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ORIGINAL ARTICLE

Vulnerability Assessment of Formal and Informal Credit Borrowers: In Flood Prone Zone of Punjab, Pakistan

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Abstract

In Pakistan, farmers are facing climatic and non-climatic challenges in retaining their output and profit. Their dependence on credit is increasing with passage of time. Previously, the factors behind availing credit policy are discussed in different studies, but there is no study found that empirically compares vulnerability of formal and informal farmers on the basis of credit facility in flood prone zone. For estimation and analysis, quantitative and qualitative measures are used. The quantitative measures are based on estimating vulnerability indices. The data were collected through survey of 146 households through multistage-stratified random sampling technique. The qualitative data focus group discussion which helps in sampling and investigate factors behind vulnerability of farmers. Results suggest that formal credit borrowers are more vulnerable than informal credit borrowers in terms of higher exposure and sensitivity and lower adaptive capacity. Formal credit borrowing farmers are affected by inefficiencies namely, late declaration of calamity, defective loss assessment, slow procedure of claim disbursement, meager amount of claims, political influence in listing of disaster affected village, and delayed credit payment operations. The higher vulnerability of formal credit borrowers raises need for overall improvement of credit policy of Crop Loan Insurance Scheme.

Keywords Vulnerability · Floods · Formal and informal credit policy

1 Introduction

The agriculture sector of almost all developing countries has remained significantly affected by increasing uncertainty of crop from sowing to harvest. The major causes of this uncertainty are natural extreme events, epidemics, shortage of irrigated water, unavailability of pesticides, lack of access to credit, lack of information about farming practices due to the absence of research institutes in their communities and lack of access to basic facilities like health, and educational facilities (Rahman et al. 2012; Raju and Chand 2008; Ali 2013; Chen 2011). Because a large segment of population in developing countries is dependent upon income generated by agriculture farming (Choudhury et al. 2015), poverty rates are triggering by these uncertainties.

The agriculture sector is the backbone of Pakistan's economy; it remained the major source of income for 80% of small landholders (Ali 2013). Contribution of agriculture comes from crops (31% major and 11% from minor crops) and livestock (Syed Ali Raza et al. 2012).

In case of Pakistan, climate change has become a threat, especially for agriculture sector (Abid et al. 2015), because performance of this sector is dependent on suitable weather conditions. These climate conditions are responsible for affecting production and prices of agriculture which influences economic growth (GoP 2017). The farming community faces climate-related risks, namely, extreme minimum and maximum temperature, diseases in animal diseases, pest attack, and changing crop time periods, and water shortages. These outcomes of climate change have resulted to lower crop and livestock output (Abid et al. 2015).

Since the 1950s, Pakistan has faced 24 flood disasters resulting in severe losses of US $ 18 billion (GoP-INDC

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2016). The trends of climate change and increased frequency of climate-induced extremes events (like, floods and droughts) have increased agriculture losses, i.e., 10.63 million acres of crops destroyed including 38.12 million people affected, 3.45 million houses damaged, food security, rising sea level, and erosion of coastal zones (GoP 2016). These disasters were treated by allocating 5.8 and 7.6% of total expenditure in the federal budget in 2015 (GoP-INDC 2016). The Government of Pakistan (GoP) has actively involved institutional reforms by launching Federal Flood Commission (FFC) in January 1977 (GoP 2018) and National Disaster Management Authority (NDMA), and National Disaster Management Commission (NDMC) in 2010 (Zeeshan and Khan 2015) (Table 1).

Along with institutional reforms, Mandatory Crop Loan Insurance Scheme (CLIS) was launched in 2008 by Ministry of Finance, GoP. The main objective of this policy was to smooth out the income of farmer by provision of financial support against natural disasters (SBP 2014a, b). Government of Pakistan is working on the formulation of National Agriculture Insurance Scheme (NAIS) to support farming community to increase their resilience against extreme events (like floods) through climate change adaptation strategies mainly crop insurance without loan criterion (Gop 2017). Because, climate change shock affects ecological conditions in rural areas, especially agriculture productivity shifts. It leads to harming income of poor and marginal farmers (Saeed et al. 2015).

The major adaptations performed by farming community are altering crop types, varieties, and planting dates. However, these adaptations are facing constraints like lack of financial resources, constrained access to provision of institutional services like, credits, farm inputs, machinery, marketing services, weather forecasting, and information (Abid et al. 2015). Particularly, the subsistence and small farmers' are facing severe limitations to afford basic inputs of cropping, namely, high quality seeds, sufficient fertilizer, and farm implements. These farmers have lower income, lower savings, and lower capital formations (Saboor et al. 2009). The farmers need financial support for dealing with their social needs, purchasing farm inputs, and enhancing crop productivity. Credit plays a pivotal role in agriculture, as it not only supports small farmers but also medium and large farmers for improving farm output. The access to credit is becoming challenging for farmers because of its limited availability of formal credit to farmers (Saqib et al. 2018).

In fact, these farmers need credit for two reasons: production and development. The credit for production purpose is used for purchasing inputs namely, seeds, fertilizers, pesticides, water ('Abiyano'), and fuel charges. The microfinance programs increase welfare of participating households, especially credit policies are generally designed and supported by governments to help out farmers. However, issues of limited access to credit and program design, sometimes, do not lead to positive impacts. The major reasons for limited access to credit are collateral issues, and high markups which become barrier for availing formal credit in Pakistan (Akram et al. 2008). It is one of the barriers for having formal lending.

