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Flood Risk Perception and Its Attributes among Rural Households under Developing Country Conditions: The Case of Pakistan

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Abstract: Managing and communicating flood risks necessitates a strong understanding of how people perceive risk. It has become critical to examine risk perception to implement effective disaster risk management (DRM) measures. Socioeconomic determinants have an impact on risk perception, which in turn affects future adaptive capacity and disaster preparedness. First and foremost, this research attempts to determine how Pakistani people in rural areas perceive flood risk, and second, to examine the factors that can influence rural residents' perceptions of flood risk. The data for this study were collected through face-to-face interviews with 600 respondents (household heads) from Charsadda and Nowshera districts that were severely affected by the 2010 flood. A flood risk perception index was developed (using a risk matrix) using relevant attributes on a Likert scale and classified into two categories: high and low perceived risk. Furthermore, a binary regression model was used to examine the influence of socioeconomic and institutional factors on rural households' risk perception. Flood risk was perceived by 67 percent of the total sampled participants in the study regions. The results of binary logistic regression demonstrate that flood risk perception is strongly linked to socioeconomic variables such as age, education, house ownership, family size, past flood experience, and distance from the nearest river source, as well as institutional factors such as access to credit and extreme weather forecast information. The findings of the current study additionally revealed that flood risk perception varied among household heads based on education (1–10 years perceived high flood risk (51.47%)), age (age greater than 40 years perceived high flood risk (52.83%)), and monthly income levels (lower monthly income group perceived high flood risk (73.02%)). The findings of this study shed light on rural households' perception of flood risk and the factors that shape such perceptions. These findings can assist provincial and local disaster management authorities in better understanding flood risk and adopting local actions that could be used to respond to flood and other climate-related disasters.

Keywords: flood disaster; risk perception; rural communities; preparedness; socioeconomic and institutional factors; Khyber Pakhtunkhwa; Pakistan

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1. Introduction

Natural hazards can be classified as either sudden or gradual onset [1]. It is predicted that by 2050, a significant number of people will be exposed to the deadliest natural hazards [2]. Of the various natural hazards in terms of economic and social consequences, flood disasters are perhaps the most prevalent cause of death and destruction in society [3]. Floods are accountable for more than 30% of all natural hazards that have occurred in the last century [4–7]. Besides the impacts of climate change, water-related catastrophic events are becoming more frequent in Pakistan. According to the Climate Risk Index (CRI), Pakistan is the world's seventh most vulnerable countries in the world to climate change, while it comes in at number 18th (out of 191) on the Global Risk Index (GRI) [8]. Pakistan was hit by 21 significant floods between 1950 and 2011 (with one flood occurring every three years on average) [9]. Approximately USD 19 billion has been lost indirect economic losses due to these 21 floods that have killed 8887 people and affected more than 100,000 villages [10]. However, Pakistan saw its worst flooding in history in 2010, affecting nearly all four provinces of the country at once. The 2010 flood resulted in a total economic loss of USD 9.7 billion, claimed the lives of 1985 people, and affected about 20 million people across the country [1,11–15]. The devastation wrought by the 2010 flood was enormous in contrast to other natural hazards that occurred between 2000 and 2010 (for example, the earthquake in Pakistan in 2005, the 2005 Cyclone Katrina and the devastation in Haiti, and the 2008 Cyclone Nargis) [13,16]. These disasters had a profound effect on the overall community perception and attitude toward risk [17].

Studies on disaster risk are mainly concentrating on people's perceptions of risk. People who are vulnerable to external threats are predicted to take protective actions [18]. Moreover, it is a part of predicting how people would react in the event of natural catastrophes [19]. Higher risk perceptions are expected to increase the awareness level of the local communities and improve their ability to adapt to climate change and natural hazards. When communities have a thorough understanding of how risk perception works, they can predict how they could react to a specific risk. This knowledge could perhaps be used to improve public education and outreach initiatives [20]. Notwithstanding their importance, very few studies have been carried out in Pakistan to examine how people perceive flood risk in urban areas [17] and mountain terrain [21]. However, little research has been conducted on rural people's risk perception of flooding in Khyber Pakhtunkhwa (KP) province, Pakistan. It is anticipated that the findings of this research would aid in flood prevention and adaptation in these flood disaster-hit communities or regions of the country.

The next section of the paper contains the theoretical underpinning of risk perception (Section 1.1), research objectives and questions (Section 1.2), and an explanation of the data and methodology used in this research (Section 2). The results section (Section 3) presents the findings on the flood hazard exposure, risk perceptions, and its attributes, while the ramifications for government and policymakers are incorporated along with the conclusion section (Section 4).

1.1. Theoretical Underpinning of Risk Perception

Risk perception plays an important role in household vulnerability and resilience [17]. Thus, it has become more important to incorporate disaster risk reduction as well as climate change adaptation into risk perception. People would not be able to discern how others intend to lessen these risks if they do not conduct a thorough risk perception assessment. The lack of data or information regarding flood risk perception would make it more difficult to effectively communicate flood risks [22]. While studying rural people's perception of risks, it is pertinent to mention that a considerable amount of the literature has concentrated on people's personal experiences with prior floods and their socio-demographic characteristics [23]. Assessing flood risk is essential to identify the appropriate method for delivering flood information [24]. In the very same way, the community would have more faith in its government and be better prepared to deal with flood disasters.

It was shown in research conducted by Duží et al. [25] that "expert flood risk assessment diverges dramatically from people's flood perception". Experts have a more realistic perspective of flood risk than ordinary people [26]. Thus, community underestimation of flood risk presents a serious challenge to the flood risk management paradigm. Encouragement of proactive flood risk mitigation among the most vulnerable people in society begins with an understanding of the community's perception of flood risk (Becker et al. 2013). In order to better comprehend the coping skills of the local inhabitants, it is necessary to understand how they react and interpret flood risks [27]. Consequently, it is necessary to know how inhabitants in disaster-prone areas perceive flood risk in ways to construct and execute flood risk management techniques [21,28].

There are two ways to evaluate risk perception. One is a rationalist approach, and the other is a constructionist approach (please see [18]). In the year of 1969, Starr made a concerted effort to examine how the public values benefits and costs associated with technological risk [29]. Starr analyzed historical records of incidents and accidents to determine the appropriate societal cost of technological risks. In his research [30], he discovered that people are willing to incur a greater risk if the action is voluntary rather than involuntary. In the wake of Starr's work, Solvic, in support of his research team, conducted extensive research on the cognitive processes that underlie societal risk-taking behavior (e.g., [18,21]). There was a claim that risk is a subjective concept that may be psychometrically characterized to reflect quantitative levels of judgment (see [31]). They focused on the cognitive attributes that underlie risk perception. In this light, risk assessment ought to be centered on the individuals. It also examines the disparities in risk perception between certain general public and experts. The focus of this approach is on how people evaluate and appraise different kinds of risks. Researchers in cognitive psychology were also influenced by Starr's 1969 study on preferences and needed to look for differences in human behavior [18] and judgments made in the face of uncertainties. This method or approach is referred to as "the heuristics and judgment approach", and it tries to categorize people's decisions based on their appraisals of extrinsic losses and gains. It acknowledges that individuals commonly use mental guidelines to make decisions in uncertain situations, which can lead to prejudice or inaccuracy [32].

