

THE IMPACT OF CHALGHUZA PINE NUTS PRODUCTION ON LIVELIHOOD OF THE INHABITANTS OF SUB DIVISION DARAZINDA DISTRICT DERA ISMAIL KHAN

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Abstract

This study examines the socio-economic impact of Chalghuza pine-nut (*Pinus gerardiana*) production on the livelihoods of inhabitants in Sub-Division Darazinda, District Dera Ismail Khan, Pakistan. Given the region's limited agricultural capacity, Chalghuza pine forests represent a critical non-timber forest product and a primary income source for local communities. Using a purposive sampling technique, data were collected through structured questionnaires from 140 producers engaged in pine-nut harvesting from the Takht-e-Suleiman mountain forests. Both descriptive statistics and multiple linear regression analysis were employed to evaluate the influence of natural, human, financial, and physical capital on household income. Results reveal that 97% of respondents consider Chalghuza pine-nut collection their main livelihood source, with an average seasonal production of 122 kg per producer and mean earnings of PKR 1,382,500. Regression analysis indicates that the number of trees owned (natural capital), harvesting experience (human capital), government assistance (financial capital), and site accessibility (physical capital) significantly affect annual income. The findings highlight the species' economic importance and the dependency of rural livelihoods on sustainable forest management. Policy implications include the need for improved market access, training in sustainable harvesting techniques, and infrastructure development to enhance economic benefits while conserving forest resources. This study provides empirical evidence for policymakers and development practitioners to integrate non-timber forest products into rural development strategies.

Introduction

Forests cover approximately 4.06 billion hectares globally, representing over 30% of the Earth's land area, and contribute substantially to ecological stability, biodiversity conservation, and socio-economic development (FAO, 2017). Beyond timber, non-timber forest products (NTFPs) such as fruits, nuts, medicinal plants,

and resins play a pivotal role in sustaining rural livelihoods, particularly in developing countries (Angelsen & Wunder, 2003; Vedeld et al., 2007). These resources provide food security, raw materials, and supplementary income for millions of households worldwide.

In Pakistan, forests occupy roughly 4.5 million hectares—just 5% of the total land area (GOP,

2020). Among these, Chalghuza pine (*Pinus gerardiana*) stands are ecologically and economically significant. Indigenous to Pakistan, Afghanistan, and India, this slow-growing, high-altitude conifer produces edible seeds with exceptional nutritional value and strong international demand. In Pakistan, dry temperate zones such as the Suleiman Mountain range host extensive Chalghuza forests, contributing up to 20% of the country's forest cover and supplying 74% of its total pine-nut production (Mandokhail, 2021).

The Sub-Division Darazinda, District Dera Ismail Khan, lies within this production zone. Characterised by harsh climatic conditions and limited agricultural potential, the region's economy depends heavily on forestry and livestock. For many tribal households, Chalghuza pine-nuts represent the main source of cash income. A single mature tree can yield nuts worth up to PKR 165,000, with local and export markets—particularly in China, the Middle East, and Europe—ensuring high economic returns. However, harvesting is labour-intensive and constrained by rugged terrain, lack of infrastructure, and limited technical knowledge, factors that can reduce both productivity and sustainability.

The livelihood framework proposed by Carney (1998) conceptualises five core assets—natural, human, financial, physical, and social capital—that collectively shape income generation and well-being. NTFPs such as pine-nuts contribute directly to these capitals by providing harvestable resources (natural capital), employment opportunities (human capital), marketable products (financial capital), and assets for community resilience (social capital). Globally, NTFPs account for 10–25% of rural household income in many forest-adjacent communities (Neumann & Hirsch, 2000), with non-timber nut production—such as walnuts, pistachios, and pine-nuts—providing particularly high-value returns.

In Pakistan, Chalghuza pine-nuts are among the most valuable NTFPs, with per-kilogram prices reaching PKR 10,000 in recent years (PakistaniStores.com). This high market value

creates significant livelihood opportunities but also raises concerns about overexploitation and resource depletion. International Union for Conservation of Nature (IUCN) assessments classify *Pinus gerardiana* as a near-threatened species, highlighting the need for sustainable management practices.

Problem Statement

Despite the economic potential of Chalghuza pine-nuts, empirical research on their socio-economic impact in Pakistan remains scarce, particularly in Khyber Pakhtunkhwa's former Federally Administered Tribal Areas (FATA). The Sub-Division Darazinda, with its heavy dependence on pine-nut harvesting, presents an important case for examining how natural resource-based income affects household welfare. Challenges such as inadequate market infrastructure, price volatility, unskilled harvesting methods, and limited access to formal financial support constrain the sector's contribution to sustainable livelihoods.

Without evidence-based interventions, these constraints could undermine both household income security and forest conservation. Understanding the relationship between livelihood capitals and pine-nut-derived income is therefore critical for designing policies that enhance economic benefits while ensuring ecological sustainability.

Objectives of the Study

The primary objective of this study is to examine the impact of Chalghuza pine-nut production on the livelihoods of producers in the Sub-Division Darazinda, District Dera Ismail Khan. Specifically, the study aims to:

1. Quantify household income generated from pine-nut harvesting.
2. Identify the socio-demographic characteristics of producers.
3. Analyse the relationship between livelihood capitals (natural, human, financial, and physical) and pine-nut-derived income.
4. Provide policy recommendations for sustainable resource management and livelihood improvement.

Research Question

Does the production of Chalghuza pine-nuts significantly affect the livelihoods of producers in the Sub-Division Darazinda, District Dera Ismail Khan?

What are the socio-demographic characteristics of Chalghuza Pine-Nut producers in Sub-Division Darazinda, District Dera Ismail Khan?

To what extent do different forms of livelihood capital (natural, human, financial, physical) influence household income from Chalghuza Pine-Nut production?

How dependent are local households on Chalghuza Pine-Nut production for meeting their essential expenditures, such as housing, health, and food security?

Significance of the Study

This research addresses a critical gap in understanding the economic and social importance of Chalghuza pine-nuts within Pakistan's rural development context. By integrating livelihood theory with empirical economic analysis, the study offers actionable insights for policymakers, forest managers, and development practitioners. The findings will contribute to strategies aimed at:

- Enhancing income-generating capacity through sustainable harvesting practices.
- Improving market access and price stability.
- Strengthening rural infrastructure to reduce transaction costs.
- Conserving a high-value but vulnerable forest resource.

Given the Chalghuza pine's dual role as an ecological asset and an economic commodity, the outcomes of this research can inform both environmental conservation policies and rural poverty alleviation programs.

Literature Review

Non-Timber Forest Products and Rural Livelihoods

Forests provide critical ecological services and direct economic benefits through both timber and non-timber forest products (NTFPs). NTFPs, including fruits, nuts, medicinal plants,

and resins, contribute significantly to household income and food security in rural areas, particularly in developing countries (Vedeld et al., 2007). The livelihood framework of Carney (1998) conceptualises five capital assets—natural, human, financial, physical, and social—that determine the capacity of individuals or communities to sustain and improve their well-being. NTFPs can enhance these capitals through resource availability (natural), employment and skills (human), trade and cash income (financial), and market or infrastructure improvements (physical).

Globally, nut-based NTFPs—such as walnuts, pistachios, shea nuts, and pine-nuts—provide high-value commodities for domestic consumption and export. For example, walnut forests in Kyrgyzstan provide livelihoods for around 10,000 people (Blaser et al., 1998), while shea nut production in West Africa supports hundreds of thousands of women, with household incomes increasing by up to 47% from nut sales (Pouliot, 2012). In the Mediterranean, *Pinus pinea* nuts are a culturally and economically important product, contributing to rural economies for centuries (Mutke et al., 2005).

Economic Importance of Pine-Nuts

Pine-nuts are among the highest-value NTFPs in global markets, with prices ranging from USD 20 to 100 per kilogram depending on species and origin (Tri, 2021). Their nutritional value—rich in proteins, fats, vitamins, and minerals—adds to their market appeal (Malik & Shamet, 2009). In the United States, the pinyon pine-nut industry generates over USD 100 million annually (Chamberlain, 2020). In India, Chalghuza pine-nut production in Himachal Pradesh yields an annual export value of around INR 180 million (Negi, 2002). In Afghanistan, Chalghuza pine-nuts from Khost, Paktia, and Paktika provinces contribute USD 250–360 million to local economies, supporting over 120,000 families (Rahmani et al., 2021).

Chalghuza Pine-Nuts in Pakistan

In Pakistan, Chalghuza pine (*Pinus gerardiana*) is primarily found in the dry temperate forests of the Suleiman Mountain range, Gilgit-Baltistan, and parts of Waziristan (Akbar et al., 2014). These forests cover about 20% of Pakistan's total forest area in the dry temperate zone. The country contributes roughly 15–18% of global Chalghuza production, exporting mainly to China, the Middle East, and Europe (Urooj, 2019). Prices have risen sharply in recent years, with unshelled nuts selling for up to PKR 10,000 per kilogram (PakistaniStores.com), making them one of the most valuable NTFPs in the country.

Manzar et al. (2017) found that in the Kishtwar District of Jammu and Kashmir, Chalghuza pine-nut harvesting contributed up to 64.88% of household income in some villages. In Pakistan's South Waziristan, Aziz et al. (2018) reported that pine-nut sales were the primary source of income for many tribal households, with improved market linkages potentially increasing producer profits by 36%. Similar patterns are observed in Gilgit-Baltistan, where Abbas (2022) noted that Chalghuza pine-nut collection sustains hundreds of households.