In the light of above literature review, significance of credit policy cannot be denied. It has already been established that formal credit policy is more restrained by institutional standard of procedures (sops) as compared to informal credit sources. However, this study fills gap left out by the previous studies. This study not only compares vulnerability assessment of formal and informal borrower in context of flood prone zone but also investigates factors behind ineffectiveness of national credit policy, i.e., Crop Loan Insurance Scheme (CLIS). These factors help to finalize aims of this study,

The aim of study is to assess the vulnerability of formal and informal borrowers in flood prone zones of Pakistan. A comparison is made between farmers who availed Crop Loan Insurance Scheme (CLIS)—both from formal and informal sectors. This comparison helps us to estimate vulnerability of farmers living in the same hotspot area.

1.1 Objectives

1. To conduct vulnerability assessment of formal and informal farmers residing in flood prone zones of Punjab, Pakistan
2. To determine factors behind vulnerability of formal and informal farmers residing in flood prone zones of Punjab, Pakistan

2 Data and Methodology

2.1 Vulnerability Index

The expected utility theory describes about theoretical framework of study. This theory was given by John Von Neumann and Oscar Morgenstern in year 1944 that discus about the development of expected utility model. This theory based on decision making to deal with risky situation, like, prizes and lotteries, etc. (Levin 2006). The farming community, like other individuals, makes decisions to minimize risk and deal with challenges related to production, marketing, etc. These decisions help to understand their inclination towards adaptation policies (Nantui et al. 2012, Barry 1984). The challenge of climate change influences farmers' decision for adaptations. However, these adaptations are subject to socioeconomic factors, farm characteristics, and changes in climate factors (Deressa et al. 2008). To measure adaptive

capacities of communities facing climate risk, vulnerability assessment tool is considered to be an effective tool (Hahn et al. 2009). This tool comprises of three components, namely, exposure, sensitivity, and adaptive capacity (Ibid).

The concept of vulnerability assessment is a new and assessment practice evolved to measure impact of climate change. It has been used for issues such as livelihoods, food security, natural hazards, global environment change, climate change, and others (Füssel and Klein 2006). The most widely quoted definition of vulnerability is given by IPCC assessment report, as, "it is an integrated measure of the expected magnitude of adverse effects to a system caused by a given level of certain external stressors" (McCarthy et al. 2001).

The alternate studies used different frameworks for estimating Vulnerability Index of communities. The study of Antwi et al. (2015) estimates community vulnerability of four districts of Ghana. The Vulnerability Index was comprised of four subcomponents like engineering, socio-economic, ecological, and political, and these subcomponents were further comprised of other indicators. Another study of Adeyemi (2014) also estimates vulnerability of farmers to flood disaster in Oyo State, Nigeria. The Vulnerability Index was based on MOVE framework which estimates the subcomponents of socio-economic characteristics, capacities, flood exposure, and susceptibility.

There is another type of framework developed for estimating impact of vulnerability on livelihoods of people or communities. It is known as sustainable livelihood framework which comprises of assets of household, namely, natural, social, financial, physical, and human capital (Chambers and Conway 1992). The combination of exposure, sensitivity and adaptation strategies by household becomes an effective tool for measuring risk due to climate change (Hahn et al. 2009).

The study of Hinkel (2011) elaborates that vulnerability assessment has become common tool for academic researchers, policy makers, and organizations. The common purposes of vulnerability assessment are six problems, namely, identification of mitigating targets, second, identification of vulnerable people, community, or regions, third, raising awareness, fourth, allocation of adaptation funds, fifth, monitoring of adaptation policy, and sixth, conducting scientific research. Among all aforementioned problems, only identification of vulnerable people, communities, and regions is most considerable. Therefore, policy makers should rightly introduce variables in vulnerability assessment. However, as described in the study of Hahn et al. (2009), it has been used in the variety of circumstance, for example, analyzing the early warning system, mapping for targeting food aid, and other issues of poverty, health status, biodiversity, and globalization.

2.2 Construction of Livelihood Vulnerability Index

The vulnerability indices were based on the review of numerous research studies and expert opinions during constructing it. Some of important studies used are namely, Hahn et al. (2009), Panthi et al. (2016) and Salik et al. (2015). The definition for vulnerability is based on IPCC's definition which defines it as comprised of exposure, sensitivity, and adaptive capacity.

These subcomponents of exposure, sensitivity and adaptive capacity are defined by variable that are supported from the literature review. The variable selection under these subcomponents with their literature support is given below in Table 2.