The rationalist approaches to risk perception emphasize the requirement for individual cognitive action, and the existence of a challenging situation is thought to inspire people to think more critically about the situation so that they can adopt preventative and protective measures (see [18]). Consequently, research based on the rationalist paradigm usually focuses on modeling, describing, and projecting behavioral outcomes under various risks. Between 1970 and 1980, researchers began to question rationalist assumptions about risk and how people perceive risk [33,34]. Rationalists failed to acknowledge the importance of the organization and social structure (see [35]). Keeping this rationale in mind, the researchers applied the notion of political ecology theory to risk studies. The goal of the political ecology study is to learn more about how communities interact with hazards by looking into the contextual elements (including structural constraints as well as the political pressures and economic attributes) that contribute to varying levels of susceptibility in disadvantaged groups. Researchers could use such concepts to establish a risk constructivist approach. Under the constructivist viewpoint, the risk(s) are shaped by society and linked to a system's dynamics, which include institutions, society, organization, values, and beliefs [35]. Risk varies depending on the context, which indicates that a hazard in one social system could be a potential opportunity in another social system, and vice versa (e.g., [36]). It views risk perception as more than just a social system's dependent factor and suggests that disaster incidents should be evaluated rigorously [21]. Furthermore, it demonstrates that risk is versatile and often inflicted by coercion on society, which is perceived by segments of society differently. Another important theoretical breakthrough associated with the constructivist approach is the cultural theory of risk. This thesis claims that people's risk perception is influenced by their social and cultural upbringings. Further, it emphasizes that perhaps the structures of social organizations generate and enhance the perception that an individual possesses. According to this theory, a person's views and actions can be described in terms of four major perspective groups, i.e., (1) fatalistic; (2) hierarchic; (3) individualistic, and (4) egalitarian [37]. In order to comprehend risk perception, a constructivist perspective looks at it as a socially constituted phenomenon. This method is premised on the idea that people's decision-making processes and judgments are largely formed and influenced by their social contexts or environments, including organizations and institutions.

Furthermore, People's risk perceptions are influenced by a variety of factors (e.g., socioeconomic status) that vary greatly from person to person and community to community, and they are strongly influenced by a variety of socioeconomic circumstances. Burton and Kates [38] categorized explanatory variables that impact flood risk perception as the relationship between hazard and the main resource usage, the frequency with which floods occur, as well as individual differences in flood experience. According to Wachinger et al. [39], it can be divided into four categories including scientific risk (e.g., the likelihood) followed by the personal (e.g., age and gender, etc.), contextual (e.g., education as well as experience), and informational (e.g., media, risk communication). Among the factors that influence flood risk perceptions, Aerts et al. [40] classified them as social (including age and literacy) followed by the economic (such as income and equity), geographical (e.g., distance from flood zone), cultural (e.g., heritage and language), and informational (e.g., media as well as data availability) [40], while Lechowska [41] categorized them as per intrinsic nature (including cognitive as well as demographical and geophysical) and influence (such as worry, followed by the preparedness/readiness and awareness) [42]. Even though the risk levels or circumstances remained the same, these variables alter the acceptable level of risk and the measures for adapting amongst individuals and groups (communities) [43]. Over this, it is critical to examine the factors that influence people's perceptions of flooding to design more effective flood management measures.

Variability in age affects cognitive processing and, thus, the perception of risk. It can also be linked to prior experiences as well as the sense of place and flood readiness [44]. Studies show that older persons have a higher perception of flood risks than younger ones [45,46]. While making important decisions, those with little or no formal schooling are limited in their access to information and conceptual understanding. According to numerous studies, the way people perceive risk might be influenced by their education and level of knowledge [33,47]. People with lower levels of education tend to view risk as being low. However, it was also revealed that in some circumstances, education does not affect the local inhabitants' perception of flood risks [38,48]. However, several studies found a significant correlation between income and the perception of flood risk [47,49], whereas others have found no such link [33,50]. According to Kellens et al. [46], there is no correlation between the perception of flood risk and the ownership of a house. Some studies, however, discovered a robust connection between owning a house and the perception of flood risk [33,51]. It is possible to make wise choices for those who have been through floods before. High flood risk is perceived by those who have been exposed to risks in the past [46], leading them to take precautionary measures or make hazard adaptations [52,53]. It was discovered that the distance from the risk source has a substantial impact on the local people's flood risk perception [33]. As a result, comprehending people's perceptions of flood risk is useful for successful flood risk management.

1.2. Research Objectives and Questions

The willingness of rural communities to take preventive measures would be influenced by a deeper comprehension of flood risk. Therefore, the local inhabitants in disaster-prone areas must be aware of the risk of flooding to acknowledge and endorse climate change (CC) and DRR policies. The main objectives of the current study are listed below:

- To investigate the flood risk perception among rural households in two severely affected regions (namely Charsadda and Nowshera) in Khyber Pakhtunkhwa province, Pakistan;
- To look at the determinants that could influence rural household flood risk perception in two severely affected regions (namely Charsadda and Nowshera);

Specifically, to achieve the above set objectives, the study intends to address the four main research questions;

- What are the major risks experienced by the rural households in the study areas?

- What is the level of different risk sources among rural households?
- What factors influence and shape rural households' perceptions regarding flood risks?
- How do flood risk perceptions differ among different groups based on socioeconomic characteristics, including age, education, and monthly income of the household head?

2. Materials and Methods

2.1. Study Area Description

Natural hazards are common in Pakistan because of the country's geographical location, extreme weather conditions, and high levels of exposure and susceptibility. A broad range of potential threats, including avalanches, cyclones, storms, droughts, floods, glacial lake outburst floods, earthquakes, landslides, tsunamis, and epidemics, constitute a serious threat to Pakistani society (http://www.science.gov/topicpages/e/extreme+natural+hazards.htm; accessed on 14 February 2022). It is important to note that some of these hazards (such as floods, for example) are seasonal and occur every year. On the other hand, hazards such as earthquakes and tsunamis are extremely rare yet can be quite damaging. Rapid changes are taking place in Pakistan from a largely rural and agricultural economy to one that is more industrial, as well as urban economy (http://www.eldis.org/vfile/upload/1/document/0901/UR_overview.pdf; accessed on 14 February 2022). Residents of hazard-prone regions who have lived in the area for a long time are generally equipped with mechanisms for spotting and responding to potential hazards. High population expansion feeds this tendency and can lead to extremely damaging behavior such as unregulated logging, which can amplify and alter preexisting risks [54]. Flooding is expected to become more intense and less predictable due to changes in monsoon and precipitation patterns brought on by climate change. In July and August of 2010, Pakistan was devastated by one of the worst floods in its history [55]. The precipitation from a high-elevation basin has flooded areas of northern and north-western regions of Pakistan, including Gilgit-Baltistan, the Azad Jammu and Kashmir, and Khyber Pakhtunkhwa. This research was carried out in the Khyber Pakhtunkhwa province, Pakistan. Between 1950 and 2014, there were 22 recorded floods, but the most destructive was the 2010 flood, which damaged millions of people and their livelihoods in the KP province. In the KP province, most of the floods occur in the rivers that flow through Kabul, Swat, Panjkora, Chitral, and Kurrum. In the whole province, the floodplain management teams are concerned about riverbank erosion and changes in the river's course. Such floods inflict serious damage owing to the lack of readiness and early warning systems. Marginal protection dikes and guided head spurs were built in crucial breaching locations in the province to reduce flood losses [9]. The two study locations of district Nowshera and Charsadda were continuously rated as high-risk areas for flooding due to their vicinity to the main river sources (including river Sardaryab as well as river Jindi, river Khyali, river Kabul, and Indus rivers). As a result, these research locations were chosen for this study (Figure 1).

