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Contribution of Small-Scale Agroforestry to Local Economic Development and Livelihood Resilience: Evidence from Khyber Pakhtunkhwa Province (KPK), Pakistan

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Abstract: Agroforestry plays a vital role in enhancing environmental sustainability, improving local economies, and reducing poverty through livelihood resilience. Several researchers have studied the importance of agroforestry, but little attention has been paid to livelihood resilience and local economic development in developing countries. This study aims to find the role of small-scale agroforestry in local economic development in the Shangla and Swat districts of Khyber Pakhtunkhwa (KPK) Province, Pakistan. In this study, a total of 350 quantitative household surveys, 12 qualitative household case studies, and interviews of experts are used. The ordinary least squares (OLS), linear regression model, household income, wealth index, and five capitals of sustainable livelihood approach (SLA) were used to measure livelihood resilience. Results show several significant findings which may apply on a larger scale and in other cities of Pakistan or other countries. First, it directly shows the association between agroforestry, resilience-building, and local economic development. Second, financial capital can be improved through agroforestry, which can improve other capital assets. Third, small-scale agroforestry brings non-financial benefits such as environmental sustainability, improved living standards, reduced soil erosion, and provided shade. Fourth, irrigation plays a vital role in building livelihood resilience and promoting agroforestry. Lastly, on-farm diversity can be improved through agroforestry. This research discusses several practical implications along with recommendations for future research.

Keywords: small scale agroforestry; local economic development; livelihood resilience; climate change; sustainable livelihoods approach; KPK Pakistan

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1. Introduction

Climate change and environmental degradation are rapidly becoming important global issues, creating severe challenges for local people and international development organizations. It is essential to establish a robust framework of local economic development and livelihood resilience to preserve economic, political, environmental, and social sustainability. Pakistan is an agricultural-based country with 21% of GDP and 43.7% of employment made up of the agriculture sector, which have about 47.03% agriculture land percentage of total land [1,2]. Agriculture contributes to 25.6% of national growth and

42.02% of the total labor force in Pakistan. A study of MOA Finance [3] revealed that approximately 9% of total exports are supported by agriculture, showing a positive impact on economic growth. Meanwhile, the Pakistani agriculture sector encounters constraints from developed countries due to inadequate quality, poor supply chain management methods, and worldwide market rivalry [4].

Moreover, agriculture in Pakistan also provides raw materials to agro-based industries, such as textiles, leather, ghee, and sugar. The underprivileged community of Pakistan accounts for around 40% of the overall population that are directly or indirectly affected by the agriculture expansion and rely on agriculture and agroforestry for their livelihood. This sector's contribution to economic growth is in decline because of the rapid growth of the industrial sector in developing countries [5,6]. The limitations of the agricultural sector, similar to advanced level agricultural technology with trained framers, which affect its productivity, may be the primary reason for its decline [7,8]. However, this industry continues to face several issues, necessitating immediate action to design and make strong agricultural systems that safeguard livelihoods while promoting sustainable economic development [9,10]. Agroforestry is defined by the World Agroforestry Centre (WAC) as a collective name for land-use systems and technologies, where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and livestock, either in some form of spatial arrangement or temporal sequence. There are both ecological and economic interactions between the different components [10–13]. Agroforestry has an essential role in providing food and nutritional security [14–17], controlling land degradation [18,19], and supporting environmental benefits across a range of landscapes and economies [20–22]. Small-scale agroforestry seems to potentially promote livelihood resilience, local economic development for low-income families, and biodiversity conservation on a small scale [21,23,24].

Many research studies have shown positive associations between agroforestry, ecosystem services, and the development of local economies and livelihoods around the globe [25,26]. The productivity of the agricultural/forest sector can be improved through small-scale agroforestry in level. Such activities can enhance land productivity by combining different trees with crops. Pastures could conserve resources, including soil volume, solar radiation forest reduction, and positively contribute to environmental sustainability [24,27–29]. Different ecosystem and cultural services such as soil erosion control, air quality, pest control, fire retardation, water quality, nutrient retention, recreation control, aesthetics, cultural values, and livelihoods can be maintained and managed by agroforestry [30–32]. The Kyoto Protocol also recognizes agroforestry as an instrument for carbon sequestration for the mitigation of climate change [33].

Small-scale agroforestry is one of the central parts of agriculture. A forest can develop livelihoods for poor farmers, helping them adapt to changes according to the situation and improve economic and environmental sustainability [12,24,34,35]. Thorlakson and Neufeldt [36] illustrate that little attention is given to the function of small-scale agroforestry in creating livelihood resilience. Furthermore, the few studies on the role of agroforestry trees creating ecosystem resilience have not thoroughly investigated the particularly effective system such as human society and the agro-environment [37]. Researchers highlighted that both the development and academic sectors need additional research on resilience and small-scale agroforestry [38–40]. Despite the various benefits of agroforestry, there is still little knowledge on the benefits and disadvantages of agroforestry's contribution to the livelihood resilience of poor communities.

Agroforestry can play an essential role in improving livelihood by producing food products (e.g., fruit, nuts, edible leaves, sap, and honey), fodder, timber, fuelwood, fibers, livestock, and medicines) many rural poor farmers are practicing low-input agricultural practices [41]. Agroforestry can improve food and nutrition security by supporting staple-crop production along with edible tree products for home consumption, raising farmer incomes through the sale of tree products and surplus staples, producing fuelwood for cooking and heating, and supporting pollination services, which are essential for the production of food plants [42]. Some trees are considered to be the tree of life, as all parts are highly nutritive and consumed, which are helping poor people. The leaves, fruit, and other parts of many species of trees can serve as fodder for livestock, especially in dry seasons when other sources of forage are not available [43].

Several researchers have studied the importance of agroforestry, but little attention has been paid to livelihood resilience and local economic development in developing countries. No empirical study has examined the role of small-scale agroforestry in the local economic development in KPK, Pakistan. The government of KPK, Pakistan accomplished the mega afforestation project known as the billion-tree afforestation program (BTAP). The specific objectives of this project are to significantly raise forest areas, resolve environmental degradation, provide jobs to dissenters and develop local economics [44]. The Pakistan government believes that the project has boosted the local economic growth and livelihood by offering small business units in forest and agroforestry nurseries, agroforestry, and other green jobs opportunities to the local household [45–47]. Based on the success and worldwide recognition by the International Union for Conservation of Nature (IUCN) on achieving the Bonn challenge, the Pakistan government has extended the BTAP initiative, known as the ten billion trees afforestation program (BTAP), across the whole country until 2030. The agroforestry system supplements the social, economic, and environmental benefits by providing fruit, nuts, fodder, wood fuel, livestock, timber and other products, and environmental services such as soil fertility replenishment and erosion control carbon sequestration. Trees normally remain in a landscape for many years, with rotation lengths depending on species and desired end-products. This system enhances economic growth, supporting sustainable development goals and helping to reduce poverty. However, we have not come across any study that considers the impact of small-scale agroforestry on enhancing livelihood resilience in Pakistan. Based on these arguments, here, we strive to answer the call for more empirical evidence by drawing on fieldwork in Swat and Shangla KPK to address the research question: Has the application of agroforestry systems over time contributed to resilience in the Shangla and Swat districts? In examining this research question, our primary objectives are to understand: (1) the relationships between practicing agroforestry and non-practicing (2) specific agroforestry benefits that contribute to livelihood resilience, and (3) how agroforestry directly and indirectly builds livelihood resilience with the impact of small–scale agroforestry on local economic growth, poverty alleviation and environmental sustainability in selected districts of KPK, Pakistan.

