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An empirical assessment of farmers' risk attitudes in flood-prone areas of Pakistan

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ABSTRACT

Farmers are confronted with several sources of climatic risks. As such, their risk attitudes play an important role in farm management decisions. Few studies have attempted to explore farmers' risk attitudes in flood-prone areas. This study examines the effects of socio-economic factors on risk attitudes of farmers in a flood-prone area of Pakistan. The data were collected from 168 subsistence farmers through a standardized questionnaire. The farmers were selected through multi-stage sampling techniques. For farmers' risk attitude measurement, Equally Likely Certainty Equivalent (ELCE) method and a cubic utility function were employed. Risk perceptions of farmers were measured by the risk matrix technique. A Logit model was employed to investigate the effects of socio-economic factors on farmers' risk attitudes. The findings of the study reveal that the majority of farmers were risk averse in nature. The results for the logit model show that education, experience, farmers' group, landholding size, off-farm income, and risk perceptions of floods significantly affect the risk attitude of farmers. The study provides useful insights into the most important factors affecting the risk attitude of farmers. The results have implications for policy makers in providing farmers with accurate risk mitigating and management tools, such as agricultural credit and crop insurance, to cope with climatic risks.

1. Introduction

Since 2010, the agricultural sector in Pakistan has faced three massive floods that had devastating impacts on the entire economy, particularly in the agriculture sector. The monsoon floods of 2010, 2011, and 2014 caused huge damage to agricultural crops, fisheries, forestry, livestock, and primary infrastructure, such as water channels, tube wells, houses, people, seed stocks, animal shelters, fertilizers and agricultural equipment/machinery. The floods struck just before the harvesting period of the main crops: rice, cotton, sugarcane, maize and vegetables. The total production loss of paddy, sugar cane, and cotton was assessed at 13.3 million metric tons. Over two million hectares of standing crops were damaged, and over 1.2 million livestock, excluding poultry, died in the 2010 flood [59]. In 2011, another massive flood struck Sindh and Balochistan provinces, which severely affected these areas. The people suffered from a loss of livelihood, especially relating to agricultural activities. Approximately 80% of the Sindh's rural population is dependent upon agricultural activities for their livelihoods; livestock, crops, fisheries and forestry [39]. The flood in 2011, destroyed standing crops of sugar cane, cotton, sorghum, rice, vegetables and pulses; livestock also suffered heavy losses. For instance, approximately 115,500 livestock were killed, and though around 5 million livestock survived, they were also indirectly affected through disease and displacement. The estimated total loss was US$ 1,840.3 million, of which 89% was direct damage and 11% indirect losses. The highest damage (approximately US$ 1.84 billion) occurred in the agriculture sector, particularly to fisheries and livestock. The total damage caused by the 2011 floods has been estimated at US$ 3.7 billion, and the total cost of recovery and reconstruction estimated at US$ 2.7 billion [43]. In the recent floods of September 2014, 367 persons died, and over 2.5 million people were affected by heavy rains and floods. Moreover, 129,880 houses were damaged, and more than 1 million acres of cultivated land and 250,000 farmers were affected. The cost of recovery and resilience building were estimated at US$ 439.7 million and US$ 56.2 million respectively [40]. These statistics illustrate the fact that agriculture was the most affected sector due to floods in Pakistan.

The agriculture sector is highly dependent on variations in climatic conditions, thus making it a risky enterprise. Climate variability is the main source of risk for agriculture and food systems [13]. The rising severity and frequency of extreme weather

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have substantially damaged agriculture [30]. Farmers are routinely exposed to various natural disasters, erratic rainfall and pests. For example, farmers are confronted with heavy rains, floods, pests and diseases [29,54,55], droughts [54], and market price fluctuations [29]. According to Musser and Patrick [38], there are five important sources of risk factors in agriculture: production, financial, marketing, legal, environmental, and human resources. First, production risks associated with variations in crop yields and livestock from several sources, such as uncertain weather conditions, incidence of disease and pests. Second, financial risks: i.e. a farmer's ability to pay their bills to continue farming and avoid bankruptcy. Third, marketing risks, which involve fluctuations in prices of agriculturally produced commodities. Fourth, the legal and environmental risks associated with agriculture. Fifth, limited human resources, such as the unavailability of family members for labor and farm management. As the outcomes of these risks can negatively affect production levels causing considerable production losses, it is therefore crucial for farmers to perceive and manage production risks accordingly [19].