Charsadda District is one of the most fertile regions in Khyber Pakhtunkhwa province, with an area of 996 km^2. It is located 25 km from Peshawar as in the north, it borders with Malakand district, while to its east and south are the Districts of Nowshera and Peshawar and to the west is the District of Mohmand. There are 49 union councils in the Charsadda District, which is divided into three administrative sub-divisions named Charsadda, Tangi, and Shabqadar. The district is bounded by three major rivers (Sardaryab River, Swat River, and Jindi Nullah, or Seend River). These rivers furnish most of the district's irrigation water. This region is frequently inundated by the Kabul River. Nearly 71,813 families were impacted by the 2010 flood [16,56].

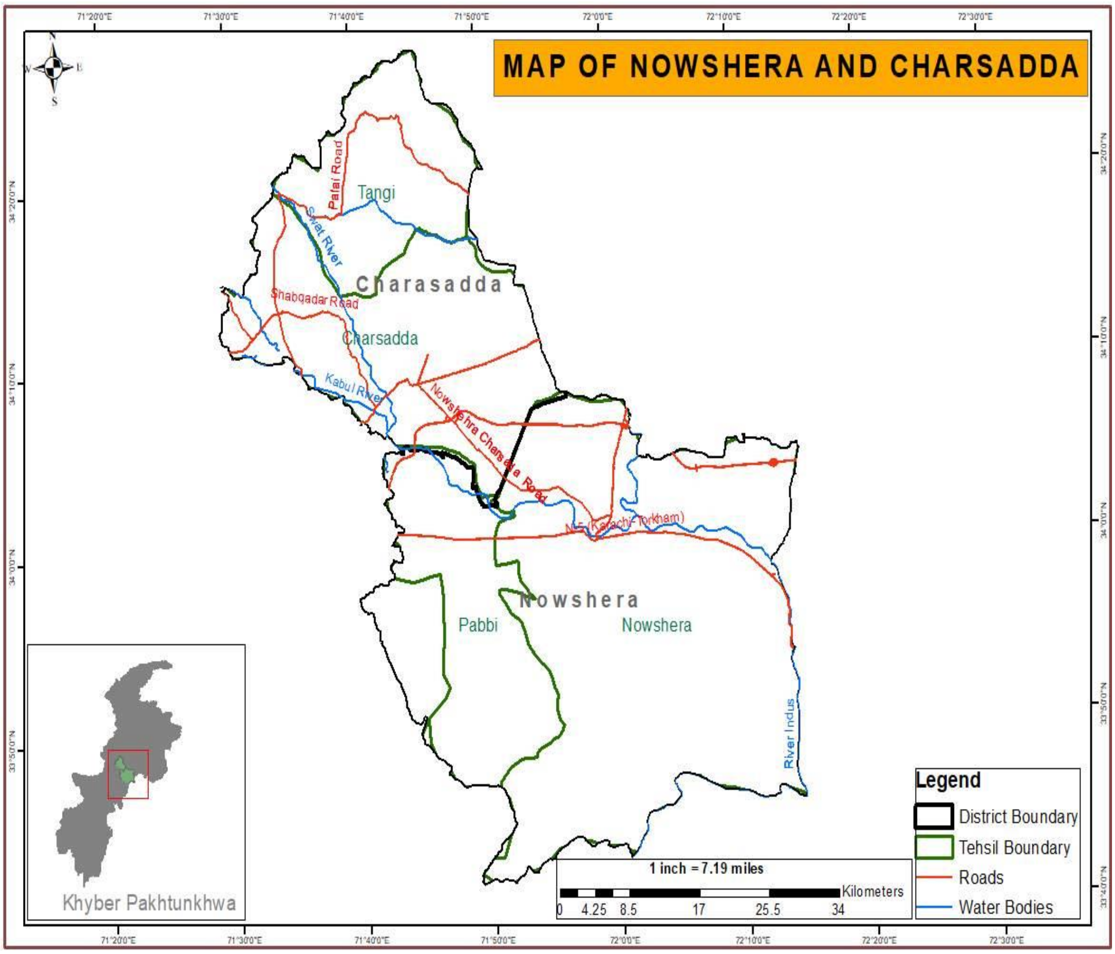

Figure 1. Study area map.

District Nowshera is made up of 47 UCs and one Tehsil, with a total area of 1748 square kilometers. The district has a population of around 1.25 million. Nowshera is bordered by Peshawar (west), Charsadda and Mardan (north), Swabi (east), and on the south by Attock. The western Peshawar basin is endangered by both riverine and flash flooding. The Swat and Kabul Rivers merge with large tributaries in the Peshawar basin, including Jinday and Khiali (Swat River), Shah Alam, Naguman, and Sardaryab (River Kabul). Other prominent rivers include Kalpani, which springs from the north of Mardan, and Bara, which springs from the south. The Kabul River is a junction area for seven major rivers, which makes this region vulnerable to flooding, but also offers the district of Nowshera plenty of floodwaters. For example, more than 20,000 families were forced to flee their homes due to flooding in 2006. Additionally, in 2010, a total of 72,403 households were impacted by the flood disaster [16,56].

2.2. Sampling Procedure and Data Collection

Primary data collection took place between February 2018 and June 2018. A total of 600 households (household heads) were interviewed face-to-face utilizing a predesigned structured questionnaire to gain a better understanding of the research objectives. The study locations and sampled households for the current research were chosen using a multistage sampling strategy. The KP province was selected in the initial round of sampling because it is susceptible to natural hazards, particularly floods (caused by the Indus River) and earthquakes (due to its location in an unstable tectonic zone). In the second stage of sampling, we used a purposive sampling technique to choose two severely affected districts (namely Charsadda and Nowshera) out of the 24 districts that were inundated in

2010. The third stage of the sampling procedure involves selecting three union councils (UCs, a second-smallest unit of local governance system) from each district (priority given to locations that are more prone to flooding), followed by the selection of two villages from each UC in the fourth stage of the sampling. In the final and fifth stages, we used a list provided by the UC Nazim (elected chairman) to randomly select around 50 households from each village, resulting in a total sample size of 600 flood-affected households (300 = Charsadda and 300 = Nowshera). The sample size (n) for this study was calculated using the formula in Cochran (1977) with finite sample correction as shown in Equation (1). The formula in Equation (1) returns the minimum sample size required to ensure the reliability of the results.

$$n = \frac{\frac{Z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{Z^2 \times p(1-p)}{e^2 N}\right)} \quad (1)$$

In Equation (1), p represents the proportion of the population, and it is assumed to be 0.5, which is conservative. The symbol "e" represents the margin of error, which is set at 5% for this calculation. Z is the Z-score corresponding to the area of rejection under the bell curve, and N is the population of the region, which, in our case, is the population of Nowshera (1,250,000) and Charsadda (1,450,000) districts. The sample size estimated through the formula above is 273. We rounded up the sample size to 300 for each district to obtain more comprehensive responses across the two districts. Even though the survey questionnaire was written in English, however, it was administered to respondents in their local language (PUSHTO). In order to confirm the predesigned survey questionnaire validity and reliability, a pre-testing was undertaken on 30 households from outside the sample. To make data collecting easier, we employed two enumerators from a local university.

