frontiers | Frontiers in Water

TYPE Original Research
PUBLISHED 22 May 2024
DOI 10.3389/frwa.2024.1393226

OPEN ACCESS

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RECEIVED 05 March 2024
ACCEPTED 29 April 2024
PUBLISHED 22 May 2024

CITATION
Savari M, Jafari A and Sheheytavi A (2024) The impact of social capital to improve rural households' resilience against flooding: evidence from Iran.
Front. Water 6:1393226.
doi: 10.3389/frwa.2024.1393226

The impact of social capital to improve rural households' resilience against flooding: evidence from Iran

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Floods have significantly affected many regions worldwide, imposing economic, social, and psychological consequences on human societies, in recent decades. Rural communities in Iran are particularly vulnerable to floods, and without effective risk reduction systems, the impact can be exacerbated. In this context, this study aims to investigate the role of social capital in enhancing the resilience of rural households against floods in the southwest of Iran. The statistical population includes all rural households in Shushtar County that have experienced floods at least once. The primary tool for data collection was a questionnaire and obtained data were analyzed using structural equation modeling. In examining the situation of confrontation between different groups of people based on the state of social capital and resilience, it can be said that men, older people and people with higher income had more resilience and social capital to deal with floods. In addition, the results revealed that components of social capital (social networks, social solidarity, social trust, social awareness, participation and collection action) explained 68.1% of the variance in the resilience of rural households against floods. Overall, our findings can provide new insights for policymakers in the area, contributing to the reduction of flood impacts and promoting safer living conditions in flood-prone areas.

KEYWORDS

natural hazards, social participation, capacity building, empowerment of rural households, Iran

1 Introduction

Natural hazards constitute one of the primary factors contributing to the increasing prevalence of malnutrition and food insecurity worldwide, particularly in developing countries where vulnerable agricultural communities face greater challenges in coping with climatic adversities (FAO, IFAD, UNICEF, WFP, WHO, 2018; Pham et al., 2020; Shokati Amghani et al., 2022; Savari et al., 2024a). The rise in temperature and other climate-related changes likely amplifies the frequency and intensity of natural hazards, particularly floods, in many Asian countries (Raghavan Sathyan et al., 2018; Sam et al., 2021; Savari et al., 2024b). Flood risk is a manifestation of climate change that is less predictable than other climatic phenomena (Wasson et al., 2020). Additionally, floods can be triggered by the intensity and duration of rainfall, topographical features, and anthropogenic factors (Mamo et al., 2019). Approximately 40% of all natural disasters worldwide result from floods, accounting for nearly 50% of total

casualties, with Asia having the highest flood potential (Noji, 1996; Ohl and Tapsell, 2000; Iqbal and Nazir, 2023). Over the past 20 years, the livelihoods of approximately 400 million people were annually affected by floods, resulting in 28,000 flood-related fatalities in Asia between 1987 and 1997 (United Nations University, WHO, 2001; National Disaster Management Authority NDMA, 2022). Studies documented that floods have widespread adverse effects globally (Alhassan, 2020; Ndue et al., 2023), exacerbating regional inequalities (Mohanty et al., 2020). Floods, a natural phenomenon, can have the most significant impact on the world's human population (Ahmadi et al., 2022). However, individuals residing in flood-prone areas are more vulnerable, with their property and lives at greater risk of damage (Kovacs et al., 2017). Furthermore, this natural disaster can lead to the destruction of crops, and critical infrastructure, and other social damages (Owusu et al., 2016). Besides, floods have far-reaching adverse effects on human health, food security, economic activities, physical infrastructure, natural resources, and the environment (Eze et al., 2018; Savari, 2023; Savari et al., 2023a,b). In addition to direct impacts, these phenomena create other indirect damages such as social unrest, mental distress, and an imbalanced production and consumption system (Iqbal and Nazir, 2023). Consequently, reducing the damages caused by floods remains a significant concern for human societies (Ahmadi et al., 2022).