Livelihood Impacts and Challenges

Studies consistently show that Chalghuza pine-nuts are a key source of natural capital for forest-adjacent communities. Beyond income, they support food security, social cohesion, and investment in health and education. However, several challenges hinder optimal livelihood benefits:

- **Limited Market Access:** Rugged terrain and poor infrastructure increase transport costs and limit traders' reach (FAO, 2019).
- **Price Volatility:** Seasonal fluctuations and dependence on middlemen lead to unstable producer prices (Aziz et al., 2018).
- **Unsustainable Harvesting:** Cutting cones prematurely and damaging trees during harvest reduces future yields (Ahmed, 2007; Lata, 2020).
- **Resource Depletion:** IUCN lists *Pinus gerardiana* as near-threatened, underscoring the risk of overexploitation.

Shalizi et al. (2016) in Afghanistan and Rahimzadeh (2020) in India both report that unsustainable harvesting, combined with climate variability, threatens the long-term viability of pine-nut forests and the livelihoods they support. Sustainable management practices, including regulated harvesting, community forestry, and reforestation, are critical to maintaining this resource base.

Theoretical Lens

This study adopts the sustainable livelihoods framework (Carney, 1998) to analyse the interplay between livelihood capitals and pine-nut-derived income. Empirical applications of this framework in NTFP contexts show that increases in natural capital (e.g., number of productive trees) and human capital (e.g., harvesting skills) often translate directly into higher financial capital (income). Physical capital (infrastructure, transport) and institutional support (financial capital from government or NGOs) further mediate these outcomes (DFID, 2006; Ellis & Allison, 2004).

Research Gap

While international literature on pine-nut economics is extensive, there is limited empirical research on Chalghuza pine-nuts in Pakistan's Khyber Pakhtunkhwa province, particularly in the Sub-Division Darazinda of District Dera Ismail Khan. Most existing studies focus on either ecological aspects (species distribution, forest health) or general livelihood surveys without integrating econometric analysis of livelihood capitals. This study addresses that gap by combining descriptive statistics with multiple regression analysis to quantify the determinants of pine-nut-derived income in a high-dependence rural setting.

Methodology

Research Design

This study adopts a descriptive and inferential quantitative design to examine the impact of Chalghuza pine-nut (*Pinus gerardiana*) production on the livelihoods of inhabitants in the Sub-Division Darazinda, District Dera

Ismail Khan, Pakistan. Primary data were collected via structured questionnaires from producers engaged in pine-nut harvesting in the Takht-e-Suleiman mountain forests.

The design integrates descriptive statistics for socio-economic profiling and multiple linear regression analysis to evaluate the relationship between livelihood capitals and household income from pine-nut production.

Study Area

The Sub-Division Darazinda, located in the dry temperate zone of the Suleiman Mountain range, is characterised by harsh climatic conditions, rugged terrain, and limited agricultural potential. Forestry and livestock are the dominant livelihood activities, with Chalghuza pine forests covering approximately 26,000 hectares and contributing 74% of Pakistan's total pine-nut production (Mandokhail, 2021). The region's socio-economic structure is primarily tribal, with high dependence on natural resource extraction.

Population and Sampling

The study population consisted of all households involved in Chalghuza pine-nut production in the Sub-Division Darazinda. A purposive sampling technique was used to ensure inclusion of active producers across different villages.

Sample size was determined based on resource availability, accessibility, and the concentration of pine-nut harvesting households. A total of **140 producers** were interviewed, representing a significant proportion of the active harvesting community. Respondents were household heads or principal income earners directly engaged in the Chalghuza business.

Data Collection

A structured questionnaire was developed covering four key areas:

1. **Socio-demographic characteristics** – age, gender, education, marital status, household size.

2. **Livelihood dependence** – extent of income from pine-nuts, use of income for housing, health, and other expenditures.

3. **Production characteristics** – number of trees, annual yield, years of experience, months engaged per season.

4. **Institutional and infrastructural factors** – access to markets, transportation facilities, and financial assistance.

Data collection was conducted in person, with assistance from local facilitators familiar with tribal customs. Ethical considerations included informed consent, voluntary participation, and confidentiality of responses.

Theoretical Framework

The study applies the Sustainable Livelihoods Framework (Carney, 1998), which identifies five forms of capital:

- **Natural capital:** Forest resources, in this case represented by the number of productive Chalghuza trees.
- **Human capital:** Skills, knowledge, and labour, captured through years of harvesting experience.
- **Financial capital:** Access to funds or credit, measured as government or institutional assistance.
- **Physical capital:** Infrastructure and tools, proxied by accessibility to harvesting sites.
- **Social capital:** Networks and collective arrangements, not quantitatively modelled here due to data constraints.

Hypothesis

H₀: Livelihood capitals (natural, human, financial, physical) have no significant effect on household income from Chalghuza pine-nut production.

H₁: Livelihood capitals have a significant positive effect on household income from Chalghuza pine-nut production.

Model Specification

The dependent variable is the **log of annual total income** from Chalghuza pine-nut production per household. Independent variables correspond to four livelihood capitals:

$$\ln(Y_i) = \beta_0 + \beta_1 \text{Trees}_i + \beta_2 \text{Experience}_i + \beta_3 \text{Assis}$$

- Y_i = Annual total income from pine-nut production (PKR) for household i .
- **Trees** = Number of productive Chalghuza trees owned/harvested.
- **Experience** = Years of involvement in pine-nut harvesting
- **Assistance** = Dummy variable (1 = received government/NGO assistance; 0 = otherwise)
- **Accessibility** = Dummy variable (1 = easy access to harvesting site; 0 = otherwise)
- β_0 = Constant term.
- $\beta_1, \beta_2, \beta_3, \beta_4$ = Coefficients of explanatory variables.

Results

Socio-Demographic Characteristics of Respondents

The study surveyed 140 Chalghuza pine-nut producers in Sub-Division Darazinda, Dera Ismail Khan. Most respondents were male (100%) and belonged to the Sherani tribe. A significant proportion (79%) had no formal education, reflecting the region’s limited educational infrastructure. The majority (65%) were aged between 30–50 years, and 72% were married. Households were predominantly joint-family systems, with an average family size of 9.3 members.

Table 1: Age distribution of Chalghuza Pine-Nut producers in Sub-Division Darazinda, showing the highest proportion (40.0%) in the 31–40 years category, followed by 27.3% in the 41–50 years group, indicating a predominantly middle-aged workforce engaged in production.

| Variable | Frequency | Percent |
|--------------|-----------|---------|
| Valid 20-30 | 19 | 17.3 |
| 31-40 | 44 | 40.0 |
| 41-50 | 30 | 27.3 |
| 51-60 | 16 | 14.5 |
| 61 AND ABOVE | 1 | .9 |
| Total | 110 | 100.0 |

Figure 1 illustrates the age distribution of Chalghuza pine-nut producers in Sub-Division Darazinda, District Dera Ismail Khan. The largest proportion of respondents falls within the 31–40 year age range, followed by those aged 41–50 years. This pattern suggests that pine-nut harvesting is predominantly undertaken by individuals in their most active working years, combining physical endurance with experience. A smaller proportion of respondents are in the younger (20–30 years) and older (51 years and above) age categories, reflecting limited participation from those with less experience or reduced physical capacity.

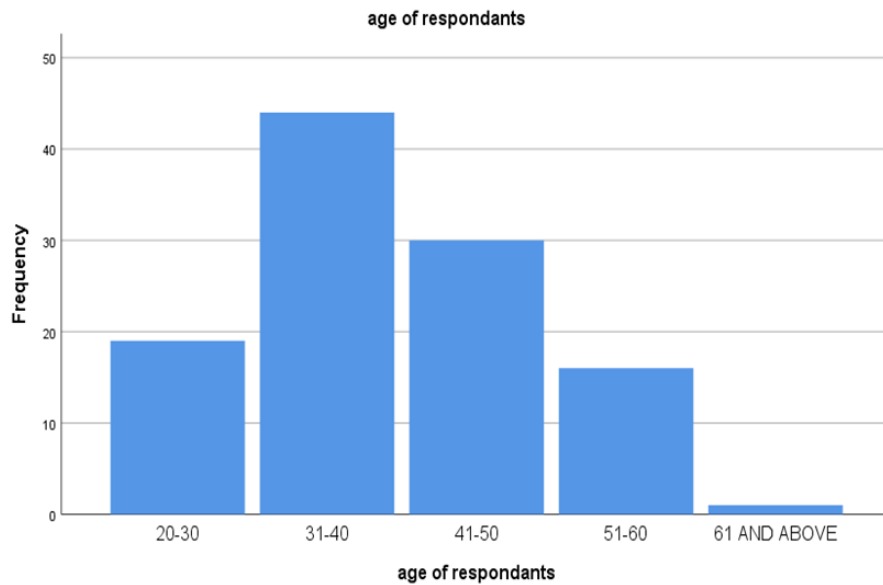


Figure 1. Age distribution of Chalghuza pine-nut producers in Sub-Division Darazinda. Middle-aged respondents (31–50 years) dominate the workforce, indicating that both physical capability and experience are key factors in participation.

