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WEATHER INDUCED RISKS, MITIGATION STRATEGIES AND FARMERS' WILLINGNESS TO PARTICIPATE IN FLOOD INSURANCE SCHEME IN PUNJAB, PAKISTAN

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ABSTRACT

Affordable insurance coverage remains a challenge in many economies demanding public-private support to mitigate disaster risks. The private sector can play an important role in creating public awareness to adopt financial protection against these risks. The lack of insurance penetration is common in developing countries and needs a careful innovative initiative in the agricultural sector specifically. Keeping in view the success of flood insurance schemes globally, it may be a viable option to help rural farmers during recurring catastrophic events in Pakistan. Present research study was conducted to evaluate weather-induced risks, farmers' mitigation strategies and determining factors affecting the willingness of the farmers to adopt flood insurance schemes. The study used primary data randomly collected through a field survey from 240 farmers of three disaster-hit districts of Punjab during 2018-19. Binary regression was applied to estimate the results. The results of descriptive statistics show that most farmers (80%) consider floods a major weather-induced threat. At the farm level, money savings, diversified agriculture and keeping a high plinth of the house were among the main strategies to mitigate the risks of flood disasters. Factors like education level, off-farm earnings and involvement of farmers in other mitigation programs had a positive and significant contribution to enhancing willingness to participate in a flood insurance scheme. In contrast, higher land size, farmers relying on credit facilities, more contact with agriculture extension staff, and raised houses/plinth of the house were negatively affecting the adoption of flood insurance schemes. The findings can guide the agricultural policymakers and National Disaster Management Authorities towards improving their efforts to mitigate the negative impacts of floods and enhancing the willingness to adopt crop insurance schemes. These findings and measures can promote private insurance companies to propagate their initiatives for public welfare through the launch of insurance schemes more progressively.

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INTRODUCTION

Although, Climate Change is a global issue but has become more severe in developing regions of the world, such as Asia and Africa. Climate extremes: floods and droughts have become common issues with continuous increase in intensity and frequency worldwide (Hirabayashi et al., 2013) and gaining the attention of researchers and policymakers for suggesting mitigation measures (Wade and Jennings, 2015; Hossain et al., 2022). The agriculture sector is directly affected by climate change-induced risks more significantly in developing countries (Mahmood et al., 2020), affecting crop yield and rural livelihoods and highlighting the need for urgent adoption of mitigation strategies (Abid et al., 2019). Countries of the South Asian region are amongst the most vulnerable under climate change due to high dependency on the agriculture sector for livelihood (70%), employing more than 60% of the workforce and contributing significantly to the economy (22% of GDP). Frequent flooding, droughts and other extreme weather events have become more common in the recent decade, coupled with a lack of adaptive capacity and behavior at the same time, a serious threat to agrarian economies (Mahmood et al.,

2020). Resilient agriculture from climate-induced risks is the key factor for the development of an agrarian economy. The extant literature claims that flood insurance is one of the key solutions and has been adopted in developed countries successfully (Surminski and Oramas-Dorta, 2013; Surminski and Oramas-Dorta, 2014; Champonnois and Erdlenbruch, 2021; Stolf et al., 2021). But unfortunately, developing countries have not yet adopted this policy properly.

Pakistan stands amongst the top ten most affected and vulnerable countries (Kreft et al., 2017), having an agro-based economy and a major source of rural livelihood directly or indirectly. Pakistan has been facing the severe impacts of climate change in the form of floods, droughts, heat waves, and erratic rainfalls. Pakistan has a risk index score of 8.8 in terms of the country's most exposed to floods and other extreme weather events worldwide in 2022 (Statista, 2022). The recent most severe floods as a result of heavy monsoon rains in June-November, 2022 have claimed that more than 33 million people have been severely affected (Fayyaz, 2022). According to NDMA (2022), 81 districts have been declared as

calamity hit in Pakistan. The flood-brought devastations in Pakistan are in line with the projections made by Yao et al. (2012) and Rasul et al. (2012), cautioning Pakistan about the higher risk of flooding in the future in the wake of expected climatic changes almost a decade ago. The situation demands more efforts to tackle the climatic changes bringing disasters. OECD (2015) emphasizes that affordable insurance coverage remains a challenge in many economies demanding public-private support to mitigate disaster risks.

