HOUSEHOLD MARKET PARTICIPATION, ACCESS AND FARM PRODUCTIVITY IN AJK, EVIDENCE FROM FARM HOUSEHOLD DATA

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ABSTRACT

The goal of the study is to get insight into agriculture production and market constraints in the AJK region. The objective of this research is to determine what factors influence agricultural productivity and market participation. The fundamental idea is to assess farm productivity within a given resource and technology, as well as household market participation within a particular market access condition, in order to build a link between them. Both qualitative and quantitative methodologies were used in this mixed methodology study. A total of 1,200 farmers, 120 from each of AJK's ten districts, and 40 key informants, including stakeholders, were questioned for the survey.

Technical efficiency estimates also show how much individual farmers are optimal in their production. In order to achieve the objectives in the first stage, we estimated the production function in the presence of inputs used and obtained technical efficiency scores that are explicitly dependent on the farm and farm specific variables. For this, single-step stochastic production estimation was applied. Tobit regression was employed in the second phase, with the market participation index as the dependent variable and market accessibility factors and efficiency as explanatory variables. The findings show that all inputs contributed favourably and considerably to farm production, with a mean technical efficiency of 58 percent, indicating that sample farmers might achieve the maximum production frontier by raising their efficiency to 42 percent.

Among the determinants of technical efficiency farm size, land fragmentation and traction power negatively contributed to inefficiency. Market participation was less approximately 47 percent of the sample farmers have less than 50 percent market participation and 20 percent did not participate in market. The major factors that affects market participation was efficiency in production, distance from road and market, credit facility, trainings, experiences and internet and refrigerator facility. All the variables were positive and significantly contributed to market participation while family size and processing negatively contributed. Policymakers and stakeholders, such as regulatory authorities and governing bodies, will benefit from this economic analysis.

PREFACE

Agriculture is the backbone of Pakistan's economy. Despite the fact that the sector has a lot of potential to enhance its share of GDP through greater productivity and innovation. Its contribution to GDP has gradually dropped to 19.3 percent over the last few decades. The economy of Azad Kashmir is still in its early phases. With a per capita income of 1,512 dollars, the provincial GDP is predicted to be 6.5 billion dollars. When compared to development in other parts of the country, Azad Kashmir is underrated. Agriculture is vital to the people of Azad Jammu and Kashmir (AJK), with 80 percent of the rural population relying on agricultural and livestock goods to survive.

Overall, the goal is to survey the field of thought and experience, as well as the most overlooked and critical topics to be addressed in these assessments. We also used these as a starting point for emphasizing issues, difficulties, future expectations, and driving forces in this sector. In order to highlight more policy issues that need to be addressed, we looked at the existing state and scenario of agriculture-related activities, establishments, and policies. This research paves the way for future policy development based on survey data. There is a dearth of data on all of these aspects unique to AJK. Using the survey data, we may assess individual farmers' efficiency and market participation in the context of available resources and constraints. We are grateful for the Research for Social Transformation and Advancement (RASTA) - Competitive Grants program, which has allowed me to focus on this vital topic, particularly for the agricultural sector of the AJK. Mentors from the RASTA platform helped to improve the quality of the research. We appreciate Vice-Chancellor PIDE, Dr. Nadeem-ul Haq's insightful views. We also recognize the assistance of Department of Agriculture officers and field staff.

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INTRODUCTION

1.1 Baseline of the Study

Barriers to market access and understanding product performance and are key factors in overcoming market failure. The majority of the small farmers in Azad Kashmir, whose access to the market is limited and the only farmers who have access to the market, participate in the agricultural market. Due to this market failure in this particular area, there is a dire need for government programs in this area to invest in improving market access, infrastructure and the agricultural production side. Improving one can help improve another and both can boast of the quality of life: Higher market participation can increase productivity, as long as incentives, information for working capital be encouraged. Higher yields may increase market participation because higher yields may have additional crops to be sold.

AJ&K has abundance of rich terrain and seasons that are ideal for various crops and fruits. Due to its climate-friendly nature, the traditional farming system has a distinct advantage. All of AJ&K's districts, which are located in distinct agro-climatic zones, provide ideal circumstances for growing multiple crops at the same time. Agriculture's potential is not being completely realized since the AJ&K agricultural sector is beset by challenges. The development of the agricultural industry in Azad Kashmir is hampered by a lack of financial resources as well as agriculture-related enterprises, packing and value additions, storage facilities, and advanced research and development facilities.

Agricultural sector employed 8% of the active labor force. Around 72% of the household own agricultural land. The average size of the farm was assessed to be 1.1 acres. Bhimber has the highest percentage of agricultural proprietors at 76 percent, with around 87 percent growing crops. Only 10% of households sold and contributed to market participation indicating that 90% of the households were subsistence farmers who grew crops for their own consumption. Only 31% of subsistence farmers are able to meet their household's consumption demands. The average income per harvest of commercial farmers was Rs. 81,086, which was also low (Anwar, 2021). In AJ&K, 77.2 percent of the sample farmers cultivate maize, according to the variety of crop production categories. Wheat is grown by 59.4 percent of farmers, while pulses and rice are grown by 3.2 percent. Growers of vegetables and fruits account for 18.4% and 12.8 percent, respectively (SDG 2021)

In addition, weak marketing strategies have contributed to the peasant community's lack of interest. Standard seed production is also difficult. On a commercial scale, small farms holding have an impact on agricultural production. The overall farmland area in Azad Kashmir was around 47% of the total land area. Approximately 31% of the entire farm land was under cultivation. AJ&K's irrigation area was 6.2 percent of the total agricultural area (P&DD 2018).

Wheat-maize-wheat cropping pattern is essentially "mountain agriculture," as opposed to agriculture in the lowland plains agriculture. Crop and marketing promotion plans have not been devised. Due to a lack of infrastructure and financial assistance, the area is characterised by low productivity and limited market access. Market involvement is contingent on having access to the market. Smallholders selling from their farms or manually lugging to the closest local markets. A increasing body of evidence suggests that improving infrastructure, such as road conditions and market information, has a positive impact on farmers' access to markets (Fari and Fraser, 2009;

Juijs et al, 2004). However, there is no actual data on the magnitude and scope of inefficiency. Our hypothesis is that farmers participate in the market with a high level of efficiency and have better market access. To overcome the problem of market failure in this specific sector, this must be investigated. Although many other factors contribute to agricultural productivity, such as technological advancement, regulatory framework, and optimal use of material inputs, these elements may not have an impact on agricultural performance unless better marketing conditions prevail (Cabas, et al. 2010),. Landowners in Azad Kashmir, who are often peasants, have limited financial and technical resources, hence a policy aim in this area is critical. To our knowledge, there is no systematic research on agricultural productivity and market participation in the Azad Jammu Kashmir (AJK) region. There are issues in the region's data availability and veracity. To compensate for these statistical flaws, it might be beneficial to limit international studies to a local environment.

1.2 Purpose and Scope

The prevalent idea is to evaluate farm productivity within given resource and technology, and household market participation within given market access condition, to establish a linkage between these for the agriculture market of the Azad Jammu Kashmir. There are more particular purposes of this research:

- To measure the impact of farm variables on farm production and technical efficiency.
- To estimate the linkage between market participation and market access conditions in addition to farm level efficiencies; and
- The study would trace out what sort of policy interventions have been adopted by relevant departments to reduce farm inefficiency and supporting the farmers to link with market. And what sort of the challenges they are facing to implement their policy agenda.

The underlying study is set to answer the following key questions.

- What are the reasons that cause production inefficiency at farm level?
- Are farmers producing optimum level of output to market it?
- Are they able to get benefit of marketing their product and sell these at reasonable price?
- What are the area-specific barriers to market access?
- Are improvements in farm productivity increased market participation, having better market access requirements?
- Has the increase in the volume of agricultural sales increased due to improvements in agricultural production, even though access to the market is poor?
- On the contrary, whether new roads and improved accessibility to the market increase the commercialization leads to continuous production?

1.3 Relevance to Public Policy

The underlying research provides policy alternatives for improving farm-level production efficiencies as well as food production and market participation. This would also be useful for developing food and marketing policies to address farm-level constraints to market access. Finally, recommendations was made based on the findings after estimating the empirical model.

REVIEW OF LITERATURE

Many studies have been conducted to assess the technical efficiency of crops in underdeveloped nations. In Sudan, Adam et al. (2005) calculated technical efficiency for sorghum yield, whereas Alemu et al. (2007) estimated it for agricultural output in Ethiopia. Similarly, Binam, et al. (2004) did a study in Cameroon to measure the technical efficiency of maize and sorghum production. There is no shortage of research on assessing technological efficiency in Sub-Saharan African countries (Fakayode, 2009; Kariuki, et al., 2008; Kibara, 2005). Rios and Shively (2005) calculated the technical efficiency of Vietnam's coffee yield. The measurement of technical efficiency for farmers has also been established using evidence from South Asian countries. Thiruchelvam (2005) conducted a study for Sri Lanka that estimated the technical efficiency of chilli and onion growers.

Similarly, for different crops, a large body of literature has studied farm efficiency in other South Asian countries. Hassan and Ahmad (2005) used empirical studies on wheat to estimate farm efficiency in Pakistan (Punjab). Thus, creative literature exists in Pakistan that has measured farm efficiencies for various crops such as wheat, rice, vegetables, and citrus (Zahid and Ahmed; 2017; Javed, et al., 2009; Hussain, et al. 2012; Sohail, et al., 2012; Khan and Ghafar, 2013). The majority of these are focused on a particular crop and do not link farm productivity to market participation that limit their scope. As a result, the focus of this research is on agricultural productivity, as well as their market participation. Surprisingly little research has been done on how these variables interact. Previous studies have looked into the relationship between market involvement and productivity (Gory,Jane and Nyoro 1999; Strasberg et al., 1999; and Govereh and Jayne, 1999).

Few studies related to the current work that focused on a single crop in developing countries such as Africa, Latin America, and South Asia are Deaton, 1989; Benjamin and Deaton, 1993, Barrett and Dorosh, 1996; Jayne et al, and Kirsten and Delgado, 2001; Vakis, Sadoulet and de Janvry, 2003; Renkow, Hallstrom and Karanja, 2004; Makhura, Edmeades, 2006;; Boughton et al., 2007).