To formulate index, we need to convert variables from different scales to single scale. This process is known as normalization of variables for using in the index. The basic step for normalization is the min–max normalization technique (Poverty and Human Development Initiative 2011):

$$\text{Index}_{\text{sd}} = \frac{S_{di} S_{\min}}{S_{\max} - S_{\min}}. \tag{1}$$

Each subcomponent of index is normalized through above formula given in Eq. (1). Here, S_{di} is defined as the original value of a variable for each respondent, and $S_{\min}$ and $S_{\max}$ reflect the minimum and maximum values of overall variable, respectively. Second step for the calculation of index is method of aggregation to find out the values of exposure, sensitivity, and adaptive capacities using the following equation:

$$\text{CF}_d = \frac{\sum_{i=1}^{n} w_{pi} P_{di}}{\sum_{i=1}^{n} w_{pi}}. \tag{2}$$

Each subcomponent of Vulnerability Index is aggregated through above formula given in Eq. (2). Where, CF_d is the contributor factor like; exposure, sensitivity, and adaptive capacity. Where, w_{pi} is the weightage of one of the major contributing factor and P_{di} is the major component for district d indexed by 'i' (Panthi et al. 2016). In the above formula, 'n' reflects the number of major components in each of the contributing factors. Similar aggregation occurs for Livelihood Vulnerability Index which comprises of socio-demographics, credit, climate variability, food, water, livelihood strategies, health, social networking, and natural disasters components. After obtaining the values of exposure, sensitivity, and adaptive capacities using the above equation, we applied the following IPCC formula to obtain the results of IPCC-Livelihood Vulnerability Index (IPCC-LVI). IPCC-LVI ranges from − 1 (least vulnerable) to 1 (most vulnerable):

IPCC-LVI = (Exposure-adaptive capacity) × Sensitivity.

Table 1 Components of Vulnerability Index

Exposure			
Climate extremes/disaster	Average number of frequencies of climate extremes in the last 10 years (based on survey)	More frequent events leads to higher exposure	Panthi et al. (2016), Hahn et al. (2009), Salik et al. (2015)
Near to river	Distance between river and land	Increase in distance reduces risk of being exposed	Adegbile (2014)
Min temperature variability	Monthly min temperature variability	Increase in temperature variability increases the risk to crop yield	Hahn et al. (2009)
Min temperature variability	Monthly max temperature variability		Hahn et al. (2009)
Hot months	Number of extreme hot months with temperature above 30 °C	Higher the frequency, higher will be the exposure	Salik et al. (2015)
Cold months	Number of extreme cold months (below − 10 °C with temperature	Higher the frequency higher will be the exposure	Salik et al. (2015)
Precipitation variability	Monthly variability in total precipitation	Increase in the variability of precipitation increases the risk to crop yield	Porter et al. (2014), Salik et al. (2015)
Extreme dry months	Number of extreme dry months explained as the month during spring season having precipitation < 5 mm and in summer precipitation = 0 mm	Higher the frequency of dry months higher will be risk of droughts/water shortage which leads to enhanced exposure	Salik et al. (2015)
Diurnal min. temperature	Monthly average diurnal min. temperature range	Higher the range of temperature higher will be exposure	Salik et al. (2015)
Diurnal max. temperature	Monthly average diurnal min. temperature range	Higher the range of temperature higher will be exposure	Salik et al. (2015)
Indicators and subcomponents	**Explanation**	**Functional relationship**	**References**
Sensitivity			
Any health issue/disability in your family since the past 3 months?	Households having disability in family	Higher the health issues, higher sensitivity	Panthi et al. (2016)
Cost on health issues	Average health related cost per month for the household	Higher cost implied, higher sensitivity	
Number of days flood water stayed on land	Average time impact on farmers farm by water	Higher the value, higher will be sensitivity of farm land	Adegible
Household having limited supply of food staff during climate extremes	Percentage of household having limited supply of food staff during climate extremes	Higher food insecurity, higher will be sensitivity	Panthi et al. (2016)
Monetary loss	Average monetary loss incurred due to last extreme event	Higher the loss, more will be the sensitivity	Pachauri et al. (2014)
Adaptive capacity			
Experience of agriculture	Number of years involved in agriculture	Higher the experience, higher will be adaptive capacity	
Dependency ratio	Ratio of the population 0–14 and 65 and above year of age over the population between 15 and 64 years of age	Higher the age dependency ratio, lower will be the adaptive capacity	Panthi et al. (2016)
Education	Percentage of household who did not attended school		Panthi et al. (2016)

Table 1 (continued)

Indicators and subcomponents	Explanation	Functional relationship	References
Income diversification	Percentage of households who have more than one source of income	Income diversification increases adaptive capacity	Panthi et al. (2016)
Access to media/information	Percentage of households having access to phone, Internet, and TV	Communication media helps to enhance awareness of hazards and preparedness which ultimately contributes to adaptive capacity	Panthi et al. (2016)
Crop diversity	Households planting more than one crop in single season	Higher crop diversity will increase adaptive capacity	Hahn et al. (2009)
Livestock diversity	Households having more than one livestock type	More diversity of livestock, higher will be adaptive capacity	Hahn et al. (2009)
Social networking	Percentage of households who are actively involved in: local politics, social relief work, and local-level associations, and have a strong friendship circle	Social networking enhances adaptive capacity by providing support in the form of physical help, information, and experience sharing etc.	Hahn et al. (2009)
Selling assets during emergencies	Selling assets for adjusting with flood shocks	Higher the floods higher chances of selling assets	
Willingness of CLIS	More willingness more chances of adaptation toward crop insurance	More willingness more chances of adaptation toward crop insurance	Arshad et al. (2016)
Awareness of crop insurance in CLIS	Awareness can increase chances of availing CLIS	More awareness of crop insurance, more chances of adaptation toward crop insurance	Chikaire et al. (2016)
Other government support	Received any government support after natural calamity like flood	Support from government will increase adaptive capacity	Panthi et al. (2016)
Visits of agriculture extension officer	Percentage of people who agreed for visits of agriculture extension officer	Higher visits higher will be adaptive capacity	Adegible
Took loan	Borrowing credit to cope with any type of shock in past 5 years	Higher borrowing higher will adaptive capacity	Panthi et al. (2016)