The private sector can play an important role in creating public awareness to adopt financial protection against these risks. The lack of insurance penetration is common in developing countries and requires a careful innovative initiative in the agricultural sector. The government of Punjab is trying to work on crop insurance (GOP, 2018), but the efforts are in the initial stages. No doubt, the private insurance mechanism in Pakistan is well established and has some success stories in life, vehicle and property insurance in close harmony with the banking sector (CDKN, 2012). It is hoped that replication of the model mentioned above of insurance companies in disaster affected farming sector may reduce the substantial budgetary pressure on the national public exchequer for rehabilitation and reconstruction of affected infrastructure because the flood insurance mechanism can compensate and mitigate the harsh effects of disasters in exchange for a guaranteed premium (Akter et al., 2011; Dawson et al., 2011). Past studies depict that floods and earthquake-affected countries were more likely to purchase insurance for handling severe perils after these events despite low take-up rates of insurance (CIPR, 2017). According to the knowledge of the authors, the popularity of flood insurance mechanisms among farmers in disaster-hit areas is least known in many developing nations, and Pakistan is no exception. In Pakistan, farmers don't have access to crop insurance or alternative livelihood options (Ajani and Geest, 2021). Therefore, only a couple of studies are available concerning the possibility of flood insurance mechanisms in Pakistan (Abbas et al., 2015). Keeping in view the recurring nature of catastrophes, the ad-hoc nature of disaster response and increasing threats of disasters in the country imply the central role of flood insurance in dealing with post-flood financial hardships of the resource-poor farmers.

A handful of studies have investigated the possible impacts of climate change on agriculture in different areas of Pakistan (Arshad et al., 2017a, 2018; Ahmad and Afzal, 2020). However, previous studies have identified several adaptation strategies in response to climate change to minimize the harmful impacts on agriculture in different agro-ecological zones (Arshad et al., 2017b; Fahad and Wang, 2018; Khan et al., 2020; Shahzad and Abdulai, 2020) but at the same time, these studies have highlighted the need for more research on the identification of area-specific adaptation strategies. The current study is designed at selected districts, Chiniot, Jhang and Layyah having a specific geographic location in the Indus River Basin System, to evaluate flood insurance status as an adaptation strategy. Literature has extensively focused on factors affecting adaptation measures by measuring willingness to pay for flood insurance, farm management decisions and agricultural production. This literature focuses on risk perception, risk behavior, risk attitude and socio-economic factors for adaptation of flood insurance and other strategies (List et al., 2020; Sapkota, 2021; Văculeșteanu et al., 2022; Hossain et al., 2022). The current study takes into account some specific measures elaborated in Tables 1, 3 and 4 contrary to those widely used in extant literature. The study will

be an addition to existing literature focusing on the local and regional adaptation strategies more specifically.

The next part of the paper is structured as follows: 2nd section discusses the research methodology, 3rd section explains the results of the field survey, and 4th section presents the conclusion and policy recommendations based on the study.

METHODOLOGY

Data collection and description of the Study Area

The study is carried out in the three most flood-hit districts of the Punjab Province; Chiniot Jhang and Layyah. The severity of flood damage to animals, crops and people, the history of the flood, and the role of districts in agricultural production were the criterion for the selection of study districts. Some discussions with the agriculture experts of the areas and local disaster management authorities were also held to give appropriate representation to the past flood-affected households. Finally, districts Chiniot, Jhang and Layyah have been selected as case studies witnessing flooding from rivers Jhelum and Chenab. A purposive random sampling technique is followed to collect primary data through well designed and pre-tested questionnaire. A number of 80 farm households from each of the districts is selected, totaling a sample size of 240 from three districts. The survey questions mainly pertained to the socio-economic background of the respondents, weather-related risks, and mitigation strategies adopted at the farm and household levels focused. The willingness to opt for flood insurance against flood disasters is the main objective to be evaluated among farmers. This is measured in the response of binary modes, i.e., "Yes" or "No," to analyze their future behavior on participation in the flood insurance scheme. The survey was conducted through face-to-face interaction with respondents as it is the most acceptable and easy to get information. Through one-on-one interaction, it was easier to convey the purpose of the research and get the information by translating questions into their native dialect. The survey was carried out during the year 2018-19 with breaks in field visits for other official assignments in the department.

