

Farmers' Attitudes Towards Crop Insurance under Climate Change Threats

Daniyal Storay¹, Sajjad Khan² and Hasan Ali³

Article History:

Received Date:

14th September

Revised Date:

30th October 2024

Accepted Date:

29th November 2024

Published:

2nd December 2024

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Abstract

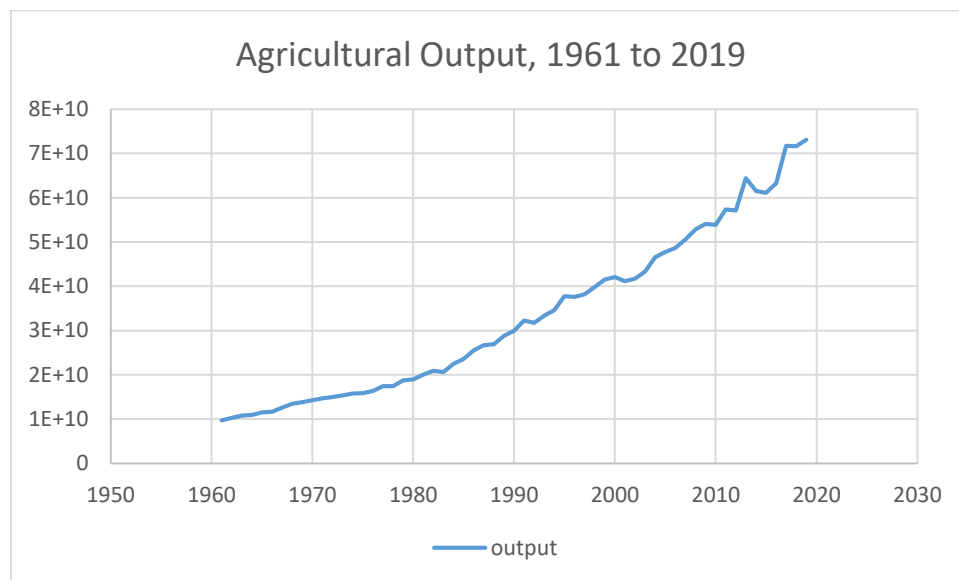
This study examines Farmers' Attitudes towards Crop Insurance under Climate Change Threats. The question under study is: what factors influence farmers' willingness to pay for crop insurance? To accomplish the task, we collected primary data from 44 farmers through a questionnaire and face-to-face interviews using the contingent valuation method. The data for the research has been collected from 44 farmers of Tehsil Tangi, District Charsadda. The data collected through questionnaires was done through Statistical Package for the Social Sciences (SPSS). Descriptive analysis of the data revealed that a large number of farmers were unfamiliar about the crop insurance concept. Furthermore, it has been found that the income level of households is the main factor that influences farmers' willingness to pay for crop insurance programs. And most of the farmers are unaware of crop insurance programs. Based on the findings of the research, it is recommended that policymakers first raise awareness among farmers about crop insurance programs and then adapt programs to increase insurance adoption and effectiveness.

Key Words: Crop Insurances, Climate Risk, Climate Change, Farmer Preferences, Awareness



1. INTRODUCTION

Agriculture is essential to the economy of Pakistan, serving as the backbone of the nation's Economy. With agriculture being the second-largest sector in Pakistan, a significant portion of the population's livelihood is directly or indirectly dependent on it (Zahid et al., 2007). This contribution is vital as it ensures poverty alleviation, food security, and overall economic stability (Hussain et al., 2015). Most of the people in Pakistan rely on agriculture and Agricultural goods are also exported to international countries, which contribute to the Gross Domestic Product (GDP) of Pakistan's economy. It also helps to control food inflation.



Source: United States Department for Agricultural (USDA) Economic Research Service

Figure 1 Agricultural Output in Pakistan (1961-2019)

In 2010–11, agriculture made up 21% of Pakistan's GDP, but its importance goes beyond just money. Nearly half of the workforce, about 43%, was in agriculture during that time (Government of Pakistan, 2012-13). The agriculture sector of Pakistan contributes 22.9 % towards national GDP and the agriculture sector of Pakistan generates 37.4% employment (GOP, 2022).

Khyber Pakhtunkhwa (KPK) is a province in northwest Pakistan bordered by Afghanistan and known for its hilly topography and rich valleys. The region supports a wide range of agricultural



operations, with main crops including wheat, maize, and other fruits including apples and pomegranates. Potatoes are an important vegetable, as are cash crops like tobacco and sugarcane. Despite its agricultural potential, KPK has issues such as water scarcity and land degradation, all of which have an influence on production and sustainability.

Pakistan mostly produces wheat, cotton, maize, sugarcane, rice, tobacco, Bajra, and a variety of vegetables. The Pakistan Economic Survey 2022–2023 shows that 27,634 kg/Ha of wheat were produced on 9,043 thousand acres 390 kg/Ha of cotton were produced on 2,144 acres, 390 kg/ha, sugarcane was cultivated on 91111 acres and produced yield of 69085 kg/Ha. Rice was cultivated on 2976 acres and produced yield of 2460 kg/Ha, Mize was cultivated on 1720 acres and produced a yield of 5922 kg/Ha, compared to last year the production of tobacco and Bajra increased by 0.1 percent, and 13.3 percent respectively.

Most of the agricultural activities in Pakistan are linked to rural areas. The challenges they face are lack of poor harvest infrastructure, unavailability of electricity, scarcity of capital, lack of proper education, poor handling and lack of proper transportation. Due to these reasons, households lost a significant amount of crops. (Khan et al., 2019).

Many farmers suffer due to a lack of information about the existence and benefits of crop insurance policies. These risks include a great number of natural disasters, pests or disease epidemics. This may mean significant amounts lost in money terms by these parties since they might not have money needed to recover from such tragic scenarios. Enhancing farmers' understanding of crop insurance necessitates a multifaceted strategy that engages them across various platforms. Employing educational campaigns that utilize radio, television, social media, and print media can effectively convey the advantages of crop insurance and present real-life success stories to illustrate its operation.(Ghazanfar et al., 2015)

According to the Pakistan Economic Survey 2022–23, Pakistan's agriculture sector suffered the most losses and damages of any sector. One million livestock were lost, and over 4.4 million acres of crops were damaged due to monsoon rains followed by flooding. Thirty-one billion dollars was the overall amount of damages and losses, of which US\$12.9 billion (or 43%) went to agriculture.



Of the overall damage and losses, the agricultural subsector accounted for 82%, livestock for 7%, and fisheries and aquaculture for 1%. US\$ 4 billion, or 25%, of the US\$16 billion needed for recovery and reconstruction was needed for the agricultural sector.