2. Literature Review

2.1. Theoretical Framework of Local Economic Development and Livelihood Resilience

Local economic development through small-scale agroforestry and livelihood resilience thinking is the focus of this study. BTAP highlights how agroforestry can increase environmental sustainability and local economic development activities by ecosystem services such as flood control, soil erosion, wild population, and watershed and creating small business units such as nurseries and generating employment with forest cover increase [45]. According to Zada, Shah [44], local households can improve their income through nurseries, fuel woods, construction material supply, fodder, non-timber products, honey, beeswax, traditional medicines, mushrooms, and fruits and other edible fruits, ecotourism, and other small business [48]. These local economic activities double as local manufacturers purchase raw material from other local producers; basically, their employees first spend their income locally. They sell products in a large market to big origination and contribute to country exports [49]. In contrast, early regional development theories and growth are focused on that once employment opportunities are created, in-migration occurs [50].

Holling [51] coined the term "resilience thinking", which relates to social–ecological systems. This critical concept discusses the competence of a system to bounce back and recover after troubles and shocks [51]. This area of study stems from ecology, but it has been utilized in various disciplines such as climate change adaptation, engineering, disaster risk reduction, and forest management for the past four decades [52–54]. The meaning of a resilient social–ecological system in this study is a productive agricultural and forest area that can keep delivering ecosystem services for livelihood support despite the fact it can experience shocks and disturbances [55,56]. A social–ecological system can have specific resilience or general resilience. By specific resilience, we mean resilience to a particular shock, and general resilience refers to handling an uncertain future. The object of this study is to focus on the general resilience of a community.

Resilience has gained sufficient consideration among researchers in the last couple of decades in the fields of climate change adaption, forest management, local development, and international development policies [57–59]. Brown [60] believes that the natural systems are the main focus of resilience thinking, and its ignorance of the social side of social–ecological systems is often criticized. According to Tanner, Lewis [61], in the light of resilience, human livelihoods need much more attention because it helps to develop and adapt the strategies, which is the need of the most vulnerable segment of population rural poor propel. Due to this, the resilience theory now includes a livelihood development perspective. To fix issues of maintaining livelihoods and environmental conservation, Tanner, Lewis [61] promote a livelihoods resilience perspective because it focuses on human empowerment and agency. To deal with an uncertain future, people are likely to build livelihood resilience and improve their economic level. Livelihood resilience is "the ability of general population around the world to sustain and improve their livelihood and welfare despite economic, environmental, political and social disturbances." According to Tanner, Lewis [61], human beings can play a central role in handling unpleasant situations by linking with livelihood resilience.

Furthermore, resilience for whom and resilience of what are two essential questions that the help of studying livelihood resilience can answer. Brown (2014) suggests that by answering the "resilience for whom" question, the "resilience of what" question can be answered. Coping strategies are essential in livelihood resilience because they help households during times of stress. These impulsive coping strategies are preparation and planning to deal with shocks. Marschke and Berkes [62] explain that a household requires some livelihood resilience building to deal with a special surprise. A livelihood system is robust if it displays low sensitivity but high resilience [63]. A vulnerable livelihood system, however, has the opposite characteristics. The livelihood resilience concept is increasingly used in global economic, climate change, and social systems transitions [64]. Bahadur and Lovell [65] write that livelihood resilience is now implicitly and explicitly acknowledged by the UN's Sustainable Development Goals for 2030.

2.2. Small-Scale Agroforestry Local Economic Development and Livelihood Resilience

Researchers worldwide agree that agroforestry is one important source that can assist local economic development, build livelihood resilience for an uncertain future, and maintain environmental sustainability [56,66–70]. Luedeling, Smethurst [71], and Sinclair [72] explain that in agroforestry, the livestock, trees, and crops can be combined with temporal sequences and spatial arrangements. This concept can bring a variety of benefits for the growers [20,73,74]. Agroforestry provides several benefits to the smallholders and nature: food, cash income, energy, construction materials, medicine, livestock fodder, soil & water conservation, and windbreaks [75–77]. It not only increases food security but also enhances soil fertility [78]. Approximately 43% of the total farmlands in the world have at least 10% of tree cover, where about 1.8 million populations depend on agroforestry products and serveries for their livelihoods [79,80].

Agroforestry is a prevalent source of livelihood, while only a few studies have discussed the link between livelihood resilience and agroforestry empirically and comprehensively. The majority of researchers only focused on the indirect benefits of agroforestry. From an ecological point of view, agroforestry trees provide shade to crops, which influences precipitation and temperature variation [34,66,67,70]. These trees also overcome destruction due to storms [81]. As trees have deep roots, they can survive during droughts, but the crops alongside can perish [70]. Climate variability is normal, and sometimes the blow of a natural disaster is risky for farmers to save their crops. Through agroforestry and growing trees, they can overcome this risk and protect their crops, too. Garrity, Akinnifesi [82] highlight that due to small-scale agroforestry, farmers can obtain crop yields despite droughts, but the farmers without agroforestry suffered crop failure.

Furthermore, agroforestry can provide households with construction materials, fruits, and vegetables for direct household consumption or sales for earnings, increasing their economics and livelihood resilience. The literature review concludes that agroforestry plays the primary role in the local economic development of environmental sustainability and improves social well-being [83]. This is also the best option for the farmer to improve their livelihood resilience through agroforestry. With the understanding of significant evidence, no proper research has been conducted on the role of small-scale agroforestry in local economic development and building livelihood resilience in KPK, Pakistan or any other country.