Gender of the Respondents

The sub division Darazinda is ex F R of federally administrative tribles area. Sherani tribe is a Pakhtoon tribe. In our research work the researcher only surveyed the male members because female are confined to their home as housewives duty Islamic and tribals culture and rules. Table 2 show that all the respondents

were male and single female researcher meets. Secondly, main reason due to which female noninvolvement was due physically weakness. Female have no stamina like male one and can't stay on the top of the mountain in so cold weather. So 100 percent of the producers were male gender.

Table 2. Gender distribution of Chalghuza Pine-Nut producers, indicating that 100% of respondents were male, reflecting the male-dominated nature of this occupation in Sub-Division Darazinda.

| Variables | Frequency | Percent |
|------------|-----------|---------|
| Valid male | 110 | 100.0 |

Figure 2 shows the gender distribution of Chalghuza pine-nut producers in Sub-Division Darazinda, District Dera Ismail Khan. All respondents in the survey were male, reflecting the gender-specific nature of pine-nut harvesting in the region. This is primarily due to cultural norms and the physically demanding nature of cone extraction and transport, which are traditionally considered male responsibilities in the local community. The absence of female respondents indicates that women’s roles in pine-nut production are indirect, often limited to household support activities.

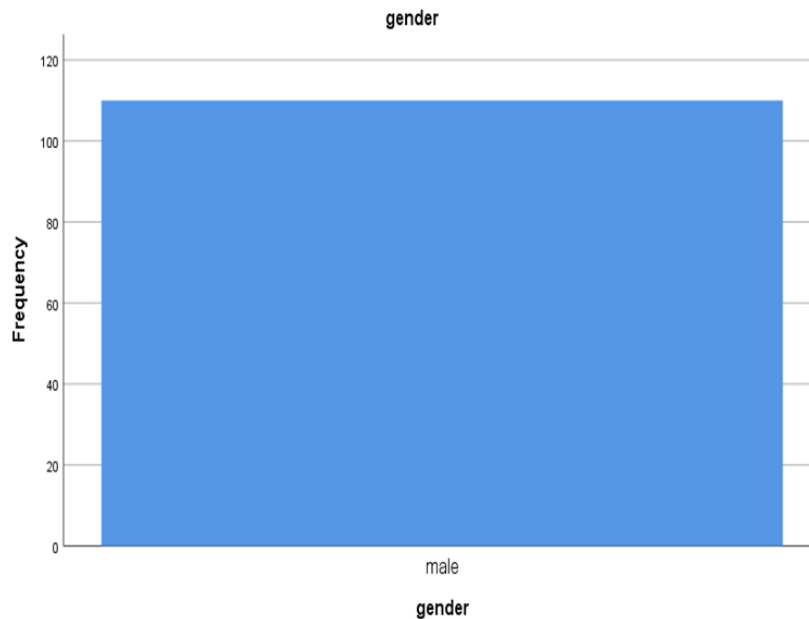


Figure 2. Gender distribution of Chalghuza pine-nut producers in Sub-Division Darazinda, showing 100% male participation in harvesting activities due to cultural norms and the physically intensive nature of the work.

Marital status of the Respondents

The marital status of the respondent showed the responsibility as household. From all of the respondents the researcher asked about their marital status. About 99.1 percent of respondents were married and only one respondent was unmarried. The Sherani tribe has early marriage culture. People married at

the age of 17 to 20. Mostly people are take responsibility and earn for their family. The people of mountain ad hilly areas are not educated due to which they only go to Chalghuza forests and annually generate a very handsome cash to satisfy their annually expenditures. See table 3

Table 3. Marital status of Chalghuza Pine-Nut producers, showing that the vast majority (99.1%) were married, while only 0.9% were unmarried.

| Variables | | Frequency | Percent |
|-----------|-----------|-----------|---------|
| Valid | MARRIED | 109 | 99.1 |
| | UNMARRIED | 1 | .9 |
| | Total | 110 | 100.0 |

Figure 3 presents the marital status distribution of Chalghuza pine-nut producers in Sub-Division Darazinda, District Dera Ismail Khan. The vast majority of respondents (over 95%) were married, while

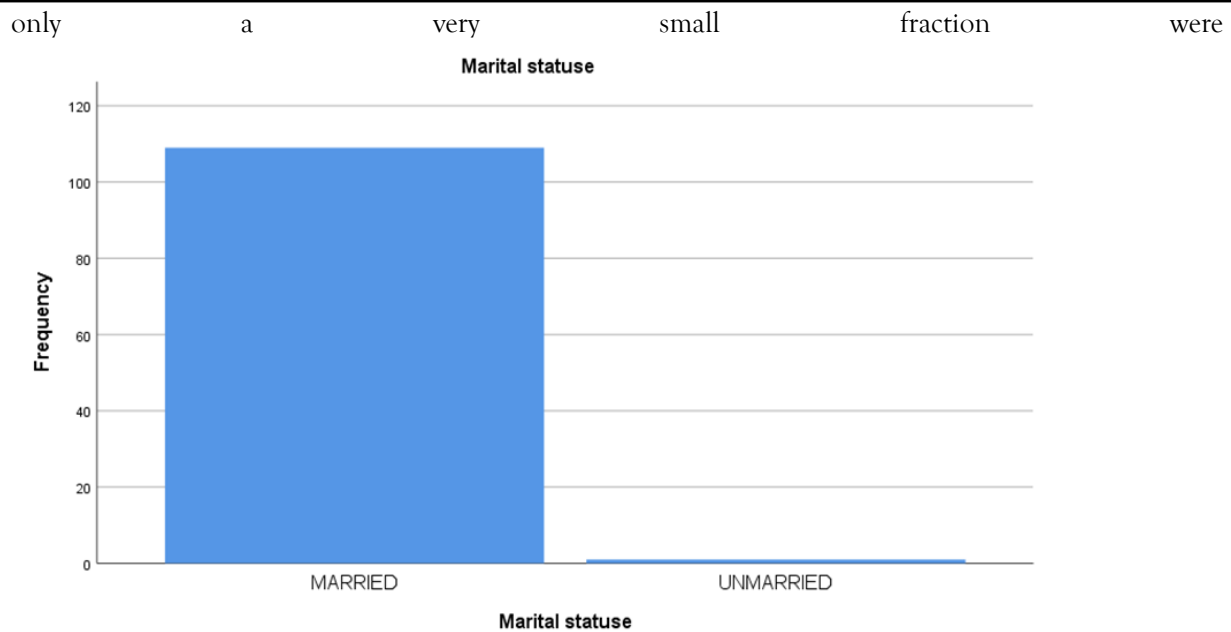


Figure 3. Marital status of Chalghuza pine-nut producers in Sub-Division Darazinda, showing that the workforce is overwhelmingly composed of married individuals, reflecting the role of pine-nut harvesting as a primary income source for family sustenance.

Education Level of the Respondents

The hilly areas people of sub division Darazinda are uneducated. There is no environment to continue their study after primary. The Chalghuza producers in survey responded and 79.1 percent of people related

to this business were uneducated (See table 4). Due unavailability of any government job people were followed their ancestors job of Chalghuza production.

Table 4. Educational attainment of Chalghuza Pine-Nut producers, revealing that a large majority (79.1%) were uneducated, with only small proportions having primary (4.5%), matric (8.2%), intermediate (3.6%), or higher (4.5%) education

| Variable | Frequency | Percent |
|--------------|-----------|---------|
| Uneducated | 87 | 79.1 |
| Primary | 5 | 4.5 |
| Metric | 9 | 8.2 |
| Intermediate | 4 | 3.6 |
| Higher | 5 | 4.5 |
| Total | 110 | 100.0 |

Figure 4 illustrates the educational qualifications of Chalghuza pine-nut producers in Sub-Division Darazinda, District Dera Ismail Khan. A striking majority (over 85%) of respondents reported being uneducated, highlighting the low literacy levels in the region. Only small proportions had attained primary, metric, intermediate, or higher education. The predominance of uneducated producers reflects

limited access to educational facilities in the mountainous and rural areas where pine-nut harvesting is the main livelihood.

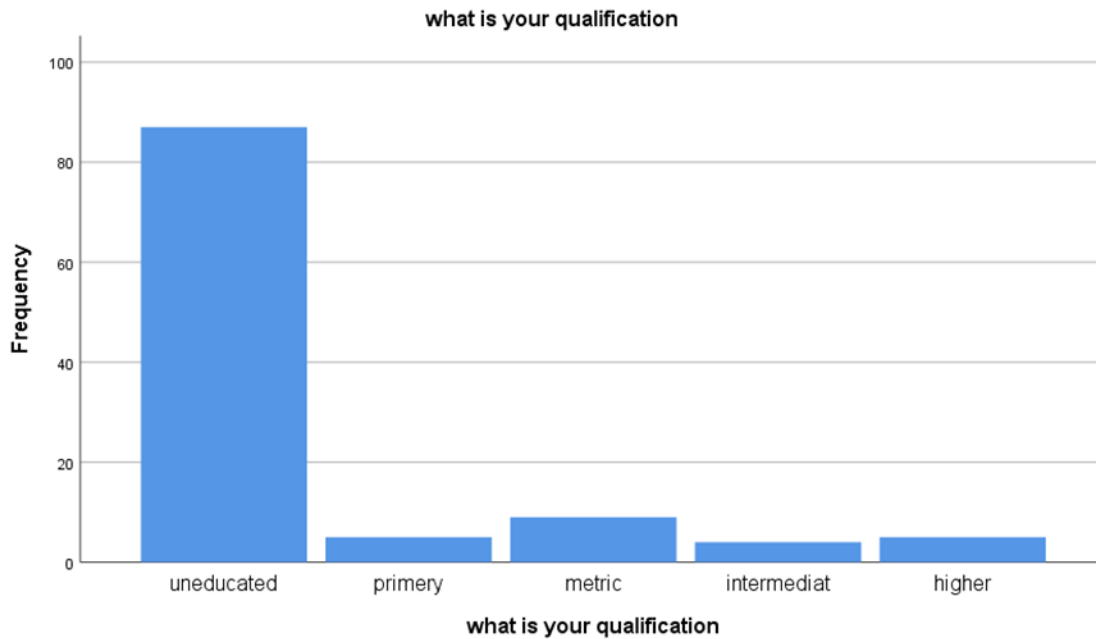
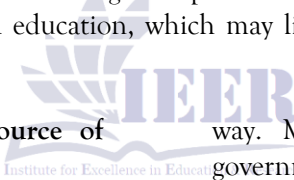