2.3. Risk Matrix Used for Rural Household's Flood Risk Perception—Objective 1

It was shown in the disaster literature that indices are useful for quantifying risk perception, which is frequently a subjective phenomenon. The use of indices in disaster risk and climate change susceptibility research is widely acknowledged as an efficient technique to represent and quantify complicated data sets [57]. An index must be constructed by aggregating datasets that were standardized before the index was constructed. Thus, weights are used to normalize responses so that a composite index can be calculated. Variables about risk perceptions were selected after careful consideration of the scientific literature (Table 1). Some of the indicators included the individual's capacity to manage, a thorough understanding of emergency protocols, and the ability to communicate effectively as well as placing faith in government initiatives, even though they do not offer any precise measurement of risk perception. They also serve as one's capacity to cope with risk, which is inextricably linked to total or overall risk perceptions.

As part of the risk matrix method, respondents were asked to rank the flooding risks scale from 1 (very low) to 5 (very high) in terms of their likelihood and impacts. Figure 2 shows a matrix of responses from households on both the likelihood and impact of flooding, which were then computed against both variables. A cumulative computed score of 2 to 5 was deemed low, and a cumulative determined score of 6 to 10 was regarded as high. For example, if the sampled household head provides a likelihood score of 5 and an impact score of 3, then the calculated risk score is 8, which is regarded as high risk. We then looked at the sampled households' flood risk perception scores on a dichotomous scale: 1 for high flood risk (score range 6–10) and 0 for low flood risk (score range 2–5) [58].

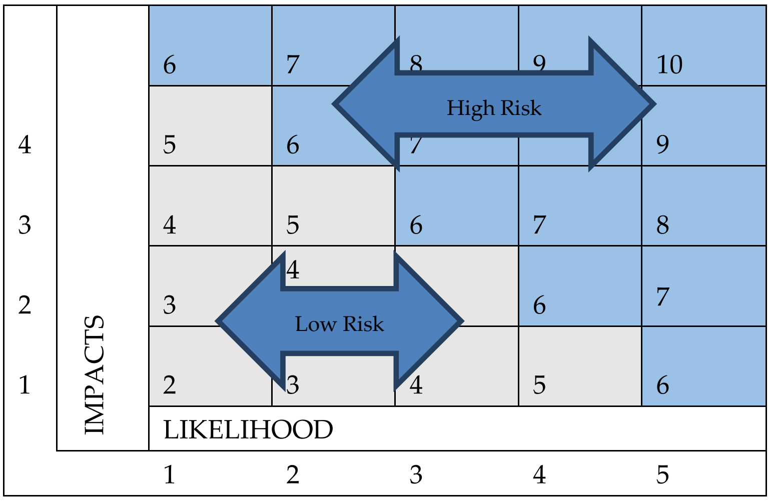

Figure 2. Risk matrix.

2.4. Variable's Selection and Description

The demographic and socioeconomic determinants used in this study include respondents' age, literacy, income for monthly periods, family size, house ownership, past flooding experience, distance from the nearest river source, and access to information sources on credit and weather forecasting. Age and education are continuous variables; the total monthly earnings of the family head in PKR (Pakistani rupee), while the house ownership is measured as if the household head owned or rented the house. Family size is counted as the headcount of household members sharing the same kitchen flood experience is estimated as 1 if the household head had past flooding experience and 0 for otherwise, distance from the nearest water source is measured in kilometers (km) (Table 1). We also looked at the household's access to credit and weather information, and we requested that the respondents indicate their interactions with each credit and weather information source within a month of the survey (1 = if the head of the household has access to credit and weather forecast sources and 0 otherwise).

Table 1. Variables and their description.

Variables	Description
Flood incidence	Likert scale 1 = very low to 5 = very high
Flood impact	Likert scale 1 = very low to 5 = very high
Flood risk perception (pooled)	1 = high flood risk perception (score range 6–10); and 0, otherwise (score range 2–5)
Age (years)	Household head age
Education (Years)	Schooling years
Monthly income	Monthly household income in local currency (PKR)
Family size (numbers)	Total family members per family
House ownership	1 = owner; and 0, otherwise
Past floods experience	1 = past flooding experience and 0, otherwise
Distance from the nearest river source	Measure in Kilometers (km)
Credit sources	Household's access to credit sources (1 = access to credit sources, 0 = otherwise)
Information sources	Household's access to information sources (1 = access to information sources, 0 = otherwise)

2.5. Empirical Modelling for Flood Risk Perception Attributes—Objective 2

By using logistic regression, this study examined the rural household flood risk perceptions and their attributes in two severely affected districts of Khyber Pakhtunkhwa province, Pakistan. A logit/probit model or a linear probability model (LPM) was used to compute the probabilities given the components' two-fold (binary) existence. LPM has advantages over Logit and Probit models in that it is easier to understand the estimated coefficients. However, the LPM has the following drawbacks: (1) Expected values can be higher than 1 and 0, (2) all levels of linear variation should have a consistent marginal effect, and (3) residuals can be inconsistent with the premise of homoscedasticity. Both Probit and Logit models explain the shortcomings of the LPM models, which offer the most accurate probability assessments. The logistic regression model is thus used in the analysis in simplistic terms; both Logit and Probit models offer comparable results in line with common practice for disaster management. Statistical analysis was performed using the SPSS program version 19. This model considers the possibility of a disturbance with a zero mean and a constant variance.

$$\mu \text{ € } (0, 1)$$

Here, μ is a disturbance term. If the above assumption of the error term is not satisfied within the logistic regression (LR) model, it is based on the Bernoulli distribution, which is a binomial subset, with the binomial denominator having a value of 1. The mathematical form of LR in terms of Bernoulli distribution can be written as;

$$f(yi;\pi i) = \pi yii(1-\pi i)1-yi \tag{2}$$

where πi shows the probability of success and yi is Bernoulli distribution. The deviance that can be used as a goodness of fit statistic is twice the difference between the saturated log-likelihood and model log-likelihood. The deviance is represented in the LR model;

$$D = 2\sum_{i=1}^{n}\{y_i ln(y_i/u_i) + (1-y_i)ln(\frac{1-y_i}{1-u_i})\} \tag{3}$$

where D is the deviance, u_i is mean,

$$x\prime\, i\beta = ln\left(\frac{\mu i}{1-\mu i}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n \tag{4}$$

Here, $x\prime\, i\beta$ is the linear predictor, $ln(\mu i/(1-\mu i))$ is the link function β_0; β_1, β_2, and β_n are the parameters; and x_1, x_2, and x_n represent the coefficients.

The value of μi, for each observation in the logistic model, is calculated as

$$\mu i = 1/(1+exp(-x\prime i\beta)) = exp(x\prime i\beta)/(1+exp(x' i\beta) \tag{5}$$

Here μ is the probability for the logistic model.

The equation for this model is given as

$$logit(Yi) = ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 x_1 + \beta_2 x_2$$

In the above equation, Yi represents a binary dependent variable that symbolizes a household's risk perceptions of high and low levels of response to flood disasters. xi refers to the indicator or independent variable (socioeconomic, physical, and demographic features, and institutional factors). βi covers the parameters to be established, and α displays an intercept. ln represents the odd ratio log to determine the probability density function.