2.3 Data Collection

2.3.1 Survey Area

Over a past decade, district Sargodha has faced riverine flooding through Jhelum and Chenab Rivers; particularly for years 2010, 2011, and 2014 as per annual flood commission report (Siyal 2018). This study has considered most recent floods year of 2014 for Sargodha.

This study comprises of primary data analysis which is based on the field survey of flood affected villages of Sargodha district. The field survey was based on multistratified random sampling technique. In the first stage, 'Sargodha' district was selected based on availability of data. In the second stage, out of seven tehsils (Behra, Bhalwal, KotMomin Sargodha, Shahpur, Silanwali, and Sahiwal), three (Behra, Sargodha, and Sahiwal) were randomly selected. Out of each three tehsils, one village was randomly selected, namely, Aqil Shah Village, and Lakhiwaal Village, and Sheikhpurkona. In the third stage, listing of formal and informal farmers was done through focus group discussions. Out of listing, we randomly selected 146 farmers, in total. This survey took almost 3 months, from January to March 2017 (Fig. 1).

2.3.2 Cropping Profile in Sargodha District

The season of Rabi crop ranges from October to December months and harvested in months of March–April. The majority of farming community grows 'Wheat' as their major Rabi crop. Other common crops are oranges, vegetables, and fodder. The farmers have started a new trend of cropping of 'Rose' plants during Rabi season.

During floods, kharif crops faced severe damages during their harvesting. The season of Kharif season starts from April–May and harvested in August–September. The majority of farming community cropped 'sugarcane' as their major crop in kharif season, and other crops sown are cotton, fodder, and rice. The watermelon is a new crop trend introduced recently which is sown by a few farmers.

The Kharif crops get severely damaged by floods when it is about to harvest. Sometimes, flooding along with monsoon rainfall, like flood of year 2010, affects Rabi crops also during their sowing season.

Out of total sample of 146 farmers, the category which availed Crop Loan Insurance Scheme (CLIS) is '80' which is termed as 'formal loanee'. The loanee farmers borrowed loan against major crops (Wheat, Cotton, Sugarcane, and Rice). We considered loan borrowers who took loan with in past 5 years. The crop loan is taken for major crops (wheat, rice, sugarcane, and cotton) by farmers in district Sargodha. Similarly, the term 'Informal loan borrowers' are farmers who are not availing Crop Loan Insurance Scheme are 66 in number. The farmers of both categories have different land size. Both farming categories include rich and poor farmers. The rationale behind it was to generalize reasons behind vulnerability between formal and informal borrowers. The time period of survey is 1 month, i.e., during March 2017. During survey, farmers were busy in cultivating kharif crop.

A multistage stratified random sampling has been used to draw the sample size. Stratification is most suitable technique, especially when heterogeneity and sample biases prevail in the data. This is the best suited sampling technique. Similarly, studies of Saqib et al. (2018) used multistage-stratified random sampling technique for increasing effectiveness of targeted population. At the first stage, the survey team selected flood affected three tehsils and villages of Sargodha district. In the next stage, formal borrowers and informal borrowers were selected through focus group discussion to identify targeted farming community. Then, those farmers were randomly selected to conduct survey.

Along with primary survey of farmers, three focus group discussions with farmers were conducted in aforementioned villages. These focus group discussion had more than eight farmers which were inquired about overall credit policy and vulnerabilities faced by floods.

3 Results

The scale for Livelihood Vulnerability Index is comprised of 0–1 values. Here, '0' shows least vulnerability and '1' shows highest vulnerability (Fig. 2).

The chart of VI tells us about Vulnerability of farmers who have taken loan "Loanee" and who have not taken loan from formal source, i.e., "Non-Loanee or Informal loan borrower". The Vulnerability Index is comprised of three components, namely, exposure, sensitivity, and adaptive capacity. The results show that exposure and sensitivity of loanee is higher than non-loanee, but adaptive capacities of loanee are lower than non-loanee (Table 3).

The empirical results of Vulnerability Index are based on the formula of $(E+S\,(1-A))$ in which 'E' shows exposure, 'S' shows sensitivity, and 'A' shows adaptive capacity. The overall result of Composite Vulnerability Index (CVI) shows that non-loanee farmers are less vulnerable than loanee farmers.