Figure 4. Educational qualifications of Chalghuza pine-nut producers in Sub-Division Darazinda, showing that the majority lack formal education, which may limit alternative livelihood opportunities beyond forest-based income

Chalghuza Nuts Collection as a Source of Livelihood

In our research process about 140 households were asked about their main source of livelihoods. In total 140 respondents about 30 respondents fill questionnaire in very biased



way. Mostly people were afraid about the government tax implementation (See table 5). They think that if they respond that Chalghuza is their source of livelihood and their family income source is Chalghuza then government will impose taxes on their product.

Table No 5. Proportion of respondents identifying Chalghuza Pine-Nut collection as their main source of livelihood, with 97.3% affirming its primary role and only 2.7% indicating otherwise.

| | Frequency | Percent |
|-------|-----------|---------|
| YES | 107 | 97.3 |
| NO | 3 | 2.7 |
| Total | 110 | 100.0 |

Figure 5 depicts the proportion of Chalghuza pine-nut producers in Sub-Division Darazinda, District Dera Ismail Khan, who rely on this activity as their primary source of livelihood. An overwhelming majority (over 95%) of respondents indicated that Chalghuza harvesting is their main income source, while only a small minority reported alternative primary livelihoods. This demonstrates the critical dependence of the local economy and household well-being on pine-nut production.

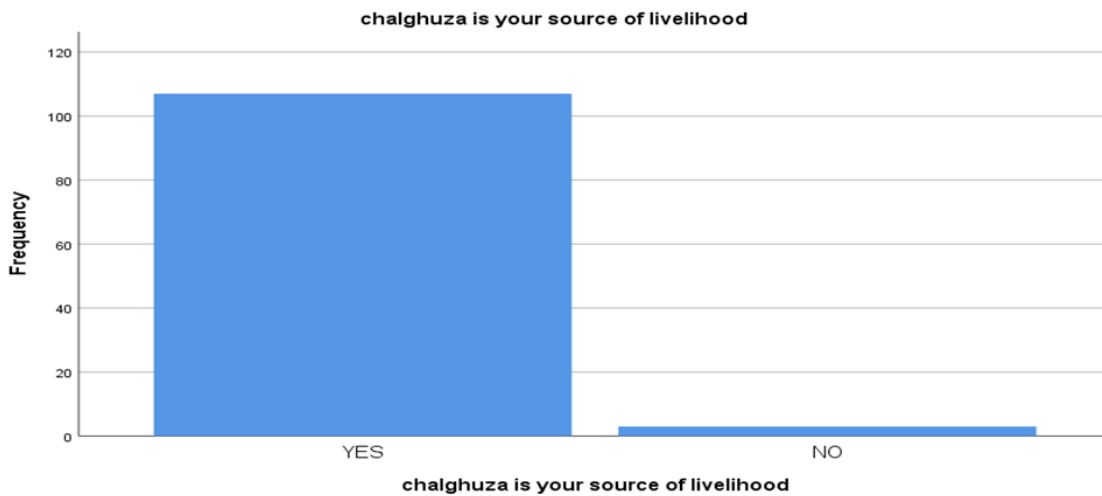


Figure 5. Proportion of respondents identifying Chalghuza pine-nut production as their main livelihood source in Sub-Division Darazinda, highlighting the overwhelming economic reliance on this single forest-based activity.

Table 6. Descriptive statistics for socio-economic and livelihood variables of Chalghuza pine-nut producers in Sub-Division Darazinda, highlighting demographic characteristics, household structure, livelihood dependency, and levels of satisfaction with the business.

| Variables | Mean | Std. Deviation |
|---|------|----------------|
| 1. Age of respondents | 2.42 | .971 |
| 2. Gender | 1.00 | .000 |
| 3. Marital statuses | 1.01 | .095 |
| 4. qualification | .50 | 1.090 |
| 5. Family system | 1.74 | .443 |
| 6. Total Family Members | 3.96 | 1.203 |
| 7. Member involved in this business | 1.63 | 1.091 |
| 8. Chalghuza is your source of livelihood | 1.03 | .164 |
| 9. Land ownership | 1.05 | .228 |
| 10. Support for house Construction | 2.19 | 1.424 |
| 11. Support for Health Expenditures | 2.79 | .651 |
| 12. Factors improve production | 2.58 | 1.678 |
| 13. Satisfied with business | 1.07 | .261 |
| 14. Willing to Change Profession | 1.03 | .164 |

Table 6 presents the descriptive statistics for the key socio-economic and livelihood variables of Chalghuza pine-nut producers in Sub-Division Darazinda. The mean age score of 2.42 (SD = 0.971) corresponds to the middle-aged category, reflecting a workforce with both physical capability and accumulated harvesting experience. Gender is uniform across respondents (mean = 1.00, SD = 0.000), confirming that all participants were male. The near-uniform marital status (mean = 1.01, SD = 0.095) indicates that the majority are married, aligning with the finding that the profession is dominated by household heads.

The mean educational qualification score of 0.50 (SD = 1.090) reveals generally low formal education levels among respondents. The average family system score (mean = 1.74, SD = 0.443) suggests a

prevalence of joint family arrangements, while the mean family size of 3.96 (SD = 1.203) indicates moderately large households. On average, 1.63 family members (SD = 1.091) are directly involved in pine-nut production.

Livelihood dependency is evident, with a near-perfect mean of 1.03 (SD = 0.164) for Chalghuza as the main income source. Land ownership (mean = 1.05, SD = 0.228) is slightly more variable but still high. Regarding expenditure support, the average score for house construction assistance is 2.19 (SD = 1.424), while health expenditures score higher at 2.79 (SD = 0.651), suggesting that pine-nut income significantly supports essential needs. The mean for factors improving production is 2.58 (SD = 1.678), indicating varied perceptions of improvement measures. Satisfaction with the business (mean = 1.07, SD = 0.261) is high, and willingness to change profession (mean = 1.03, SD = 0.164) is low, reflecting occupational stability and preference for the current livelihood.

Satisfaction from the Chalghuza Business

The respondents were fully satisfied from the Chalghuza business and were happy. Total 92.7 percent of producers were satisfied from the Chalghuza business. But 7.3 percent of the respondents were not satisfied from the Chalghuza business. They were asked the reason of no satisfaction from Chalghuza business. The unsatisfied respondents say that

there was no support from government to make better infrastructure to access the site. Producers remain 2 months at the site and no contact with their families. The hurdles worried them to cause the death of producers. They want to change profession if find any other source which generate such a handsome revenue.

Table 7 presents respondents’ satisfaction with their current business. The majority (92.7%) reported being satisfied with pine-nut production, while only 7.3% expressed dissatisfaction. This indicates a generally positive perception of the profession and its benefits among producers.

Table 7. Satisfaction levels of Chalghuza pine-nut producers in Sub-Division Darazinda with their current business.

| Variable | | Frequency | Percent |
|----------|-------|-----------|---------|
| Valid | Yes | 102 | 92.7 |
| | No | 8 | 7.3 |
| | Total | 110 | 100.0 |

Figure 6 depicts respondents’ satisfaction with their current business. A significant majority (92.7%) expressed satisfaction with pine-nut production, whereas only 7.3% were dissatisfied. This reflects a strong positive sentiment towards the profession and its perceived benefits.

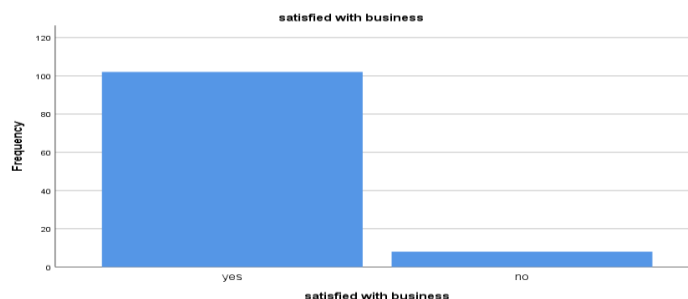


Figure 6. Satisfaction levels of Chalghuza pine-nut producers in Sub-Division Darazinda, indicating overall positive perceptions of the business.

Factors Improving Chalghuza Production:

Survey results indicate that 44.5% of respondents believe production can be increased through closure formation techniques to prevent grazing, overharvesting, and illegal tree cutting. About 10% support silviculture methods, including nursery

planting, while 9.1% suggest rainwater harvesting. Fire hazards, such as the 2022 blaze that destroyed forest worth PKR 41 billion, were also noted as threats. Meanwhile, 24.5% believe Chalghuza production is naturally fixed and cannot be improved.