Crop insurance programs are present across many countries such as United States, China (People's Insurance Company (Group) of China Limited) and India (Agriculture Insurance Firm of India Limited). In the United States, the Federal Crop Insurance Program provides federal crop insurance coverage to farmers against losses resulting from natural disasters such as drought, floods, hurricanes, other risks associated with weather. Indemnity payments to farmers to make up for a fraction of their losses and recover their assets and farm on when they have suffered a loss. (Pai, 2010).

Government institutions in Pakistan offer a number of crop insurance programs to protect farmers against losses caused by disease, pests, and extreme weather, Zarai Taraqi Bank Limited, Adamjee Insurance Company Limited and the National Insurance Company limited. The National Insurance Company Limited, covers subsistence farmers' premiums for the five main crops wheat, cotton, sugarcane, rice, and maize.

In Khyber Pakhtunkhwa Jazz company offers a crop insurance program under the name Crop Parametric Takaful which offers crop insurance programs to farmers that protect them from crop losses. This study will contribute in terms of whether such programs are viable in Khyber Pakhtunkhwa or not. This research will be beneficial for insurance companies offering crop insurance by providing valuable insights into the demand for crop insurance among farmers, the type of coverage and policies that farmers prefer, the perceived value of crop insurance in managing climate-related risks. Our study will be beneficial for farmers by providing insights into the value of crop insurance in managing climate-related risks, Identifying their specific needs and concerns regarding crop insurance also enhancing their resilience and ability to recover from natural disasters.

2. LITERATURE REVIEW



Many studies have investigated the impact of insurance on the farming sector in the past. Ali et al., (2020) examined how much farmers are willing to pay for weather Index based insurance in a semi-subsistence farming setting using data from northern Togo. The farmer's willingness to pay was measured through the Choice Modeling approach (CMA). The authors considered farm size, age, liquid assets of the households, no formal education, primary education, supply weather information, access to loan, access to drought-tolerant seeds, premium (per hectare) which influencing farmers willingness to pay and found that farm size, education positively influence former's willingness to pay whereas farmers' enrollment in the weather index base is negatively correlated with age. It was discovered that farmers with only a primary school education were less likely to sign up for weather index-based insurance. Working in the same line, Fahad et al. (2018) conducted a household survey to determine Pakistani farmers' willingness to pay insurance premiums. Primary data was collected from 600 farmers in four flood-prone districts of Khyber Pakhtunkhwa province, Pakistan: Charsadda, Peshawar, Mardan, and Nowshera. The authors employed the contingent valuation method to determine farmers' willingness to pay. The authors consider crop damage, distance of form land from Major River, the form land height, level of commercialization, income sources besides agricultural income and annual crop production as major factors which influence the farmers' Willingness to pay (WTP) for Insurance premiums and found that WTP has a positive correlation with annual crop production, level of commercialization and the flood damages incurred by farmers, while a negative relationship exists between the form land height and distance of form land from major river. However, income sources besides agricultural income have no impact on farmer willingness to pay for crop insurance.

Many studies have evaluated the effect of crop insurance on income distribution and satisfaction level. Knapp et al. (2021) examined the connections between the use of crop insurance and seven different forms of income diversification. To determine what factors affect crop insurance, the authors look at the Shannon Diversity Index, processing and direct selling, agrotourism, financial reserve generation, forestry work, off-farm investment, and share of off-farm income. While forestry labour and off-form income were shown to be negatively linked with insurance uptake, the Shannon Diversity Index, processing, and direct marketing were found to be positively associated with it. Agrotourism, financial reserves, and off-farm investment, however, had little effect on the adoption of insurance. Shirsath et al. (2019) researched a new technique for contract



design for weather-based insurance and presented the 'Farmer Satisfaction Index' as a potent evaluation tool for estimating the effectiveness of insurance products by measuring basis risk. District stations provided the climate time series and crop yield data. The percentage of premiums, the claims ratio, and the satisfaction index were considered while designing contracts for weather-related insurance discovered that lowering the total amount insured and the farmer's share of the premium would make it more appealing to farmer cooperatives. It also found that improving the correlation between payouts and yield loss and the risk associated with production smoothing by cutting down on wasteful payouts to farmers and increasing overall financing to the insurance business

Afriyie et al. (2020) developed weather index-based insurance for coca, an example of a perennial crop. For this purpose, the authors gathered household-level survey data from 313 randomly selected households in 20 communities. The study was done in the Dormaa West district (DWD) of the Brong Ahafo region and the BIA East district (BED) of the Western region of Ghana. The authors include assessments of extension services, oldest (age), ownership, coca-income share, household size, and gender as important factors influencing weather index-based insurance for Coca crop. It was discovered that the factors extension and ownership have a favorable influence on coca farmers' willingness to purchase insurance, but the variables oldest and coca-income share had a negative affect on coca farmers' interest in purchasing insurance. However, the authors employ household size and gender as control factors.

Möhring et al. (2020) examined the relationship between pesticide use in European agriculture and crop insurance. Between 2009 and 2015, the panel data sets for France and Switzerland were examined by the writers. The intricate relationship between farmers' decisions about land use, pesticide usage, and insurance uptake is taken into consideration by the authors' conceptual and empirical framework, which may lead to links between insurance and pesticide use at the intensive and wide margins. The average yearly temperature, education level, land use in cropland, and use in grassland categories are all examined by the authors in their investigation of the relationship between crop insurance and pesticide use in agriculture. Pesticide costs per hectare decrease with an increase in "grassland" (keeping "crop land" constant), but pesticide costs per hectare rise with



an increase in "cropland" (keeping "grassland" constant) (only significant in France). The use of pesticides is negatively correlated with temperature and education level.

On the other hand, Tok et al., (2023) investigate factors that influence farmers' decisions to buy crop insurance and outline their perspectives on the product.. For this purpose authors collected data from 121 farmers through face to face surveys, the study was conducted from October to November 2019 in the Akhisar district (western Turkey). Farmer willingness to pay was measured for crop insurance was measured by Binary logit model The size of the olive farming land (SOFL), farmers' record-keeping (FRK), and membership in a farmers' cooperative (MFC) were found to be important factors in farmers' decisions to purchase agriculture insurance. However There was no effect of age, education (ED), persons in the household who worked in agriculture (IHWA), olive farming experience (OFE), or nonagricultural income (NAI) on the probability that a farmer would purchase agricultural insurance.

Jørgensen et al. (2020) explored the use of insurance as a climate change adaptation strategy in agriculture. In 2013, a national representative survey of Danish farmers was carried out to achieve this purpose. ASPECTO administered the poll, and its farmers' panel consisted of around 5,000 members. The authors take a Denmark as a case study. A choice experiment is used to reveal Danish farmers' preferences (The Danish Agricultural Agency) regarding an insurance contract. The authors inspect Reduction in tilled area, Status quo, Soil type, Arable, Pigs, Premium, factors affecting the likelihood of insurance uptake. Concluded that lower the soil quality of land in which farmers operates, the higher the utility farmers get from an insurance contract while reduction in tilled area, insurance premium, pigs farmers, status quo is negatively influencing farmers likelihood of insurance uptake. However farmers who do not expect that the future climate will lead to significant impacts will be less likely to purchase insurance.