On the basis of Comer et al. (2012) and Hammill et al. (2013), we can see that component of exposure of loanee and non-loanee farmers is low as its values laid between $0.0 \leq \mathrm{CVI} \geq 0.3$. Similarly, component of sensitivity of loanee and non-loanee farmer is showing medium level of sensitivity. Finally, adaptive capacity component of loanee shows medium level of adaptive capacity but for non-loanee

Table 2 Construction of Livelihood Vulnerability Index Source: Authors' calculation

Components	Formal borrowers	Informal borrowers
Socio-demographic profile	0.45225	0.4855
Livelihood Strategies	0.468	0.532
Social network	0.7208	0.2782
Health issues	0.36	0.3566
Food	0.539	0.461
Water	0.641	0.661
Natural disaster	0.296	0.251
Credit	0.462	0.537
Climate change	0.2978	0.2978
Sum	4.23685	3.5623
Livelihood Vulnerability Index (LVI)	0.47076	0.39581

has high adaptive capacity. The overall values of Composite Vulnerability Index (CVI) show the medium level of vulnerability for farming categories, loanee and non-loanee.

3.1 Inter-Governmental Panel on Climate Change (IPCC) Vulnerability Index

The IPCC Vulnerability Index is calculated through formula of (exposure-adaptive capacity) × sensitivity. The result of IPCC Vulnerability Index is given below (Table 3).

The scale for IPCC Vulnerability Index is given in the paper of Hahn et al. (2009). The scale ranges from − 1 (least vulnerable) to 1 (most vulnerable). The results in the above table show that loanee farmers are more vulnerable than non-loanee against floods even after availing CLIS. This result was supported by the previous Composite Vulnerability Index (CVI).

3.2 Livelihood Vulnerability Index (LVI)

The Livelihood Vulnerability Index (LVI) is based on socio-demographic profile, livelihood strategies, social network, health issues, food, water, natural disasters, and credit and

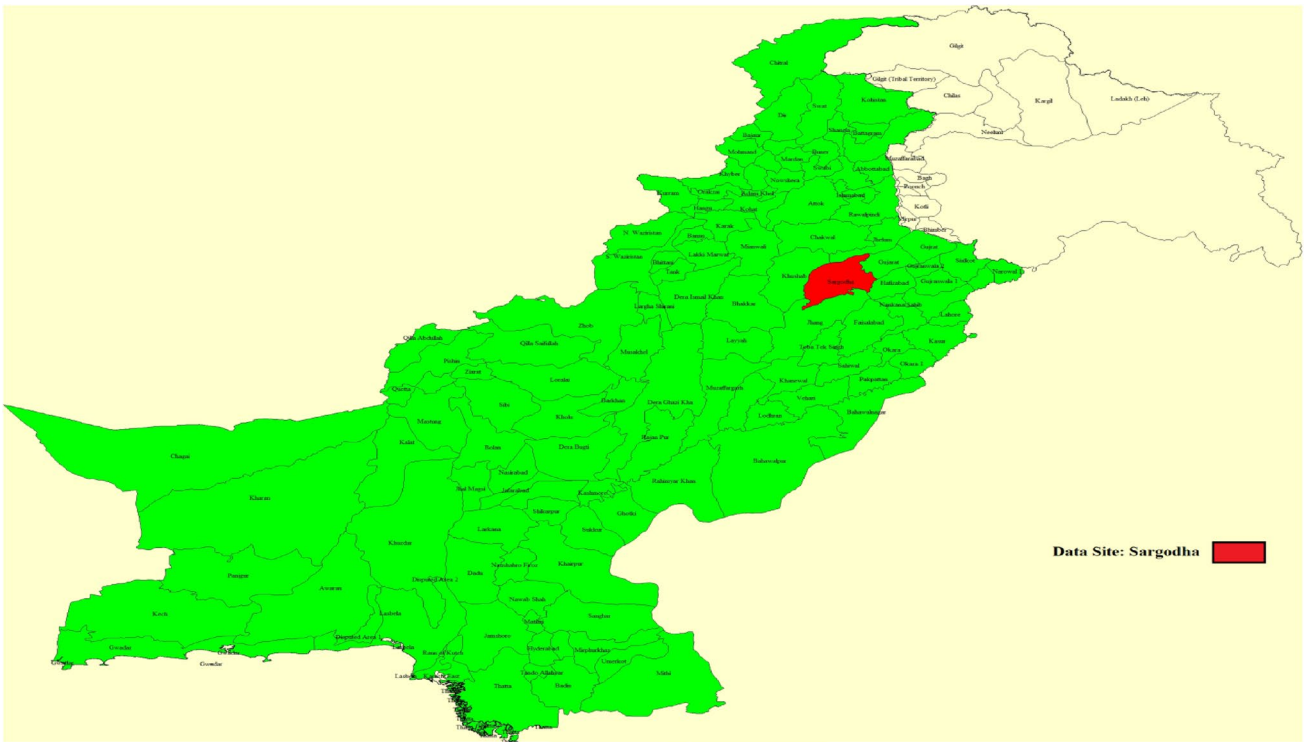

Fig. 1 Data site map Source: Map constructed by authors

climate change (Fig. 3). The values of each component are given in Table 4.

Formal borrowers are having higher livelihood vulnerability than informal borrowers. The index of Composite Vulnerability Index (CVI) shows that informal loan borrowing farmers are less vulnerable on basis of Livelihood Vulnerability Index. On the basis of assets categories, formal loan borrowing farmers are weaker on the basis of Socio-demographic profile, livelihood strategies, water resources, and credit facilities. Particularly, adaptive capacity of component of Composite Vulnerability Index (CVI) highlights reasons of lower adaptive capacities of formal borrowers. The subcomponents are namely, years of experience in agriculture, access to phone/TV/Internet, crop and livestock diversity, social activeness, willingness for crop insurance, and government support.