The heightened concern among policymakers revolves around identifying factors that can contribute to greater resilience of rural households against floods (Alhassan et al., 2019; Thennakoon et al., 2020). The increasing urgency and intensity of climate change have highlighted the significance of resilience as a vital component in rural planning (Leichenko, 2011; Coaffee and Clarke, 2015; Béné et al., 2018; Mustafa et al., 2018). Consequently, resilience becomes crucial for the sustainability of rural households facing both persistent and unpredictable climate shocks, such as floods (Ali and Rahut, 2019; Thennakoon et al., 2020). However, the resilience of rural households is influenced by a multitude of factors during flood events (Deressa et al., 2009). In the contemporary risk management paradigm of flood management, there is an emphasis on the involvement of private stakeholders such as flood-prone residents in participating in risk reduction activities (Bubeck et al., 2017; Wiering et al., 2017). This approach has evolved into a critical aspect of integrated flood management in many countries (Semnan et al., 2023). In this method, rather than relying solely on public protective measures like constructing levees, individuals are expected to take responsibility for preventing and preparing for flood disasters (Semnan et al., 2023). Through collective efforts to mitigate flood risks, individuals can safeguard their properties and those of other households (AIDR, 2017).

One of the crucial factors influencing collective efforts in coping with climate-related disasters, such as floods, is social capital (Azad and Pritchard, 2023). The focus on social capital is particularly important and necessary in developing countries, as stronger social capital can compensate for financial, human, natural, or physical resource deficits (Rockenbauch et al., 2019). Previous studies revealed that this factor plays a role in various aspects of the disaster management cycle, including risk reduction, preparedness, response, and recovery (Savari, 2023). Before the hazard initiation, social capital facilitates information gathering and decision-making, including evacuation plans (Wuepper et al., 2018). During the disaster, this factor enables mutual care and assistance, facilitating the provision of physical, financial, and emotional support. In post-disaster conditions, it can be vital for people's access to information and resources crucial for reconstruction. Generally, a positive relationship has been found between the presence of social capital and resilience to disasters (Hagedoorn et al., 2019; Wang et al., 2021). In other words, social capital can moderate the effects of climate-related hazards and enhance adaptive capacity and recovery pathways (Smith, 1981; Adger, 2010; Aldrich, 2012, 2014; Klinenberg, 2015; Sadri et al., 2018). In this regard, this research followed three general goals: (i) investigating the state of resilience and social capital of rural households during floods (ii) the effect of social capital on resilience and (iii) formulating practical policies and suggestions for the planners of this it was the field.

1.1 Social capital and resilience

Contemporary perspectives and theories related to natural disaster management and sustainable development aim to create resilient communities in the face of various environmental events. In light of these interpretations, numerous researchers contend that resilience stands as one of the paramount subjects in achieving sustainability (Savari et al., 2023c). Psychologists define resilience as a series of actions aiding individuals in overcoming adversities and stressors (Seyed Akhlaghi and Taleshi, 2018). Furthermore, it was asserted that residing in an environment prone to natural hazards does not inherently involve damage and vulnerability. Instead, the absence of resilience and individuals' awareness and understanding of the degree, type, and nature of risks can lead to harm (Zhou et al., 2010). Given its dynamic nature and adaptability in the face of challenges, resilience is deemed essential for the psychological well-being of individuals, especially in navigating various stressors and potentially traumatic events (Marschke and Berkes, 2006). In the context of disasters, the development of resilience is seen as a process contributing to both the mitigation and recovery from adverse events, as well as the enhancement of individual capacities to cope with and adapt to changing conditions (Seyed Akhlaghi and Taleshi, 2018).