Peng et al., (2021) examined the effects of risk perception and disaster shock on farmers' inclination to buy insurance. Because of this, information was gathered from 328 farmers in the Shandong province in East China. The impact of disaster shocks and risk perception on farmers'



inclination to purchase insurance was evaluated using cluster analysis, analysis of variance, hierarchical linear model, and structural equation model in this research. The authors examined a number of factors, including education, income, gender, disaster shock, and risk perception, to determine how willing farmers were to purchase insurance. They discovered that, while gender had no discernible effect, education, income, disaster shock, and risk perception all positively impacted farmers' willingness to purchase insurance.

Okoffo et al. (2016) investigated the factors that influence coca farmers' willingness to pay for crop insurance schemes, as well as the readiness of insurance companies to provide crop insurance to coca farmers. Data were collected from 240 farmers from four communities in the Dormaa West District of the Brong-Ahafo Region. Farmers' willingness to pay was measured using a double-hurdle model. Age, gender, marital status, education, household size, cropped area, cocoa income, and income from other sources were found to be the factors that most positively influenced cocoa farmers' willingness to pay for farm insurance. On the other hand, household size and cropped area had a negative impact. These findings are discussed by the authors in their analysis of the factors that influence cocoa farmers' willingness to pay for farm insurance. Similarly, cocoa income and marital status had a negative impact on the premium that farmers were willing to pay, whereas age, household size, and cultivated area all had a significant and favorable affect.

Ghosh et al. (2021) evaluated the effect on freshwater withdrawals for irrigation in US counties west of the 100th meridian of the federal crop insurance premium subsidy. Data from the USGS National Water Information System, which was monitored throughout the western United States every five years, was provided to us for the years 1985–2015. An intuitive conceptual framework for examining several processes through which crop insurance premium subsidies may influence freshwater withdrawals for irrigation. The authors identify three crucial components in the relationship between crop insurance subsidies and freshwater withdrawals for irrigation: crop acreage, total freshwater withdrawals, and fresh surface water withdrawals. Subsidies for crop insurance premiums were found to have a positive effect on surface and total water withdrawals for irrigation; crop insurance, however, had essentially no effect on crop acreage. The authors find



that premium subsidies under revenue insurance are more sensitive to freshwater withdrawals for irrigation than yield insurance is.

Sibiko and Qaim (2020) explored the factors that influence weather index insurance uptake, as well as the consequences that weather index insurance has on input utilization and crop productivity. In mid-2014, 386 Kenya farmers provided primary data through face-to-face interviews with household heads. Regression models using instrumental variables are used to investigate weather index insurance adoption and its impact on input utilization and agricultural productivity. The authors examined characteristics impacting farmers' willingness to pay for weather index insurance, including age, risk aversion, farm size, asset ownership, share of off-farm income, agriculture extension, chemical fertilizer, and enhanced seed. Farmers' age (older), farm size, other asset ownership, chemical fertilizer, and improved seed all had a favorable effect on insurance uptake, whereas risk aversion, agricultural extension, and percentage of off-farm income had a negative effect on weather index insurance uptake.

Arshad et al. (2016) examined the socio-economic and technological factors influencing farmers' willingness to pay premiums for flood and drought insurance schemes. It will also look into the potential range of premiums that farmers are ready to pay for flood and drought insurance separately. During October 2012 and January 2013, data were collected from eight districts in Pakistan, one from each of the eight agro-climatic zones. A primary data set of 240 farm households was obtained. The data was collected through face-to-face interviews. Farmers' willingness to pay was assessed using the double bounded dichotomous contingent valuation method. The researchers analyze bid premium, farm income, and off-farm income. Age and education. Family size, land ownership, availability to credit, and access to extension services are all factors that influence farmers' willingness to pay for flood insurance, as well as farm revenue. Family size, landownership, and access to a credit facility are favorably associated with demand for flood insurance, while age, education bid premium, and access to extension services have a negative affect on demand for crop insurance against flooding. However, off-farm income has had no substantial impact on flood insurance demand. Drought insurance premiums are



minimal, and farm revenue Land ownership and family size increased willingness to pay for drought insurance, whereas availability to canal irrigation decreased interest in crop insurance.

According to King & Singh's (2020) investigation into the factors behind the low demand, farmers consistently undervalue agricultural index insurance. The authors employed the 2008, 2010, 2012, 2014, and 2016 Viet Nam Access to Resources Household Survey (VARHS) data set for this purpose. Vietnamese families from twelve provinces make up the data set for the Viet Nam Access to Resources Household Survey. Former's willingness to pay and risk premium are assessed using the Constant Relative Risk Aversion (CRRA) utility function. The authors examined factors influencing farmers' willingness to pay for agriculture insurance, including education, membership of a farmer's union, riskiness, and income. They discovered that education, membership of a farmer's union, and riskiness are positively related to willingness to pay, while private transfers from non-household-based family members are negatively related. Income did not affect farmer willingness to pay for agriculture insurance.

Wang et al. (2020) investigated farmer preferences for several forms of crop insurance. For this purpose, the authors conducted a household survey in November 2017 in China's Liaoning province. Choice experiments were used to test farmers' willingness to pay. Farmers' age, gender, education, and insurance experiences are examined as factors influencing farmers' willingness to pay for insurance. The authors discovered that farmers' age, gender, and education level play a minor role in farmers' willingness to pay for crop insurance, whereas farmers' positive insurance experiences in the past are positively correlated with farmers' willingness to pay for crop insurance.

Similarly, Farzaneh et al., (2017) investigated farmers' stated preferences and willingness to pay for silkworm insurance, filling a knowledge gap in farmers' behavior towards insurance adoption. For this purpose, the authors collected data from 376 farmers. The study was carried out with silk farmers in the Guilan Province of northern Iran. The farmer's willingness to pay was measured by logistic regression model. The author's considered Income in the previous year, Income from sources other than silk farming, Distance from insurance office as influence factor of willingness to pay for crop insurance and found that distance from insurance affiliate, income from sources



other than silk farming, and silk farmers' income in the previous year had a significant impact on insurance adoption while income from sources other than silk farming had a negative impact on insurance adoption.

In conclusion, the reviewed literature underscores the complexity and multifaceted nature of farmers' willingness to pay for agricultural insurance. Factors such as income level, land ownership, education, and previous experience with insurance significantly influence farmers' decisions to adopt insurance products. Additionally, regional differences and specific crop characteristics play crucial roles in shaping these decisions understanding these determinants is vital for designing effective insurance schemes that cater to the needs of farmers and enhance their resilience against climatic and economic shocks. Future research should focus on addressing the identified gaps and exploring innovative insurance solutions tailored to the diverse needs of farming communities worldwide.