Few research have looked into crop market involvement. In West Africa, Strauss (1984) studied cereals, whereas Budd (1993) looked at food crops, and Strasberg et al. (1999) and Heltberg and Tarp (2001) looked at total crop production in east Africa. Because they employ farm-level data on one crop, usually wheat, cotton, and rice, and some inputs, same is the case in Pakistan, recent studies on the technical performance of agriculture in Pakistan do not provide a clear picture of farmers' productive performance. The current study adds to this analysis. All crops should be combined with all measurable inputs and outputs and link them with market. By summarising the preceding debate, the underlying research contributes to the literature in the context of the AJK agriculture market's agro-climatic structure. It would be evaluating local farmers' farm inefficiencies and tracking their market involvement. The findings of the underlying study would update the literature surrounding agriculture specifically related to farm efficiency and farmers' market involvement because the topography, cropping patterns, and adoption of technology differ from place to region.

METHODOLOGY

The underlying research primarily focuses on the use of mixed approaches to assess the defined objectives. This method is often used to combine the results of quantitative and qualitative instruments to provide a comprehensive picture of the study problem (Aramo-Immonen, 2013). The project follows a quantitative approach in which primary data was obtained from farmers in AJK using a detailed questionnaire. In addition to primary data, secondary data was used to establish facts and figures about the structure of the agriculture sector in the sampled areas. Secondary data will be collected by conducting a desk review of secondary information—government published reports on the agriculture sector in AJK.

Furthermore, the qualitative method was used to conduct Key Informant Interviews (KIIs) in order to obtain expert opinions on policy activities in light of the study's objectives. Questions about their views, subjective norms, perceived behaviour, future expectations, and attitude toward new technology adaptation, government backing, and input availability make up qualitative data. The following is a detailed discussion of qualitative and quantitative approaches.

3.1 Quantitative Methods

The quantitative methods involve the use of primary data gathered from 1200 farmers in all 10 districts of the AJK via a detailed questionnaire. All socioeconomic characteristics of farmers, farm features, and specific information on agricultural activities and market accessibility factors was included in the questionnaire.

Data Collection

In first step, study area is divided into two regions[1] based on topography and climate to give due coverage to all type of heterogeneity in units of farm household in AJK. In step two, since all ten districts are located at different climatic zone, two tehsils was selected from each sampled districts based on farm population for the household survey which becomes total sampled tehsils 20=10*2. In third step, two union-council (villages) was taken from each tehsil. Thus, there are 40=20*2 UC (villages) in 20 tehsils from which sampled respondents was taken. Detail is given in ***Annexure-A*****.** And, in final step, 30 farmers will be selected from each union council which becomes total sample 1200=30 (farmers)*40 (UC villages). The sample of farm household was selected from each union council randomly based on potential farmer's population. Following these reasons, their particular geographical, agricultural, demographic, and socioeconomic characteristics can provide important understandings for our research questions. We focus on Rabi (winter) and Kharif (summer) crops for the agriculture year (2020- 2021) for simplification because these crops are grown in specific time of the years. There are two principal crop seasons covered in our data set includes "Rabi," which stretches from October-December 2020 to April-May 2021, "Kharif," with sowing beginning in April-June 2021 and harvesting taking place in October-December 2021. Agriculture is a process involving multiple crops and inputs. The production of several crops for each farm is merged into a single product applying the production function technique. Farm products includes all outputs from farm including crops, livestock,

[1] The Northern districts which are generally mountainous include Muzaffarabad, Jhelum Valley, Neelum valley, Bagh, Haveli, Poonch, and Sudhnoti while Southern are comparatively plain districts such as Kotli, Mirpur, and Bhimber. Map is given in Fig 1 appendix.

fruits, and vegetables. We did not consider livestock and livestock products into our analysis for which representative data are hard to come by and needs couple of years to carry it out. Statistical data include information about household demographics, farm specific characteristics, farm level inputs, technical practices, and variables related to output production, geographical, infrastructure, and market access. We employed field assistant and agriculture graduate from different tehsils to collect the data. Subsequent trainings was given to the selected enumerators**.** The survey was conducted through face-to-face interviews by previously trained enumerators. Quantitative data is collected during November and December 2021 because harvesting of summer crops starts from November. The primary data was then inserted into the SPSS software, after cleaning of the data estimation was performed in R-software according to the research purpose. The final report was prepared to discuss the results and propose policy recommendations.

Empirical Model

After quantitative data collection, the underlying study would implement statistical analysis, and basic data techniques to analyse the data through graphical and tabulation tools. Since, the computation of farm inefficiency is purely econometric based, so this study would implement empirical model to accomplish our objectives.

Stochastic Production Frontier Approach is preferred instead of using a simple production approach because it is best fitted with the data and objectives of our survey i.e. large units of cross-sectional data, separate form, biological and the inclusion of social features, non-observable characteristics of the farmer, technological neglect (Kumbhakar and Lovell 2000, Salvo, et al. 2013).

The study covers three aspects of farm household. First, we evaluate farm-level technical performance scores using the Stochastic Production Frontier. If there is a technical inefficiency, it means that the farmers are not producing on maximum level of production frontier curve but below and therefore the technical performance is less than one. The R-Frontier software package is used to estimate the stochastic frontier model and generate technical ineffective scores. Second, we gain access to the specific constraints and conditions of the region for market access to sample household. This test assumes that production efficiency increases market participation due to higher sales in the presence of improved market access conditions. Third, we analyse the relevance of production efficiency and market participation in terms of market accessibility such as infrastructure, distance to roads, sources of market information, and distance from markets, marketing experience and other market related variables. The Tobit model has been implemented to determine relations. To participate in the market, the sales index is used as a fraction of the total sales of the total product. Farm-specific inputs (land, labor, capital, and materials) serve as explanatory variables to determine their impact on farm production (gross value from vegetables, fruits, grains, and other food crops). The study considers the effects of different farmers' characteristics, such as age, education, and farm size on farmer performance such as the 'technical ineffectiveness model'. Depending on the specific features of the farm in line with (Battese and Coelli 1995).

Specification of Empirical Model

When analysing unit level information like the household farm survey, the production frontier using the stochastic frontier approach is a better way to quantify production efficiencies (Hughes, et al. 2011). We can also use the stochastic frontier model to deal with specific random shocks (Thiam and Bravo-Ureta 2001). Traditional deterministic methods ignore noise, which can lead to an overestimation of technical inefficiency. A 'composite error term' with two components is used in the stochastic frontier technique. The first is technical inefficiency, which is defined as "farm departures from the production frontier," and the second is statistical noise, which captures the influence of random shocks on each producer as defined by his or her operating environment (Coelli 1995). This method also enables for the statistical testing of assumptions about the production structure and degree of inefficiency.

Various functional forms have been used in the literature to assess farm performance. Cobb-Douglas and translog functions are the most commonly employed functional forms by academics to measure efficiency in the agriculture sector. The translog function has a more flexible functional form and is most commonly represented in logarithm form such as:

$$ln(Y_i) = \alpha_o + \sum_k \beta_k lnX_{ki} + \sum_j \beta_j ln\, X_{ji} + \frac{1}{2}\sum_j \sum_k \beta_{jk} lnX_{ji} lnX_{ki} \dots \dots (1)$$

This function is viewed in three ways by Boisvert (1982): first, as an exact production function; second, as a second order Taylor series approximation to a general, but unknown production function; and third, as a second order approximation to a CES production function. Boisvert (1982) defined the exact production function in Cobb Douglas functional form as

$$ln(Y_i) = \alpha_o + \sum_k \beta_k lnX_{ki} + \sum_j \beta_j lnX_{ji} \dots \dots\dots\dots\dots\dots (2)$$

We chose Cobb Douglas functional form because this study employ a number of exogenous variables and a large number of parameters to evaluate. Assuming that the number of production factors is n, the number of parameters to be estimated is n (n+3)/2, which increases the risk of severe multicollinearity, which could result in contradicting interpretation of parameters (Pavelescu 2011). Based on applied economic literature, the C-D function form is favoured for use because of its simplicity and ability to avoid collinearity among the independent variables. The linear form of the CD production frontier function is as follows:

$$\ln(Y_i) = \alpha_o + \sum_k \gamma_k\, lnX_{ki} + \sum_j \beta_j lnX_{ji} + v_i - u_i \dots \mathrm{i} = 1, 2, 3, \dots, \mathrm{N} \dots \dots (3)$$

Y_{it} is the ith farm output and X_{ki} is vector of k, *j* inputs (land, labor, capital and material) of the i[th] farm. Technical inefficiency affects u_{it} derived in the preceding equation is specified as

$$u_i = d_\circ + d_1 Z_i + e_i \dots \dots . (4)$$

Where Z_i are the vectors of farmer and farm specific characteristics of the i^{th} household, e_i is the error term.

$$TE_i = \exp(-u_i) \dots\dots (5)$$

This demonstrates that the lesser the nonnegative inefficiency component *u,* the more efficient the *ith* farm. By construction, technical efficiency indices range from zero to one. Higher technical efficiency indices denote higher levels of efficiency. Households having a technical efficiency index of one are considered technically efficient. A single step estimating technique is used to estimate the model (Battese and Coelli 1995). The maximum likelihood technique (MLE) was

proposed by Battese and Coelli (1995) for the simultaneous estimation of parameters of the stochastic production frontier and the inefficiency model. With the use of the R-frontier package, the MLE technique will employ the following variance parameter: δ^2 is total error variation, $\delta^2 = \delta^2{}_v + \delta^2{}_u$ and $\gamma = \frac{\delta_\mu^2}{\delta^2}$ which represents the technical inefficiency contribution to total error variation.

The two-step modelling approach was questioned by Battese and Coelli (1995) and Battese et al. (1996) because it violated one of the most crucial assumptions of the stochastic frontier model: 'identically independently distributed technical inefficiency effects.' Various statistical tests can be used to determine the model's validity. The null hypothesis H_0=γ=0 that the technical inefficiency effects are not present in the model and are not random is of particular importance. Furthermore $H_0 = d' = 0$, expressed the null hypothesis that the household specific attributes have no effect on technical inefficiency level where d' denotes the vector of parameter, d with the constant term d_0 omitted, assumed that it is included in the expression $Z_i d'$ .The generalized likelihood-ratio statistic λ is defined by λ = -2 ln $[L.(H_0)/L.(H_1)]$, where H_0 and H_1 are the null and alternative hypotheses respectively. If, H_0 is true, then is asymptotically distributed as a chi-square random variable (see Coelli 1995 and 1996).