The reasons for higher vulnerability of loanee farmers can be understood from focus group discussions (FGDs), as given in the following table.

Claim receiving duration: formal credit borrowers (farmers) described delayed payment of insurance claims; almost 6 months to 1 year. Due to delayed payments, farmers faced issues in financing of next crop. Farmers used personal savings, took another loan, or sold household assets which exacerbate financial stress on them.

Ineffective loss assessment: formal credit borrowers (farmers) described that amount of claims was not sufficient as compared to losses which they faced. Mostly, insurance companies do not conduct individual loss assessment of farm. Farmers suggested that government should ask insurance companies to provide us either 50% of loss recovery or 50% of input cost recovery through reimbursement.

Crop loss: formal credit borrowers (farmers) described that crop loss was higher than claim amount. Formal credit borrowers (farmers) described that chances of loss for wheat, cotton, and vegetable crop were 100%. However, for rice, it was 70% chances of loss, and for sugarcane, it was 50%. Apart from major crops, neither vegetables nor oranges were insured against disasters under CLIS.

Political influence: farmers from both categories; formal and informal loanee considered political influence was also a major factor in declaration of disaster affected villages. Source: focus group discussions (FGDs) and key informant interviews.

4 Conclusion and Policy Recommendations

The significance of credit cannot be denied under rising challenges to farming community in Pakistan (Abid et al. 2015, Saboor et al. 2009; Saqib et al. 2018). This study conducted the vulnerability assessment of formal and informal credit borrowing farmers in the flood prone zones of Pakistan. The data site of this study is three flood prone tehsils of Sargodha district, namely, Behra, Sahiwal, and Shahpur. This study conducted followed multistratified sampling technique focus group discussion in aforementioned study area to identify targeted farming community. After that, this paper, the results of vulnerability indices show that Formal Credit borrowers (farmers) are more vulnerable as compared to informal credit borrowing farmers. The reasons for their higher vulnerability are delayed credit approval duration, late declaration of calamity, ineffective loss assessment, slow procedure of claim disbursement, meager amount of claims, and political influence in listing of disaster affected village. The study shows that the farming community is, in general, well informed of the relevant climatic changes that affect their business prospects. They confirmed that they had observed climatic changes and disasters in last 10 years. These climatic changes include irregular rainfall, decrease in rainfall, increase in temperature, changes in number of hot and cold days, frequent climate extremes, and more humidity. The farming community also noted increase in climate-induced disasters namely, floods, hailstorms, and pest attack. The major outcomes of climatic changes are decrease in crop productivity or quality, increase in chilling temperature, increase in pest attack, increase in day light for crops, and decrease in water for cropping. In addition, outcomes of floods are crop destruction, prevalence of water borne diseases, increase in salinity, damage of road/infrastructure, shortage of food items, death of livestock, spread of contaminated water, spread of disease in livestock, physical damage of settlement, and decline in crop yield.

4.1 Recommendations

On the basis of research findings and discussions, it is clear that there is need for improvement in this policy which will not only reduce vulnerability and improve resilience of farmers against climate-induced disasters (especially, floods) but also effectively allocate subsidized incentive to right farmer. Therefore, this study recommends that:

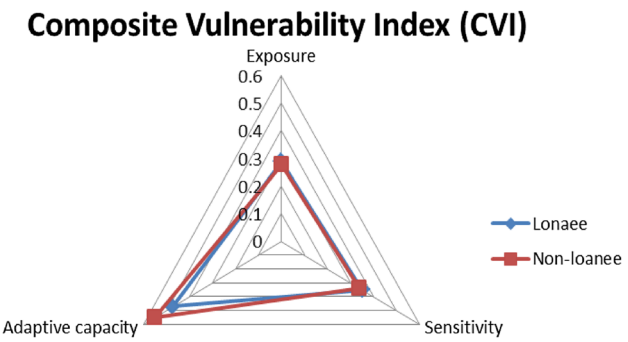

Fig. 2 Composite Vulnerability Index Source: Author's findings

Table 3 Vulnerability Index (composite) Source: Authors' estimations

	Exposure	Sensitivity	Adaptive capacity
Lonaee	0.2881	0.3524	0.4729
Non-loanee	0.2781	0.3376	0.5516
Composite Vulnerability Index $(E+S\,(1-A))$	Formal CVI = 0.3892		Informal CVI = 0.3547