3. Results

3.1. Descriptive Statistics of the Study

The descriptive statistics of the study are presented in Table 2. The findings in Table 2 show that 67% of the total sampled household heads reported high flood risk in the study region, followed by flood incidence (65%) and flood impacts (70%) (Figure 3). About 77% of respondents said that they had experienced different nature and magnitude of flood disasters in the past 10–20 years. The average household head age and education were 45 and 6 years. The average family size consists of about six members. The average monthly income of a household head was around PKR 20,442. The majority of the households owned their houses (80%), and about 89% of the household reported that their homes were located within a distance of less than one kilometer from the river bank. Access to credit sources and weather forecast information was appeared to be high, i.e., 88% and 79%.

Table 2. Descriptive Statistics.

Variables	Mean	SD
Flood incidence	0.65	0.60
Flood impacts	0.70	0.62
Flood risk perception (pooled)	0.67	0.38
Age (years)	44.79	13.29
Education (Years)	6.01	5.17
Monthly income	20,442	9863
Family size (numbers)	5.62	2.150
House ownership	0.80	0.593
Past floods experience	0.77	0.42
Distance from the nearest river source	0.11	0.13
Credit sources	0.88	0.33
Information sources	0.79	0.41

Derived from field survey data.

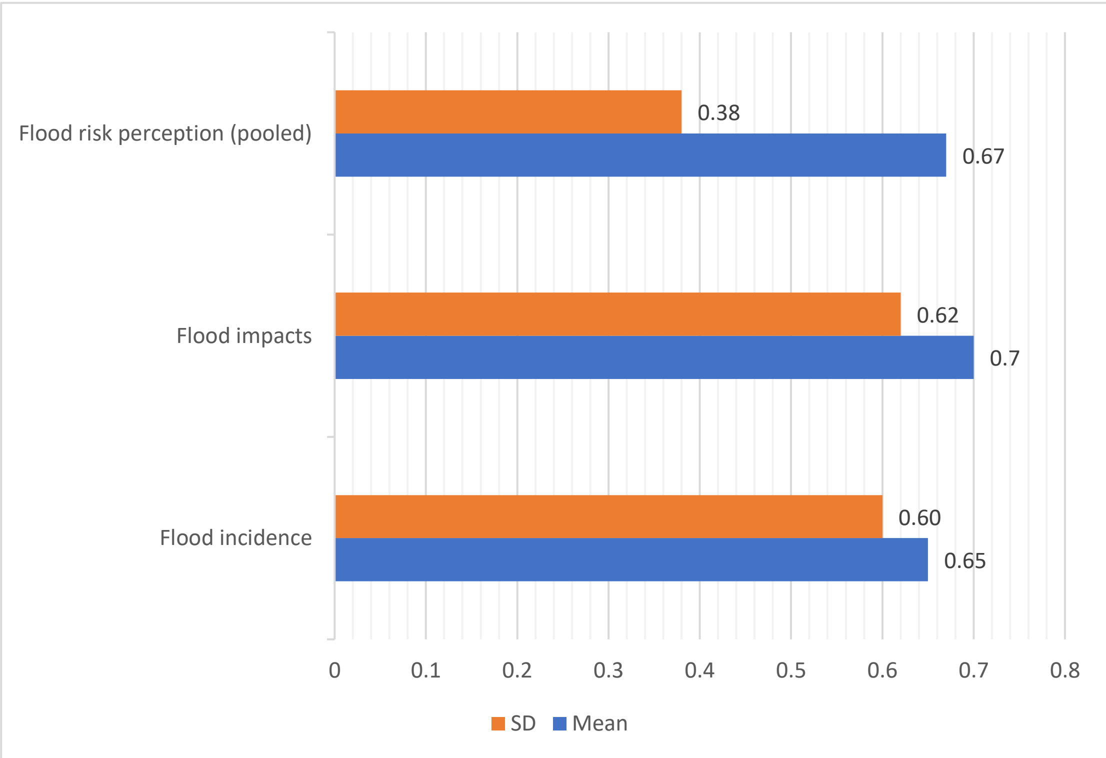

Figure 3. Flood risk perception/incidence and impacts.

3.2. Major Risks Experienced by the Rural Households in the Study Areas

Table 3 shows the distribution of respondents based on different perceived risks in the study areas. The survey results in Table 3 show that 66 percent of the respondents in the Charsadda district perceived flood risk, followed by 9% who perceived landslides risk, 6% indicated earthquakes, 7% of respondents reported drought risks, and 9% of the total respondents reported infectious diseases and epidemic risks. On the other hand, only 3% of those polled said that cyclones were the most substantial threat to their lives. In district Nowshera, 69 percent of total respondents believed there was a high risk of flooding (with household heads in UCs Akbar Pura (70 percent on average), and UC Mohib Banda

(69 percent on average) reported higher flood risk than those in UC Pirsabaq where the average response was 67 percent). The other perceived risks by the sampled respondents in district Nowshera were landslides (9% on average), drought (7%), infectious diseases and epidemics (8%), earthquakes (6%), and 2% of the total respondents' perceived cyclone risks. Overall, 67% of the total sample respondents perceived flood disaster as the main potential threat (very high), with household heads in the Nowshera district (69% very high) falling well ahead compared with the sample respondents in the district Charsadda (66% very high). On average, 9% of total sampled households reported landslides, 6% (on average) reported earthquake, 7% (on average) perceived drought risk, 9% on average perceived infectious diseases and epidemics, and 2% perceived cyclone as the main potential threat in the sampled study areas.

Table 3. Major risks experienced by the local inhabitants.

District	Union Councils	Flood	Landslide	Earthquake	Drought	Infectious Diseases and Epidemics	Cyclone
Charsadda	Agra	65	7	6	8	10	4
	DolatPura	69	12	4	6	7	2
	Do-Sehra	64	8	7	7	11	3
	Sub Total	66	9	6	7	9	3
Nowshera	Akbar Pura	70	7	6	8	7	2
	PirSabak	67	13	5	7	6	2
	Mohib Banda	69	7	6	5	12	1
	Sub Total	69	9	6	7	8	2
Grand Total		67	9	6	7	9	2

Source: Derived from field survey data (the responses are presented in percentages).

3.3. Rural Household's Flood Risk Perception

Results in Table 2 show a diverse perspective on flood risks and their consequences. The mean of a variable or indicator can be used to determine its degree of significance. Flood disasters were found to be more frequent (flood incidence) in the study region (0.65) (with a higher mean value in the district of Nowshera (0.47; Table 2)). Consequently, the high average of flood impacts (0.70), which represent the damage to community assets and livelihoods, shows that both districts were negatively affected by floods (Table 2). To be more specific, the higher mean value (0.46) in the Nowshera district indicates a greater intensity of flood impacts and damages as compared to district Charsadda's impact and damages.

