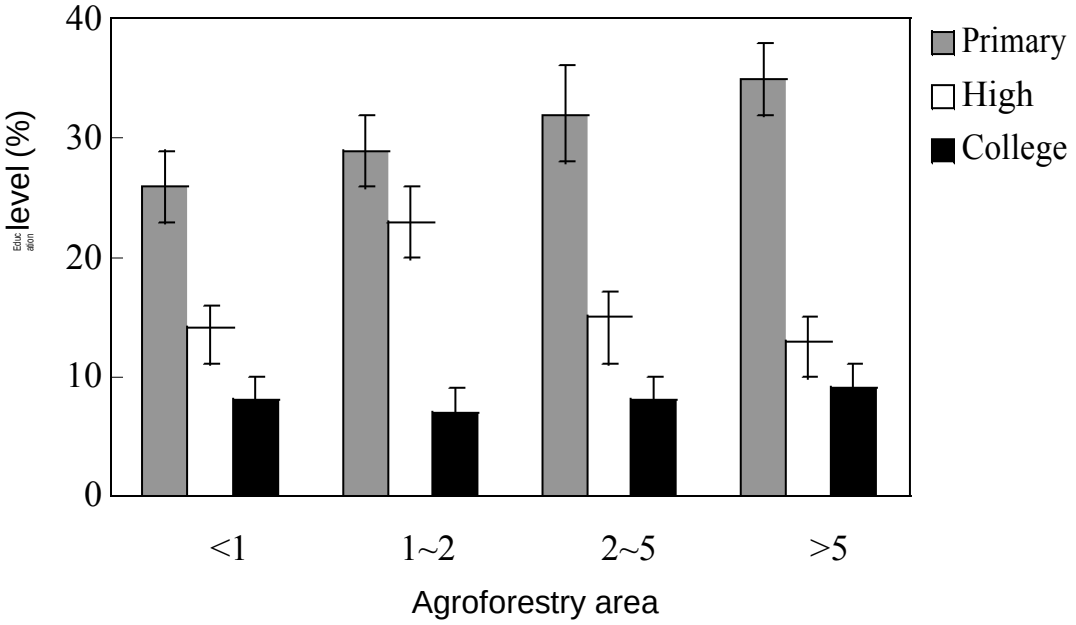


**Figure 3.** Area under agroforestry and its relation with education rate of the farmers.

that could play a tangible role for an outstanding land use system in the rural areas of our country.

Factors have been identified by Nkamleu (2005) that influence the adoption of agroforestry practice as gender of farmer, household family size, level of education, farmer's experience, membership within farmers' associations, contact with research and extension, security of land tenure, agroecological zone, distance of the village from nearest town, village accessibility and income from livestock. Zubair and Garforth (2006) also found that attitudes significantly predicted farmers' decisions to adopt agroforestry. Initiation of agroforestry development programs in the area could benefit farmers for better planning of an agroforestry system. Conservation oriented land-use practices can also support land-use decisions to the farmers. Changes in land tenure and market economics have been reported responsible for changes in land use systems in Bangladesh (Khaleque and Gold, 1993).

## Suggestions

The community suggested urgent measures for the enhancement of agroforestry (Table 4) through immediate provision of gas supply in the area. Water channels