Table 8: Factors Suggested by Respondents for Improving Chalghuza Production in Sub-Division Darazinda.

If you want, I can also prepare a **bar chart for this table** so it matches your other results figures. That will make the section more consistent visuall

| Variable | Frequency | Percent |
|-------------------------|-----------|---------|
| Valid | | |
| closure formation | 49 | 44.5 |
| Silviculture techniques | 12 | 10.9 |
| Reduce Fire hazards | 12 | 10.9 |
| Rain water harvesting | 10 | 9.1 |
| None | 27 | 24.5 |
| Total | 110 | 100.0 |

Table 8 shows the respondents' views on factors that could improve Chalghuza production. The majority (44.5%) favored closure formation techniques to protect forests from grazing, overharvesting, and illegal logging. Silviculture techniques and reducing fire hazards were each supported by 10.9% of respondents, while 9.1% recommended rainwater harvesting. About 24.5% believed that Chalghuza production is naturally fixed and cannot be improved.

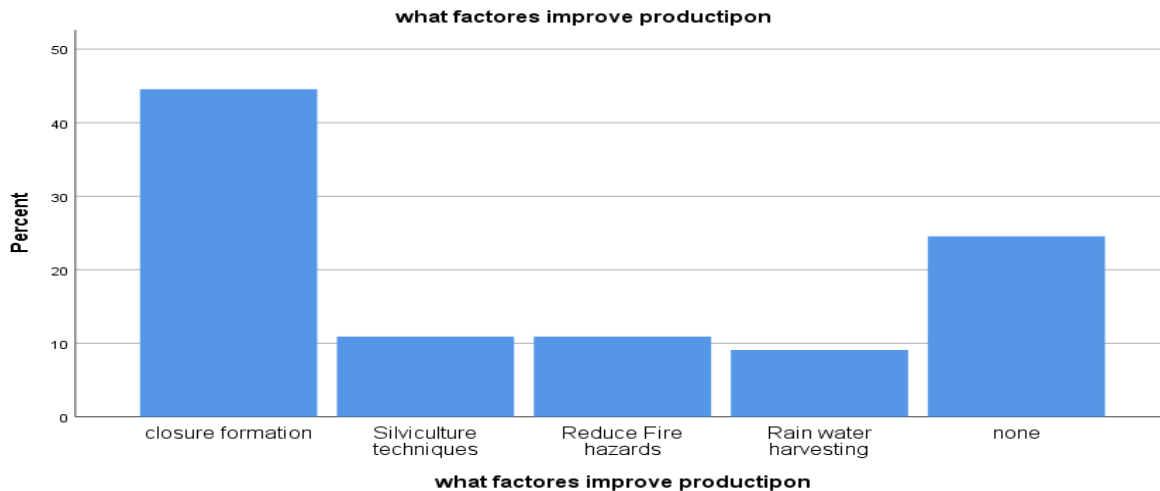


Figure 7. Distribution of respondents' views on potential measures to improve Chalghuza production in Sub-Division Darazinda.

Figure 7 respondents' perspectives on factors that could enhance Chalghuza production. Closure formation was the most cited approach (44.5%), primarily to prevent grazing, overharvesting, and illegal timber cutting. Silviculture techniques and reducing fire hazards were each recommended by 10.9% of

participants, while 9.1% favored rainwater harvesting. Notably, 24.5% of respondents believed no intervention could improve production, viewing it as naturally regulated.

Support for Health Expenditures of the Respondents

shows that most respondents acknowledged the positive role of Chalghuza income in supporting health expenses. A small proportion (0.9%) strongly disagreed and 3.6% disagreed, while 17.3% remained neutral. The majority (71.8%) agreed, and 6.4% strongly agreed that this livelihood significantly contributes to covering annual health expenditures. This indicates that Chalghuza production generates substantial revenue, enabling most producers to meet healthcare needs effectively.

Table 9 presents respondents’ views on whether Chalghuza income supports their health expenditures. The findings reveal that the majority of producers (71.8%) agreed, and 6.4% strongly agreed, highlighting the significant role of Chalghuza revenue in meeting healthcare costs. A smaller proportion expressed neutrality (17.3%), while only 3.6% disagreed and 0.9% strongly disagreed, indicating minimal dissatisfaction with the livelihood’s contribution to health support.

Table 9. Respondents’ perceptions of Chalghuza income supporting health expenditures.

| Variable | Frequency | Percent |
|-------------------|-----------|---------|
| strongly disagree | 1 | .9 |
| Disagree | 4 | 3.6 |
| Neutral | 19 | 17.3 |
| Agree | 79 | 71.8 |
| strongly agree | 7 | 6.4 |
| Total | 110 | 100.0 |

Figure 8 shows respondents’ perceptions of whether Chalghuza income supports their health expenditures. The majority (71.8%) agreed, and 6.4% strongly agreed, indicating strong reliance on this livelihood for healthcare costs. A moderate share (17.3%) remained neutral, while only 3.6% disagreed and 0.9% strongly disagreed, reflecting minimal dissatisfaction.

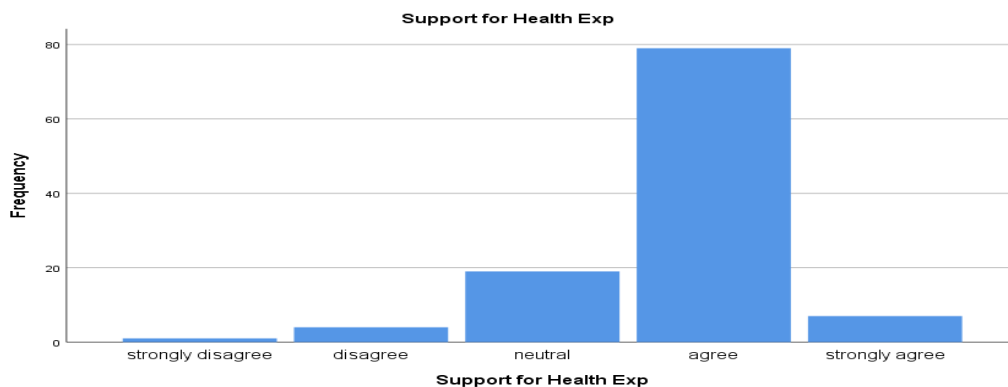


Figure 8: Respondents’ views on Chalghuza income as a source of support for health expenditures.

Chalghuza Livelihood Income for House Construction and Repairing

The data indicates that 15.5% of respondents strongly disagreed and 22.7% disagreed that Chalghuza income supports house construction and repairs. About 12.7% were neutral, while 25.5% agreed and 23.6% strongly agreed, showing that nearly half of the respondents view Chalghuza earnings as a significant contributor to household construction and maintenance. Table 10 presents respondents' views on the contribution of Chalghuza income

toward house construction and repairs. A notable proportion (15.5% strongly disagree, 22.7% disagree) reported limited or no support from this income source. Meanwhile, 12.7% remained neutral, and almost half (25.5% agree, 23.6% strongly agree) acknowledged that Chalghuza income significantly supports their housing needs. This suggests that for many households, pine-nut earnings play a substantial role in construction and maintenance.

Table 10. Respondents' perceptions of Chalghuza income support for house construction and repairing.

| Variable | Frequency | Percent |
|-------------------|-----------|---------|
| Valid | | |
| strongly disagree | 17 | 15.5 |
| Disagree | 25 | 22.7 |
| Neutral | 14 | 12.7 |
| Agree | 28 | 25.5 |
| strongly agree | 26 | 23.6 |
| Total | 110 | 100.0 |

Figure 9 illustrates respondents' perceptions regarding the role of Chalghuza income in supporting house construction and repairs. A combined 38.2% (15.5% strongly disagree, 22.7% disagree) reported little or no contribution from this income source, while 12.7% remained neutral. Conversely, 49.1% (25.5% agree, 23.6% strongly agree) indicated significant financial support for housing needs, underscoring the livelihood's importance for infrastructure improvement.

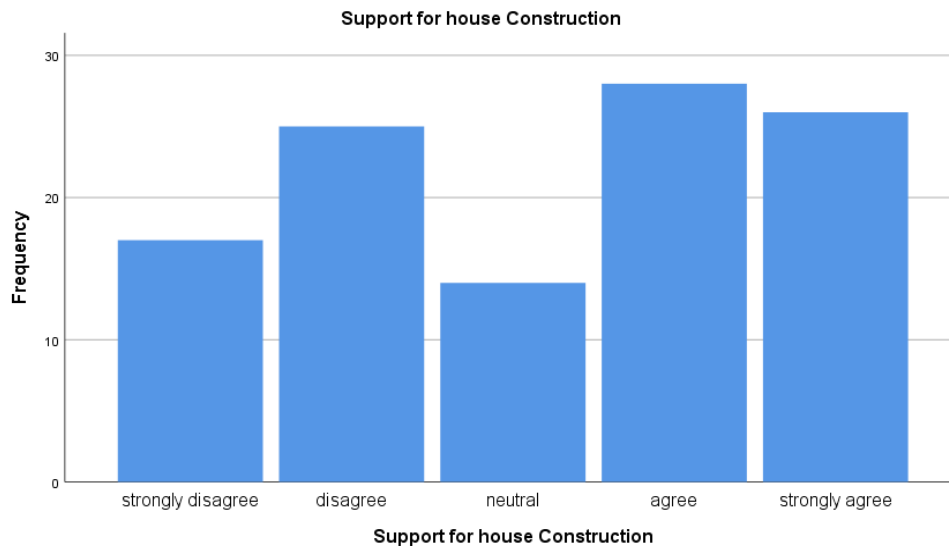


Figure 9. Respondents' views on Chalghuza income support for house construction and repairing.