Overall, 67 percent of the total selected households had a high flood risk perception (with the district of Nowshera having the largest percentage of residents with a high-risk perception of the floods (Table 2)). Both communities had a stronger dread of flooding and a greater concern for their safety, with mean scores of 0.88 and 0.95, respectively. Households in Nowshera reported a higher level of fear and a greater threat to life than those in Charsadda, but the perceptions varied widely between the two districts. Figure 3 shows that floods had a greater impact on food and other needs (i.e., food and related products) in both study regions. Particularly in Nowshera, residents reported that floods had disrupted their social networks and connections with neighbors across the region (0.71). Findings from Figure 4 indicate that the communities in both districts believed that they have a fair level of expertise (0.78) to deal with flooding and its effects. In Charsadda and Nowshera districts, the ability of residents to deal with flood disasters is dramatically different, but there is no major difference in their ability to adapt their lives to the flood incidents. The community's faith in government policies and activities connected to flood risk management and reduction was also assessed in this study. Results from our study show that Charsadda residents placed more value on government policies than those in Nowshera (Figure 4).

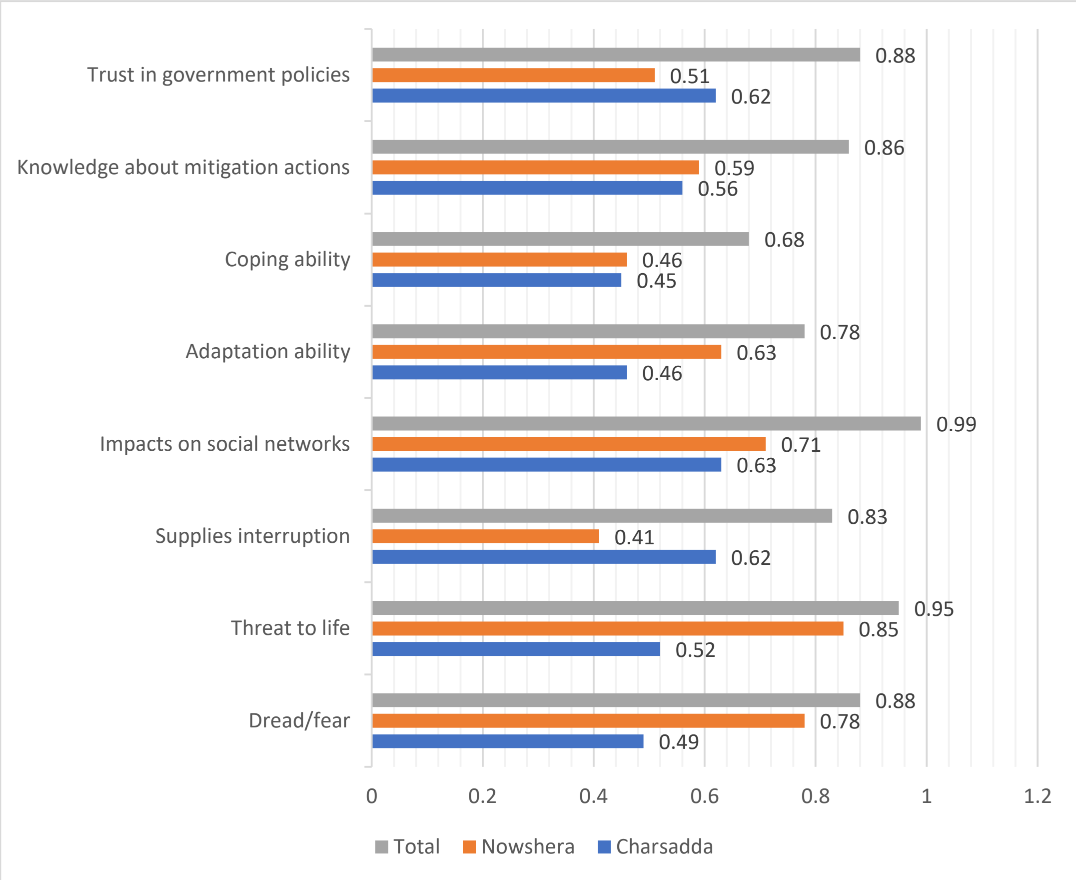

Figure 4. Other related uncertainties/adaptabilities.

3.4. Important Attributes That Could Influence Households Flood Risk Perception

The logistic regression is employed to analyze the factors influencing the household risk perception (Table 4). The high R-square value shows that explanatory variables explain well the change in risk perception. The important flood risk perception attributes show that household head age ($p < 0.01$) [46,52,59], education ($p < 0.01$) [33,50], family size ($p < 0.01$) [17], housing ownership ($p < 0.01$) [60], past flood experience ($p < 0.01$) [17,33,48], access to credit sources ($p < 0.1$) [61], and access to weather information ($p < 0.01$) [41,61,62] are positively linked with the flood risk perception whereas the distance from the main river sauce ($p < 0.1$) [63,64] and monthly income (insignificant) showed a negative relationship with the flood risk perception.

Table 4. Important attributes that could influence households flood risk perception.

Explanatory Variables	Flood Risk Perception
Age (years)	0.094 (0.029) ***
Education (years)	0.194 (0.068) ***
Income (PKR)	−0.000 (0.000) ns
Family size	0.566 (0.168) ***
Housing ownership	1.765 (0.569) ***
Flood experience	3.001 (0.534) ***
Credit sources	0.935 (0.521) *
Information sources	1.837 (0.510) ***
Distance from nearest river source	−1.044 (0.502) *

Table 4. *Cont.*

Explanatory Variables	Flood Risk Perception
Constant	−6.590 (1.338) ***
Log-likelihood	−78.887
LR chi2 (9)	186.43 ***
Pseudo R2	0.5416
Number of observations	600

Standard errors in parentheses, *** represent $p < 0.01$, and * $p < 0.1$, whereas, ns shows non-significant.

3.5. Flood Risk Perception across Regions and Socioeconomic Characteristics Categories

This section explains how respondents' demographic and socioeconomic characteristics affect their perception of flood risk. For comparative reasons, the heads of households are grouped into different categories depending on their attributes and level of flood risk perception (high). For this reason, we broke down the education of the household head into three subcategories: (i) illiterate, (ii) 1–10 years of formal schooling, (iii) >10 years of formal schooling. Similarly, age is categorized into three subcategories (i) <24 years, (ii) 25–40 years, and (iii) >40 years, while household head's monthly income is divided into (i) low, (ii) middle, and (iii) high-income groups. Figure 5 shows that 51.47 percent of the total sample respondents who had education levels of 1–10 years estimated a high flood risk compared to respondents with more than 10 years of schooling (14.06 percent on average) and those who were illiterate (34.47 percent on average). As shown in Figure 6, respondents older than 40 years (52.83 percent on average) had a higher perception of flood risk than younger respondents (6.80 percent on average) or those aged 25–40 years (40.36 percent on average). On the other hand, when it comes to household head monthly income (Figure 7), 73.02% of the total sample respondents with low monthly income reported a higher perception of flood risk than those with the high–medium income (11.56 percent on average) and high monthly income (15.42 percent on average).