Market Participation

Market participation is measured in sales as a fraction of overall output for the household's entire agricultural crop production. This "sales index" would be zero for a household that sells nothing, more than zero for families that sell their crops, and greater than unity for households who add value to their crop production through additional processing (Govereh and Jayne 1999). Its definition is

$$sale\ index_i = \left[\frac{\sum_{j=1}^{J} Crop\ marketed_{iy}}{\sum_{j=1}^{J} Crop\ harvested_{iy}}\right] \begin{cases} Non\ seller & = 0 \\ seller & > 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where different jth crops are grown from ith farms. The sale of crops involves transactions with people and organizations out of the farm household. Y_m is the amount marketed, Y_h is amount harvested it does not contain the portion used for home consumption Y_C and the gift portion Y_G or stored as seed $Y_S$for the coming season.

$$Y_m = Y_h - Y_C - Y_S + Y_G$$

Where $Y_h > 0$ if $Y_C, Y_S, Y_G. > 0$ and Y_m/Y_h=1 if the farmer sells the crop harvested or $0 < \frac{Y_m}{Y_h} < 1$ if the farmer distributes his crop and sells portion of it in some market. Therefore, the value of the dependent variable is between 0 and 1.

The next analytical step involves identifying factors which influence Market participation using regression analysis. The determinants of market participation are those that affect productivity and hence domestic market access conditions.

The general model can be written as $(MP)_i = f\{(u)_{i,}, (MA)_i, (D)_i\} \ldots i = 1 \ldots\ldots N$ ... (6)

Where MA are the vector of variables that determine market access conditions u is technical efficiency scores generated from above model and D shows demographic condition whereas MP is market participation. We used the Tobit model to estimate this because of the truncation of market participation variables (Barrett et al.2001).

$$\text{Tobit}(MP_i) = \ln\left[\frac{Y_m}{Y_h}\right] = \beta_1 + \beta_2(\text{MA})_i + \beta_3(D)_i + \beta_4(u)_i + \varepsilon_i \ldots (7)$$

3.2 Qualitative Methods

The study has implemented the qualitative methods to accomplish the objectives related to the policy interventions by stakeholders. The underlying study implements the qualitative method to carry out the checklist to the Key Informant Interviews (KIIs) which may contain the information about agriculture sector in AJK from the stakeholders. The objective is to ask them what sort of the support they are provided to the farmers to reduce farm inefficiencies. Moreover, KIIs maintain focus on the problem faced during provision of assistance to farmers, and how the relevant institutions are providing help to farmers to participate in the market. Qualitative information will be collected from different interlinked departments such as Agriculture Department Officials, Planning and Development Department(P&DD), Irrigation and Small Dams Department, Extension Service Management Academy (ESMA), Agriculture Tourism Development Corporation and Crop Reporting Services (CRS)

Focused Interviews

The qualitative data were collected in accordance with Yin (2003) to ensure the reliability of individual case study interviews, personal observations, focus group discussions (FGD) methods was used. Some crucial questions about agriculture productivity and marketing of the relevant sectors were included in the surveys. They were also given some specific questions about the reasons for agricultural inefficiencies and marketing faults, as well as their suggestions, roles, challenges, and expected policy recommendations.

To collect data, 40 key informant interviews (KIIs) and direct observations at various institutions at all levels were conducted. This group is made up of people from ten interconnected departments. Interviews were conducted with 36 field specialists and four members of a privately owned farm. Each interview lasts approximately one hour. Twenty percent of the key informants (KIs) were female and eighty percent were male. 68 percent had M.Sc. (hons) or higher education, while 22 percent had B.Sc. (hons) and 10% had intermediate education and worked on private farms. Experts represent from all agriculture sector departments from all district. 50% have more than 14 years of experience in the agricultural sector. Four focus group discussions (FGD) with eight to ten participants were also held.

RESULTS AND DISCUSSION

4.1 Farm Household Characteristics

Socioeconomic Characteristics

To present our findings, we employed descriptive statistics. The average family size of the sample farmers was 9, according to Table 1 in the appendix. On a broad scale. We obtained the dependency ratio, which has a range of 0 to 24 and a mean of 0.7. In this location, reliance is prevalent to the extent of 70%. Farm household heads were on average 49 years old, with ages ranging from 15 to 95. Overall, 53 percent of the participants were under the age of 50, while 47 percent were over 50. The household head's education ranges from illiteracy to 18 years of education. The average household head has nine years of education. While 69.3 percent of the population is below intermediate, 0.7 percent is illiterate, and 30% is above intermediate.

The household head had 23 years of *farming expertise*. The *tenancy status* of households revealed that 96% of farmers are owners, while the remaining 4% are owner cum tenant and renter. Only 27% of respondents have remained in the same location for up to 20 years, while 73% have worked for more than 20 years. 45 percent of farmer household heads belonged to a union, 12 percent to an association, 4% to a non-governmental organization, and 33% to a government organization. While 5% were not *affiliated* with any organization.

Farm characteristics

The average size of the sample respondent's farm was 21 kanal, or about 1 hectare or 2 acres. With a minimum of 1 kanal and a maximum of 360 kanal. 76 percent of the sample farms are rained, whereas 2% irrigate via direct streams and rivers, according to the percentage of irrigation sources. 8.9% came from water pipes, 10% from main and minor canals, and the rest came from various sources. The average cultivated area was 15 kanal, ranging from 252 kanal to 0.7 kanal. In response to a question about their soil type, fertility, and soil issues. 23 percent have clay soil, 66% have loam soil, 4.3 have sandy loam, and 4.7 have other types.

Soil issues such as erosion, waterlogging, and salinity affect 21% of the population. Only 3% of people have tube wells, while 97% do not. 50 % percent of respondents said they solely used their own or hired tractor for land cultivation. Another 27% said they used both bullocks and tractors to cultivate their land. Bullocks are only being used for land plowing by 23% of respondents. Only 10% of the population has their own tractor. The 78% farms were located in areas where there were no water courses or channels, while the rest were near water channels.

The average amount of weedicide and pesticide used was 5 liters, with 45 percent of farmers not using any. 15% of farmers did not use any FYM at all, and 50% used less than six carts. The average FYM was 20 trolleys. DAP and urea were the most often utilized fertilizers in the past. 20% of farmers did not use any fertilizer, while 50% used less than 60 kg. The average amount of DAP and Urea fertilizer utilized was 113 and 106 kg, respectively. These fertilizer provided 107 kg of NPK nutrients. The average number of irrigation was 4. The average seed used per kanal was 14 kg, with 30 man-days from hired labour. The mean gross value from crops was 3,52238 Rs annually from two seasons that was also low.

Market Related Characteristics

Table 2 appendix contains descriptive statistics for the variable that represents market accessibility. 58 percent of households active in market participation were involved in value addition and processing activities, whereas 42 percent were not. Wheat flour accounted for 35% of processed items, maize flour for 48%, and dried legumes and pulses for 7.2 percent. Oil/nuts accounted for 5%, while spices/sauces/James others accounted for 3%. Farmers have a tremendous opportunity to sell directly to the market and generate a profit because the function of the intermediary in this region is limited. In this region, 40% of products are sold directly at market. Within various sales channels.20% at the roadside, 15% in the field or on the farm, and 10% direct delivery to private wholesalers,4 percent direct delivery to the processor,2 percent farmer organization,4 directly to exporter and 5 percent to govt organization.

The distance to the nearest market is a key determinant of market participation. 80.7 percent of sample farms were within 15 kilometres, 14.3 percent between 15 and 30 kilometres, and 5% beyond 30 kilometres. 90% had less than 20 years of experience.

Distance of farm from road is important determinant for market participation according to survey 51 percent were living at roadside, 38 percent within 5 km and 11 percent within 15 km or above. *Source of information* about market showed 75 percent received information about market from agriculture extension services 13 percent from farmer organizations and association.4 percent from radio and television and 8 percent from other sources like neighbor farmers and relatives. Among the respondent 25 percent availed *credit facility* while 75 percent did not get. We asked them if they have availed what was the source, 40 percent from commercial banks, 45 percent from friends and relatives and 15 percent from other private people.27 percent received *training* about agriculture and marketing and 73 percent did not receive. Marketing experience on average was 10 years. Household assets and facilities in specific area are important determinants of market accessibility and hence participation are given in table 3.

4.2 Stochastic Frontier Analysis Results

Firstly we estimate the model by using all inputs in order to determine its fitness. Table: 4 in an appendix with the results. The gamma value is highly significant so we reject the null hypothesis null hypothesis $H_0 = \gamma = 0$ that the technical inefficiency effects are not present in the model and are not random because the gamma is quite positive 0.51 and highly significant. In the second model Table 5 we incorporate household and farm specific characteristics as determinants of technical inefficiency. Most of the variables are significant so we also reject the null hypothesis that the household specific characteristics have not any influence on technical inefficiency level is expressed by $H_0 = d_0 = dn' = 0$, where d' denotes the vector of parameter. LR value was 45 with df =7. chi- sq value of 8.6 with p value was 0.001658 was given by likelihood-ratio statistics that was high significant so we reject model with OLS and no efficiency and support model with error component frontier (ECF).

To attain the objective we have chosen the variable based on economic literature. Stochastic production frontier was estimated by using gross value from all crops as dependent variable and set of inputs used as explanatory variables. However the inefficiency sores generated made explicitly a function of socioeconomic variables. Model was estimated in single step following Battese and coelli 1995). Elasticities of all inputs was positive and significant. All inputs

contributed positive to increase in gross value of crop produced. So it must be provided in time and in sufficient quantity and quality. Table 5 shows that 13 of the 15 parameter estimates for the stochastic production frontier are statistically significant at least one percent level of probability. All of the listed variables' coefficients have the anticipated signs. The cultivated area parameter estimate is 0.50, which is significant and has a positive sign, implying that a 1% increase in area under cultivation would result in a 0.50 percent improvement in farm productivity. This finding is in line with Ali and Chaudhry (2008), Coelli and Battese (1996), and Battese and Broca (2001). (1997).

The partial output elasticity of the labour variable is 0.17. This figure means that a 1% increase in labour allocation would improve farm output by 0.17 percent. As a result, more labour availability during peak season would result in a higher output response. The partial output elasticity of fertiliser is 0.16, which is statistically significant and has a positive sign. Tractor use (dummy) has a parameter estimate of 0.48, which is positive and statistically significant. The elasticity of tractor is relatively high, which could be related to the fact that tractor availability is limited during peak agricultural seasons, resulting in late sowing and harvesting, resulting in farm output losses. The partial output elasticity of the seed variable is 0.019 which is also positive and statistically insignificant. The coefficient of pesticide and weedicide use was 0.10, which is statistically significant and positive. Farmyard manure has a positive coefficient of 0.11, which is statistically significant at the 5% level of significance. Organic fertiliser (fym) must be applied at the right time and in the right amount in combination with inorganic fertilisers to reap the benefits—various empirical research have found comparable results (e.g. Battese et al. 1993; Ahmad et al. 2002; Ahmad 2003 and Hassan and Ahmad 2005). The irrigation variables' coefficient is 0.16, which is positive and statistically significant at the 5% level—this result shows that reduced irrigation water supply under a changing climate—characterized by higher temperatures and lower rainfall—would severely harm agriculture in AJK.