Farmers' attitudes toward agricultural risks are very important for planning risk management strategies. Dadzie and Acquah [15] revealed that farmers' attitudes toward risk are the foremost step in understanding the behavior and coping strategies they adopt to mitigate the effects of environmental risks. Farmers' risk attitudes are critical in the adoption of modern agricultural technologies, such as production and investment decisions, in agriculture [33]. Han and Zhao [26] argue that special consideration needs to be given to the risk attitudes of farmers because risk-averse farmers are less likely to adopt new practices due to uncertainty about the costs and returns of their strategies. Many studies have reported that farmers, particularly poor farmers, are at high risk to natural disasters [4,9,18,29,53]. However, this risk factor is of an adverse nature, which negatively affects poor farmers' attitudes; they are therefore reluctant in adopting new technologies in agriculture [17,20]. Showing a different perspective, Yu et al. [61] reported that crop and variety selection were the most common methods adopted by farmers in Northeast China to cope with the effects of climate change, as opposed to disaster prevention and infrastructure improvement. Hence, due to uncertainty and the frequent occurrence natural disasters, farmers are in a continuous search for risk coping strategies.

Risk management is a continuous process for farmers. Decisions in these uncertain situations are based on their perception about the environment, information, their attitudes, and preferences [33]. Ullah et al. [57] found that in risk-prone areas farmers addressed production risk proactively by using their precautionary savings, agricultural credit, and diversification as risk management tools at the farm level in Pakistan. Likewise, farmers adopt diversification beyond the farm, such as diversification in crops, scheduling of farming practices, migration, and a variety of other diversification methods such as irrigation and water conservation techniques to cope with climatic risks [7]. Similarly, to cope with droughts, farmers practiced income diversification, assets depletion, expenditure adjustment, water shortage coping techniques and migration [6]. However, risk management in agriculture is not only important for avoiding risk, but also has ramifications concerning the optimum combination of risks and returns that can result in a wide range of outcomes [27].

Farmers' attitudes toward risk depend on several factors, ranging from cultural background to individual psyche [25]. Farm household characteristics such as experience and education also affect risk attitudes and risk perceptions [29,54] stated that educated farmers perceive crop disease as less risky, which resulted in a negative relationship with risk aversion, whereas experience was found to be positively related. Likewise, other studies reveal that the risk attitudes of farmers differ [28,36], with income [14,15,29,55] and with age [15,29,32,51]. Similarly, farm size [32,36], land ownership status [36,54], off-farm employment [33], farm size [29], and farmers' risk perceptions [55] greatly affect the risk attitudes of farmers.

Climatic risks in the agriculture sector have long been studied, which has had a substantial influence on farmers' production decisions. The literature has not only addressed the risk coping strategies adopted by farmers, but also the government policies that are being initiated, particularly risk reduction policies. Risk is clearly the main characteristic of any agricultural decision. However, there is a gap in our knowledge about the attitudes of farmers toward risk and where the problems lie, particularly in situations where risk attitudes are closely associated with the complex individual characteristics of farmers. Therefore, this study design is based on two objectives: to determine the risk attitudes and assess the effects of socio-economic factors of farmers in the study area.

The paper is divided into six sections. Section 2 is the theoretical framework; Section 3 is about the materials and methods; Section 4 shows the results of the descriptive analysis and regression model; Section 5 describes the discussion; Section 6 is the conclusion of the study.

2. Theoretical framework

Different approaches have been adopted by researchers to measure the attitudes of farmers [15]. Two basic approaches, direct and indirect are used for measuring risk attitude. The direct method, as suggested by von Neumann and Morgenstern, has complications that result from the fact that the subjects have different levels of tolerance or intolerance for gambling and that the concepts of probability are by no means intuitively obvious, and moreover, it is a time consuming method [37]. Risk attitude can be measured through eliciting Certainty Equivalents (CEs) and the experimental method as gambling with real payoffs [9]. In interviews for farmers' elicitation of preferences, Anderson et al. [3] have discussed several techniques. These include the von Neumann-Morgenstern (N-M) model, Equally Likely Certainty Equivalent (ELCE) method, a modified version of the N-M model, and the Equally Likely but risky outcome method. Based on the above discussion, we have adopted the interview method of the direct approach with the ELCE, using a Purely Hypothetical Risky model (explained in Section 3.3). The farmers are categorized into three groups. First is risk-preferring: those willing to take risks or the expected outcome is preferred over certain. Second is risk-neutral: those who are indifferent to certain and uncertain outcomes, but has the same expected income. Third is risk-averse; where farmers give preference to certain income over income that is uncertain. It is assumed that the selection of expected or sure outcomes is based on utility. Farmers opt for that choice which gives them more utility. Farmers maximize utility. Utility, in our case, is a function of wealth, but we use it as a function of income [27,42].

$$U = u(w) \tag{1}$$

The individual wants to maximize utility with respect to income.

$$U'(w) \geq 0 \tag{2}$$

The first differential is positive and indicates that more is preferred over less (also called convex utility function). Likewise, risk aversion is a state of utility function that shows a decrease in marginal utility as the payoff increases (also called concave utility function). Risk neutral has a linear utility function [27].