Fig. 3 Livelihood Vulnerability Index Source: Author's findings

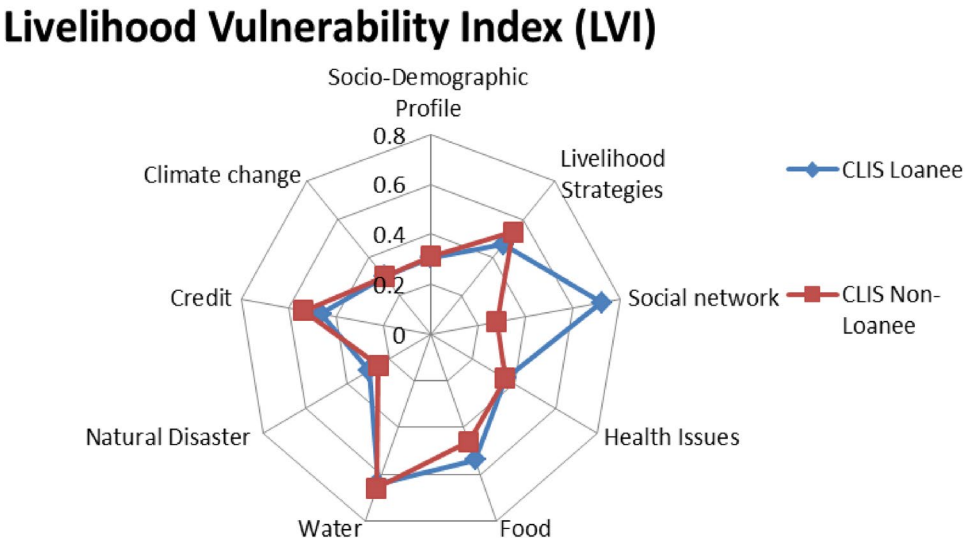

Table 4 IPCC Vulnerability Index Source: Authors' estimations

IPCC Vulnerability Index	
Formal loan borrowers	−0.06512352
Informal loanee borrowers	−0.0923336

- Government should expedite procedure of Crop Loan Insurance Scheme (CLIS) which will help in conducting loss assessment timely and effectively.
- Government should also consider declaration of other natural calamities like excessive rain, hailstorm, and pests attack under CLIS along with floods.
- Introducing crop insurance policy without criteria of loan at least in hotspot areas to willing farmers.
- Increasing the amount of claims by covering either 50% of input cost of cropping or 50% of loss faced by farmers.
- Initiation of weather or yield-based index rather than indemnity-based crop loan insurance. It will speed up the process of effective and individual losses assessment to provide claims before cropping of next season.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Abid M, Scheffran J, Schneider UA, Ashfaq M (2015) Farmers' perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan. Earth Syst Dyn 6(1):225

Adeyemi AO (2014) Vulnerability of farmers to flood disaster in Akinyele Local Government Area, Oyo State of Nigerai. West African Science Service Centre on Climate Change and Adapted Land Use. https://www.wascal.org/special-pages/file-show/container/download/?tx_ggfilelibrary_pi1%5Bfile%5D=132&cHash=44308543e9f2567eefa87afb742d4d79. Accessed 27 Dec 2017

Akram W, Hussain Z, Sial MH, Hussain I (2008) Agricultural credit constraints and borrowing behavior of farmers in rural Punjab. Eur J Sci Res 23(2):294–304

Ali A (2013) Farmers' willingness to pay for index based crop insurance in Pakistan: a case study on food and cash crops of rain-fed areas. Agric Econ Res Rev 26(2):241–248

Antwi EK, Boakye-Danquah J, Owusu AB, Loh SK, Mensah R, Boafo YA, Apronti PT (2015) Community vulnerability assessment index for flood prone savannah agro-ecological zone: a case study of Wa West District, Ghana. Weather Clim Extremes 10:56–69

Arshad M, Kächele H, Krupnik TJ, Amjath-Babu TS, Aravindakshan S, Abbas A, Müller K (2016) Climate variability, farmland value, and farmers' perceptions of climate change: implications for adaptation in rural Pakistan. Int J Sustain Dev World Ecol 24(6):532–544. https://doi.org/10.1080/13504509.2016.1254689

Barry PJ (ed) (1984) Risk management in agriculture. Iowa State University Press, Ames

Chambers R, Conway G (1992) Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies (UK), London