3. Materials and Methods

3.1. Study Site Description

This study examined various prospects of small-scale agroforestry that contribute to local economic development, livelihood, poverty reduction, and the crucial roles that agroforestry plays in the economic development of the KPK province of Pakistan, with specific reference to the Shangla and Swat districts (See Figure 1). Geographically, these districts cover 6905 square km, and the overall estimated cumulative population of the two sample districts is about 3.07 million KPK province was purposefully selected because it is the forest and agricultural rich province of Pakistan and needs research in this field. The forestry and mining industries dominate the region; however, agriculture has been an essential part of the whole province of KPK. The people of Shangla and Swat also grow different crops and trees on their land or leased land. This area is known for producing high-quality fruits and agro trees such as Persimmon, Oriental Plane, Black Persimmon, Peach, Walnut, Poplar, Pear, Loquat, Acacia, Plum, Apple, Apricot, Fig, Cedar, Melia, Olea, and Prunus. These Cities have been victims of various economic and political crises in the past., some military operations devastated livelihoods associated with agriculture and forestry. Still, people have now started it again on a large scale. The agroforestry concept is not new here; the community has been involved in it for a long time, and many poor people have benefited from this KPK. The government has recently completed a mega-project named BTAP to support this sector and the sustainable development of forests [84,85].

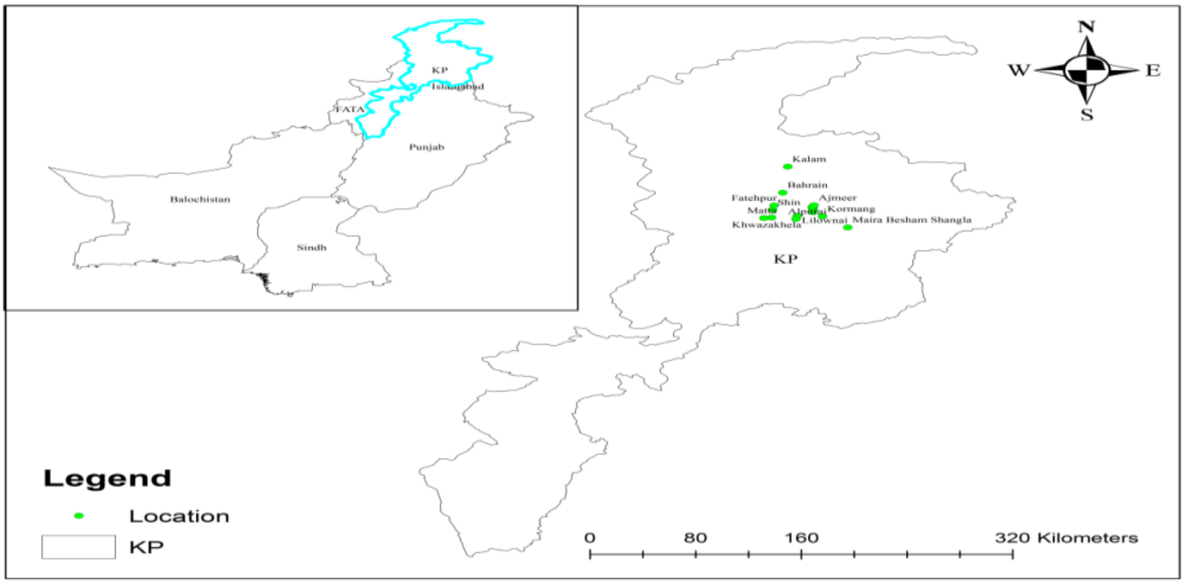

Figure 1. Study area map.

Furthermore, the population of Shangla is almost poor, depends on forestry and agriculture for livelihoods, and Shangla is one of the less developed districts of KPK, while Swat has little development compared to Shangla [44,86]. Moreover, Shangla and Swat are likely to be affected by economic and climate change. It is also important to mention that these two districts are famous for agroforestry production in Pakistan. Due to this, the responses would be diverse concerning the research question. The climate zone of Shangla and Swat is agroforestry friendly [87]. Due to a large population and scarcity of employment opportunities, the people of these districts encounter difficulty meeting the requirement of daily life. The primary source of income and livelihood is small agriculture farming, income from livestock, remittances, mining, and other small businesses. Thus, these factors have made the area a perfect place to investigate the role of small-scale agroforestry in building livelihood resilience.

3.2. Measuring Local Economic Development and Resilience with Sustainable Livelihoods Approach

It is not easy to measure local economic development and resilience, but several researchers have suggested different methods for measuring resilience [53,55,88–90]. It is because measuring resilience directly is hard yet possible, which is why experts have suggested using quantifiable indicators of resilience [58]. The SLA has been engaged in this research to organize and develop indicators of livelihood resilience and economic development. Overall, households' "economic development and livelihood resilience will then be measured using indicators". According to Krantz (2001), the concept of sustainable livelihoods has its origins in the work of the Brutland Commission, which published a report in 1987 advocating for nations to focus on sustainable development. After the Brutland Commission successfully proposed sustainable development as a crucial global agenda item, many researchers began to pay closer attention to the subject. The concept of sustainable livelihoods arose and grew insignificance in this context. Robert Chambers is recognized as one of the first attempts to define sustainable lifestyles, which he used in a discussion paper he co-authored with Gordon Conway in 1992. According to Chambers and Conway (1992: 7), "a livelihood comprises the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living; a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long-term." Wider adoption and practice of the concept of sustainable livelihoods entailed began to be adopted by development agencies mainly from the United Kingdom, such as the Department of International Development (DFID), Cooperative for Assistance, and Relief Everywhere (CARE), and Oxford Committee for Famine Relief OXFAM. DFID later modified the definition given by [91]; they defined a sustainable livelihood as encompassing. Development agencies, primarily from the United Kingdom, such as the Department of International Development (DFID), Cooperative for Assistance and Relief Everywhere (CARE), and Oxford Committee for Famine Relief OXFAM, began to adopt practice the concept of sustainable livelihoods on a larger scale. The notion of sustainable living was later updated by DFID, who defined it as comprising (Chambers and Conway, 1992) "the capabilities, assets, (including both material and social resources) and activities required for a means of living and the sustainability of a livelihood is when it can cope with and recover from stresses and shocks and maintain or enhance capabilities and assets now and in the future while not undermining the natural resource" [92].

According to the SLA that household livelihoods should be considered in the form of household access to the five capital assets (financial, human, physical, social and natural capital), in this method, households combine capital assets to generate their livelihood, and how a household can increase their assets with the collaboration of the with other institution and actors [91,93–96]. This is the actual portrayal of sustainable livelihood. Five types of capital assets included human capital, financial capital, physical capital, social capital, natural capital, all basic elements essential for a sustainable livelihood and local economic development [97–100].