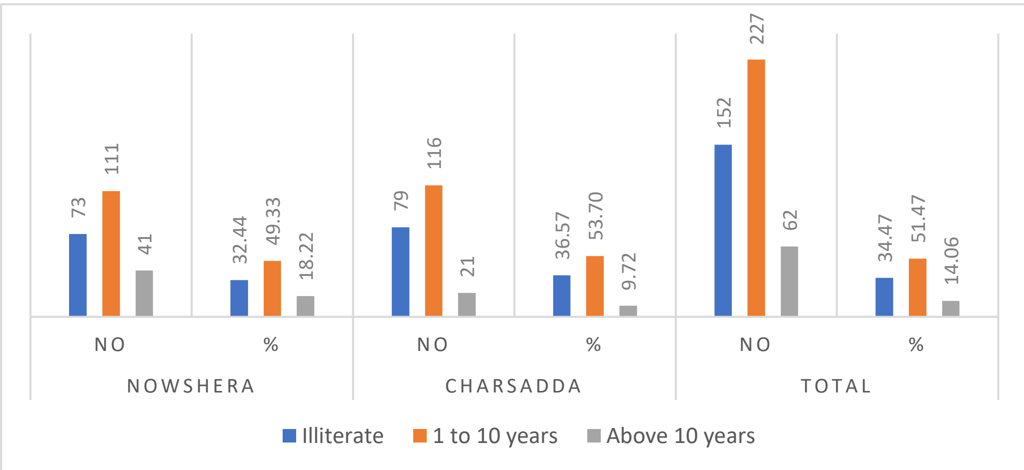

Figure 5. Flood risk perception varies based on the household head's education.

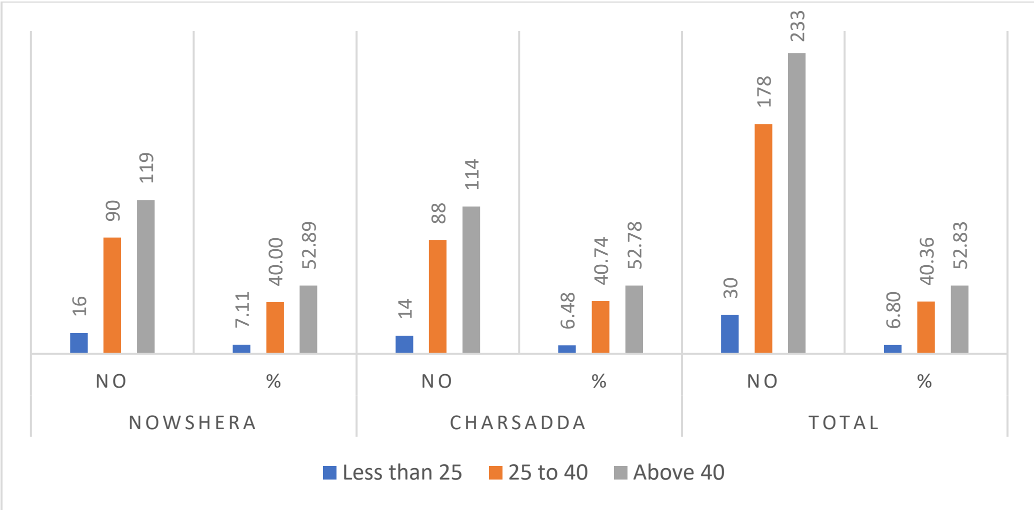

Figure 6. Flood risk perception varies based on the household head age.

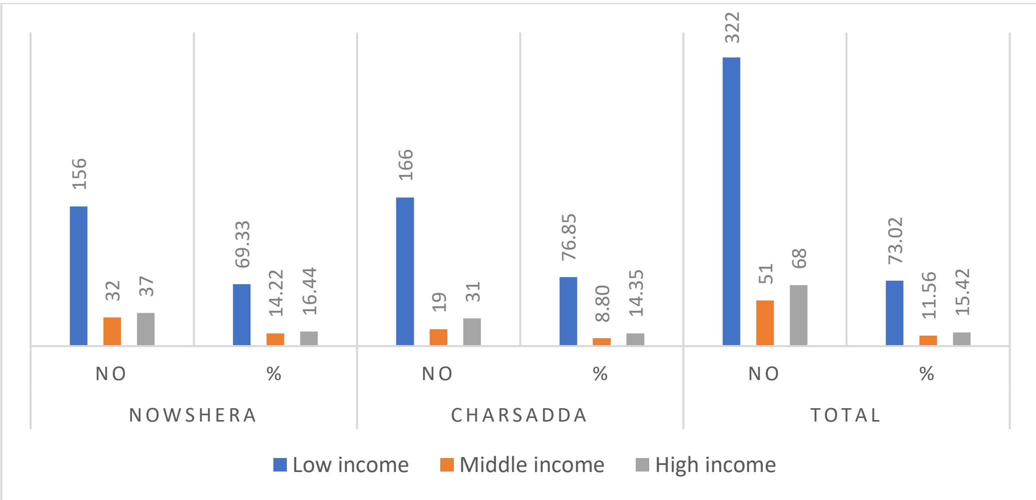

Figure 7. Flood risk perception varies based on the household head's income.

4. Discussion

The sampled household heads in both research districts were asked to rank the multiple potential risks they encountered between 2010 and 2014. The survey findings revealed that flooding was deemed to be the greatest risk to people and property in both study areas as compared to other risks, such as landslides, infectious diseases, earthquakes, droughts, and cyclones. The findings on flood risks among rural households are consistent with those of the KP Provincial Disaster Management Authority [9], which found that the KP province is vulnerable to a variety of natural hazards, including floods. These disasters have had a devastating effect on the local inhabitants in terms of overwhelming losses of human lives, damage of essential infrastructures, destruction of crops and livelihoods, as well as ecological deterioration. As a result, this circumstance necessitates well-thought-out disaster mitigation and readiness plans, which include measures to reduce risk and provide an efficient response mechanism. Shah et al. [9] highlighted that flooding is one of those natural hazards that have long-term consequences on many levels, including social networks. The study findings revealed that flooding disrupted social networks with other communities by ruining public infrastructures such as roads and telecommunications systems. As a result, these communities were isolated for extended periods from surrounding urban centers as well as rural residents. Furthermore, the government policies and initiatives to manage and reduce risks were distrusted by the sampled households (especially in the Nowshera district) since the existing interventions may not be sufficient to help these communities. Recent studies in the region have found that public organizations are under-equipped to support community-based disaster risk management [45].

Socio-demographic factors have a significant role in flood disaster risk assessment [44]. Attributes identified as having the potential to sway rural household head perceptions of flood risk are listed in Table 4. This is in agreement with the other studies' results [46,52,59] that indicated that elderly household heads or individuals see floods as a potential threat source that can damage their livelihoods or property. Education is a crucial source of information that could influence the household head flood risk perception [65]. As seen in Table 4, the relationship between education coefficient and flood risk perception is positive and statistically significant, implying that rural household heads with a higher educational status perceive flood disaster as a major threat contrasted to household heads with no (illiterate) or lower educational level. They could motivate those with lower educational backgrounds to become involved in flood prevention initiatives. In line with the findings of our research, Qasim et al. [33] and Botzen et al. [50] found that education improves public understanding of environmental risks. Furthermore, our education coefficient results contradict the findings of Wang et al. [66], who reported that people with higher educational backgrounds are less anxious about flood hazards. The family size coefficient of the household head shows a positive and significant relationship with flood risk perception. This implies that a household with large family members congregating in one place and exchanging ideas and information about flood hazards has a greater impact on risk perception compared with the small family size. This finding is in line with Rana et al. [17], who found a link between household head family size and risk perception that may be attributed to the frequent exposure of the household head with the previous catastrophic flood events in the Muzaffargarh region of Punjab province, Pakistan.