3. DATA AND METHODOLOGY

3.1 Data and Variables

The data for the research has been collected from 44 farmers of Tehsil Tangi, District Charsadda. For data collection, a purposively constructed closed ended questionnaire was used. In our investigation, we shall use the contingent valuation approach. This strategy involves directly asking families about their willingness to pay for a crop insurance program. The contingent valuation method is a popular survey-based strategy for determining the non-market worth of products and services, especially in environmental situations. It helps in calculating the monetary value of environmental resources and benefits that are not sold in typical marketplaces (Arrow et al.1993; Bateman et al.1999; Mitchell and Carson, 1989). The main parts of the questionnaire are discussed below. Detailed questionnaire is available in Appendices.

Our variables are gender, age, education, residence, marital status and parents' education as family size and composition, occupations, income and expenditure socio-economic status of a farmers

3.2 Sampling



The data was gathered from 44 farmers using a non-probability sampling technique. Respondents were chosen based on their proximity, availability, and willingness to take part in the survey. Although generalizability is weakened in nonprobability samples, it is the easiest and quickest technique to collect data.

We used the Statistical Package for Social Sciences (SPSS) to examine the data. Specifically, the study utilized frequencies, percentages, and descriptive statistics to summarize the data.

4. RESULTS AND DISCUSSION

Quantitative data are summarized using descriptive statistics, frequencies and graphs. The results are discussed in the context of existing literature, highlighting the implications of the findings. Figure 4.2 shows some basic features of the respondents. According to the statistics griped in panel (a), 26 of the respondents (59.1%) were married, while 18 (40.9%) being unmarried. Furthermore, panel (b) and (c), respectively sheds light on the educational backgrounds of the respondents' mother and father, panel (b) reveals that just only 6 (13.6%) of respondents' mothers were educated, while panel (c) shows that 19 (43.2%) of respondents' father was educated. Likewise 29 (65.9%) respondents revealed that their father was also farmer while 15 (34.1%) reported their father as pursuing other jobs.



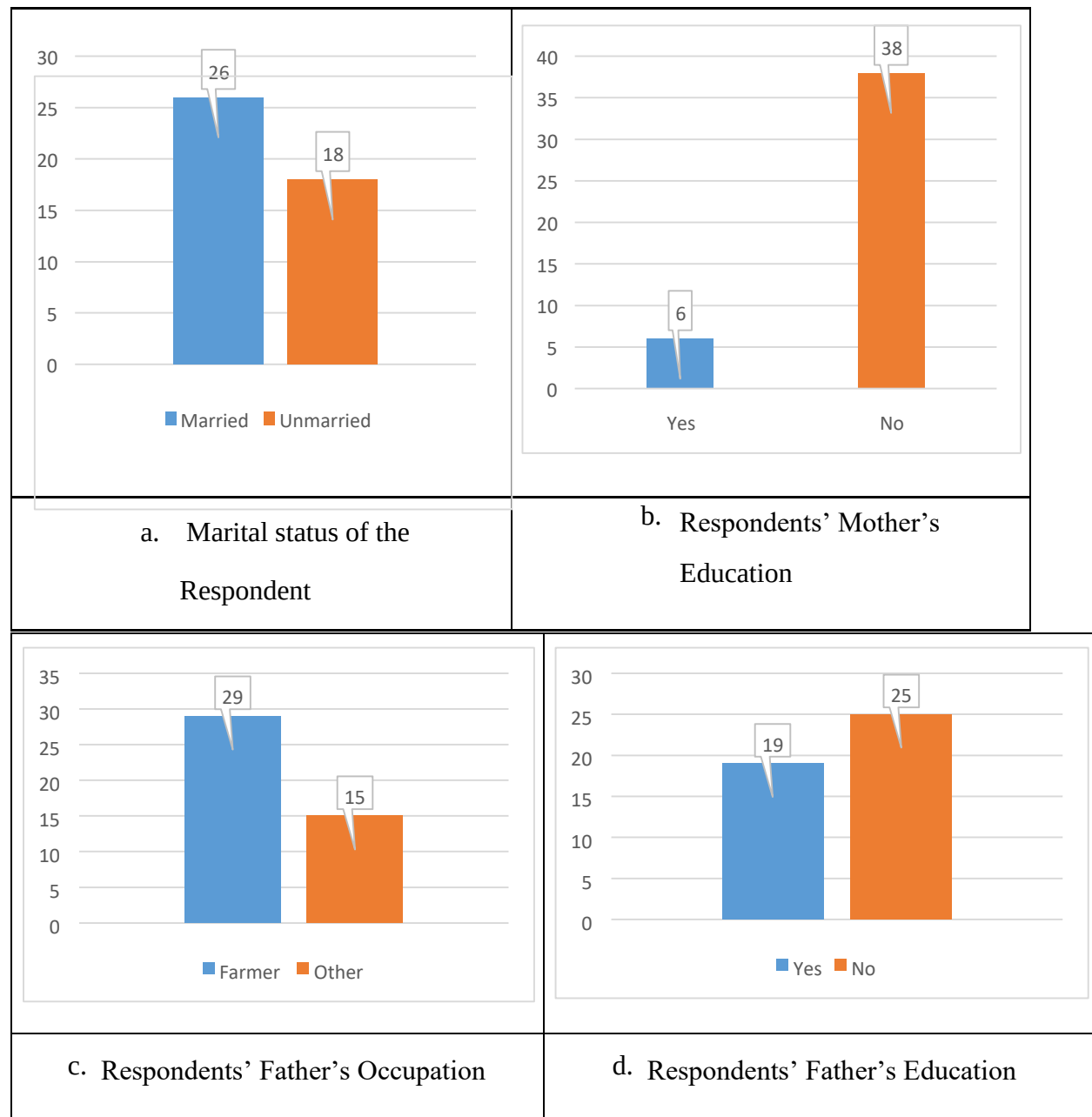


Figure 4.2 Information about the Respondents

Table 4.3 shows the key features of the respondents. According to the statistics, respondents' ages ranged from 20 to 70 years. Furthermore, the respondents' average age was 35.38, with a standard deviation of 14.507. The data also shows that the respondents' minimum and highest education levels were 0 and 18 years, respectively. The average education level of the respondents is 11.16,

with a standard deviation of 5.434. Furthermore, the table shows the average age of the household, with a minimum of 14 and a maximum of 42.