Financial capital defines economic resources which are obligatory by an individual to meet livelihood goals. These may include savings, credit, inflows of remittances/state transfers, and the size of livestock farm pertain [98,99,101]. Physical capital refers to access to basic infrastructures and services, which is essential for supporting and developing sustainable livelihood. These may include roads and irrigations [97]. Human capital refers to the knowledge, education, training, and the capability to work in excellent health that empowers individuals to follow livelihood strategies [100]. Social capital represents the features of a social organization that serve to coordinate actions. These are social resources individuals draw on in pursuit of livelihood objectives and include networks, exchange, associations, groups, reciprocity, and relationships of trust [102]. Natural capital consists of the natural reserves that are essential contributions for the poor households and from which livelihood is generally derived. It ranges from tangibles to intangible goods, such as s air quality, soil quality, biodiversity, and saline and lodging for a healthy environment [98,99].

A household is expected to retain these five capitals in a balance [103]. Through the creation of livelihood, assets may improve the ability of households to give a timely response to shocks. The SLA also provides various assets that households use to enhance their livelihoods [86] and to understand the fluctuating arrangements of events of livelihood in a historical and changing background [104]. However, it has been evaluated for not adequately accounting for power associations [95] and not being expert driven.

SLA is one of the appropriate approaches in agroforestry for organizing resilience and local economic development indicators. This research used indicators that were adapted from the literature about livelihood resilience. The research study of Quandt [105] was consulted; it considered local perspectives of the impacts of floods and droughts [106,107]. According to the study of Jones and Tanner [58], livelihood resilience promotes some measures of individual resilience, although measuring it is a top-down, objective process. As Gupta, Dagar [108] studied that agroforestry is earning improving living standards and environmental sustainability. Based on past studies, this question has been addressed by including subjective, local ideas of livelihood and economic development in the indicators of this research study. The indicators were transformed into quantitative questions that helped measure livelihood resilience by asking a targeted population. After asking questions, the answers were accumulated for the five livelihood capitals (composite asset indexes) and household overall (overall composite asset indexes). Figure 2 describes this process, and more details will be covered in the results section Multitude of assets and diversity (related to livelihood resilience) is the focus of methods used in this study [94,109,110]. Moreover, the local economic development and well-being of livelihoods can be increased, and the risks of shock can be reduced through diversification [110]. Five livelihood capital assets helped this research study contrast and compare livelihood capitals between households and measure resilience in a non-monetized approach.

A few studies have used the SLA to measure local economic development and resilience; it has not been frequently used [96,98,99]. Community and household resilience have been measured by Thulstrup [96] with the help of SLA after government interventions in Vietnam. The poverty maps were created by [99] to build resilience with the help of five capital assets. This research study is also based on previous works in this area.

3.3. Questionnaire Design and Sampling Technique and Data Collection

Surveys employing a quantitative research methodology for data collecting in Shangla and Swat using the Bureau of Statistics Pakistan's prepared questionnaire by two-step cluster sampling procedures. To avoid confusion of items or ambiguities in the response groups, the designed questionnaire was pre-tested in the last two weeks of January 2018 on a sample of 50 households from the selected districts in KPK, Pakistan. For proper data collection in June 2019, ten social organizers with a minimum of four years' experience in the social sector from national NGOs were selected. Data were collected from both groups (people linked with agroforestry and people not linked with agroforestry). For this purpose, fifteen villages were randomly selected for this research in Shangla and Swat, and then we distributed 370 questionnaires among these social organizers, one questionnaire per household. Out of these 370 questionnaires, 350 were considered valid to be used in the analysis. The response rate was 94.59%. Out of these 350, 260 individuals were currently filled from Swat and 90 from Shangla.

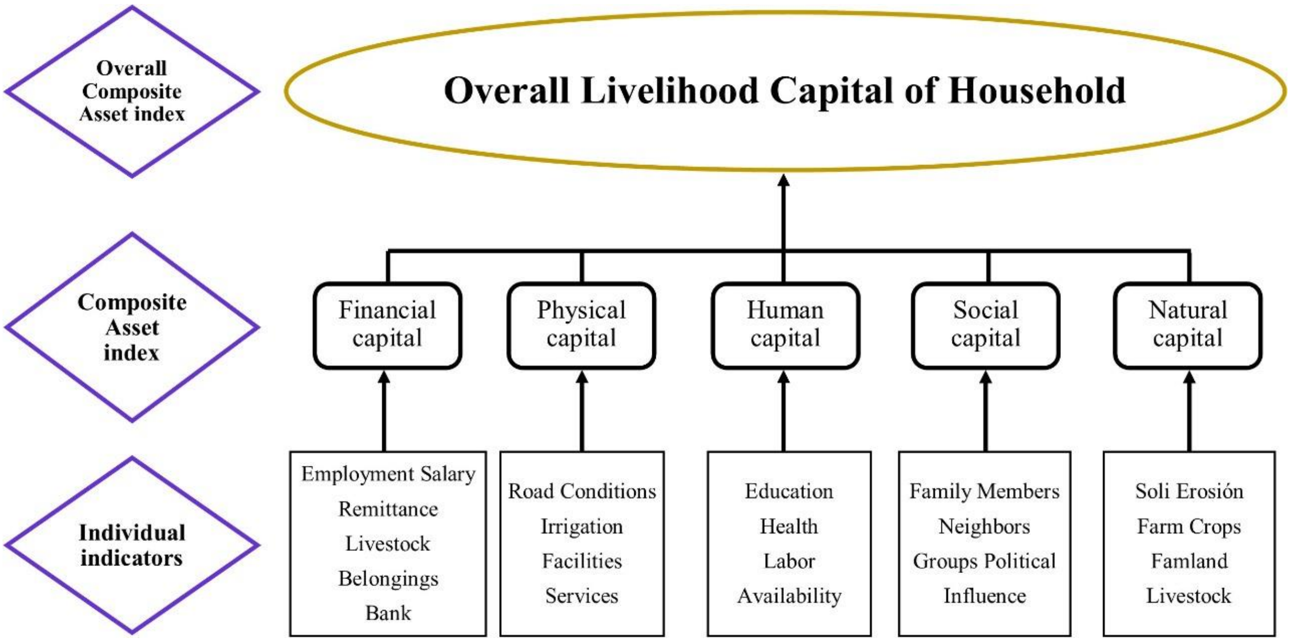

Figure 2. SLA-modified framework.

Furthermore, 176 households are directly linked with agroforestry, while 174 households were not directly linked and beneficiaries of small-scale agroforestry. Similarly, 12 qualitative case studies of households and interviews of experts were conducted, seven from Swat and five from Shangla. This information is instrumental in discovering the fundamental role of small-scale agroforestry in building livelihood residences in Shangla and Swat.