Chen YT (2011) Weather index-based rice insurance: a pilot study of nine villages in Zhejiang province, China. ETH Zurich, Zurich
Chikaire JU, Tijjani AR, Abdullahi KA (2016) The perception of rural farmers of agricultural insurance as a way of mitigation against climate change variability in Imo State, Nigeria. Int J Agric Policy Res 4(2):17–21
Choudhury A, Jones J, Okine A, Choudhury RL (2015) Drought triggered index insurance using cluster analysis of rainfall affected by climate change. J Insur Issues 39(2):169–186
Comer PJ, Young B, Schulz K, Kittel G, Unnasch B, Braun D, Hammerson G, Smart L, Hamilton H, Auer S, Smyth R, Hak J (2012) Climate change vulnerability and adaptation strategies for natural communities: piloting methods in the Mojave and Sonoran deserts. Report to the U.S. Fish and Wildlife Service. Nature Serve, Arlington, VA
Deressa TT, Hassan RM, Ringler C, Alemu T, Yesuf M (2008) Analysis of the determinants of farmers' choice of adaptation methods and perceptions of climate change in the nile basin of ethiopia. International Food Policy Research Institute, Washington, DC
Füssel HM, Klein RJ (2006) Climate change vulnerability assessments: an evolution of conceptual thinking. Clim Change 75(3):301–329
GoP (2016) Annual flood report. Office of the Chief Engineering Advisor and Chairman Federal Flood Commission, Islamabad
GoP (2017) Agriculture, Pakistan Economic Survey 2016–17, Ministry of Finance. http://www.finance.gov.pk/survey/chapters_16/02_Agriculture.pdf
GoP (2018) Federal Flood Commission. Office of Chief Engineering Adviser/Chairman Federal Flood Commission. http://www.ffc.gov.pk/. Accessed May 2017
GoP-INDC (2016) Pakistan's intended nationally determined contribution. Government of Pakistan. http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Pakistan/1/Pak-INDC.pdf. Accessed Aug 2017
Hahn MB, Riederer AM, Foster SO (2009) The Livelihood Vulnerability Index: a pragmatic approach to assessing risks from climate variability and change—a case study in Mozambique. Glob Environ Change 19(1):74–88
Hammill A, Bizikova L, Dekens J, McCandless M (2013) Comparative analysis of climate change vulnerability assessments: lessons from Tunisia and Indonesia. Competence Centre for Climate Change, Bonn, Germany. https://gc21.giz.de/ibt/var/app/wp342deP/1443/wpcontent/uploads/filebase/va/vulnerability-guides-manuals-reports/Comperative-analysis-of-climatechange-vulnerability-assessments.pdf
Hinkel J (2011) "Indicators of vulnerability and adaptive capacity": towards a clarification of the science-policy interface. Glob Environ Change 21(1):198–208
Levin J (2006) Choice under uncertainty. Standford University. https://web.stanford.edu/~jdlevin/Econ%20202/Uncertainty.pdf. Accessed Jan–July 2017
McCarthy JJ, Canziani OF, Leary NA, Dokken DJ, White KS (eds) (2001) Climate change 2001: impacts, adaptation and vulnerability. Cambridge University Press, Cambridge
Nantui MF, Bruce SD, Yaw OA (2012) Adaptive capacities of farmers to climate change adaptation strategies and their effects on rice production in the northern region of Ghana. Russ J Agric Soc Econ Sci 11(11):1–9
Pachauri RK, Allen MR, Barros VR, Broome J, Cramer W, Christ R et al (2014) Climate change 2014: synthesis report. In: Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. IPCC, p 151
Panthi J, Aryal S, Dahal P, Bhandari P, Krakauer NY, Pandey VP (2016) Livelihood vulnerability approach to assessing climate change impacts on mixed agro-livestock smallholders around the Gandaki River Basin in Nepal. Reg Environ Change 16(4):1121–1132
Porter J, Dessai S, Tompkins E (2014) What do we know about UK household adaptation to climate change? a systematic review. Clim Change 127:371–379
Poverty O, Human Development Initiative (2011) Training material for producing national human development reports: the Human Development Index (HDI)
Rahman Z, bin Dost MK, Wassan AA (2012) Socio-economic problems of farmers in Pakistan: focused area Tauluka Pano Akil District Sukkur. Kuwait Chapter Arab J Bus Manag Rev 1(5):94–103
Raju SS, Chand R (2008) A study on the performance of National Agricultural Insurance Scheme and suggestions to make it more effective. Agric Econ Res Rev 21(1):11–19
Saboor A, Hussain M, Munir M (2009) Impact of micro-credit in alleviating poverty: an insight from rural Rawalpindi, Pakistan. Pak J Life Soc Sci 7(1):90–97
Saeed DF, Salik KM, Ishfaq S (2015) Climate change and heat-waves: rural to urban migration in Pakistan. A silent looming crisis. SDPI, Policy Brief no. 47. https://sdpi.org/publications/files/Climate-Change-and-Heat-Waves-Rural-to-Urban-Migration-in-Pakistan-A-silent-Looming-Crisis.pdf. Accessed Jan–July 2017
Salik KM, Jahangir S, ul Hasson S (2015) Climate change vulnerability and adaptation options for the coastal communities of Pakistan. Ocean Coast Manag 112:61–73
Saqib SE, Kuwornu JK, Panezia S, Ali U (2018) Factors determining subsistence farmers' access to agricultural credit in flood-prone areas of Pakistan. Kasetsart J Soc Sci 39(2):262–268
SBP (2014a) Prudential regulations for agriculture financing. Agriculture Credit and Microfinance Department. http://www.sbp.org.pk/publications/prudential/PRsAgriApproved.pdf. Accessed 21 May 2017
SBP (2014b) Indicative credit limits and eligible items for agri-financing. Agriculture Credit and Microfinance Department, SBP, Karachi
Siyal GA (2018) Farmers see room for improvement in Crop Loan Insurance Scheme. The Express Tribune. https://tribune.com.pk/story/1657400/2-farmers-see-room-improvement-crop-loan-insurance-scheme/. Accessed Apr 2018
Syed Ali Raza M, Ali Y, Mehboob F (2012) Role of agriculture in economic growth of Pakistan. Int Res J Fin Econ 83:1–8
Zeeshan A, Khan MB (2015) Implementation of disaster risk reduction policy in Pakistan—an evidence from Sialkot. ISSRA paper 2015. http://www.ndu.edu.pk/issra/issra_pub/articles/issra-paper/ISSRA_Papers_Vol7_IssueI_2015/07-Implementation-of-Disaster-Risk.pdf. Accessed Feb 2017

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