Table 4. 3: Household's Socioeconomic & Demographic Characteristics

Variables	Minimum	Maximum	Mean	Std-Dev
Age of the respondent	20	70	35.38	14.51
Education of the Respondent	0	18	11.16	5.43
Household's Average Age	14	42	26.68	6.62
Average Education	1	12	7.55	2.38
Household's Male Female Ratio	0	4	1.27	0.69
Household Members Involve in Farming	1	6	3.30	1.30
Household's Per Capita Income	2857	57143	11804.68	12974.43
Household's Per Capita Consumption	2143	54286	10545.73	10352.62

The average age of the households was 26.68, with a standard deviation of 6.622. The table also shows the average education level of the family. The least average education is one year, and the maximum average education of the family is twelve years. The Mean education of the family is 26.68, with a standard deviation of 6.22. The table also shows the fundamental features of the respondents. The statistics show that the household's minimal male-female ratio is 0, while the maximum is 4. The mean male-female ratio in the family is 1.27, with a standard deviation of 0.694. Furthermore, the data shows that the smallest number of family members working in farming is one, while the highest is six. The average number of family members engaged in farming is 3.3, with a standard deviation of 1.304. In addition, the table shows the household's per capita income. The households reported a minimum per capita income of 2857 and a maximum of 57143. The average per capita income of the family is 11804.68, with a standard deviation 12974.426. Additionally, the table highlights the household's per capita consumption. The least per capita consumption is 2143, while the greatest consumption is 54286. The household's average per capita income is 10545.73, with a standard deviation of 10352.617. Similarly, the table includes information about the respondents' neighborhood income. The stated minimum neighborhood income was \$30,000, with a maximum of \$200,000. The average neighborhood income among respondents was 69318.18, with a standard deviation of 37518.847.



Table 4.4 presents a summary of respondents' perceptions of household conditions and socioeconomic status. There is a discernible trend in terms of food security: a significant proportion of respondents report periodically going without required food due to resource restrictions (75%), and a significant number admit to relying on a narrow selection of reasonably priced food (75%). Furthermore, the statistics show that monetary constraints influence food selection, with a substantial majority (70.5%) agreeing that, while eating a balanced diet is good to health, price remains a barrier.

Housing conditions appear to be generally satisfactory, since the majority of respondents (86.4%) report having access to basic utilities such as kitchens, bathrooms, and toilets. However, there are clear maintenance issues, with 25% of respondents stating that their homes need to be fixed. The provision of essential utilities such as energy and clean drinking water varies, with a considerable number reporting deficits (31.8% and 9.1%, respectively).

Furthermore, the data demonstrates challenges in acquiring healthcare and transportation; a sizable proportion report hurdles to healthcare facility proximity (43.2%) and an inability to fund family mobility, such as vehicles (75%). Overall, the responses gave insights into a range of socioeconomic conditions, highlighting areas of need such as access to healthcare and utilities, food security, and housing maintenance.

Table 4. 4: Respondents' Socio- Economic Status

Statements	NT	ST	At
We always have plenty of our favorite food.	56.8	20.5	22.7
We always have plenty of food, but it's not always what we want.	4.5	86.6	9.1
Sometimes we don't get essential food due to a shortage of resources.	75	9.1	15.9
Most members of my family eat less because they care about their health.	52.3	6.8	40.9
Our family subsists on a few types of less expensive food.	6.8	18.2	75
A balanced diet is good for health, but we cannot afford it.	25	4.5	70.5
Our house has all types of facilities, such as a bathroom, kitchen, and toilet.	2.3	11.4	86.4
Our house is protected from natural disasters, such as rain and heat.	15.9	18.2	65.9
No part of our house needs repair.	68.2	6.8	25



Energy sources in the home (e.g., electricity, UPS, solar system) are sufficient to meet our basic needs.	31.8	22.7	45.5
The available water in our house is safe for drinking.	9.1	2.3	88.6
At a reasonable distance, we can access basic health facilities round the clock.	43.2	4.5	52.3
We don't have to travel more than 500 meters to buy food.	68.2	2.3	29.5
Our children are admitted to standard schools.	72.7	4.5	22.7
We do not use dry dung and firewood for cooking food.	50	31.8	18.2
Compared to our neighborhood, our financial status is worse.	34.1	0	65.9
We can't afford a car for household use.	25	0	75
My family's income barely covers our basic needs, such as housing, education, and health.	6.8	11.4	81.8
Our family cannot participate in their preferred recreational activities.	13.6	6.8	79.5

Note: NT stands for never true, ST for sometimes True, and AT for Always True

The table 4.5 investigates several types of land ownership, organized by water system condition (irrigated or Barani). The three main types of possible ownership are owned, rented, and sharecropped. Every property type is further characterized by its water system condition, and mean attributes are presented for each categories. For owned land, both irrigated and Barani kinds had explicit mean potential benefits of 0.86136 and 0.26364, indicating some variation in total activity., indicating some dissimilarity in their general operation. Also, rented land displays Mean of 0.71523 for irrigated and 0.11227 for Barani, recommending varieties in efficiency or other important elements between the two sorts. However, there is a significant difference in sharecropped land, with irrigated land mean value of 0.11296 and Barani land receiving a significantly higher mean value of 0.89773. The table provides a comprehensive view of the performance of the various land ownership and irrigation types as a overall, with a final mean value of 2.963185 across all categories.

Table 4. 5: Land Owned, Rented and Share-cropped by the Respondents

Land Ownership	Type	Mean	
		Category	Overall
Owned	Irrigated	0.86136	1.09
	Barani	0.26364	



	Barani	0.26364	
Rented	Irrigated	0.71523	0.83
	Barani	0.11227	
Share-Cropped	Irrigated	0.11296	0.203
	Barani	0.89773	
Overall			2.12

Table 4.6 provides significant data on wheat cultivation and crop damage among respondents. According to the statistics the minimum wheat cultivated on irrigated land is 0 kg and the maximum wheat cultivated on irrigated land is 5000 kg. The Mean value of wheat cultivated on irrigated land is 1963.64 with standard deviation of 1287.3430. In a similar vein, the respondents grow wheat on Barani land, the minimum wheat cultivated on Barani land is 0 kg and the maximum wheat cultivated on Barani land is 3000 kg, The Mean value of wheat cultivated on Barani land is 352.27 with standard deviation of 749.415. Additionally the minimum of total wheat cultivated is 0 kg and the maximum total wheat cultivated on land is 3000 kg, The Mean value of wheat cultivated on total land is 352.27 with standard deviation of 749.415 Furthermore, the data emphasizes how damaging natural disasters are to wheat harvests; estimated damages range from zero to three thousand (3000) kg, with an Mean of 539.55 units and a noteworthy standard deviation of 519.995 units.

Table 4.6: Approximate Output and Damages to Wheat

Output & Damage (KGs)	Minimum	Maximum	Mean	Std.Deviation
Output-Irrigated land	0	5000	1963.64	1287.34
Output-Barani Land	0	3000	352.27	749.42
Output-Total	0	5000	2315.91	1171.55
Damages	0	3000	539.55	519.99

Table 4.7 provides relevant statistics on Maize cultivation and agricultural damage among respondents. The figures reveal that the minimum Maize planted on irrigated land is 0 kilogram,



while the maximum production is 2500kg. The mean value of maize grown on irrigated land is 204.55, with a standard deviation of 610.739. Similarly, respondents grow Maize on Barani land, with the minimum Maize (output) cultivated being 0 kg and the maximum being 1800kg. The Mean value of Maize cultivated on Barani land is 63.64 with a standard deviation of 307.345. Moreover, the minimum total Maize cultivated is 0 kg, and the maximum is 2500 kg. The Mean value of Maize cultivated on total land is 245.45 with a standard deviation of 655.373. Additionally, the data demonstrates the impact of natural catastrophes on Maize harvests, with estimated damages ranging from 0 to 1500 kg. The Mean damage is 79.55 units with a substantial standard deviation of 275.832 units.