The concept of social capital emerged in the field of sociology and was first introduced by Bourdieu (1986), who claimed that social capital is a relationships network that aids actors to acquire actual and potential resources. Coleman (1988) subsequently defined social capital as a personal asset determined by structural social resources in terms of functional performance. Besides, Putnam et al. (1994) elevated social capital from an individual level to a collective one, asserting that social capital includes specific features of social organizations such as social trust, social networks, and social norms. In this study, we defined social capital as social relationships and the ability of actors (individuals, groups, or societies) to use these relationships to access financial, emotional, physical, or other resources to meet survival and improvement needs (Savari et al., 2015; Panday et al., 2021). The key dimensions of social capital influencing individuals' behaviors in the environment include social networks, social awareness, collective action, social solidarity, and social trust (Dolnicar and Hurlimann, 2010; Blackburn, 2013; Savari et al., 2013; Allo and Loureiro, 2014; Fielding and Roiko, 2014; Fikret, 2018; Ito et al., 2018). Table 1 illustrates the relationship between social capital and resilience.

2 Materials and methods

2.1 Study area

Shushtar is situated in the northern region of Khuzestan Province and holds significant value due to its abundant water resources (Figure 1). It is a significant agricultural center in Iran, producing crops such as wheat, corn, legumes, and vegetables. Animal husbandry also holds great importance in this country. Over the past years, Shushtar has been repeatedly affected by floods, leading to the inundation of many villages, particularly due to its geographical location within Khuzestan Province.

2.2 Study type

This research is quantitative, utilizing field research methods for data collection and adopting a cross-sectional approach in terms of time horizon.

2.3 Statistical population and sampling method

The statistical population of the study includes all rural households exposed to floods in Shushtar County. To estimate the sample size, Krejcie and Morgan (1970) table was used. Accordingly, 400 rural household heads were selected for the study, using a proportional allocation for a stratified sample. Shushtar city has three sector: "Shoaibieh," "Central" and "Mianab." At first, it was tried to select two rural district from each sector, and finally, two villages from each rural district were selected for study. In this section, the respondents were classified into two sections. (1) The respondents had sufficient education and were able to read the questionnaire items easily. (2) There were respondents who lacked education and did not have enough power to read the questions. For this group of participants, the interview method was usually used and the items of the questionnaire were read to them and the questionnaire was completed based on their answers (Tables 2, 3).

2.3.1 Participants

The findings showed that the average age of the respondents was 46.88 with a standard deviation of 11.88 years and the age range of 18 to 71 years. In addition, in terms of gender, 58% were male and 42% female. The average annual income of the examined household was 205.77 million Rials per year with a standard deviation of 85.36 million Rials. Also, the results of the average number of family members showed that it was 4.78 with a standard deviation of 1.63 people.

2.4 Survey instrument

The primary instrument for this research was a questionnaire, comprising two main sections. The first section (i) covered the demographic characteristics of rural households. While the second section (ii) included 27 items related to the measurement of social capital components. These components were based on a theoretical literature review, encompassing social networks (Hillig and Connell, 2018; Kawamoto and Kim, 2019; Panday et al., 2021; Savari and Khaleghi, 2023; Savari et al., 2023d), social solidarity and Participation and collection action (Hillig and Connell, 2018; El Zahed and Habib, 2020; Nugraha et al., 2021; Savari and Amghani, 2022), social trust (Harpham and Dawson, 2006; Savari, 2023), and social awareness (King et al., 2012; Lu et al., 2013; Chen et al., 2014; Martini et al., 2014).

Section (iii) comprised 15 items designed to measure the resilience component based on the Disaster Management Cycle model (Queensland Reconstruction Authority, 2011). This factor assessed preparation, response, Rehabilitation and recovery, and prevention components. The Likert scale (1-very low to 5-very high) was used to measure these components.

TABLE 1 The relationship between social capital and resilience.