This finding is consistent with Hassan and Ahmad (2005), Ahmad (2003), and Ahmad et al (2002). The dummy variable parameter for south districts assuming north districts as a base has a favourable effect on farm productivity as well. As in the south, there is a huge area under cultivation and considerable agricultural crop potential. The cultivated area has the maximum elasticity of 0.50 percent, which suggests that bringing more land under cultivation will result in a substantial improvement in agricultural productivity, while 40% of the land in this region remains uncultivated. When compared to other inputs, the usage of a tractor for ploughing has a considerable elasticity of 0. 48 percent. Agriculture's performance will improve when more mechanisation is used.

Analysis of the Determinants of Technical Inefficiency

The findings demonstrate that farm-level technical inefficiencies exist. In the lower panel of Table 5, the parameter estimates of the factors affecting (in)efficiency by estimating equation 4 are provided. We were able to use characteristics including the farmer's age and educational level, farm size and traction power, irrigation source, and land fragmentation with the data we had. The result shows that among the determinants of inefficiency, the variable age is insignificant, however the variable education is positive and significant, implying that more educated individuals contributed positively to technical inefficiency at farm. This is because higher education tends to divert people to other occupations such as government positions, and they contributed less to increasing agricultural efficiency. The fact that the coefficient for the variable

farm size is negative indicates that increasing farm size reduces technical inefficiency since it allows farmers to cultivate a wider variety of crops, use new technology and machines, and enhance production. This result is in line with Ahmad and Ahmad (1998), Ahmad et al. (2002), and Ahmad et al (2003).

The explanation for this could be that larger farmers, because of their stronger financial and social standing, have more access to information, farm machinery, and extension services, and can undertake agricultural operations with more timely and with precision. Furthermore, farm operations of a larger scale may be able to utilize inputs more efficiently (Ahmad, et al. 2002). Dummy for irrigation is positive, which indicates that inefficiency is increasing. This could be due to irrigation sources not being accessible in the appropriate amount, or because the majority of the land is rainfed, which has a negative impact on agricultural efficiency. The negative coefficient of land fragmentation indicates that the more land is separated and cultivated into parcels, the easier it is for farmers to manage and monitor, reducing inefficiency. The dummy for traction power when utilizing advanced machines and tractors was negative, indicating that it reduces farm technical inefficiency.

Technical Inefficiency Score

The mean value of efficiency derived from the above model, as shown in Table 6, was 58 percent, with a range of 7.5 percent to 86 percent. Indicating that farmers might achieve the maximum output frontier by raising their efficiency by 42 percent. This would be accomplished through the use of current technology and other measures. This suggests that by utilizing agricultural resources more efficiently, farm gross value from crops might increase by 42 percent. While 53 percent of the sample farmers were under 60 percent efficient, there is still space for the average farmer to increase farm production by 40 percent with the same level of inputs and technology by strengthening the farming community's managerial capacity.

4.3 Market Participation Index

Market participation is calculated by sum of all crops marketed divided by sum of all crop harvested $\left[\frac{\sum_{j=1}^{J} \text{Crop marketed}_{iy}}{\sum_{j=1}^{J} \text{Crop harvested}_{iy}}\right]$ its value ranges between 0 and 1 with mean was 0.36. Zero means they marked nothing and close to 1 means the share of crop marketed to total produce was increased and hence more market participation.1 means they sold all the crop produced. On average the farm output produced was 4215 kg and amount marketed was 2319 kg. However, contribution in market was less 47 percent of farmers have less than 50 percent market participation and 20 percent did not participate in market. The distribution is shown in table: 7.

Factors Affecting Market Participation

The determinants of market participation were technical efficiency level generated from above model along with other market accessibility factor and household characteristics that include credit facility, Agriculture and market training dummy variable. Distance of farm from road dummy variable for farm located within 5 km while others as base. Processing or value addition dummy variable. Distance from market within 15-30 km dummy variable. Marketing experience in years. Having refrigerator for storage dummy variable, having internet as source of information

dummy variable. Family size in numbers also determine market participation. The model is best fitted with sigma coefficient is high significant and log-likelihood value is also large 404 with df 12 to support the model. Results was presented in table: 8. All the variables were positive and significantly contributed to market participation except family size and processing. Increase in credit facilities along with training and increase in technical efficiency at farm result in increase in market participation. The coefficient of efficiency was 1.39 indicated that one point increase in efficiency score is associated with 1.39 point increase in market participation. Similarly the more they are located closer to the roads and market also significantly increase market participation. Having internet also positive contributed. While family size and processing negative contributed to participation they mostly process products for their immediate consumption at home like spices, maize and wheat flour. Increase in family size result in increase in household consumption and result in decrease in amount marketed.

4.4 Response Generated from KIIs

Two sections make up the qualitative questionnaire. We posed questions about farm efficiency in section A, and market involvement in section B, and their results are summarised here in percentage points..In respond to question *How is you contributing/assisting the farmers to improve farm productivity?* 20% response by providing abrupt information. 20%by introducing efficient farm practices 25%by providing education, training, and demonstrating. 7% helps in irrigation and 27% assists with other measures such as enhancing soil fertility. In response to question *Your organization is demonstrating/working on which impact based policy type?* 35% responded by input support 5% by output support accounts for 50% by technical support and 10% by financial assistance. In response to others question such as *Is your department playing role in timely provision of pesticides, fertilizers, and other inputs to farmers?* 42 percent answered yes, while 58 percent said no .*In the face of climatic shocks/disaster, what has been your role to assist the farmers?* 30 percent assist with adaptation, 25 percent with financial assistance, 45 percent with climate change perceptions, and 22 percent with other measures. *Does your department have any collaboration with some other department to assist the farmers?* 82 percent answer yes, while 18 percent respond no. *Is your department engaged in finding new research-based ways to increase the productivity of the farmers?* Yes answers accounted for 55% of the total, while no answers accounted for 45%.

Which extension teaching method, in your opinion, is most persuasive for farmers in terms of an innovation's adaptability? Individual interaction is preferred by 32 percent, group contact by 55 percent, and mass contact by 12 percent. Is the district administration working with you to help farmers raise their output? 37 percent said yes, while 62 percent said no. *Are you training farmers on how to gain market access?* 25% responded yes, while 75% responded. *Is your department encouraging farmers to go into commercial farming and switching from traditional to high-yield crops?* Yes, 80% of the time, and no, 20% of the time. *Are you having difficulty carrying out your plan to enhance farmer market participation?* Yes, 65 percent, and no, 35 percent. **Annexure B** contains the response charts.

THEMATIC ANALYSIS

Reviewing relevant literature and publications produced by associated departments such as agriculture census, report on sustainable development aim in AJK, and crop reporting services helped to substantiate the interview's findings. Nvivo software was used to create the themes. With reference to the AJK analysis, the current study sought information on regulatory framework and intervention, district-specific marketing mechanisms, capacity building, inefficiencies, barriers to market access, monitoring and roles, service delivery, market infrastructure, private public partnership, funding gap, water management, research and extension coordination, availability of modern machinery, technology, and inputs, and predicted policy outcomes. In AJK, we looked at the concept of market involvement and production efficiency in the context of a department and farmers from several districts. We discovered several roadblocks and issues that keep farmers from reaching an efficient level of production and thereby market participation. The study also identifies institutional issues that government officials encounter in this sector, which have an impact on their duties and contributions to farm production efficiency, as shown in Figure 2.

5.1 Production Factors

Based on in-depth interviews with stakeholders, it appears that the **private-public collaboration** in delivering inputs to farmers is limited. Low-quality inputs are used, seeds are not certified, and fertilizers are not available at discounted rates. There are various government projects that provide 20% cost sharing on inputs, but their **funding and outreach** are insufficient to assist all farmers, and they still target the farming community.

Labor is available in the farmer community, but some people cannot afford labour wages and choose to work on their own. Due to a **lack of financial resources**, a large number of lands remain uncultivated. There aren't enough agriculture-related enterprises in rural areas to absorb unemployed workers. To forecast weather conditions and obtain market information, field employees are not properly equipped with the latest technology or field gadgets such as tablets and internet access. In AJK, there is no agriculture research unit. To create locally appropriate varieties. They typically adopt varieties that work well in Punjab and are suggested by PARC but do not perform well in particular AJK localities with varying climatic and geographic conditions. Field employees have **no transportation or mobility** options for their frequent visits. By interviewing irrigation department employees, it was discovered that they have limited budgets and schemes to build minor dams and irrigation channels, and that the majority of the region is rain-fed, with only about 12% under irrigation.

The most essential production factor is the **availability and quality of inputs**. These are the primary drivers of market participation; if high-quality inputs are not made available to farmers in a timely manner, there will be a lack of output produce, which would negatively impact the ability of farmers who are currently involved in marketing. Instead than focusing on crop quality, they may concentrate on reducing the risk of crop loss. There are numerous problems in the management of the functions that are in the works at the local level, including maintaining quality standards, enforcing regulations, and delivering seeds, fertilizer, and pesticides. Government programs have an **inherent fault** in, that recipients are never selected in a scientific manner; instead, patronage and connections are frequently used as measurement methods for the

allocation of government-sponsored schemes. As a result, the outcome cannot be accomplished, objectives are not fully met, and recipients have no reason to take the product on a commercial basis and recipients are not given any motivation.

5.2 Market Accessibility Factors

Infrastructure, good roads, and farm gate roads all contribute to lower transportation costs and post-harvest losses. There are no dedicated storage and warehousing facilities where farmers can store their crops and sell them at a profit. As a result, the production quality is likewise poor public and non-governmental organizations (NGOs) should assist in providing training and information on credit and access to other technology to all farmers.

Farmers' market orientation can be influenced by **market information** such as present and prospective prices. Currently, the agriculture department is not involved in providing farmers with market information. Because the extension services provided by the department field assistance staff are not market oriented, AJK area is made up of far-flung farmhouses, a public-private partnership is required to engage other companies and non-governmental organizations to keep farmers informed about changing circumstances. Farmers have limited access to alternative sources of information such as the internet, television, and radio, and they are financially unable to cover the costs of transportation to market.

Farmers' organizations and associations are needed to assist farmers by assembling their produce in one location so that when items are transported and sold in bulk, transportation costs are evenly divided. As a big number of farmers become closer, it will also make administration easier. Field employees and farmers require workshops and training on market activities and product value addition. Farmers are unable to obtain fair pricing for their produce due to weak institution's regulatory involvement. Districts bordering Pakistan's big markets, such as Bhimber, Mirpur, and Kotli, which are adjacent to Rawalpindi markets, are more involved in market participation. These farmers have some experience of markets and are actively participating. Farmers in these districts have a lot of expertise and are aware of market information. Farmers have access to information on the types and attributes that buyer’s want through market sensing, and at a time when demand for their products is high.