Table 4. 7: Approximate Output and Damages to Mize Crop

Output & Damages (KGS)	Minimum	Maximum	Mean	Std. Deviation
Output-irrigated land	0	2500	204.55	610.739
Output-Barani land	0	1800	63.64	307.345
Output-Total	0	2500	245.45	655.373
Damages	0	1500	79.55	275.832

Table 4.8 involves important data on tobacco farming and crop damage among respondents. According to data, there is a minimum of 0 kg and a maximum of 4000 kg when tobacco is produced on irrigated land. The mean value for tobacco grown on irrigated land is 379.77, with a standard deviation of 1000.815. Similarly, respondents produce tobacco on Barani property, ranging from 0 kg at the lowest to 575 kg at the maximum. On Barani land, the average tobacco yield is 13.07 with a standard deviation of 86.685. Additionally, the total amount of tobacco that is cultivated ranges from 0 kg to 4000 kg. A total of 392.84 acres are farmed for tobacco, with a standard deviation of 999.494. The report also indicates how natural catastrophes effect tobacco harvests, with anticipated losses ranging from 0 to 1500 kg. With a high standard deviation of 290.753 units, the mean damage is 107.05 units.

Table 4. 8: Approximate Output and Damages to Tobacco Crop

Output-& Damages (KGs)	Minimum	Maximum	Mean	Std. Deviation
Output-Irrigated Land	0	4000	379.77	1000.815
Output-Barani Land	0	575	13.07	86.685



Output-Total	0	4000	392.84	999.494
Damages	0	1500	107.05	290.753

Table 4.9 provides significant data on Sugarcane cultivation and crop damage among respondents. According to the statistics the minimum Sugarcane cultivated on irrigated land is 0 kg and the maximum Sugarcane cultivated on irrigated land is 4000 kg. The Mean value of Sugarcane cultivated on irrigated land is 848.30 with standard deviation of 1296.422. In a similar vein, the respondents grow Sugarcane on Barani land, the minimum Sugarcane cultivated on Barani land is 0 kg and the maximum Sugarcane cultivated on Barani land is 2200 kg, The Mean value of Sugarcane cultivated on Barani land is 51.16 with standard deviation of 335.497. Additionally the minimum of total Sugarcane cultivated is 0 kg and the maximum total Sugarcane cultivated on land is 4000 kg, The Mean value of Sugarcane cultivated on total land is 898.30 with standard deviation of 1305.338 Furthermore, the data emphasizes how damaging natural disasters are to Sugarcane harvests; estimated damages range from zero to 1800 kg, with an Mean of 189.77 units and a noteworthy standard deviation of 358.539.

Table 4.9: Approximate Output and Damages to Sugarcane Crop

Output-& Damages (KGs)	Minimum	Maximum	Mean	Std. Deviation
Output-Irrigated Land	0	4000	848.30	1296.422
Output-Barani Land	0	2200	51.16	335.497
Output-Total	0	4000	898.30	1305.338
Damages	0	1800	189.77	358.539

Table 4.10 presents significant data on Fruits cultivation and crop damage among respondents. The statistics show that the minimum Fruits cultivated on irrigated land is 0 kg, and the maximum is 2000 kg. The Mean value of Fruits cultivated on irrigated land is 45.45 with a standard deviation of 301.511. Additionally the minimum of total Fruits cultivated is 0 kg and the maximum total Fruits cultivated on land is 2000 kg, The Mean value of Fruits cultivated on total land is 45.45 with standard deviation of 301.511. Furthermore, the data highlights the impact of natural disasters on Fruits harvests, with estimated damages ranging from zero to 1000 kg. The Mean damage is 22.73 units, with a significant standard deviation of 150.756.



Table 4. 10: Approximate Output and Damages to Fruits Crop

Output-& Damages (KGs)	Minimum	Maximum	Mean	Std. Deviation
Output-Irrigated Land	0	2000	45.45	301.511
Output-Barani Land	0	2000	45.45	301.511
Output-Total	0	1000	22.73	150.756
Damages				

Table 4.11 provides significant data on Vegetables cultivation and crop damage among respondents. According to the statistics the minimum Vegetables cultivated on irrigated land is 0 kg and the maximum Vegetables cultivated on irrigated land is 3600 kg. The Mean value of Vegetables cultivated on irrigated land is 442.05 with standard deviation of 993.171. In a similar vein, the respondents grow Vegetables on Barani land, the minimum Vegetables cultivated on Barani land is 0 kg and the maximum Vegetables cultivated on Barani land is 550 kg, The Mean value of Vegetables cultivated on Barani land is 12.95 with standard deviation of 82.900. Additionally the minimum of total Vegetables cultivated is 0 kg and the maximum total Vegetables cultivated on land is 3600 kg, The Mean value of Vegetables cultivated on total land is 455.00 with standard deviation of 1022.495 Furthermore, the data emphasizes how damaging natural disasters are to Vegetables harvests; estimated damages range from zero to 1000 kg, with an Mean of 106.84 units and a noteworthy standard deviation of 244.366 units.

Table 4. 11: Approximate Output and Damages to Vegetables Crop

Output-& Damages (KGs)	Minimum	Maximum	Mean	Std. Deviation
Output-Irrigated Land	0	3600	442.05	993.171
Output-Barani Land	0	550	12.95	82.900
Output-Total	0	3600	455.00	1022.495
Damages	0	1000	106.84	244.366

The table 4.12 illustrates the probability distribution of various natural disasters across different likelihood categories, ranging from 10% to 50%. Each row represents a specific disaster, while



each column indicates a probability category. Floods show a significant likelihood, with a prevalence of 63.6% in the 10% probability category, gradually decreasing to 11.4% in the 50% probability category. In contrast, fog occurrences mainly cluster within the lower probability range, with a high 93.2% likelihood in the 10% category and minimal presence in higher probability brackets. Excessive rains demonstrate a notable variability, absent in the lowest probability tier but increasing to a significant 54.5% likelihood in the 40% category. Hailstorms and windstorms follow a similar trend, both peaking in the 30% probability category and decreasing towards higher probabilities. Droughts, like floods, show a considerable probability across the spectrum, reaching a peak of 68.2% in the 10% category and decreasing towards higher probabilities. This thorough analysis highlights the diverse distribution of natural disasters across various probability scenarios, emphasizing different levels of risk associated with each phenomenon.

Table 4. 12: Likelihood of natural calamities during the cropping seasons (Rabi & Kharif).