3.4. Data Analysis and Empirical Strategy

After collection, the data were entered into the computer for analysis to obtain proper results. Different empirical strategies were applied. The strategy consisted of the three-part first descriptive statistics. The second measurement of household income and wealth index and effects of small-scale agroforestry on the income and wealth of households is the last estimate of the significant effect of variables, which uses the linear regression model.

3.4.1. Agroforestry, Household Income, and Wealth: The Empirical Model

This study estimates two equations that assess the impacts of small-scale agroforestry on the income and wealth of local households.

$$Income_i = \alpha_0 + \alpha_1 samll\ scale\ Agroforestry\ Enterprise_i + \gamma X_h + \varepsilon_i, \quad (1)$$

$$Wealth\ Index_i = \beta_0 + \beta_1 samll\ scale\ Agroforestry\ Enterprise_i + \gamma Z_h + \varepsilon_i, \quad (2)$$

$$LED_i = \theta_0 + \theta_1 samll\ scale\ Agroforestry\ Enterprise_i + \gamma Z_h + \varepsilon_i, \quad (3)$$

where $Income_i$, $Wealth\ Index_i$ measure the level of income and wealth for the ith individual, and $samll\ sacle\ Agroforestry\ Enterprise_i$ is a dummy variable that measures whether the given respondent is associated with small scale agroforestry. X_h and Z_h are household-level control variables. ε_i is a disturbance term.

To empirically estimate Equations (1) and (2), the widely acknowledged ordinary least squares (OLS) methodology was used, where α_1 and β_1 stand for the impact of small-scale agroforestry on household income and wealth. Besides income and wealth, the study used linear regression techniques to evaluate the results.

LED_i respectively measures Local Economic Development for the *i*th individual, and $Enterprise_i$ is a dummy variable that measures whether the given respondent is associated with Small-scale agroforestry. Z_h in each equation is the set of household-level control variables. ε_i denotes a disturbance term.

To empirically estimate Equation (3), ordered logit methodology was used. Technically, OLS methodology cannot provide optimal results when the explanatory variable is ordered responses [64]. There is a consensus among econometricians that the ordered logistic regression model provides efficient results in such situations.

3.4.2. Interview

The qualitative household case study interviews were coded using QSR Nvivo10 software. Codes were developed from the academic literature, the discussion topics, and themes that emerged during the research process. The different data sources (qualitative, quantitative, and ecological) were compared and contrasted with triangulating results in an iterative process.

4. Results and Discussion

4.1. Descriptive Results

Table 1 shows the comparison between households practicing small-scale agroforestry and households not practicing small-scale agroforestry in Shangla and Swat. Households engaged in small-scale agroforestry were more likely to have basic comparisons such as a bank account, labor force, crops planted, and irrigation. Agroforestry increases the income and assets of households through the profits earned by selling fruits and timbers, which can be used to pay educational fees and purchase food and medicine for their families by contributing to the local economic development. Thomas and Huber [32] showed a similar result, highlighting that the locally generated income would circulate locally. This way, they contribute to the region's local economic development. The results show that the wealth index (out of 11: tractor, computer, television, electric fan, car, air cooler, mobile phone, electric iron, motorcycle, air conditioner, and refrigerator) of both groups is 11.2 and 8.9, respectively.

4.2. Agroforestry and Its Benefits

Agroforestry plays a vital role in the sustainable development of Pakistan. Table 2 shows the different types of agro trees, and small-scale agroforestry benefits the household's economic growth in Shangla and Swat. The main agro trees of the area are Poplar, Oriental plane, Persimmon, Black Persimmon, Plum, Apple, Peach, Acacia Keekar, Fig, Pear, Walnuts, Apricot, Melia, and Morus. These trees provide several benefits to the household. The main benefits include income, food, firewood, and construction. The households use these trees for their consumption as well as for sale and profit. It is also worthy of mentioning that local people did not doubt that AF systems are an environment-friendly activity and provide many benefits to the environment. During the research, it was observed that many people use agroforestry for the beautification of the land, windbreaks, erosion prevention, rain attraction, and compost. It was also observed that the farmers target populations, also facing some major constraints in the proper development of small-scale agroforestry such as the size of farm, plants disease and pests' control, lack of proper training, local robbery of fruit, lack of water for irrigation, lack of proper know-how about the plantations, and inaccessibility to tree seeds and seedlings. Despite these constraints, the agroforestry system is improving and diversifying agricultural production with fewer inputs, less technicalities, and lower costs. Their management should be adapted according to changing circumstances as well, such as ongoing climate changes. For instance, the size of the plots, location of the plot in terms of access, slope, and land-use change can affect the biodiversity contribution of agroforestry. Below a certain level of plot size, it may be impossible to sustain livestock and another biodiversity as well. Despite the biodiversity contribution of the agroforestry system, the implication is far better than the conventional single layer of monocultures crops. It is more efficient to produce more goods on a given land area than other land management systems, such as water, sunlight, nutrients, and always more adaptive response to extreme climate events. The agroforestry system also provides a range of ecosystem services. It is best to reduce erosion, restore degraded lands, improve water conservation, water quality, climate change adaptation, and help mitigation. If deployed inadequately, it can increase competition and adverse effects.

Table 1. The difference in the household between households linked with small scale agroforestry and households not linked with agroforestry.

	Households Linked to Agroforestry (Treatment Group)	**Household Not Linked to Agroforestry (Control Group)**	**Difference (1–2)**
	(1)	**(2)**	**(3)**
		Demographic Information	
Bank account	1.78	1.03	0.75
Size of farmland	1.0	0.65	0.35
Irrigation Access	1.19	1.03	0.16
Ownership of Area	1.01	0.75	0.26
Membership	2.23	1.89	0.34
Labor force b/w 18–60	1.05	0.97	0.08
Education	7.0	6.13	0.87
Number of trees crops	1.09	0.058	0.51
		Asset Possessions	
Wealth Index (Before)	8.5		
Wealth Index (After)	11.2	8.9	2.3
Number of responses	176	174	350

Table 2. Types of trees and benefits from these trees.

Major Plants	**Income**	**Construction**	**Food**	**Fodder**	**Firewood**	**Medicine**	**Timber**
Poplar	23	6	-	-	2	-	0
Oriental plane	6	-	-	-	-	-	4
Persimmon	17	2	7	-	6	0	9
Black persimmon	13	0	9	5	8	0	5
Plum	6	5	6	-	5	2	3
Apple	12	2	5	-	0	3	-
Peach	16	-	8	0	5	1	-
Acacia Keekar	10	7	-	5	6	0	5
Fig	5	-	6	3	4	2	0
Pear	8	-	7	-	5	1	0
Walnuts	7	-	4	-	3	3	5
Apricot	4	0	5	0	3	2	-
Melia	7	5	-	3	4	-	2
Morus	5	3	-	2	2	3	3
Total	139	30	57	18	53	17	36

Scientific name: Populus, Platanus orientalis Diospyros virginiana Diospyros texana, Prunus domestica, Malus, Prunus persica, Acacia, Ficus carica, Pyrus, Juglans, Prunus armeniaca, Melia azedarach and Morus alba.