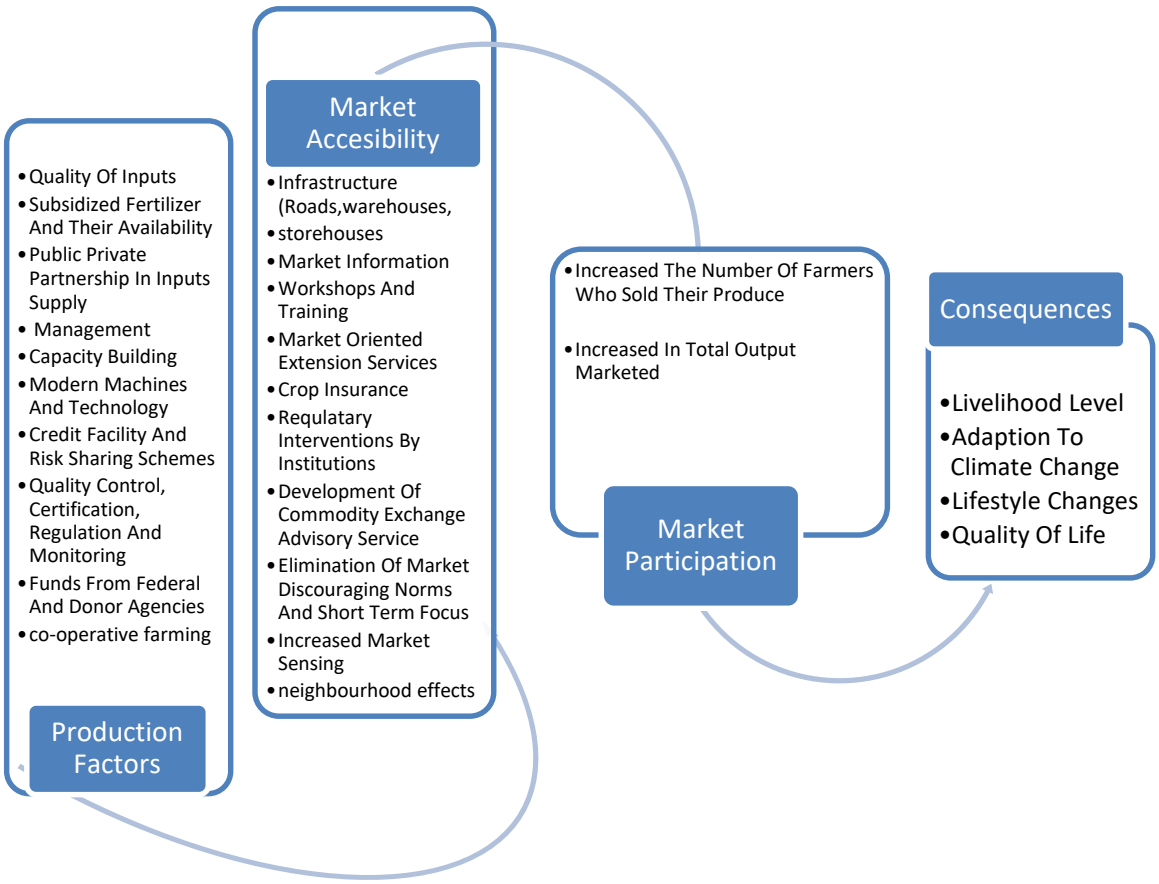
Farmers typically conduct market sensing through personal trips to the market, conversations with other farmers in their markets and on their travels, and social gatherings. We generally find lower levels of market sensing in more distant marketplaces, such as the northern district of Neelum, Poonch, Hattian, and Haveli, where farmers have less experience of participating in the market, compared to locations closer to the markets. Farmers' market responses include crop variety selection and moving from low to high value crops. (For instance, switching from cereals to veggies and fruits) or a more popular product. In terms of market involvement, social and geographic factors are more important than organizational factors. Farmers frequently conduct market research through personal visits. Farmers have adopted a market-oriented mindset but they hardly involved in predicting future demand or developing long-term plans to create and sell at a profit. They only appear in the market for a single season and then disappear. In this area, the neighborhood effect is also more widespread. Farmers are more inspired and encouraged by the methods of their neighboring farmers who are selling their produce for a higher profit. It also encourages individuals to go to nearby markets for information, which is their first step toward

market involvement. For example, if one farmer in Neelum district sells walnuts at a fair price in a Lahore market, others will fall into line and bring their produce to the same market. Market-discouragement norms are also more prevalent in some places, where farmers are hesitant to sell their crops to the market and instead prefer to give it as a gift to neighbors and relatives. It further reduces their incentive to market their products.

5.3 Market participation

All those factors that affected production efficiency and market accessibly will ultimately affects market participation. The overall output produced in this area is below the optimal level of production for marketing. Farmers in places where market access is good, such as the south districts of AJK, are encouraged to cultivate more and sell them.

Figure 2: Antecedents and Consequences



5.4 Consequences

Local economic and agricultural characteristics may influence the relationship between market participation and productivity. Roads need to be set up to enable farmers in producer organizations, provide literacy programs in rural areas, storage facilities for perishable crops, and provide access to markets. The growth in market response may mean that farmers live a more individualized lifestyle, rather than on a traditional basis.

As a result of the rise in production efficiency with market involvement alters the peasant economy. Those who use their earnings to transition from subsistence to monetized transactions, increase market involvement or production rates, or both, can boost their living standards. Farmers can become consumers of a variety of things, including manufactured goods, as their income rises. For example, the usage of mobile phones, the Internet, and computers constitutes a substantial shift in farmers' lifestyle. They can check prices, new kinds, and weather forecasts on their phones.
Farmers who are less market responsive are less responsive to climate change since selling is more difficult and less profitable for them. Farmers' market responses have an impact on their ability to respond to changes in natural conditions. These include adapting resistant varietals and hybrid seed to anticipated changes in climatic circumstances, such as drought, at the time of planting. An increase in income will help to add value to the product. Furthermore, FGDs and KIIs pointed out that increasing market access through local infrastructure investment, such as the construction of roads, warehouses, and storage facilities, might lead to continuing agricultural production improvement.

More ever, increasing production through direct investment in irrigation, improved seed and subsidized fertilizers is likely to have a more consistent impact on both production and market participation.

CONCLUSION & POLICY RECOMMENDATION

Following policy measures are therefore recommended base on Key informants interview (KIIs) to enhance the productivity of the agriculture sector in AJ&K:

- Providing local agriculture markets with the help of private sectors, at least in tehsils where small farmers have approach to sell their products.
- Financial loans to the farmers for value addition of their products so that it can fetch a place in market.
- Introduction of co-operative farming system for small farmers with less land holdings.
- One product one village policy is necessary in AJK to increase production of farmers.
- Provision of improved quality seed, plants and other agriculture-inputs that should be available at the door-step of the farmers.
- Special marketing mechanism for small farmers is necessary so that they can easily approach the market for selling of their products.
- Use of land as per soil classification and impose restrictions for use of cultivable land for any other purpose.
- Penalties for not using their cultivable land for farming purpose for last five years.
- Each district should be allocated to specific crops where there is its potential i.e North region is suitable for horticulture crops. South region is suitable for cereal crops, fodder, citrus fruits etc.
- A quality seed is a basic unit of a production function in the Agriculture Sector. Certified planting material like cereal, pulses, crop seeds, vegetable seeds, fruit plant varieties is compulsory for a profitable farming. It is recommended to establish a seed production unit in the Agriculture Department. The Unit has a critical role to play in promoting and ensuring the development of approved planting materials.
- It is suggested that a research institute dedicated to mountain agriculture be established. In distinct agro-ecological zones, soil and climatic conditions are vary and/or strongly rain-fed. Crop varieties developed specifically for mountain environments, as well as post-cultivation procedures during the crop season, are required for productive farming in this region.

The study's main goal was to establish a relationship between farm production, technical efficiency, and market participation. To respond to the research question, "Does increasing agricultural production lead to increased market participation and having better market access conditions?"

To this purpose, the study demonstrates that farm-level variables and market accessibility factors have a significant impact on agricultural productivity and market participation. The findings also revealed that, in addition to market accessibility indices, production efficiency—technical efficiencies play a substantial impact in influencing market participation levels, with a positive coefficient of 1.39. There is a room to increase efficiency level by 42 percent .Therefore, there is a need to take steps:

- To control the effects of farm inputs on production, it should be available to every farmer timely and in good quality and quantity.

- Socioeconomic factors particularly influenced farm performance. Education and agriculture skills along with training should create awareness and interest so that more educated people are involved in agriculture.
- Innovative machines should improve the management capabilities of the agricultural community and, thus, enhance technical efficiency and market participation, such as by designing and promoting infrastructure support; road, market, storage and warehouse, and transport facilities.
- Create off-farm employment and investment opportunity to help extremely inefficient farmers to start agro-related enterprises.
- Increase the size of the farm by bringing more land under cultivation Programs that encourage landowners to utilize waste lands should be introduced.
- Poor monitoring mechanisms was noted. To evaluate the impact of development schemes, advisory support systems, monitoring, and evaluation mechanisms can assist in reorganizing schemes to achieve desired goals.
- Credit and short-term loan have a significant impact on market participation, using the loan to convert traditional agriculture to modern commercial farming and hence market participation.
- Water channels need to be built near rivers, streams and aquifers to bring more area under irrigation.
- Improving the education system by incorporating agriculture and horticultural subjects in rural areas, making it more accessible to the general public, especially to those living in remote areas;
- Strategies need to be devised to equip farmers with marketing skills and opportunities so that their products can reach the market at a lower cost and faster. Proper storage and packaging facilities and transport mechanisms should be provided.
- Higher expected return encourage entrants to the market and greater volume sales for those capable of generating marketable surpluses. Farmers' access to market pricing systems and information is very important for enhancing agricultural sector economic output.
- Agricultural extension should be market oriented. Reorganize the agricultural extension system to meet the challenges of market, because extension agents are the ones who are in close contact with community they should be well equipped with update information about marketing and provide good training to improve their management skills under the changing environment.
- The crops are already under water stress, and a rise in temperature would increase the plants' water demand. As a result, increasing water storage capacity in the region is critical for ensuring agricultural production system sustainability and market participation.
- The study's findings also point to the notion that increasing production efficiencies increases market participation. As a result, greater infrastructure and farmer-friendly policies are required to remove input and output market inefficiencies, lowering production costs and making the sector more competitive.