Analytical Model

Simple descriptive analysis is carried out to find summary statistics of the socio-economic attributes of the respondents, weather-related risks and mitigation strategies adopted, while the Probit Regression technique is used for model estimation. Following the study by Paopid et al. (2020), we devised the econometric equation for assessment. The data analysis was performed in Software for Statistics and Data Science (STATA version 14).

RESULTS AND DISCUSSION

This section elaborates on the major findings of the study using descriptive statistics and also explains the regression results.

Socio-Demographic Statistics of Respondents

The results (Table 1) reveal that the average age of the farmers was 42 years, implying that the farmers fall in the active age category in Pakistan, contrary to the study of Abbas et al. (2015), who estimated average age more than 50 years in a similar study area. The average household size was 7.54 persons, and there was a lower literacy level of less than middle pass (7.5 years) in the study area. Farmers have, on average, 22 years of farming experience, which is justified on the ground of lower schooling and then joining the farming sector in the country to earn

livelihoods. The lower literacy reflects the poor availability of educational facilities/or priorities of resource-poor families to start working on farms in adulthood to earn their livelihoods. The descriptive statistics on age, literacy rate, farming experience and household size are in line with the study of Saeed et al. (2022). The average landholding, which could be an important factor influencing willingness to participate in insurance schemes, was 9.75 acres per household, and it further proves the literature reported dominance of smallholder farming in the country. Another important variable that might affect willingness decision is the average distance from the river, which in this case was about 1.69 km, while the mean plinth of the house was 7.71 feet. While Abbas et al. (2015) estimated the distance from the river and plinth of the house as 2.23 Km and 3.27 feet, respectively, in flood-hit districts of Punjab.

Anyhow, contrary to the higher plinth levels, higher family income may induce farmers to take part in flood insurance policies due to a better financial position for making premium installments. The survey results show that average monthly farm and off-farm incomes were slightly above Rs. 34000 and Rs. 28000, depicting a minor difference between farm and off-farm earnings. The difference in earnings was also minor in the study of Abbas et al. (2015), implying that off-farm income has a major contribution to their monthly incomes. Regarding livestock asset which is moveable, more of such an asset can induce farmers' decision towards joining mitigation mechanisms (e.g., flood insurance payment). The average number of more than 6 animals per family indicates that river deltas provide enough grazing grounds for the animals. Moreover, a higher number of livestock in these areas is due to their location in the mixed cropping zone of Punjab Province, where crops and animal raising is a common feature.

Table 1. Descriptive statistics of the respondents.

Variable name	Mean	S. D
Age (Year)	42.51	12.85
Household size (No.)	7.54	3.18
Education (Year)	7.56	3.87
Experience (Year)	22.97	12.15
Operational land (Acre)	9.75	6.76
Distance from river (Km)	1.69	0.96
Plinth of house (Ft)	7.71	1.31
Monthly off-farm income (Rs.)	28068.00	18014.81
Monthly farm income (Rs.)	34013.19	19672.92
Livestock (No.)	6.46	2.92

Source: Survey results.

Table 2. Types of weather related risks.

Types of Weather Related Risks	Freq.	%	Cumulative
Flood	193	80.42	80.42
Heavy Rains	11	4.58	85
Combined occurrence of flood and Rain	8	3.33	88.33
Combined occurrence of flood and Disease	28	11.67	100
Total	240	100	-

Source: Survey results.

Types of Weather Related Risks

Table 2 presents that respondents classification of respondents based on the types of natural disasters in their areas: floods, erratic rain and diseases. Results further reveal that droughts are not a common feature in the study area due to better tube well and canal irrigation facilities. The main threat to farming, according to the 4/5th (80%) majority, was the recurring occurrence of floods. The finding that floods are the main weather-related risk was also highlighted in the study, similar to Manzoor (2021).

Risk Mitigation Strategies at Farm and Household Levels

The academic literature generally reports two types of responses to climate change. One is mitigation, and the other is adaptation. According to Wapner (2014), a third dimension of climate suffering is also gaining importance in the literature on climate change. The third dimension is highly linked to the issue of "loss and damages" on account of climate change. However, we studied the mitigation dimension of disasters. Before and after the occurrence of disasters, it is natural that everyone protects himself from the tentative nuisance of disasters through different