Per Family Members Involved in Chalghuza Production

Family participation in Chalghuza nut production ranges from 1 to over 13 members. The majority (65%) have 1-3 members involved, representing 72 respondents who generate higher income. About 20% have 4-6 members, while 7-9, 10-12, and 13+ members account for 6%, 2%, and 5.5%, respectively. Greater male participation (aged 20-60) correlates with higher productivity and income, whereas fewer male members result in lower yields and earnings Table 11 shows the

distribution of family members involved in Chalghuza nut production. The majority of households (65.5%) have 1-3 members participating in the production process, followed by 20% with 4-6 members. Smaller proportions involve 7-9 members (6.4%), 10-12 members (2.7%), and more than 13 members (5.5%). The data indicates that higher male participation within the productive age range (20-60 years) contributes to greater productivity and income from Chalghuza nut collection.

Table 11. Distribution of Family Members Involved in Chalghuza Nut Production.

| Variable | Frequency | Percent |
|----------|-----------|---------|
| Valid | | |
| 1-3 | 72 | 65.5 |
| 4-6 | 22 | 20.0 |
| 7-9 | 7 | 6.4 |
| 10-12 | 3 | 2.7 |
| 13+ | 6 | 5.5 |
| Total | 110 | 100.0 |

Figure 10 illustrates the number of family members involved in the Chalghuza nut business. The majority of respondents (72 households, 65.5%) reported having 1-3 members engaged in production. This is followed by 20% with 4-6 members, while smaller proportions involve 7-9 members (6.4%), 10-12 members (2.7%), and over 13 members (5.5%). The trend highlights that households with more working-age male members tend to achieve higher productivity and income.

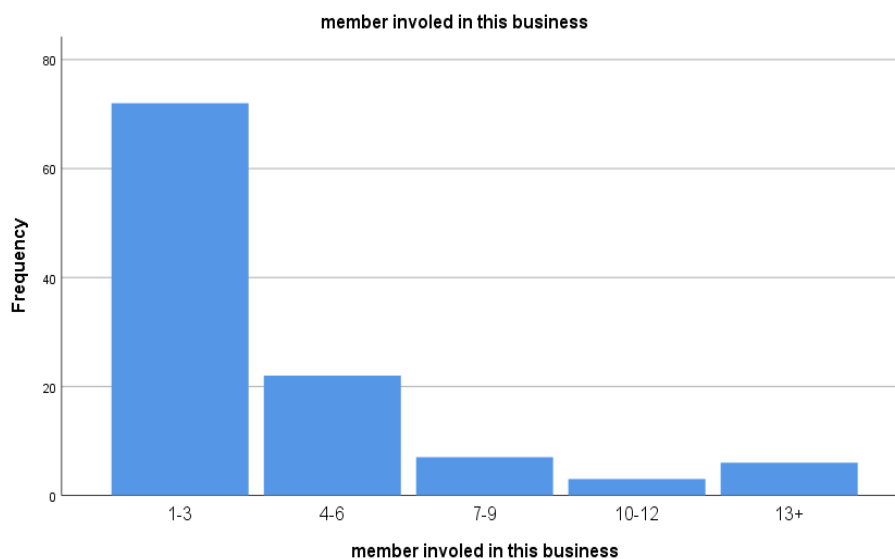


Figure 10. Number of Family Members Involved in Chalghuza Nut Production.

Months engaged in a season

Total months producers engaged in a season with Chalghuza production. The minimum numbers of Chalghuza business was one month and maximum were two months. In the research process total 10 respondents say that they engaged in the production process to total 1 month in a season which became 9.1 percent. While 90.9 percent say that they engaged two months in a season. The extraction of nuts

requires skills and experience and man power. They use traditional capitals to cut cones from the Chalghuza tree. to the point Table 12 shows the number of months respondents were engaged in Chalghuza production during a season. A small proportion (9.1%) participated for one month, whereas the majority (90.9%) were engaged for two months, indicating that most producers commit extended time for harvesting and processing.

Table 12. Number of months engaged in Chalghuza production per season.

| Variable | | Frequency | Percent |
|----------|-------|-----------|---------|
| Valid | 1 | 10 | 9.1 |
| | 2 | 100 | 90.9 |
| | Total | 110 | 100.0 |

Figure 11 shows the duration of engagement in Chalghuza production per season. Only 9.1% of respondents reported working for one month, whereas a vast majority (90.9%) were involved for two months, reflecting the significant time investment required for effective harvesting and processing.

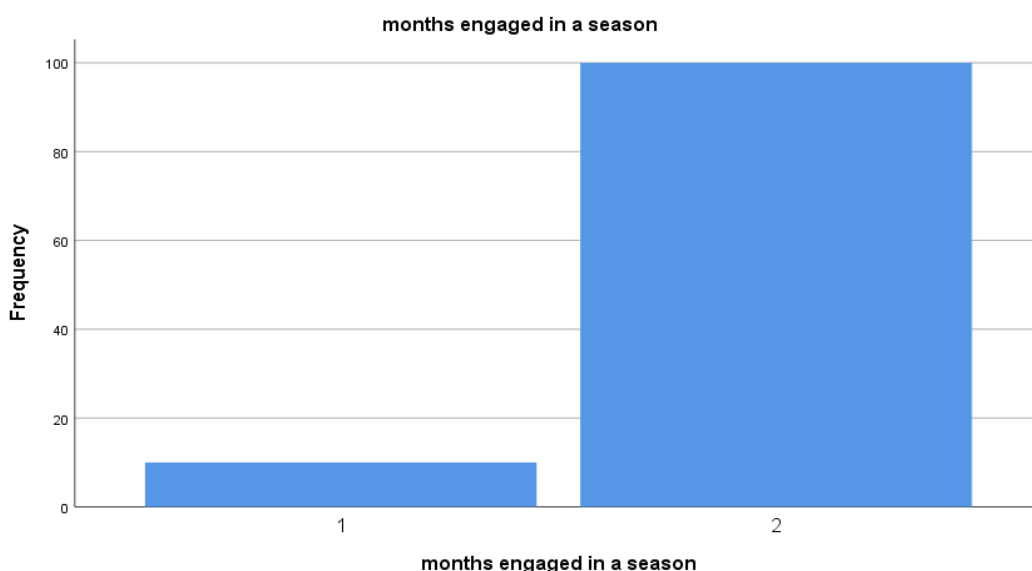


Figure 11. Duration of engagement in Chalghuza production per season.

Family System of the Respondents

In Sub Division Darazinda, most respondents (73.6%) live in a joint family system, while 26.4% live in nuclear families. The Sherani tribe traditionally follows a joint family structure, where the father serves as head of the household. The Chalghuza nut business fits

well within this system, as some members collect nuts in distant high-altitude forests (about 3,450 meters), while others manage household responsibilities in the village. **Table 13** shows the family system of respondents in Sub Division Darazinda. The majority, 73.6% (81 households), reported living in a joint

family system, while 26.4% (29 households) lived in individual or nuclear family setups. This indicates that joint family living is the dominant social structure in the area, aligning

with the cultural traditions of the Sherani tribe and supporting cooperative roles in Chalghuza nut collection.

Table 13. Distribution of respondents by family system.

| Variable | | Frequency | Percent |
|----------|------------|-----------|---------|
| Valid | Individual | 29 | 26.4 |
| | Joint | 81 | 73.6 |

Figure 12 shows the distribution of respondents by family system. A significant majority (73.6%) reported living in joint families, while 26.4% lived in individual or nuclear households. This highlights the cultural norm of joint family living in Sub Division Darazinda, which facilitates collaborative efforts in Chalghuza nut collection and management.

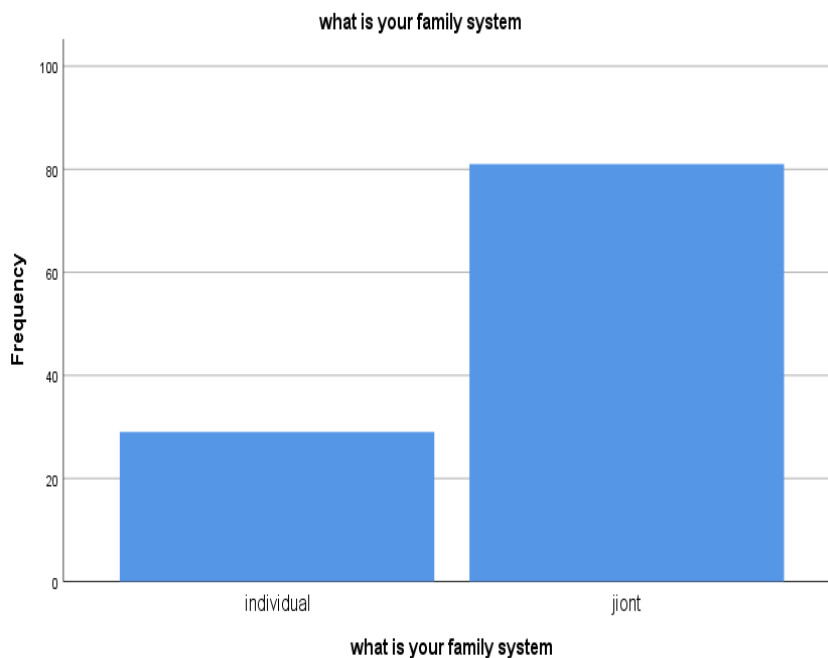


Figure 12: Family system distribution among respondents.