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Table: 1 Socioeconomic Profile of Farmer Household Head

variables	Average	Variables	Average
Household head characteristics		Farm Characteristics	
Age (years)	49	Farm size *(kanal)*	21
Education (years)	9	Cultivated area*(kanal)*	15
Illiterate*(percent)*	1		
Below intermediate*(percent)*	69	*Source of irrigation*	
Above intermediate*(percent)*	30	Rainfed*(percent)*	76
		water pipes*(percent)*	8.9
Experience (years)	23	Directly from river and stream*(percent)*	2
family size*(no)*	9	main or secondary canal*(percent)*	10
dependency ratio*(percent)*	70	*Soil type*	
Tenure status		loam*(percent)*	66
owner*(percent)*	96	Clay *(percent)*	23
Owner cum tenant*(percent)*	3	Sandy loam *(percent)*	4.3
tenant*(percent)*	1	other*(percent)*	4.7
Farming in same area		*Soil fertility*	
Less than 20 years*(percent)*	27	Poor *(percent)*	21
More than 20 years*(percent)*	73	Good*(percent)*	20
member of union		average*(percent)*	58
Association*(percent)*	12	*Tube well*	
NGO *(percent)*	4	yes*(percent)*	97
Govt organizations*(percent)*	33	no*(percent)*	3
Nonmember*(percent)*	5	*Traction source for cultivation*	
Farm inputs		Tractor (percent)	50
Insect/weeicide(liter)	5	bullock*(percent)*	23
Fym (Trolley)	20	Both bullock and tractor*(percent)*	27
Dap (kg)	113	*Location*	
Urea(kg)	106	Near water course*(percent)*	22
Npk(kg)	107	No water course*(percent)*	78
Irrigation(numbers)	4.6		
Mandays(1 manday=8hours))	30.1		
Seed(kg)	14		

Table 2: Market Related Characteristics

Market related characteristics			
Value addition(percent)		*Distance of farm from road*	
Yes	58	at roadside	51
No	42	within 5 km	38
Process products		within 15 km or above	11
wheat flour	35.93	*Source of information*	
maize flour	48.19	agriculture extension services	75
dried fruit	0.39	farmer organizations	13
dried legumes/pulses	7.23	radio and television	4
spices/jams	2.67	neighbor farmers and relatives	8
Sauces	0.55	Credit facility	
oils/nuts	5.03	yes	25
Sale channels		no	75
At roadside(percent)	20	*Source of credit*	
At market(percent)	40	commercial banks	40
At farm(percent)	15	friends and relatives	45
To processor(percent)	4	Other private people	15
Farmer organization(percent)	2	*Market trainings*	
Exporter (percent)	4	yes	27
Govt organization(percent)	5	no	73
		Marketing experience(year)	10
Distance from nearest market			
Within 15 km (percent)	80.7		
between 15 to 30 km(percent)	14.3		
above 30 km(percent)	5		

Table 3: Household assets and facilities

Household assets and facilities	yes	partially	No
have concrete home	78	17	5
Road at village	83	12	5
Mobile and telephone	93	3	4
Radio	33	27	40
Newspaper	21	40	39
School	74	10	16
Television	73	9	17
electricity	93	3	4
Gas	11	30	59
Water supply from pipes	30	17	53
Ownership of transport	19	17	64
Internet	31	23	46
Laptop/comp	18	19	63
Fridge/refrigerator	60	10	30

Table 4: Stochastic Production Frontier estimation Results

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	9.08	0.19	47.23	< 2.2e-16	***
weedicide/insect (dummy variable)	0.07	0.03	2.23	0.03	*
FYM(trolleys)	0.14	0.02	6.58	0.00	***
NPK (nitrogen and phosphorous nutrients kg)	0.17	0.02	8.89	< 2.2e-16	***
Irrigation(numbers)	0.16	0.03	5.74	0.00	***
cultivated area(kanal)	0.53	0.03	15.83	< 2.2e-16	***
Seed(kg)	0.04	0.03	1.60	0.11	
Man days(for hired labour 1manday=8 hours)	0.20	0.04	5.31	0.00	***
Tractor (dummy)	0.30	0.07	4.13	0.00	***
district south (dummy)	0.66	0.08	8.52	< 2.2e-16	***
Sigma Sq	1.25	0.12	10.85	< 2.2e-16	***
gamma	0.51	0.08	6.24	0.00	***
log likelihood value	-1598.984				
mean efficiency	0.5845371				

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 5: The Maximum Likelihood Estimates for Cobb-Douglas Production Frontier including determinants for technical inefficiency

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	9.44	0.22	2.70	< 2.2e-16	***
weedicide/insecticide(dummy variable)	0.10	0.03	3.40	0.00	***
FYM(trolleys)	0.11	0.02	5.19	0.00	***
NPK (nitrogen and phosphorous nutrients kg)	0.16	0.02	8.31	< 2.2e-16	***
Irrigation(numbers)	0.16	0.03	6.08	0.00	***
cultivated area(kanal)	0.50	0.04	13.75	< 2.2e-16	***
Seed(kg)	0.019	0.026	0.74	0.45	
Man-days(1manday=8hours)	0.17	0.04	4.71	0.00	***
Tractor (dummy)	0.48	0.10	4.90	0.00	***
district south (dummy)	0.45	0.08	5.84	0.00	***
Z_(Intercept)	-0.37	1.05	-0.36	0.72	
Age(years)	0.001	0.01	-0.15	0.88	
Education(years)	0.11	0.06	1.90	0.06	.
farm size(kanal)	-0.02	0.01	-1.97	0.05	*
Irrigation(dummy)	0.19	0.11	1.76	0.08	.
land fragmentation(numbers of parcels)	-0.89	0.52	-1.70	0.09	.
traction power(dummy)	-0.70	0.36	-1.93	0.05	.
sigmaSq	2.12	0.85	2.50	0.01	*
Gamma	0.76	0.09	8.27	< 2.2e-16	***
log likelihood value	-1553.383				

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 6: Efficiency Estimates Distribution Using CD -SFA Model

TE Range	Percent of Farms
<50	21
50-60	32
60-70	30
70-80	15
80-90	2
90-100	0
Total	100

Table 7: Market Participation Distribution

MP Range	Percent of Farms
0	20
0.01-0.10	5
0.10-0.20	13
0.20-0.30	12
0.30-0.50	17
0.50-0.70	17
0.70-1	16
Total	100

Table 8: Analysis of Market Participation Determinants (Tobit Model)

	Estimate	Std. error	t value	Pr(> t)	
(Intercept)	-0.69	0.06	-11.32	< 2e-16	***
Credit(dummy)	0.04	0.02	1.85	0.06	.
Training(dummy)	0.12	0.02	5.65	0.00	***
technical efficiency index	1.39	0.08	16.80	< 2e-16	***
distance from road(within 5 km)	0.08	0.02	4.29	0.00	***
processing	-0.05	0.02	-2.34	0.02	*
distance from market(within 15-30km)	0.11	0.02	4.77	0.00	***
marketing experience(years)	0.01	0.00	6.18	0.00	***
Refrigerator(dummy)	0.06	0.02	2.91	0.00	**
Internet(dummy)	0.04	0.02	1.90	0.06	.
Family size(number)	-0.01	0.00	-3.17	0.00	**
logSigma	-1.21	0.02	-51.16	< 2e-16	***
log.likihood	-405.00				

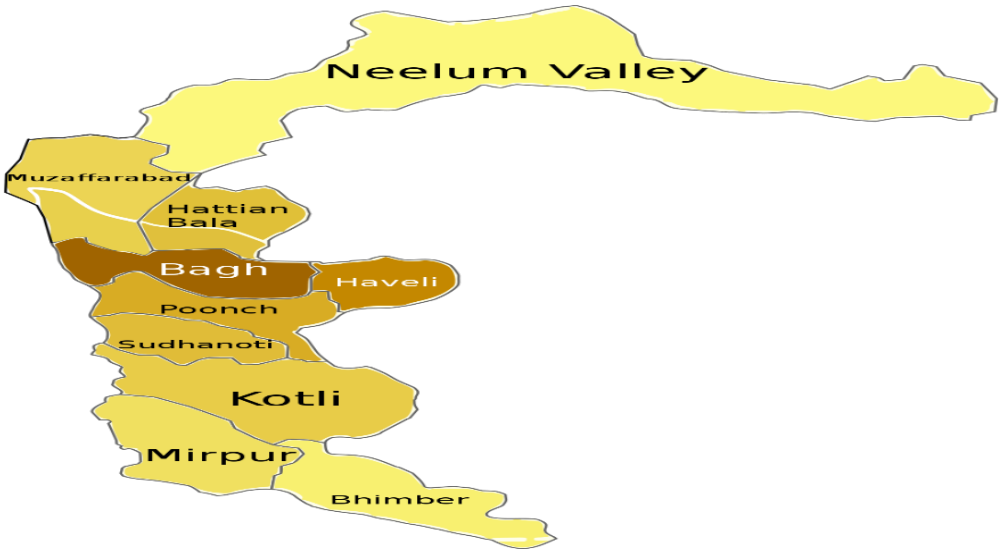
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

ANNEXURES

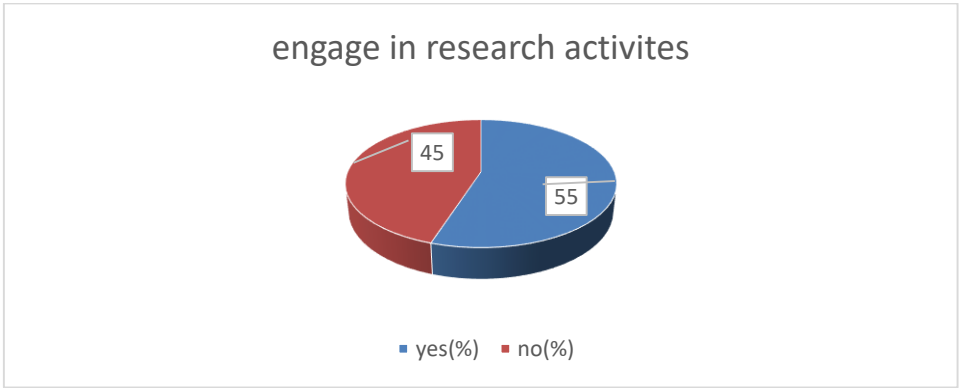
Annexure A Name of Villages Selected from Each District