protection measures. Farmers of the study area had been seen mitigating the harsh effects of natural disasters at their farms by increasing stock of money savings (Table 3) to cater to their farming needs (purchase of inputs, young stock of animals) at the time of any future undesired happenings. This finding matches the findings of Manzoor (2021), who reported that 50% of the farmers relied on domestic savings to mitigate the flood risks, a diversified/mixed farming system similar to a previous study (Van et al., 2020) by balancing the production of major crops with minor crops (Rayhan and Grote, 2010). Savings and diversification actions of respondents further imply that they were taking flooding as a positive externality for farming in the long run through its reinforcing impact on soil fertility. Literature suggests that geophysical characteristics such as house distance from the water source, house elevation from ground level and construction of embankments around the houses also show the farmers' attitudes and preparedness towards risk mitigation mechanisms. Therefore such basic information that could be useful to insurers (Botzen et al., 2009; Botzen and van den Bergh, 2012) was collected and analyzed, and results are reported in

Table 3. The main risk mitigation effort at the household level was to maintain a high plinth level against any unforeseen disasters,

while occasional migration to other areas upon facing disasters was another option.

Table 3. Adopted risk mitigation strategies.

Strategy Levels	Freq.	%	Cumulative
<i>Farm Level</i>			
Diversified (Mixed) farming	78	32.5	32.5
Money Savings	112	46.67	79.17
Credit	10	4.17	83.33
Diversified farming +Savings	40	16.67	100
Total	240	100	-
<i>Household Level</i>			
Plinth	122	50.83	50.83
Migration	48	20	70.83
Embankment around field	21	8.75	79.58
Plinth + Migration	40	16.67	96.25
Plinth + Embankment	3	1.25	97.5
Migration + Embankment	6	2.5	100
Total	240	100	-

Source: Survey results.

Table 4. Estimates of Binary Probit Regression.

Variables	Coef.	S.E	Z	p>z
Jhang district (dummy)	-0.058	0.22290	-0.26	0.794
Layyah district (dummy)	-0.174	0.24480	-0.71	0.478
Chiniot district (dummy)	0.000	(omitted)		
Household size	0.006	0.01791	0.31	0.756
Experience	-0.006	0.00747	-0.84	0.403
Education	0.068	0.02448	2.77	0.006*
Land categories	-0.205	0.11280	-1.82	0.069***
Livestock population	-0.012	0.01315	-0.93	0.35
Cemented house (dummy)	-0.072	0.23316	0.31	0.758
Semi-mud (dummy)	0.330	0.28331	1.16	0.245
Mud (dummy)	0.000	(omitted)		
Off-farm income (dummy)	0.691	0.20655	3.34	0.001*
Monthly farm income	0.000	0.00001	1.3	0.194
Credit user (dummy)	-0.455	0.20090	-2.27	0.023**
Annual contacts with extension staff	-0.259	0.10504	-2.46	0.014**
Transfer payments during hazards (dummy)	-0.219	0.18061	-1.21	0.225
Embankment around field (dummy)	-0.084	0.20247	-0.41	0.678
Distance of house from water body	-0.001	0.00010	-1.08	0.279
Plinth of house	-0.081	0.04927	-1.65	0.099***
Participation in previous rehabilitation programs (dummy)	0.310	0.19077	1.62	0.104***
_cons	0.490	0.60444	0.81	0.418
		No. of obs.	=	240
		LR chi ² (18)	=	39.69
		Prob > chi ²	=	0.0023
		Pseudo R ²	=	0.122

*Significant 1%, ** Significant 5%, *** Significant 10%

Source: Survey results.

Factors Affecting Willingness to Participate in Flood Insurance

The results of the Probit regression are reported in Table 4. The value of the likelihood ratio chi-square (39.69) depicts that the model as a whole is statistically highly significant. Many other variables are also significant. For example, the education of the respondents was found to be a significant factor making the mind to take part in flood insurance. This guides us that literacy/knowledge will elevate informed decision-making among farmers; thus, the result tallies with previous research of Ambreen et al. (2020). Out of two reported sources of monthly income, i.e., farm and off-farm, respondents earning off-farm income had more tendency to accept the new mechanism of flood insurance than farm income earners. On the other hand, large owners of the land