Type of Natural Calamities	Probability Of Occurrences				
	10%	20%	30%	40%	50%
Floods	63.6	11.4	4.5	9.1	11.4
Fog	93.2	6.8	0	0	0
Excessive Rains	0	9.1	31.8	54.5	4.5
Hailstorm	9.1	31.8	36.4	11.4	11.4
Wind-Storm	6.8	22.7	27.3	9.1	0
Droughts	68.2	20.5	2.3	9.1	0

Table 4.13 shows the predicted chance of several natural disasters influencing crop output throughout the Rabi and Kharif cropping seasons, with probabilities ranging from 10% to 60%. A particular calamity, such as floods, fog, heavy rain, hailstorms, windstorms, and droughts, is represented by each row. The probabilities of each calamity happening at the corresponding proportion are shown by the numbers in the table. For instance, there is a 63.6% likelihood that floods will occur for every 10% risk of occurring. In the same way, a 2.3% probability translates to a 20% likelihood of fog. In order to lessen the possible impact of these disasters on crop yields



throughout the course of the cropping seasons, agricultural stakeholders may plan and implement risk management measures with the assistance of this comprehensive overview.

Table 4. 13: Likelihood of natural calamities damaging Crops (Rabi & Kharif)

Type of Natural Calamities	Probability of Damaging Crops					
	10%	20%	30%	40%	50%	60%
Floods	63.6	2.3	4.5	13.6	15.8	0
Fog	95.5	2.3	2.3	0	0	0
Excessive Rains	4.5	18.2	40.9	31.8	4.5	0
Hailstorm	4.5	18.2	15.9	27.3	27.3	6.8
Wind-Storm	2.3	15.9	47.7	22.7	11.4	0
Droughts	72.7	13.6	9.1	2.3	2.3	0

We asked 44 farmers (households): Are there any government or private organizations in your area that offer crop insurance against natural calamities? So out of 44 respondents, no one mentioned any government or private organization that offers a crop insurance program against natural calamities.

We asked 44 farmers (households) whether they were offered by the government, bank, or any other reputable company to fully cover their crop damage as a result of natural calamities with the condition of paying a certain amount in advance. So out of 44 households, only 6 households do not want to participate in the crop insurance program. For this purpose, we offer different random combinations of initial and follow-up bids to see their responses. In response, 24 out of 40 farmers rejected the initial bid, which was accepted by 14 farmers. Similarly, the follow-up bid was accepted by 24 and rejected by 14 farmers.

5. CONCLUSION AND RECOMMENDATIONS

This study explored farmers' willingness to pay for crop insurance in the face of climate risks and other challenges. It appears that income is a critical factor influencing farmers' willingness to pay,



since just 6 out of 44 farmers are prepared to pay owing to financial constraints. The study underlines the importance of changing crop insurance policies to improve farmer acceptance. According to the study, some recommendations for improving crop insurance uptake, supporting farmers, and fostering sustainable agriculture include offering adaptable premiums, improving knowledge and education, providing subsidies, developing index-based insurance, ensuring transparency, incorporating sustainable practices, and promoting stakeholder collaboration.

REFERENCES

- Afriyie-Kraft, L., Zabel, A., & Damnyag, L. (2020). Index-based weather insurance for perennial crops: A case study on insurance supply and demand for cocoa farmers in Ghana. *World development perspectives*, 20, 100237.
- Ali, W., Abdulai, A., Goetz, R., & Owusu, V. (2021). Risk, ambiguity and willingness to participate in crop insurance programs: Evidence from a field experiment. *Australian Journal of Agricultural and Resource Economics*, 65(3), 679-703.
- Arshad, M., Amjath-Babu, T. S., Kächele, H., & Müller, K. (2016). What drives the willingness to pay for crop insurance against extreme weather events (flood and drought) in Pakistan? A hypothetical market approach. *Climate and Development*, 8(3), 234-244.
- Fahad, S., & Jing, W. (2018). Evaluation of Pakistani farmers' willingness to pay for crop insurance using contingent valuation method: The case of Khyber Pakhtunkhwa province. *Land use policy*, 72, 570-577.
- Farzaneh, M., Allahyari, M. S., Damalas, C. A., & Seidavi, A. (2017). RETRACTED: Crop insurance as a risk management tool in agriculture: The case of silk farmers in northern Iran.
- Ghazanfar, S., Qi-wen, Z., Abdullah, M., Ahmad, Z., & Lateef, M. (2015). Farmers' perception and awareness and factors affecting awareness of farmers regarding crop insurance as a risk coping mechanism evidence from Pakistan. *Journal of Northeast Agricultural University (English Edition)*, 22(1), 76-82.
- Ghosh, P. N., Miao, R., & Malikov, E. (2021). Crop insurance premium subsidy and irrigation water withdrawals in the western United States. *The Geneva Papers on Risk and Insurance-Issues and Practice*, 1-25.
- Hussain, J., Rabbani, I., Aslam, S., & Ahmad, H. A. (2015). An overview of poultry industry in Pakistan. *World's poultry science journal*, 71(4), 689-700.
- Jørgensen, S. L., Termansen, M., & Pascual, U. (2020). Natural insurance as condition for market insurance: Climate change adaptation in agriculture. *Ecological Economics*, 169, 106489.



- Khan, N. A., Qijie, G., Ali, S., Shahbaz, B., & Shah, A. A. (2019). Farmers' use of mobile phone for accessing agricultural information in Pakistan. *Ciência Rural*, 49, e20181016.
- Knapp, L., Wuepper, D., Dalhaus, T., & Finger, R. (2021). Revisiting the diversification and insurance relationship: Differences between on-and off-farm strategies. *Climate Risk Management*, 32, 100315.
- Möhring, N., Dalhaus, T., Enjolras, G., & Finger, R. (2020). Crop insurance and pesticide use in European agriculture. *Agricultural Systems*, 184, 102902.
- Okoffo, E. D., Denkyirah, E. K., Adu, D. T., & Fosu-Mensah, B. Y. (2016). A double-hurdle model estimation of cocoa farmers' willingness to pay for crop insurance in Ghana. *SpringerPlus*, 5, 1-19.
- Pai, J. S., & Boyd, M. S. (2010). A decision framework for optimal crop reinsurance selection. *China Agricultural Economic Review*, 2(2), 148-166.
- Peng, R., Zhao, Y., Elahi, E., & Peng, B. (2021). Does disaster shocks affect farmers' willingness for insurance? Mediating effect of risk perception and survey data from risk-prone areas in East China. *Natural Hazards*, 106, 2883-2899.
- Shirsath, P., Vyas, S., Aggarwal, P., & Rao, K. N. (2019). Designing weather index insurance of crops for the increased satisfaction of farmers, industry and the government. *Climate Risk Management*, 25, 100189.
- Sibiko, K. W., Veetil, P. C., & Qaim, M. (2018). Small farmers' preferences for weather index insurance: insights from Kenya. *Agriculture & Food Security*, 7, 1-14.
- Tok, N., Çobanoğlu, F., & Tunalioglu, R. (2023). Parameters that Motivate table olive farmers to buy agricultural insurance: the case of Western Turkey. *Erwerbs-Obstbau*, 65(4), 829-837.
- Wang, H. H., Liu, L., Ortega, D. L., Jiang, Y., & Zheng, Q. (2020). Are smallholder farmers willing to pay for different types of crop insurance? An application of labelled choice experiments to Chinese corn growers. *The Geneva Papers on Risk and Insurance-Issues and Practice*, 45, 86-110.
- Zahid, M. S., Qayyum, A., Malik, W. S., & Pant, K. P. (2007). Dynamics of wheat market integration in Northern Punjab, Pakistan [with Comments]. *The Pakistan Development Review*, 817-830.