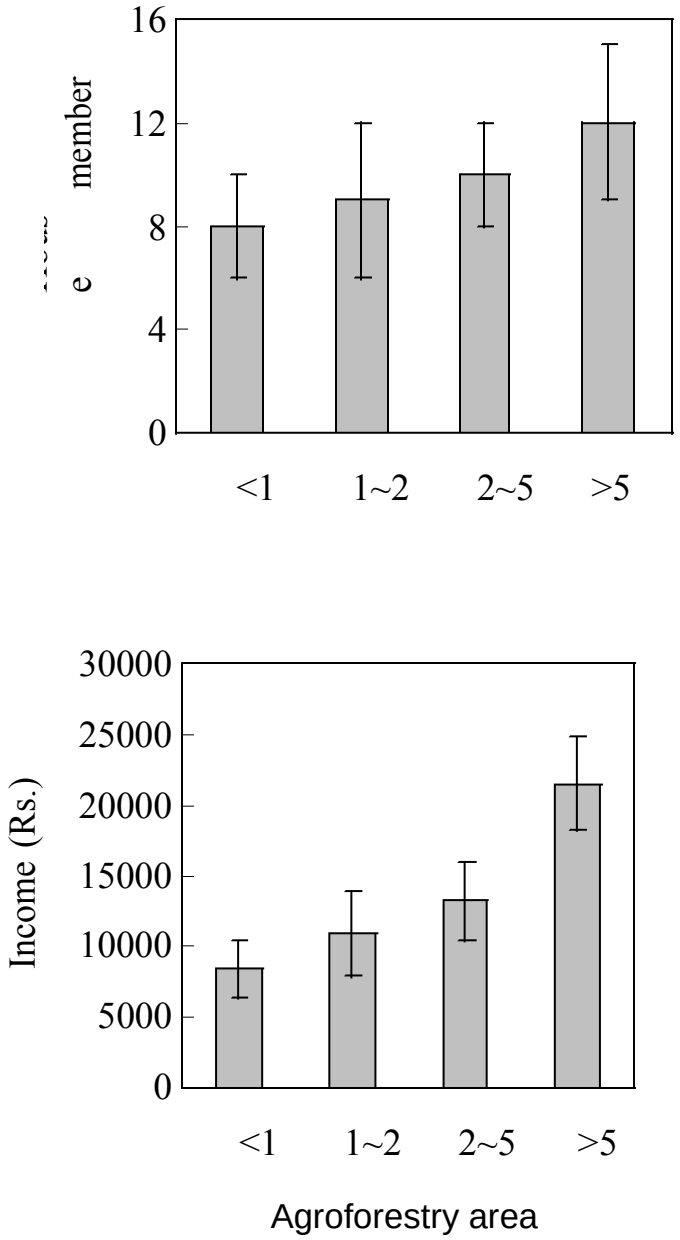


**Figure 4.** Relationship of area under agroforestry area with family size and monthly income of the farmers in Swat-Pakistan.

are critically mentioned and recommended for improvement for water saving and to avoid seepage losses. Farm to market roads should be constructed. Plant nurseries may be provided in the reachable areas. Mass education and awareness programmes should be launched for the extension of forestry system. Agricultural inputs (that is seeds, fertilizers and pesticides) may be provided at low cost or subsidized rates. Agricultural credit system should be implemented efficiently for the uplift of rural population. Timber markets need to be systemized for poor farmers.

## Conclusions

The report set out to explore the beliefs underpinning farmers' perceptions and the role of salient factors that encourage or discourage the expansion of farm forestry. This research addresses importance of agroforest and potential economic and social issues related to agroforestry and their implications on tree growing in Swat areas of Pakistan. The report describes the constraints to adoption of agroforestry system of the area. The associated issues have been reported by the

**Table 4.** Suggestions made by the farmers for the improvement of agroforestry.

| S. No | Suggestions received | Response (%) |
|---|---|---|
| 1. | Gas supply | 72 5.6 |
| 2. | Irrigation system | 05 2.2 |
| 3. | Accessibility (roads) | 05 2.1 |
| 4. | Plant nurseries | 04 1.2 |
| 5. | Education / awareness level | 12 3.2 |
| 6. | Agric. inputs (seeds / fertilizers / pest | 0 |
| 7. | Credit system | 0 |
| 8. | Timber market availability | 02 0.5 |

farmers were: poor crop-stand, lack of market, protection of plants from livestock / humans, hindrance in agricultural operations, and the harboring of insects, pests and diseases as negative impacts of tree planting. Among the social issues, less education rate has been noticed as the critical problem. This research suggests that the unless problems related to marketing, lack of awareness, accessibility of the nurseries and economic conditions of the farmers are not tackled properly, policy interventions for agroforestry or social forestry as part of farmers' livelihood strategies would be questionable. Additional efforts could be made in the field of environmental education that may increase the likelihood of farmers adopting and maintaining agroforestry. Improving rates of adoption and persistence of agroforestry would evidently improve the livelihood of the farmers. Emphasis should be given to investigate how the proportion of different tree species varies with biophysical and socio-economic factors so that suitable tree species for different social and economic categories of households can be identified. This research can be helpful for the development of agroforestry practices in view of farmers' perceptions and solving farmers' social and economic issues.

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