were less likely to involve in flood insurance as they think themselves more secure against any type of natural disaster. In other words, the smallholder farmers had more inclination towards flood insurance because they were more vulnerable to flooding situations. This finding is contrary to previous studies (Abu Madi et al., 2003; Abbas et al., 2015; Arshed et al., 2015). Our contrary finding here seems appropriate as land fragmentation has been rising steadily in the context of Pakistan, where now more than 65% of landholding falls under the small category of less than 2 Hectare and the poorest (42% poverty) also lie in this land size category (GoP, 2018). Therefore, resource-poor farmers with small landholdings are exposed to high risk and may be more willing to adopt risk mitigation schemes such as flood insurance. Similarly, farmers relying on credit from the market were more

likely to reject the phenomenon of flood insurance as they already had poor financial resources and could not bear more economic burden. The farmers having frequent contact with the agriculture extension department of the government were also more likely to refuse the insurance scheme. They get timely flood warning information so that they can take necessary and timely protective measures before any adverse situations. The coefficient of house plinth level behaved negatively with the individual's decision to participate in the flood insurance program. The finding that respondents of raised houses had less attraction to insurance schemes is similar to that noted in Thailand, where households having stairs/floors of the house decreased the tendency to pay for insurance (Paopid et al., 2020). The farmers who had previously worked with private/community-level organizations during rehabilitation programs were found more likely to welcome the services of insurance companies. Although insuring catastrophic risks is cumbersome and difficult to achieve; yet different forms of agricultural insurance exist practically around the globe (Noy et al., 2017). According to focus group discussions in the present research, the mean willingness to pay was Rs.445 per cropping season per household, approximately 0.12% of the households' average monthly income. Nonetheless, of the lowest contribution as payment of premium in case of joining the flood insurance scheme, scope exists for introducing flood-insurance mechanism in the study area.

CONCLUSION AND RECOMMENDATIONS

There are many aspects of weather-related risks in Pakistan. Still, flooding is the main threat to the farming community as it has affected it on numerous occasions over the decades. Climate change is the main driver of such disasters. However, governments resort mainly to ex-post relief, compensation and other rehabilitation programs due to limited budgetary provisions in contrast to the frequency of disastrous events, despite the fact that such events are being repeated at few years' intervals. In this backdrop, private insurance companies can do wonders to mitigate the harsh economic effects of flood risk. No doubt, the evidence from developed countries shows that flood insurance has proven a viable mechanism for rescuing farmers from financial risks due to natural hazards. The insurance policy has dual benefits. For example, it can reduce pressure on the public budget as well as lessen the uncertain circumstances during farmers' flood risk mitigation endeavours. Despite the fact that few success stories on insurance schemes are available among developing nations, the present study conducted among rural disaster-hit areas offers some interesting messages regarding the farmers' attitude towards participation in insurance, as evident by a premium contribution of 0.19% of the average monthly income of the farming households.

In addition, educated farmers of flood-prone areas are more open to accepting flood insurance as a mitigation measure. The smallholder farming community having more avenues of income, such as through off-farm work, is more likely to opt for an insurance policy to safeguard their farming from flood adversities because the capacity to contribute is improved. Therefore, the government should increase income-earning opportunities for the resource-poor rural farmers in sectors other than agriculture. Similarly, those who have taken part in previous disaster mitigation programs launched at community/private levels are more likely to welcome insurance companies for their help. The good working relationships with the community or NGOs for past rehabilitation programs is a good gesture for private sector

insurers as people have more trust in private sector functionaries than the government. There is a dire need to create awareness through education and research, which will increase the acceptance rates of insurance mechanisms. Last but not least, the bright potential of flood insurance in disaster-affected areas may further be explored on a wider scale, i.e., country level, by adding more informative dimensions because more empirical information is needed for flood-prone countries.

Limitations of the study

The current study is limited to only three districts due to budgetary limitations and the availability of human capital. We would like to suggest a detailed study at the national level with depth study and robust analysis. The study should also add insurance coverage for life, animals and assets like agricultural machinery, houses etc.

Novelty Statement

The risk mitigation strategies of the farmers at the household and farm level have been studied in the wake of recurring floods in Punjab, Pakistan. It was presumed that the country's farmers have a weak resource base to mitigate the harsh effects of climate-related stressors; therefore, alternative measures of partaking in the insurance policy can rescue them from the negative externalities of climate change. The insurance program in the agriculture sector of many disaster-hit countries of the world having similar agricultural resource bases has proved a success story in uplifting the farmers from adversities of natural disasters. In a nutshell, local solution-based policies can lessen the losses to the vulnerable economy.

Conflict of interest

The authors declare no competing interests that can hinder the publication of this research manuscript.

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