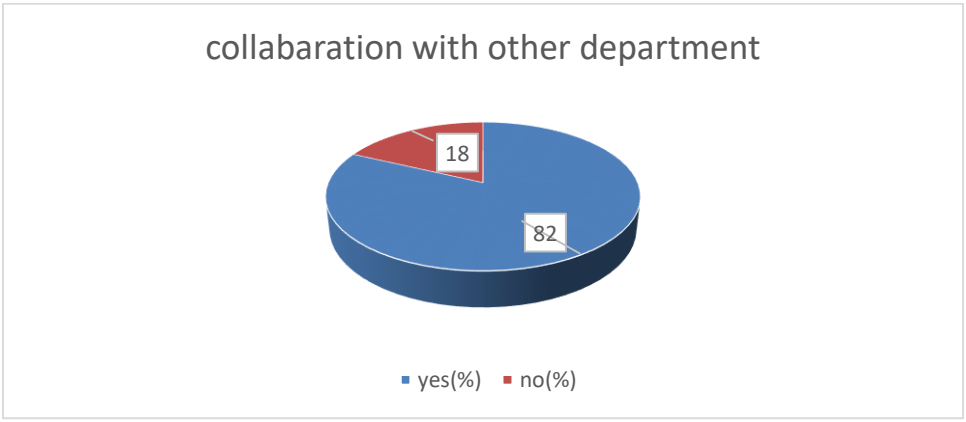
s.no	district	Tehsil	union counsil(villages)
1	Muzaffarabad	Muzaffarabad	hattian dopata
			dana
		Nasirabad	Noora Seri
			Kahori
2	Hatian Bala	Hatian Bala	Gujar Bandi
			Chak Hama
		Leepa	Bana Mula
			Nokot
3	Neelum	Authmaqam	Authmaqam
			Neelum
		Sharda	Guraiz
			Kail
4	Bagh	Bagh	Dharay
			Thub
		Dhirkot	Chamiati
			Dhirkot
5	Havelli	Kahuta	Kalali
			Digwar
		Mumtazabad	Badhal
			Sangle
6	Poonch	Rawalakot	Dhamni
			Town Area
		Thorarr	Tain
			Thorarr
7	Sudhnoti	Plandri	Baral
			Jhanda Baglah
		Trar Khal	Narian
			Pappay Nar
8	kotli	Khui Ratta	Khooie Rata
			Khorr
		Sahnsa	Sehar Mandi
			Kathar
9	Mirpur	Mirpur	Novagran
			Mirpur M/C
		Dadyal	Khathar
			Anker Khadimabad
10	Bhimber	Samani	samani
			Chowki
		Barnala	Iftikharabad Janoobi
			Barnala