4.3. Livelihood Capital and the Effect of Small-Scale Agroforestry on This Capital

Agroforestry plays a significant role in local economic development and building livelihood resilience, helping farmers provide financial capital besides financial benefit. Agroforestry also provides non-financial benefits such as social and environmental and improving household livelihood through planning different agroforestry activities such as fruits, nuts, plants, trees and livestock. The results further revealed that households linked with agroforestry earn 6% more income and have 23% more assets. Figure 3 represents the household case study, interviews, observations and relates to the S.L.A. capitals. From Figure 3, it is clear that small scale agroforestry improves these capitals, and these capitals are also interlinked with each other by agroforestry. Various benefits of agroforestry positively impact different livelihood capital. In detail, the usage of fruits boosts health (human capital) and provides a source of income (financial capital).

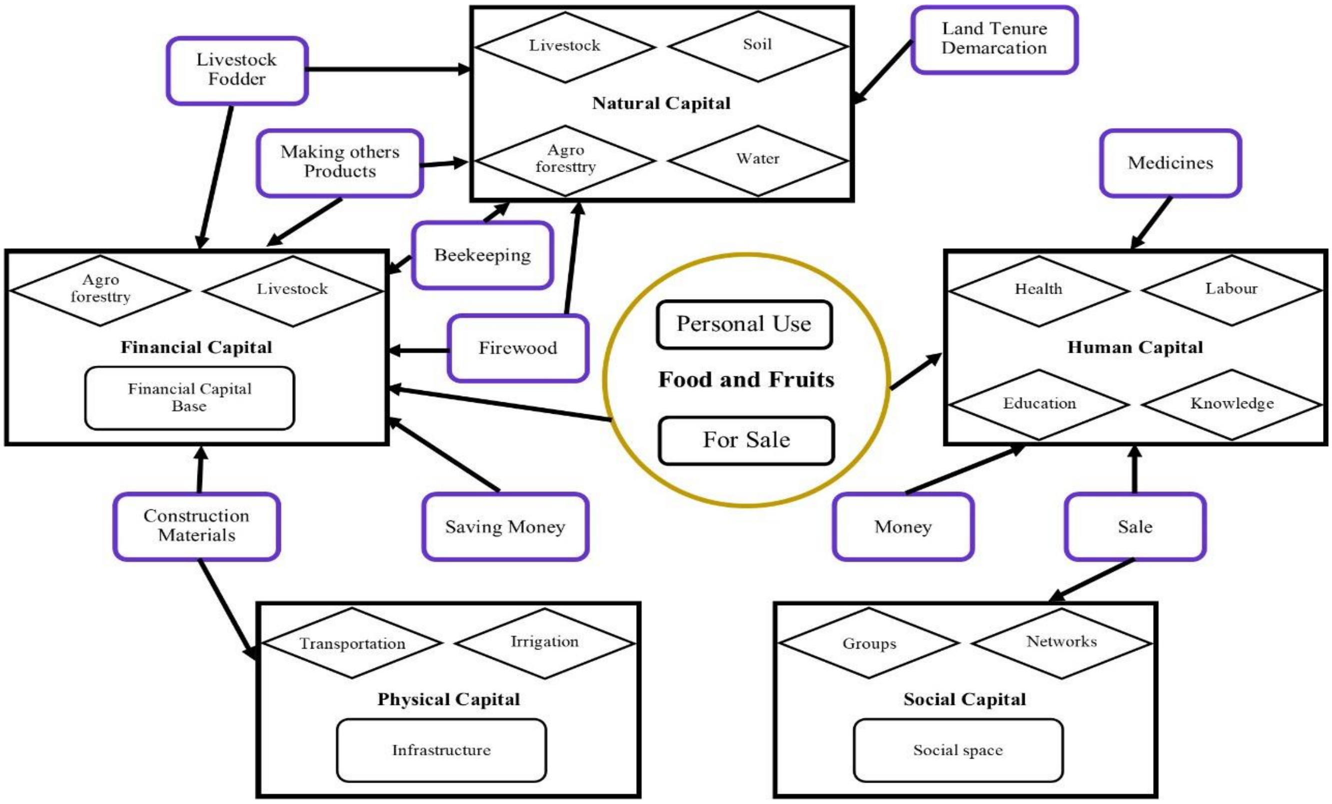

Figure 3. Agroforestry benefits and sustainable livelihood capital.

Many households sell their fruit and nuts and earn an extra profit through small-scale agroforestry. Some farmers managed to improve their livelihood capital assets by utilizing the income from agroforestry. For example, some people have paid children's school fees by using the money they earned by selling fruits and timber, which increases human capital. As an outcome of agroforestry, the overall livelihood resilience can improve consistent results with Jacobs, Nelson [103]. He also found positive effects between the five livelihood assets, building livelihoods, economic development, and agroforestry. The households with a balanced and high livelihood capital will be more resilient in the long term. The results of this analysis suggest that farmers can quickly improve their household's financial situation by using agroforestry and planting trees around their crops. A significant number of people who participated in this research study admitted increasing their income by planting trees around their crops.

Moreover, the financial capital score increased for households with a more significant number of trees. This is because an increased number of trees comes with an increased amount of income. Furthermore, the farm size also matters because it can limit the ability of a household to grow trees which means that the farm size is directly proportional to the financial capital. For this reason, farm size can be a limiting factor for small-scale agroforestry.

4.4. Results of OLS Regression

This section provides the empirical results of small-scale agroforestry impact on the differences in observed outcomes (i.e., income and wealth) between the households' link with small scale agroforestry (treatment group) and households not linked with small scale agroforestry (control group). In order to do so, OLS estimated Equations (1) and (2), and the results are presented in Table 3. Column (1) of Table 3 illustrates the results for income differences. A better return on investment can be achieved by planting trees than that grains or maize because trees have a high value. Conversely, trees help avoid income shocks. It is evident that beneficiaries of small-scale agroforestry, on average, earn 6% more.

Table 3. Small scale agroforestry and observed outcomes.