Housing ownership plays a significant role in determining how local inhabitants respond to flooding [60]. The results of this study revealed a strong positive link between the coefficient of household head housing ownership and flood risk perception. This could be attributed to the fact that the overwhelming majority of the rural households in the research regions were owners of their houses. This is in contrast to previous research by Kellens et al. [67], which revealed that homeownership did not affect risk perception. This study also found a strong correlation between risk perception and the coefficient of household head experience. This is especially true in Charsadda and Nowshera districts, where residents who had previously experienced floods perceive a high risk. It is worth remembering that the Inhabitants of the Charsadda and Nowshera districts faced riverine floods in 2010. The coefficient of household head past experience is in line with Siegrist et al. [68], who reported that a person's perception of flood risk is strongly influenced by their past experience. Other studies [17,33,48] also found that prior experiences are an important element in influencing people's perceptions of flood risk. In addition, it means that those who have been affected by floods are more willing to accept preventative actions against potential risks in the future.

Despite its significance level, distance from the nearest river source was found to have a negative correlation with the respondents' perceptions of risk. This could be attributed to the fact that those who live close to rivers would be more vulnerable to flooding than those who live further away. The finding of household head coefficient of distance from the main river source is supported by the studies [63,64] that found that this attribute has a negative correlation (but significant) with flood risk perception. The negative and significant relationship between the variable and risk perception indicates that household heads who live near the main river sources perceive higher risk than people who live further away. Flood risk perception is positively associated with household heads' access to credit facilities, which shows that persons living in high-risk locations may rely more heavily on various financial sources to deal with catastrophic disasters. Research in Pakistan [61] confirms the findings of this study that access to financial resources improves the aspirations of persons who are susceptible to flooding. Climate change awareness is raised through a range of information sources, which in turn stimulates the use of risk-management tools to reduce the possibility of natural hazards [61]. Household head access to weather forecast information and flood risk perception were found to have a positive association. The findings of household head access to weather forecast information are consistent with those of Ullah et al. [61], Raaijmakers et al. [62], and Lechowska [41], who found that households with more access to weather forecasting information are better prepared to deal with flood risks.

According to the survey results shown in Figure 5, flood risk perception was higher among respondents with 1–10 years of educational attainment (49.33% for Nowshera and 53.70% for Charsadda, respectively) than those with more than 10 years of schooling. The primary reason for this could be since respondents in the study locations with 1–10 years of education were more concerned and regarded flood risk to be a potential threat to their lives and livelihoods. Our findings are in agreement with those of Botzen et al. [63], who discovered that the perception of flood risk increases as the education level rises. Some research, however, found a negative correlation between respondents' educational level and their perception of flood risk [69]. Figure 6 illustrates how the perception of flood risk varies among different age groups of household heads. The study's findings revealed that the perception of flood risk was higher among household heads over the age of 40 than among those under the age of 25. This implies that younger household heads might not experience flood incidents in the past and thus lacked the necessary knowledge and skills to safeguard themself and other members of the family from flooding. Similarly, older people may have a more nuanced understanding of how to deal with various types of danger, which could explain why they are so concerned by flooding and have such a high flood risk perception. Our findings in Figure 6 are consistent with those of Kellens et al. [45] and Lindell and Hwang [52], who perceived flooding as a greater risk by older people. Figure 7 depicts the association between household head income and flood risk perception. Low-income households were most likely to have a significant view of flood risk than middle and upper-income households. This could be because households in the lower-income brackets were more worried about flooding and viewed it as a major threat to their possessions and property. The other reason for high flood risk among lower-income households explained this as low-income households are more reliant on the little resources that are accessible to them.

5. Conclusions and Policy Implications

Climate-related disasters in Pakistan, such as flooding, have wreaked havoc on the country's economy (by damaging physical infrastructure) along with severe fatalities of precious human lives. The findings of this study could be beneficial to rural communities where current development plans lack information on local catastrophe risk reduction and assessments. District disaster management units may not exist at all or may only have a very restricted scope in more remote areas of the country. As a result, flood risk management in Pakistan must be proactive instead of reactive. That is why Pakistan's disaster management agencies and research institutions could learn from this study when devising new disaster risk reduction strategies, particularly in rural flood-prone areas. Professionals in the field of flood risk management could use the findings of the study to build risk perception strategies, i.e., risk communication techniques, that enhance community awareness. Precautionary measures are more likely to be implemented if the community is aware of the flood risk. People will not support DRR or climate change policies if they do not understand flood risk. Since floods are multifaceted, an integrated approach is needed to account for all aspects of risk, vulnerability, and societal behavior. The Sendai Framework for Disaster Risk Reduction's first aim, recognizing disaster risk, can be aided by a better understanding of flood risk perception dynamics.

The purpose of this study is to look into the psychosocial aspects of flood risk. The two communities (namely Charsadda and Nowshera districts) evaluated in this study had significantly different perceptions of flood risk, which explains the regional differences. Both districts have been negatively impacted by floods, based on the high average of flood impacts, which represent the destruction to community assets and livelihoods. Study findings reveal that the majority of sampled respondents (very high) perceive flood disaster as the primary potential threat, with household heads in Nowshera district falling well ahead compared with sample respondents in Charsadda district. Overwhelmingly on the binary scale of a risk matrix, 67% of all households assessed had a high flood risk perception, with the highest concentration in the district of Nowshera in KP. It was found that socioeconomic characteristics of the sampled respondents such as age, education and house ownership, family size, and the distance from the river source, as well as factors such as access to credit and weather forecast information, were closely associated with households' perceptions of flood risk. The results of the current study also showed that the perception of flood risk differed across the heads of households. For example, a household head with one to ten years of formal education estimated a high risk of flooding, followed by individuals over the age of 40 and those with a lower monthly income.

In light of the varying nature of flooding in the KP province, the relevant authorities should develop policies for flood disasters. The National Disaster Management Authority (NDMA), Provincial Disaster Management Authority (PDMA), and District Disaster Management Authority (DDMA) officials can use these findings to understand local floods and other extreme events better, which can be used for adaptation in the specific setting. In addition, these results could assist in establishing the validity and adherence of land-use planning as well as other risk-reduction strategies implemented by government authorities. In addition, people's perception of flood risk is important for effective flood risk management. As a result, flood risk perception must be incorporated into district disaster management plans and policies so that local flood risks can be reduced to the greatest extent possible at the local scale. However, this study must admit its shortcomings. Firstly, the vast majority of the sampled respondents across the sampled locations were male, which should not be extrapolated to other genders. Risk perception might become difficult to evaluate because of the various variables involved, such as respondent behavior, judgments, and protective behaviors, which cannot be adequately assessed using predefined factors. This study was limited by the fact that it did not take into account the myriad theories and frameworks that were established to understand risk perception. Additional studies are required to evaluate the impact of local institutions and social norms on society's understanding of flood risk. In order to distinguish between both riverine and surface flooding, it is necessary to have a fuller insight into flood hazard types and risk perception. In the future, it is recommended to explore the impact of gender on flood risk perceptions. In light of these limitations, the psychosocial dimension of risk perception can indeed be better understood so that it may be used across climate change adaptation and disaster risk science to assess local inhabitants' resilience and vulnerability in flood-affected regions. Since our data are cross-sectional, our results should not be interpreted as causation. Furthermore, our findings should not be generalized homogeneously to other regional contexts.

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