	Definition	Relationship to resilience
Bonding capital	Bonding capital refers to the communication and interactions between members of a homogeneous society such as neighbors and family members. In this area, there are certain forms of trust and reciprocity (Woolcock, 2001)	During moments of crisis, family members, friends, and neighbors often serve as the initial respondents, disseminating preliminary warning signals (Gawith et al., 2016). They are frequently present on the scene before the arrival of specialists and rescue organizations (Aguirre et al., 1995; Zhao, 2013). These robust connections are crucial for offering temporary shelter, aiding in preliminary reconstruction efforts (e.g., through labor exchange), and contributing to livelihood recovery (e.g., sharing production tools, maintaining livestock in neighboring farms, etc.) (MacGillivray, 2018)
Bridging capital	The term "bridging capital" refers to relationships between individuals or groups that are socially and demographically different (e.g., ethnicity, culture, age) and at the same time have a similar social or economic status (Putnam, 1993; Van Deth and Zmerli, 2010)	Access to a diversity of resources, skills, and knowledge that may not be attainable solely through bonding capital is facilitated by bridging capital (Easterly et al., 2006). This capital may represent a crucial prerequisite for adaptation in the face of evolving hazards
Linking capital	Linking capital describes relationships that traverse power differentials and authority gradients, such as connections between communities and non-governmental organizations or governmental entities (MacGillivray, 2018)	Linking capital can provide communities with access to a broad spectrum of financial, technical, informational, and logistical support that cannot be internally sourced (Pelling and High, 2005). It can play a crucial role in securing the long-term investments necessary for the reconstruction of social, economic, and physical infrastructures of communities following a disaster (Marin et al., 2015)

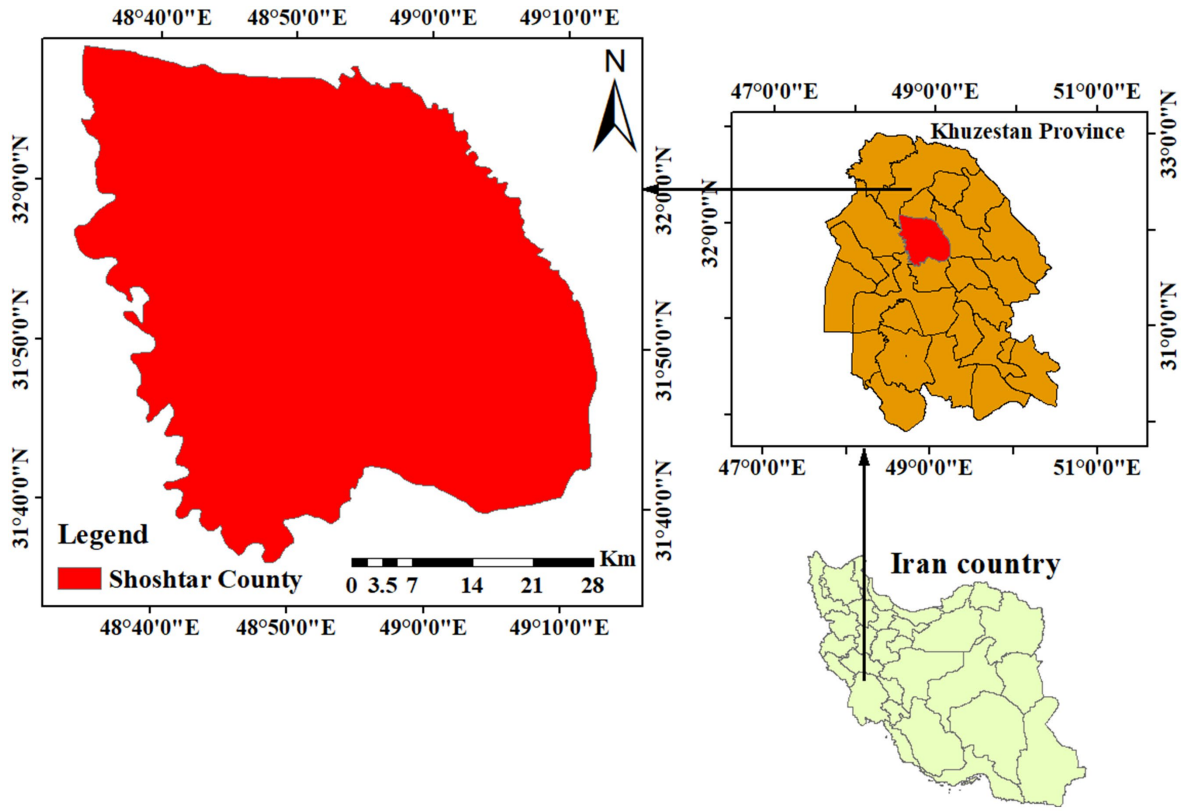

FIGURE 1
Case study.