	(1)	**(2)**
Dependent Variable(s)	**Log (income)**	**Wealth Index**
Agroforestry (=1)	6.141 ***	2.329 ***
	(0.024)	(0.024)
Bank	0.003 ***	−0.009 ***
	(0.002)	(0.005)
Size of farm land	0.280 *	0.253 **
	(0.044)	(0.125)
Irrigation access	0.00140	0.00103
	(0.00678)	(0.0486)
Ownership of area	0.00107	−0.0646 *
	(0.00520)	(0.0382)
No of Household b/w 18–60	0.058 ***	0.270 *
	(0.032)	(0.085)
Education	0.036 *	0.352 *
	(0.014)	(0.036)
Number of trees/crops	0.054 **	0.066
	(0.026)	(0.075)
Constant	1.503	8.490
	(1.412)	(1.037)
Observations	350	350
R^2	0.383	0.341

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, with robust standard errors in parentheses.

Similarly, column 2 of Table 3 indicates that beneficiaries of agroforestry own 2.3 more assets, 23%, compared to their counterparts. By the income earned from small-scale agroforestry, a household can manage their livelihoods coherent with the results of Agrawal and Perrin [111]. They revealed that a household could be more vulnerable to disturbances and shocks if it has fewer financial assets. Moreover, the effects of climate change can be higher for households with a low amount of financial assets [112].

Moreover, R2 of income and wealth index are 0.383 and 0.341, respectively, implying small-scale agroforestry. It contributes 38% to forecasting income, while 34% predicts wealth. Although many researchers have discussed the climate impact of small-scale agroforestry, the current study's findings add the new role of small-scale agroforestry into the literature of agricultural enterprises. Various studies report the positive effects of small agricultural entrepreneurship. However, this study is different, as it measured the impact of small-scale agroforestry in the local economic development and building of livelihood resilience. Moreover, these findings indicate the positive effects of agroforestry on the income and wealth of households:

We further analyzed three specific aspects of the LED measures. Table 4 indicates the perceived effects on income, employment, and savings due to a connection with SSAF. Since the dependent variable is ordinal, ordered logit regressions were used for the analysis. Columns (1–3) show that SSAF positively affects income, employment, and savings. These results are also consistent with the existing literature on small entrepreneurship, such as the findings of Ali [9], who found a positive association between forest income and the LED of households.

Table 4. SSAF and LED.

Dependent Variable(s)	(1)	(2)	(3)
	Income	**Employment**	**Saving**
Enterprise (=1)	2.286 ***	2.672 ***	2.242 ***
	(0.201)	(0.206)	(0.202)
Age	−0.0274	−0.104 **	0.0360
	(0.0402)	(0.0429)	(0.0403)
Gender	0.0272	−0.210	0.305
	(0.334)	(0.329)	(0.302)
Education	0.0951	0.0108	0.0639
	(0.126)	(0.133)	(0.124)
Family Size	−0.00590	−0.0681	0.00818
	(0.0945)	(0.0946)	(0.0970)
Knowledge (forestry)	0.0881	0.0983	−0.0186
	(0.0747)	(0.0770)	(0.0758)
/cut1	−1.653	−5.278 ***	0.250
	(1.639)	(1.723)	(1.604)
/cut2	−0.789	−4.168 **	1.350
	(1.635)	(1.707)	(1.604)
/cut3	0.869	−2.422	3.104 *
	(1.634)	(1.698)	(1.617)
/cut4	2.631	−0.687	4.936 ***
	(1.630)	(1.676)	(1.620)
Observations	350	350	350

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, with robust standard errors in parentheses.

4.5. Results of the Linear Regressions Model

In Table 5, the evaluated results of the regression analysis of the three models are reported. Table 5 represents the value of coefficients and their standard errors. The value of coefficients shows the relationship between that particular independent variable and a dependent variable. The results of model 1 show that our independent variables of the size of farmland, age, irrigational access, ownership of the area, and the number of trees have positively influenced agroforestry. However, bank account, memberships, and education have a positive and weighty link with agroforestry. This means that an increase in better education, memberships, and a bank account will increase the productivity of agroforestry. Irrigation access plays a significant part in growing trees and sustainable development. A similar result is shown by Zomer, Neufeldt [80], who highlighted the importance of irrigation for agroforestry in northern India. Irrigation can help plant trees, which in turn can boost livelihood resilience.

Results of model 2 show that our independent variables of bank account, irrigation access, number of trees, and age positively influenced tree density. The size of farmland has a positive association with tree density. This means that the increased size of farmland will increase the density of the trees. Crop diversity and tree species (a form of on-farm diversity) have helped farmers develop livelihood resilience in Shangla and Swat. Moreover, household finances can be enhanced through tree diversity and contribute to local economic development. The presence of different types of trees comes with many other benefits as well, for example, peaches, which are a favorite fruit in Swat [113]. Peaches can be used as a fruit, but they also has many other industrial applications. They are also known for shade, construction materials, and firewood, similar to results [36,114].

Table 5. Dependent variable Agroforestry, trees, trees diversity.

	Agroforestry		Trees		Trees Diversity	
Independent Variables	**Coeff.**	**Stand. Error**	**Coeff**	**Stand. Error**	**Coeff**	**Stand. Error**
Bank account	1.78 **	(0.6)	0.09	(0.13)	0.06	(0.05)
Size of farmland	1.0	(0.04)	0.09 **	(0.05)	0.01	(0.01)
Irrigational access	1.19	(0.37)	0.09	(0.20)	0.028	(0.06)
Ownership of area	1.01	(0.21)				
Agricultural Membership	2.23 *	(0.79)				
No of Household b/w 18–60	1.05	(0.06)	0.08	(0.02)	0.01	(0.01)
Education	7.0 *	(7.09)				
Number of trees/croups	1.09 **	(0.04)	0.241	(1.07)	0.058	(0.07)
R-squared	0.182		0.08			0.08

Note(s): ** $p < 0.05$, * $p < 0.1$. Correlation is significant at the 0.01 level. *. Correlation is significant at the 0.05 level.

The results of model 3 show that our independent variables of bank account, irrigational access, size of farmland, age, and the number of trees positively influence tree diversity, which is coherent with the results of Ellis [110], who found that risk can be reduced. Well-being can be increased by diversifying livelihoods and improving the economic situation of the household. Similarly, McCabe, Leslie [68] also noted that poor farmers of East Africa have been diversifying their livelihoods for decades. Doing so has helped them fight increased population, climate change, and political uncertainties.