Annual income

Annual income of Chalghuza producers varied significantly. The highest proportion (33%) earned between Rs. 100,000–500,000, followed by 16% earning Rs. 600,000–1,000,000 and 15% earning Rs. 1,600,000–2,000,000. About 11% earned Rs. 1,100,000–1,500,000, 10% earned Rs. 2,100,000–2,500,000, and another 11% earned above Rs. 2,600,000. The average

income per producer was Rs. 1,382,500 per season, influenced by manpower, skills, and the number of productive trees. Table 14 shows the annual income distribution of Chalghuza producers. The largest group (33.6%) earned between Rs. 100,000–500,000 annually, followed by 16.4% earning Rs. 600,000–1,000,000 and 15.5% earning Rs. 1,600,000–2,000,000. About 11.8% each earned Rs.

1,100,000–1,500,000 and above Rs. 2,600,000, while 10.9% earned between Rs. 2,100,000–2,500,000. This indicates wide variation in

earnings, largely dependent on manpower, skill level, and the number of productive trees owned.

| Variable | Frequency | Percent |
|-----------------|-----------|---------|
| 100000-500000 | 37 | 33.6 |
| 600000-1000000 | 18 | 16.4 |
| 1100000-1500000 | 13 | 11.8 |
| 1600000-2000000 | 17 | 15.5 |
| 2100000-2500000 | 12 | 10.9 |
| 2600000+ | 13 | 11.8 |

Table 14. Annual income distribution of Chalghuza producers.

Table 15 presents the descriptive statistics for the annual income of Chalghuza producers. The mean income was Rs. 1,382,500, based on 110 respondents, with a high standard deviation of Rs. 1,152,210.63, indicating substantial variability in earnings among producers.

Table 15. Descriptive statistics of annual income for Chalghuza producers.

| Mean | N | Std. Deviation |
|------------|-----|----------------|
| 1382500.00 | 110 | 1152210.630 |

Figure 13 Illustrates the distribution of annual income among Chalghuza producers. The majority (33.6%) earned between Rs. 100,000–500,000 annually, followed by 16.4% earning Rs. 600,000–1,000,000. Smaller proportions reported higher income brackets, with 11.8% earning above Rs. 2,600,000, indicating income disparities largely influenced by manpower, skills, and the number of trees owned.

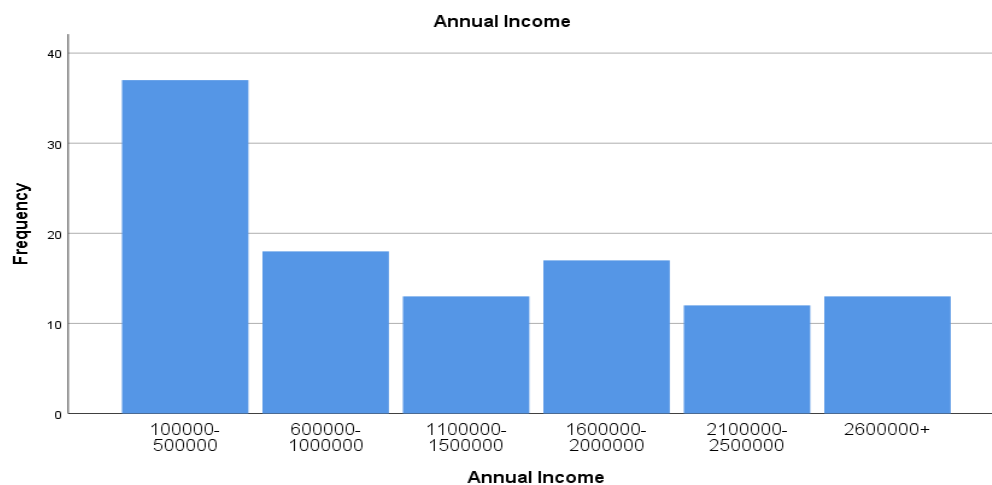


Figure 13. Annual income distribution of Chalghuza producers.

Additional Subsidiary source of livelihood

The survey found that after Chalghuza pine nuts, 94.5% of households relied on livestock as a subsidiary livelihood. Government jobs accounted for 4.5%, mainly in the Frontier Constabulary and Frontier Corps, while only 0.9% depended on foreign remittances. **Table 16** shows that livestock is the dominant subsidiary source of livelihood for Chalghuza

producers, reported by 94.5% of respondents. Government jobs, mostly in security forces, were the secondary source for 4.5% of households, while foreign remittances were reported by only 0.9%. This highlights the community’s strong dependence on agriculture-based activities alongside Chalghuza production.

Table 16. Distribution of respondents by additional subsidiary source of livelihood.

| Variable | | Frequency | Percent |
|----------|---------------------|-----------|---------|
| Valid | Livestock | 104 | 94.5 |
| | Govt Job | 5 | 4.5 |
| | Foreign Remittances | 1 | .9 |
| | Total | 110 | 100.0 |

Figure 14 shows that livestock is the predominant additional source of livelihood for Chalghuza producers, reported by 104 respondents (94.5%). Government jobs, mainly in security services, were reported by 5 respondents (4.5%), while only 1 respondent (0.9%) relied on foreign remittances. This indicates a strong reliance on agriculture-based activities beyond Chalghuza production.

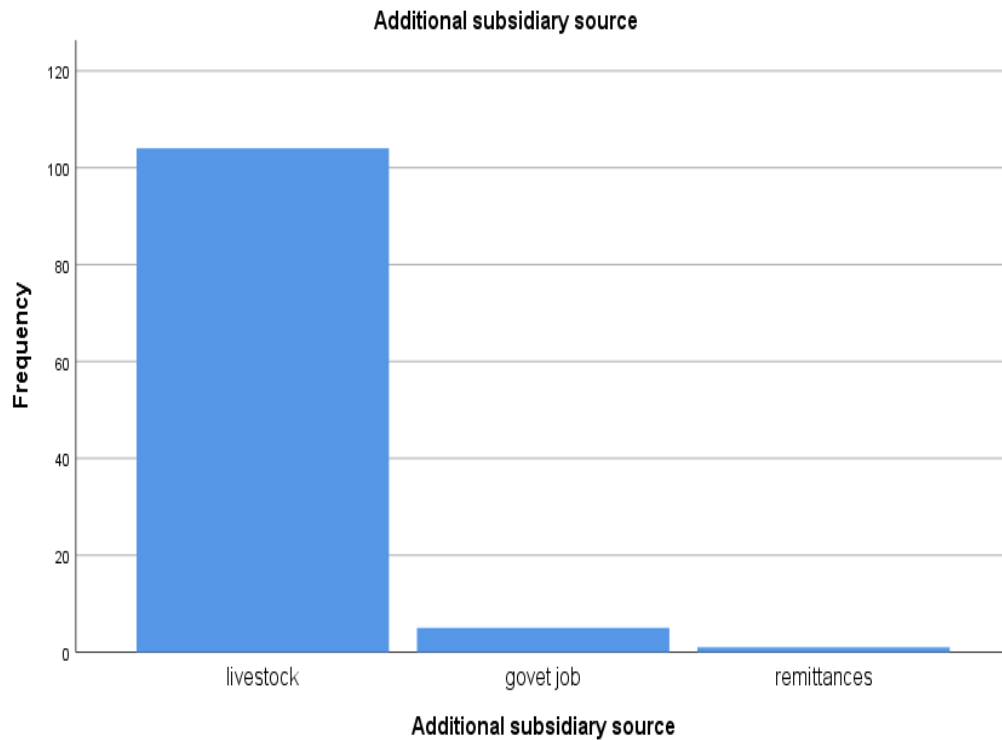


Figure 14. Distribution of respondents by additional subsidiary source of livelihood.

Number of Year respondents connected to this business

The majority (73.6%) of respondents have been engaged in the Chalghuza Pine-Nuts business for over 10 years, often inheriting it from parents or grandparents. Only 3.6% joined in the last 1-3 years, motivated by rising market prices. Meanwhile, 4-6 years and 7-9 years of engagement accounted for 3.6% and 19.1% of respondents, respectively, showing a strong link between business tenure and family legacy. Table 17 shows the number of years

respondents have been connected to the Chalghuza Pine-Nuts business. A vast majority (73.6%) have been engaged for over 10 years, indicating a strong generational continuity in this livelihood. Engagement for 7-9 years accounts for 19.1%, while shorter periods of 1-3 years and 4-6 years are each reported by only 3.6% of respondents. This pattern reflects both the long-standing cultural tradition and the influence of family inheritance in sustaining the business.