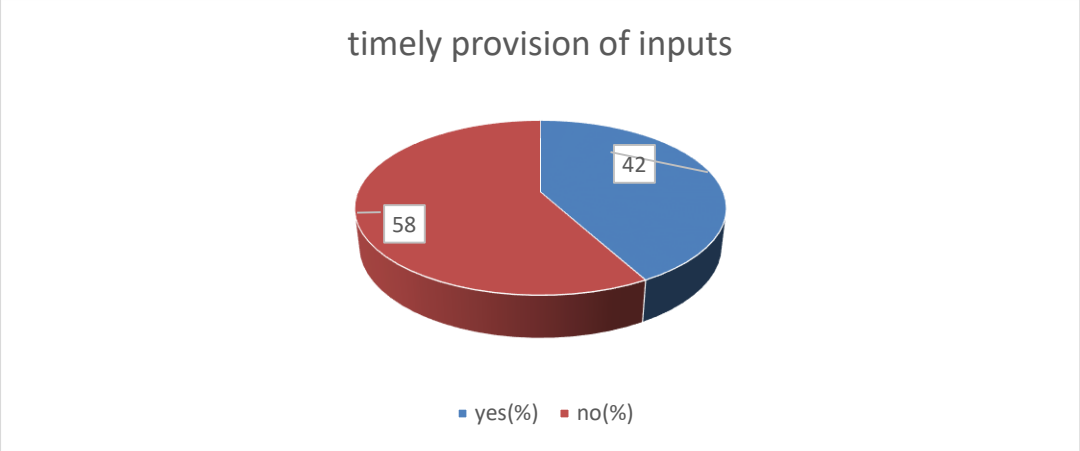
Figure-1: Map of Sampled Districts

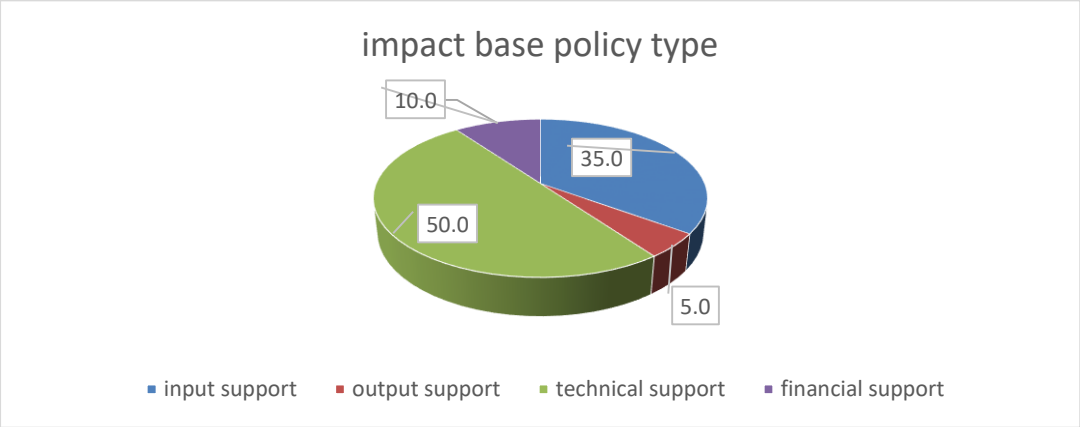


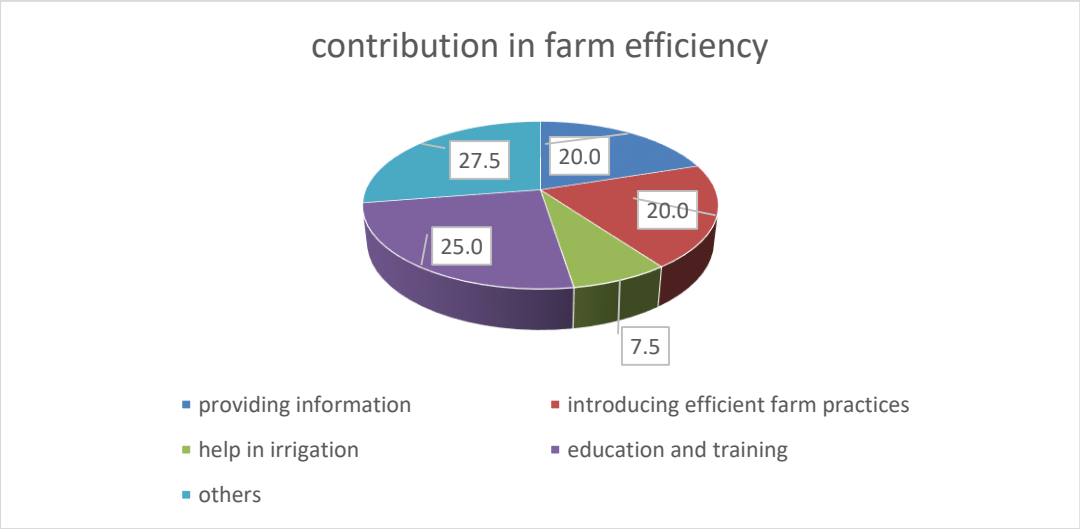
Annexure B Response Charts

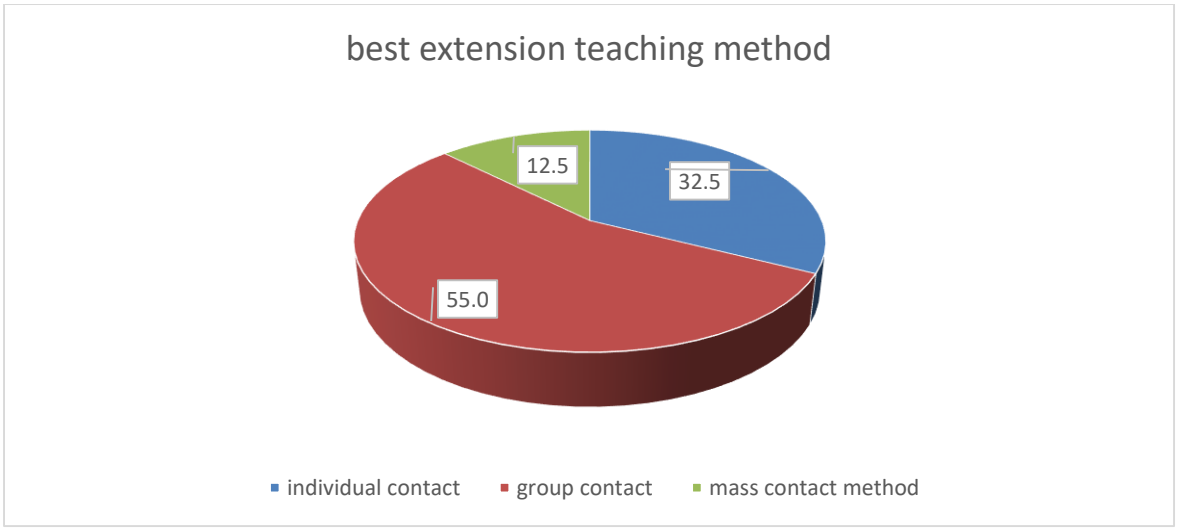


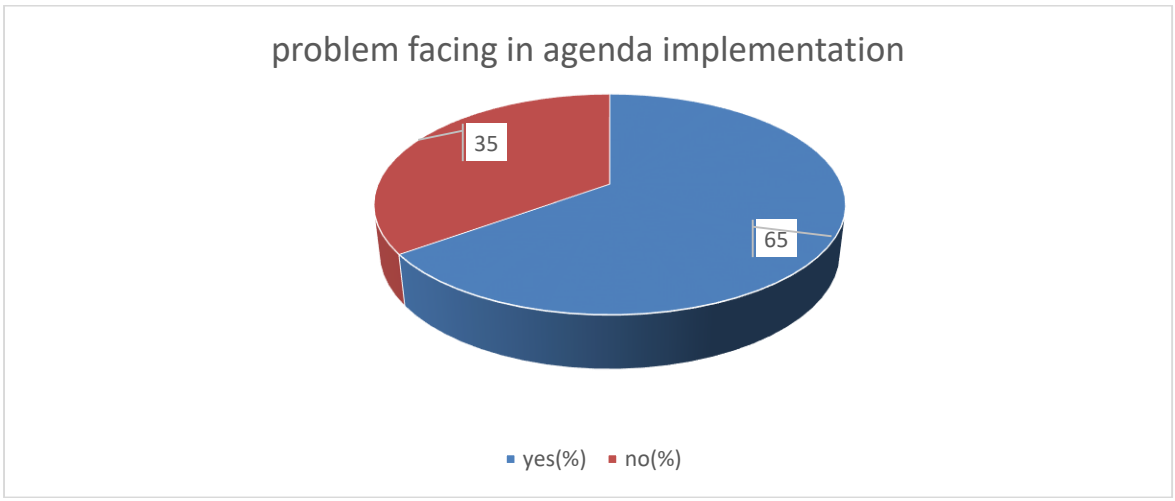


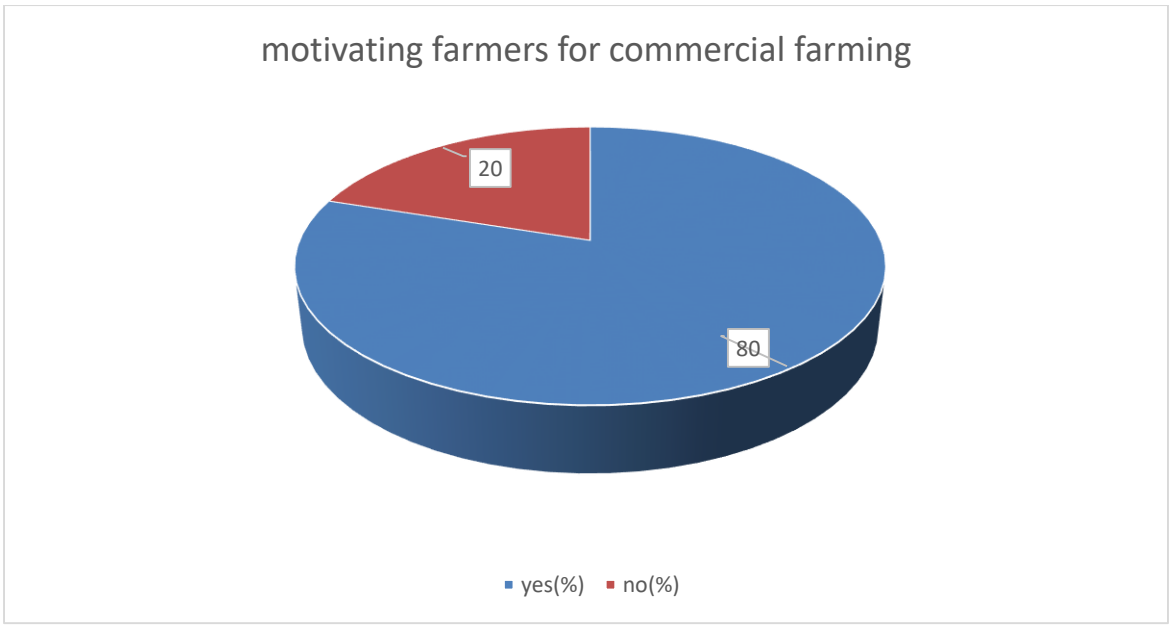

timely provision of inputs
42
58
yes(%)
no(%)

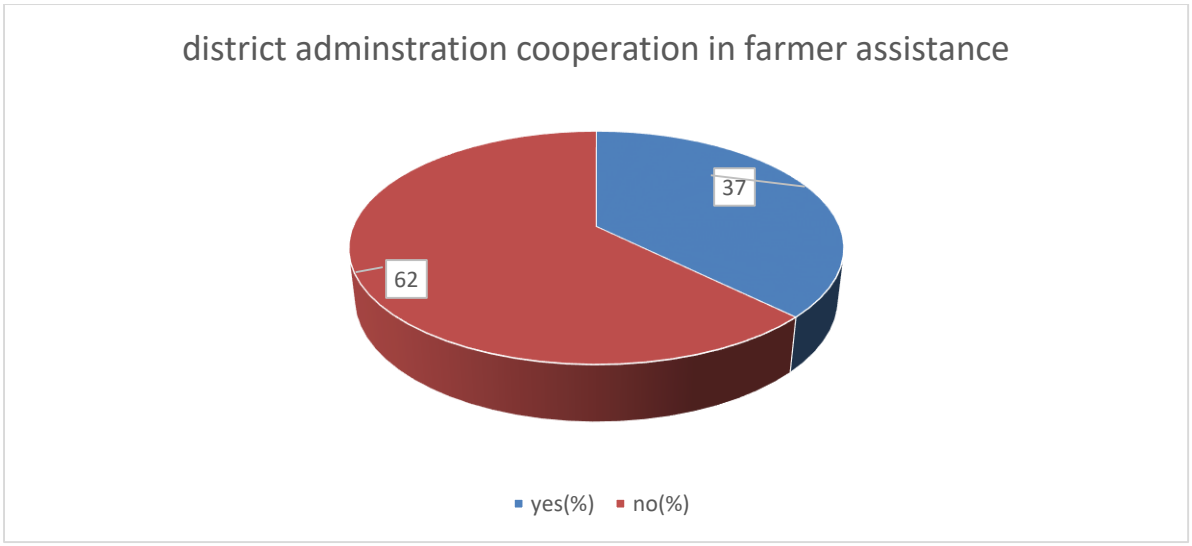

impact base policy type
10.0
35.0
50.0
5.0
input support
output support
technical support
financial support

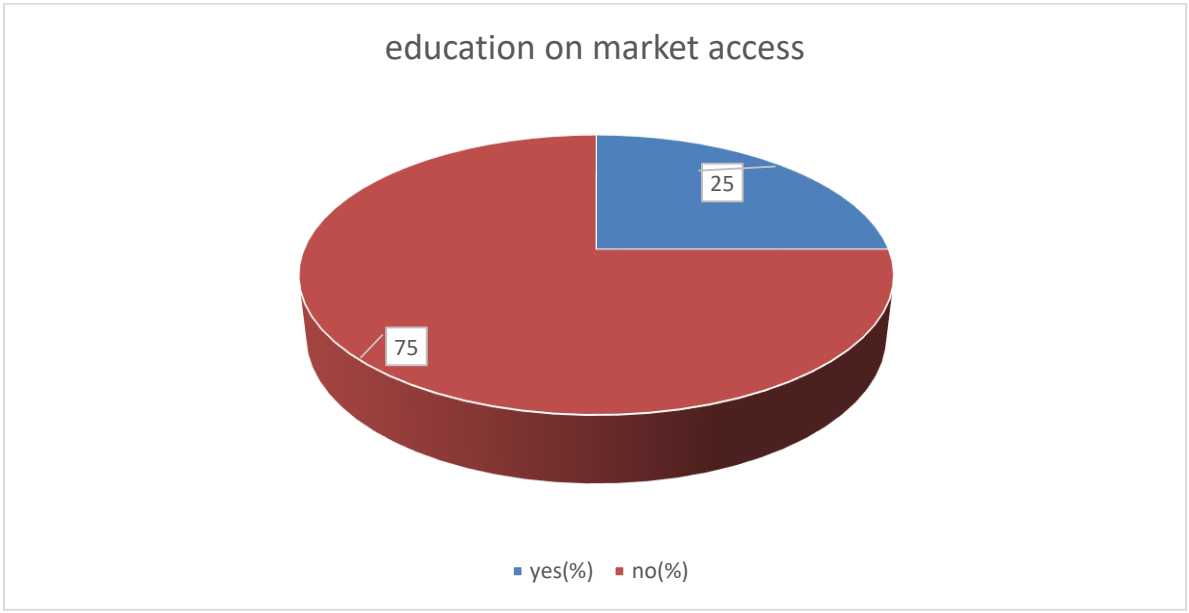

contribution in farm efficiency
27.5
20.0
20.0
25.0
7.5
providing information
introducing efficient farm practices
help in irrigation
education and training
others

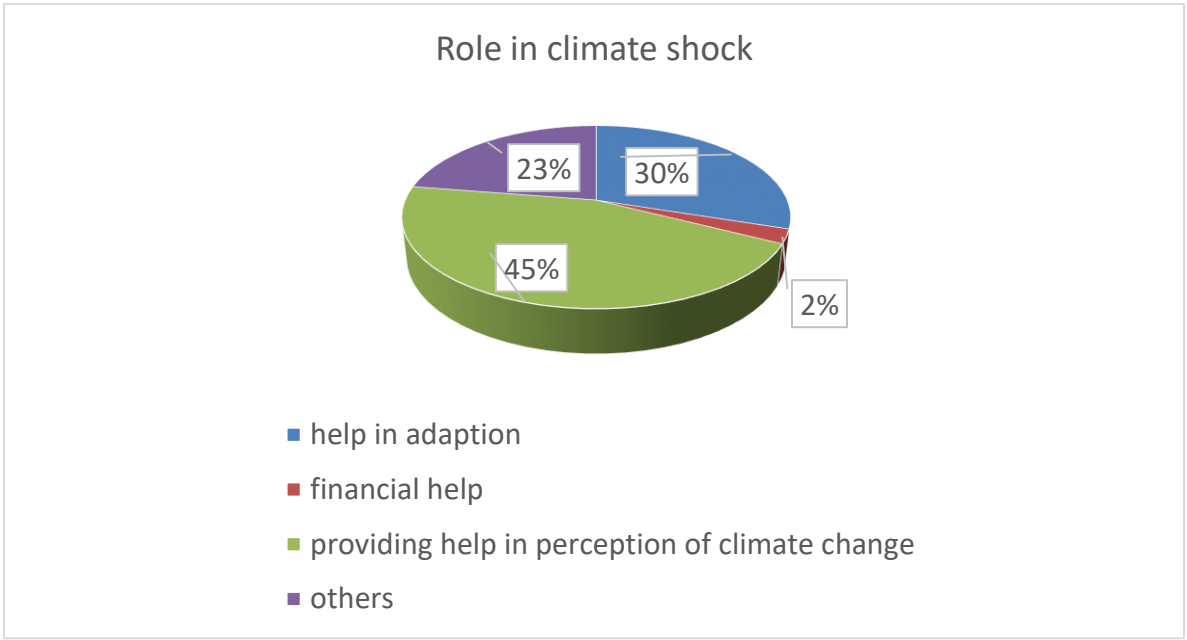

best extension teaching method
12.5
32.5
55.0
individual contact
group contact
mass contact method


problem facing in agenda implementation
35
65
yes(%)
no(%)


motivating farmers for commercial farming
20
80
yes(%)
no(%)


district adminstration cooperation in farmer assistance
37
62
yes(%)
no(%)


education on market access
25
75
yes(%)
no(%)


Role in climate shock
23%
30%
45%
2%
help in adaption
financial help
providing help in perception of climate change
others