Appendices

Part A: Additional information about the questionnaire

A 1: Gender	☐	Male	☐	Female
A 2: Age	(In years)			
A 3: Educational qualification	(In years)			
A 4: Residence	☐	Urban	☐	Rural
☐ Others	(please specify)			
A 5: Marital status	☐	Unmarried	☐	Married
Others	(please specify)			
A 6: Is your mother educated?	☐	Yes	☐	No
A 7: Is your father educated?	☐	Yes	☐	No
A 8: What was your father occupation?				
A 9: Total number of people in your family is Number of adults Numbers of children				

Part B: Social and economic characteristics of the household

B1: HH Member	B2: Gender 1 – Male 2 -	B3: Age (Years)	B4: Relationship	B5: Education (years)	B 6: Job	B7: Occupation (If employed)	B8: Helps in Farming 1 – Yes, 2 – No
---------------	-------------------------------	--------------------	------------------	--------------------------	----------	---------------------------------	--------------------------------------



	Female						
B10: Approximately monthly family income from all sources							
B11: Approximately monthly family expenditure							
B12: Approximately monthly income in the neighborhood							

B1: Please provide the name or number of the household member whose age is ≥ 5 years and ≤ 60 years. A household consists of all people who live in the same dwelling and share the same kitchen.

B4: Please mention the relationship of the enlisted household member with the respondent.

B5: Illiterate = 0, Primary = 5, Middle = 08, Matric/SSC = 10, HSSC/Diploma after SSC = 12, BA/BSc/Diploma After HSSC = 14, BS/MA/MSc = 16, MS/MPhil = 18, PhD = 20.

B6: Employed (Govt.) = 1, Employed (Private) = 2, Overseas = 3, Business = 4, Farming = 5, Unemployed = 6, Student = 7, Disable = 8, Housewife = 9.

Part C: Below are some statements regarding the social and economic status of the household. Please read each statement and rate how true/false each statement is about household?

No.	Statement	Never True	Sometimes True	Always True
-----	-----------	------------	----------------	-------------

1	We always have plenty of our favorite food.			
2	We always have plenty of food, but it's not always what we want.			
3	Sometimes we don't get essential food due to a shortage of resources.			
4	Most members of my family eat less because they care about their health.			
5	Our family subsists on a few types of less expensive food.			
6	A balanced diet is good for health, but we cannot afford it.			
7	Our house has all types of facilities, such as a bathroom, kitchen, and toilet.			
8	Our house is protected from natural disasters, such as rain and heat.			
9	No part of our house needs repair.			
10	Energy sources in the home (e.g., electricity, UPS, solar system) are sufficient to meet our basic needs.			
11	The available water in our house is safe for drinking.			
12	At a reasonable distance, we can access basic health facilities round the clock.			
13	We don't have to travel more than 500 meters to buy food.			
14	Our children are admitted to standard schools.			
15	We do not use dry dung and firewood for cooking food.			
16	Compared to our neighborhood, our financial status is worse.			
17	We can't afford a car for household use.			
18	My family's income barely covers our basic needs, such as housing, education, and health.			
19	Our family cannot participate in their preferred recreational activities.			

D: Land ownership Details (Area in Acres)



Type of Ownership	Irrigated	Barani	Total				
Owned							
Rented in							
Share Cropping							
E: Likelihood of natural calamities during the cropping seasons (Rabi & Kharif).							
Floods	10%	20%	30%	40%	50%	60%	70%
Fog	10%	20%	30%	40%	50%	60%	70%
Excessive Rains	10%	20%	30%	40%	50%	60%	70%
Hailstorm	10%	20%	30%	40%	50%	60%	70%
Wind-Storm	10%	20%	30%	40%	50%	60%	70%
Droughts	10%	20%	30%	40%	50%	60%	70%

F: How much does it Likely that the natural calamities during the cropping seasons (Rabi & Kharif) would damage crops [Scale; from not likely at all to very likely]							
Floods	10%	20%	30%	40%	50%	60%	70%
Fog	10%	20%	30%	40%	50%	60%	70%
Excessive Rains	10%	20%	30%	40%	50%	60%	70%
Hailstorm	10%	20%	30%	40%	50%	60%	70%
Wind-Storm	10%	20%	30%	40%	50%	60%	70%
Droughts	10%	20%	30%	40%	50%	60%	70%

G: Crops cultivated during the last Rabi & Kharif seasons				
	Area Cultivated (Acres)		Total Output (in KGs)	Estimated output lost due to Natural Calamities (in KGs)
Crops	Irrigated	Barani		



Wheat				
Maize				
Tobacco				
Rice				
Sugarcane				
Fruits				
Vegetables				
Other (Specify)				

H1: Are there any government or private organizations in your area that offer crop insurance against natural calamities?

☐ Yes ☐ No

H2: If yes, please enlist those organizations. _____,
_____.

H3: Where do you hear about these organizations?

I1: If the Government, a Bank, or any other reputable company offered to cover 100 percent of crop damages resulting from natural calamities, but required you to pay a certain amount upfront to access this coverage, would you be willing to take advantage of this offer? ☐

Yes

☐ No

I2: If you answered yes, please specify what percentage of the anticipated crop losses you would be willing to pay in order to take advantage of the offer?

S.No.	Initial Bid Value	Follow Up Lower Bid	Follow Up Higher Bid
1	2.5% of the Expected Losses	1% of the Expected Losses	5% of the Expected Losses
2	5% of the Expected Losses	2.5% of the Expected Losses	10% of the Expected Losses
3	10% of the Expected Losses	7.5% of the Expected Losses	15% of the Expected Losses



4	15% of the Expected Losses	10% of the Expected Losses	20% of the Expected Losses
5	20% of the Expected Losses	12.5% of the Expected Losses	25% of the Expected Losses
6	25% of the Expected Losses	15% of the Expected Losses	30% of the Expected Losses
7	30% of the Expected Losses	17.5% of the Expected Losses	35% of the Expected Losses
8	35% of the Expected Losses	20% of the Expected Losses	40% of the Expected Losses