In Table 6, the evaluated results of the regression analysis are reported. Table 5 represents the value of coefficients and their standard errors. The value of coefficients shows the relationship between that particular independent variable and a dependent variable. The evaluated results show that financial capital has an encouraging positive influence on small-scale agroforestry. The coefficient value of financial capital is 0.01. Human capital has a positive link with agroforestry. An increase in human capital will enhance small-scale agroforestry. The coefficient value of human capital is 0.32. Social capital has a positive link with agroforestry. The coefficient value of social capital is 0.45 and is statistically insignificant. Physical capital has a positive link with agroforestry. The coefficient value of physical capital is 0.39 and is statistically insignificant. Natural capital has a positive influence on agroforestry. The coefficient value of natural capital is 0.48. These results are consistent with Jacobs, Nelson [103], who studied that the balance of the five capital is essential for the household to respond to uncertain shocks. Similarly, Thorlakson and Neufeldt [36] found that agroforestry improves the household's financial position, enabling them to respond positively to future shocks. Furthermore, Tanner, Lewis [61] found that households linked with agroforestry sustain their livelihoods in a satiable way through selling fruits and timbers to generate income, which assists themselves and their livelihoods in political, economic, and ecological disturbances.

Table 6. Dependent variable: Small-scale agroforestry.

	Small-Scale Agroforestry		
	Coeff.	**Stand. Error**	***p* Value**
Financial Capital	0.01	0.018	0.000 *
Human Capital	0.32	0.035	0.229
Social Capital	0.45	0.074	0.124
Physical Capital	0.39	0.042	0.322
Natural Capital	0.48	0.039	0.000 *

Note(s): * $p < 0.1$. Correlation is significant at the 0.01 level. *. Correlation is significant at the 0.05 level.

In Table 7, the evaluated results of regression analysis are reported. Table 6 represents the value of coefficients and their standard errors. Estimated results represent a positive association between an increase in tree density and the quality of life. The coefficient value of improved quality is 0.08. An increase in tree density also has a positive impact on income or the earning of people. The coefficient value of improved quality is 0.18. Results are consistent with Tanner, Lewis [61] found that the improving livelihoods resilience perspective to solve the environmental issue and maintain livelihoods and enable household response uncertain future through the income earned from the agroforestry and contribute local economic development. Similarly, with the economic benefit of agroforestry, there are also several environmental benefits such as preventing soil erosion [115] and being a significant source for wind-breaking. Furthermore, agroforestry is also a source of shade and beautification, which protects households from the summer heat, consistent with the result of Adger [102].

Table 7. Dependent variable: tree density.

	Coeff	**Stand. Error**
Improved Quality	0.087	(0.098)
Improved income	0.184	(0.119) ***

Note(s): *** $p < 0.01$, Correlation is significant at the 0.001.

4.6. Limitation and Recommendations

Using the SLA to discuss these results, it becomes clear that the socio-economic impact relates to the livelihoods of rural farmers in many different ways; through different types of assets, through structures and processes that shape the livelihoods of the farmers, the livelihood strategies to achieve certain livelihood outcomes, and the livelihood outcomes. This broad impact of small-scale agroforestry on local economic development and livelihoods. It is believed that agroforestry plays a vital role in local economic development and building livelihood resilience. Along with the primary source of livelihoods and local economic development, agroforestry also plays an important in environmental sustainability. Furthermore, we argue that this can increase the sustainability of the measured local economic development impacts and environmental impacts in the future.

However, as of yet, the results reported in this paper still have contributed less than their potential to improve the local economic development, livelihoods and environmental sustainability. Therefore, we recommend that future researchers examine the factor affecting agroforestry in the long run and address the current challenges and issues faced by the former of the study area. Future work could relate ecological and nutritional indicators at larger spatial and temporal scales to incorporate the community, landscape, and governance conditions that enable farmers to manage agroecosystems for resilience.

The sustainable livelihoods approach is seen as central to all meaningful efforts that contribute to rural livelihood and alleviate poverty around the globe. Environmental sustainability concerns itself with looking at how livelihoods adopted externally impact other livelihoods. The notion of environmental sustainability is operationalized at different levels, the local and the global. We have placed considerable effort into assessing agroforestry farmers' livelihood resilience and the feasibility of expanding. However, some limitations could also be noted for future work. First, interviews might be carried out with local farmers who have been practicing forest to explicitly explain their social, technical, and financial difficulties and benefits in cultivation. SLA could be said to be a practical approach for evidence-based intervention and has much logic resting behind it, especially in a world undergoing rapid change and where resources to support development interventions are inevitably limited. Second, focus group discussion meetings in other selected case study areas under the KPK, Pakistan's scheme was considered particularly suitable for analyzing the potential for expanding the implementation of more agroforestry systems. There is more work needed on the environmental aspect of agroforestry.

These results are based on cross-sectional data that we only focused on a particular system, i.e., household/family farming. We recommend that longitudinal and combined methodologies be used and that more than one agricultural system be assessed in future research. Last, we recommend that the KPK, Pakistan government launches such a project that supports and develops agroforestry and local economic development in the province for the long run. Lastly, with reference to the definition the percent of land covered by tress differs based on how crowded the trees are. This aspect should be considered in future research.

5. Conclusions

This study assesses the impact of small-scale agroforestry on local economic development and livelihoods for selected districts in KPK, Pakistan. We contribute to the existing literature on agroforestry by identifying the role of small-scale agroforestry in local economic development and building livelihoods resilience by utilizing advanced econometric techniques. Using primary household survey data from 350 individuals and 12 qualitative case study households' interviews, we find a positive influence impact of small-scale agroforestry on livelihoods and economic development. Our results suggest that, on average, households connected with small-scale agroforestry earn 6% more income and have 23 percent more assets. Similarly, people from agroforestry report a higher rating of these small-scale agroforestry farms for their livelihoods. Our results are robust for various dimensions of small-scale agroforestry.

This research provides comprehensive and empirical evidence on the relationship between small-scale agroforestry livelihood resilience and local economic development. This research paper has five significant findings that may apply on a larger scale and in other cities of Pakistan or other countries. First, it provides direct evidence of the strong association between agroforestry building livelihoods resilience and local economic development, especially in Pakistan, where no such research or evidence has been established to date. Second, financial capital can be improved through agroforestry, which can improve other capital assets. Moreover, agroforestry can build a livelihood capital base, which means farmers can deal with various livelihood shocks. Third, small-scale agroforestry brings non-financial benefits such as environmental sustainability, improved living standards, reduced soil erosion, and provided shade. Fourth, irrigation plays a vital role in building livelihood resilience and promoting agroforestry. Lastly, on-farm diversity can be improved through agroforestry.

These findings are not limited to the selected cities of Pakistan; they have a broader scope. The international development of projects related to agriculture should pay much importance to livelihood resilience to safeguard the interests of small to average growers. Governments and non-governmental organizations can use the results of this study to improve the resilience, local economic development, and well-being of farmers everywhere in the world. Although the percentage of results may vary from area to area, farmers will benefit from livelihood resilience through agroforestry.

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