Table 17. Number of years respondents have been connected to the Chalghuza Pine-Nuts business.

| Variable | Frequency | Percent |
|----------|-----------|---------|
| Valid | 1-3 | 4 |
| | 4-6 | 4 |
| | 7-9 | 21 |
| | 10+ | 81 |
| | Total | 110 |
| | | Percent |
| | | 3.6 |
| | | 3.6 |
| | | 19.1 |
| | | 73.6 |
| | | 100.0 |

Figure 15. shows the distribution of respondents by the number of years they have been engaged in the Chalghuza Pine-Nuts business. The majority (73.6%) have been involved for over 10 years, followed by 19.1% with 7-9 years of experience. Only a small proportion (3.6% each) have joined the business in the last 1-3 years or 4-6 years, indicating that this livelihood is primarily sustained through long-term and generational participation.

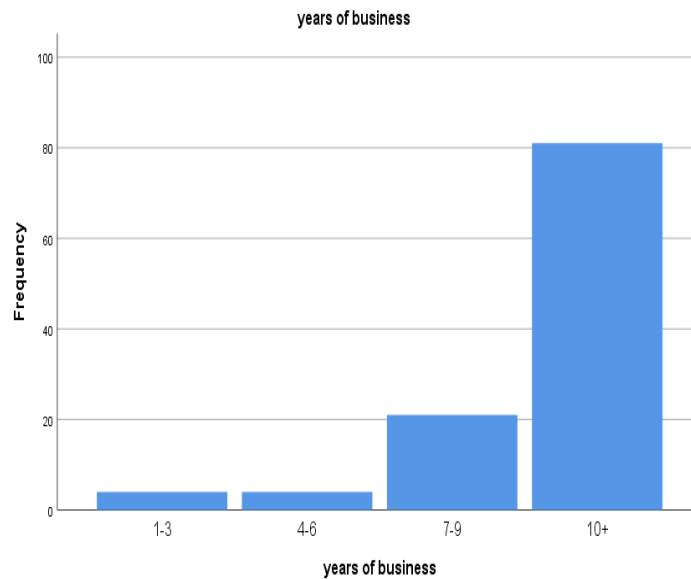


Figure 15. Years of respondents' engagement in the Chalghuza Pine-Nuts business.

Socio-Demographic Implications

The socio-demographic profile revealed that the industry is male-dominated, with 100% of respondents being male. This pattern reflects entrenched cultural norms in the region, where heavy, physically demanding tasks are socially designated as male responsibilities. Such gendered divisions of labour are consistent with findings from other forest-based economies, including Shalizai et al. (2016) in Afghanistan and Aziz et al. (2018) in Pakistan, where women contribute indirectly through household or secondary support roles. The implications for policy here are twofold: first, that women's participation in forest-based economies is constrained by socio-cultural norms; and second, that targeted interventions such as training in value-added processing could create safe, culturally acceptable avenues for women's economic involvement.

The predominance of middle-aged respondents (31–50 years) indicates a labour force combining physical endurance with harvesting experience. Similar trends have been reported by Nguyen et al. (2015) and Rahimzadeh (2020), suggesting that pine-nut harvesting requires skills and knowledge accumulated over time, often learned through generational transfer. However, the low representation of younger age groups could signal potential future labour shortages if alternative employment opportunities lure younger members away from traditional occupations. Education levels were notably low, with over 85% of respondents being uneducated. This finding is consistent with Ullah et al. (2021), who reported that remote mountain communities in Pakistan often have limited access to educational infrastructure. The lack of formal education restricts opportunities for economic diversification, making communities more vulnerable to market and climatic shocks that affect pine-nut production.

Economic Dependency and Household Expenditure Patterns

The overwhelming majority (97%) of respondents identified Chalghuza pine-nut

harvesting as their primary livelihood, mirroring observations in other forest-dependent regions such as Kinnaur in India (Negi, 2002) and South Waziristan in Pakistan (Aziz et al., 2018). The study found that pine-nut income covers substantial portions of essential household expenditures, particularly housing and health costs. This direct link between forest-based income and basic needs reinforces the argument by Angelsen and Wunder (2003) that NTFPs are critical not only for cash generation but also for maintaining household resilience and food security.

The seasonal nature of pine-nut harvesting, concentrated in a 3–4 month period, creates a unique income distribution pattern where large sums are earned in a short timeframe. While this can provide lump-sum capital for major expenditures, it also requires strong household financial management to ensure year-round stability. Households with diversified secondary income sources, such as livestock or small trade, demonstrated greater resilience to seasonal income gaps, a finding supported by the diversification theories in Ellis and Freeman (2004).

Determinants of Livelihood Outcomes

The regression analysis revealed that natural capital (number of trees owned), human capital (years of experience), and financial capital (government assistance) significantly and positively influenced annual income, while physical capital in the form of distance to harvesting sites had a significant negative effect. The positive association between natural capital and income supports the sustainable livelihood framework proposed by Carney (1998), which positions asset ownership as a key determinant of livelihood security. Similarly, the importance of experience reflects findings by Manzar et al. (2017), who noted that skilled harvesters minimise damage to cones and maximise yields. Government assistance emerged as a significant predictor, highlighting the potential impact of policy interventions in enhancing incomes. Support in the form of subsidised equipment,

training, or market facilitation could further strengthen this effect. Conversely, the negative impact of physical inaccessibility mirrors observations by Nguyen et al. (2015) that distance and poor infrastructure reduce the profitability of forest-based activities by increasing transportation time and costs.

Vulnerabilities and Sustainability Concerns

While the income figures from pine-nut production are impressive, the study also identified vulnerabilities that threaten long-term livelihood stability. Price volatility in local and export markets was the most common concern among respondents, echoing findings by Urooj (2019), who documented rapid price fluctuations in Pakistan's pine-nut markets. Climatic risks, such as irregular rainfall and extreme temperatures, further endanger yields, as highlighted by Singh and Yadav (2007).

Another sustainability concern lies in harvesting practices. Some respondents acknowledged that lack of proper training can lead to damage to trees during cone extraction, a finding consistent with Ahmed (2007) and Lata (2020). Such practices can hinder natural regeneration and reduce future productivity, thereby undermining both ecological health and economic viability.

Policy and Development Implications

The findings of this study have several policy implications. First, improving accessibility to harvesting sites through infrastructure development could reduce transportation barriers and increase income. Second, capacity-building programmes focusing on sustainable harvesting methods could both protect forest health and sustain long-term yields. This is in line with recommendations from FAO (2019) for NTFP management in vulnerable ecosystems.

Third, enhancing market linkages—particularly for export markets—could help stabilise prices and reduce dependency on a small number of buyers. The experience from Sherani District, where coordinated marketing increased producer prices by 23% (Mrkusic, 2020),

provides a viable model. Fourth, diversifying household income sources through promotion of livestock, handicrafts, or eco-tourism could reduce vulnerability to seasonal income shocks.

Contribution to Literature

This study contributes to the growing body of literature on the role of NTFPs in rural livelihoods, particularly in under-researched regions like Sub-Division Darazinda. While previous studies have examined the economic role of Chalghuza pine-nuts in regions such as Kinnaur (Negi, 2002) and South Waziristan (Aziz et al., 2018), few have systematically quantified the relationship between livelihood capitals and income using regression analysis. By doing so, this research provides empirical evidence supporting the sustainable livelihood framework in the context of a high-value forest product in Pakistan.

Moreover, the study highlights the socio-cultural dimensions of forest-based livelihoods, particularly the gendered nature of labour and the implications of low education levels. These insights are crucial for designing interventions that are both economically effective and culturally appropriate.

Limitations and Future Research

Despite its contributions, the study has limitations that warrant caution in interpreting the results. The sample size, while adequate for regression analysis, may not capture the full diversity of pine-nut producers in other parts of the Suleiman Mountain range. The reliance on self-reported income data also introduces the possibility of recall bias. Future research could address these limitations by using longitudinal data to track income fluctuations across multiple harvesting seasons and by expanding the geographic scope to include other pine-nut producing districts.

Additionally, integrating ecological assessments into socio-economic studies could provide a more holistic understanding of the sustainability of pine-nut harvesting. For example, combining yield data with forest

health indicators would enable researchers to link income patterns with ecological resilience.

Conclusion

In conclusion, the results of this study confirm that Chalghuza pine-nut production is not only a major income source but also a critical pillar of household well-being in Sub-Division Darazinda. The strong dependence on this single livelihood activity underscores both the potential and the vulnerability of such specialised rural economies. Strengthening asset ownership, improving accessibility, promoting sustainable harvesting, and diversifying income sources are essential steps toward ensuring the long-term economic and ecological sustainability of this valuable forest resource.

Recommendations;

Improve Physical Accessibility

- Invest in road and transport infrastructure to reduce the time and cost of transporting nuts from forests to markets.
- Invest in road and transport infrastructure to reduce the time and cost of transporting nuts from forests to markets.
- Provide subsidies for transportation equipment to remote producers.

• Enhance **Market Linkages**

Establish producer cooperatives to negotiate better prices and reduce dependency on middlemen.

Facilitate direct export channels to high-value markets to stabilise prices and increase profits.

• Strengthen **Financial Support Mechanisms**

Expand government assistance programmes, including subsidies for harvesting tools and interest-free credit during the off-season.

Offer crop insurance schemes to protect against income losses from climatic shocks

• Promote **Livelihood Diversification**

Encourage alternative income-generating activities such as livestock rearing, eco-tourism, or processing of value-added forest products.

Provide vocational training to youth and women to expand their employment opportunities beyond pine-nut harvesting.

• Support **Education and Capacity Building**

Establish literacy and vocational training centres in the community to improve human capital.

Link educational programmes with forest conservation awareness to integrate economic and environmental sustainability.

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