TABLE 2 Components and items used in measuring social capital variable.

Components of social capital	Items
Social Networks	Agricultural production cooperatives, financial credit funds, and savings (such as rural microcredit funds, family funds, etc.), public welfare organizations, and non-governmental organizations (NGOs)
Social solidarity	The social solidarity of the villagers during the floods, the increased cooperation and collaboration, the low level of social differences in the village, the cordial relationship with neighbors and other villagers
Social trust	Lending money to friends and acquaintances during floods, lending necessary equipment to friends and acquaintances, accepting guarantees from friends and acquaintances to obtain loans, trusting the words of government officials such as experts and meteorological information experts
Social awareness	Exchange of meteorological information on floods, information on adaptation strategies and flood management, more information on habitability through formal and informal mechanisms, and exchange of information on increasing the adaptive capacity of households A village in the face of floods
Participation and collection action	Participating in projects to build capacity and strengthen community resilience in dealing with floods, consulting with other villagers in implementing solutions to improve living conditions in the floodplain, providing intellectual advice and opinions in planning and implementing flood management plans, mobilizing local communities to apply flood coping strategies

2.5 Reliability and validity

Prior to commencing the interviews with farmers, the survey draft and questions underwent a comprehensive evaluation by a panel of experts. This expert panel consisted of professors specializing in agricultural extension and education, environment, psychology, social sciences, and agricultural sciences. Their input was taken into consideration, and necessary revisions were implemented until final approval was obtained. Furthermore, to ensure the reliability of the research instrument, Cronbach's alpha and composite reliability coefficients were utilized, yielding satisfactory results.

2.6 Data analysis

Following data collection, the gathered information underwent analysis using SPSS and Smart Pls software. Structural

Equation Modeling (SEM) is a statistical analysis method for examining structural relationships. It combines factor analysis and multiple regression analysis and is employed to analyze the interconnections between observed variables and underlying constructs (Khoshmaram et al., 2020). One of the most important reasons for researchers to use SEM is to test the theoretical framework of the research along with determining the amount of measurement error (Hoyle, 2012). Smart Pls software is a software that is used to solve problems with the partial least squares method. In this technique and software, unlike other software where sample size and normality of data are important, there is not much sensitivity (Harrington, 2009).

3 Results

3.1 The status of social capital and resilience in the studied groups

In examining the situation of confrontation between different groups of people based on the state of social capital and resilience, it can be said that men, older people and people with higher income had more resilience and social capital to deal with flood (Table 4).

3.2 Measurement models

To evaluate the research measurement model, unidimensionality, validity and reliability, and discriminant validity were investigated.

3.2.1 Unidimensionality

Given that the standardized factor loading value (ƛ) for the chosen indicators was statistically significant (above 0.5) at a significance level of 1 % ($p < 0.01$), it can be concluded that the selected markers exhibit unidimensionality. This finding confirms that the selected indicators accurately measure the research constructs and possess adequate precision (Table 4).

3.2.2 Validity and reliability

Regarding the validity and reliability assessment of the research instrument, the findings indicated that all constructs within the proposed research model exhibited composite reliability (CR) values exceeding 0.60 and Cronbach's alpha coefficients surpassing 0.70.

TABLE 3 Components and items used in measuring resilience variable.

Resilience components	Items
Preparation	Use of information from meteorological experts to make the necessary preparations in the event of flooding, use of information from trained forces and local leaders in the event of flooding, and use of local government measures to deal with flooding
Response	Using resistant materials in the construction of rural houses, building strong walls and fences against floods, ensuring assets and products in the region, and observing safety points when building houses
Rehabilitation and recovery	Participation in the reconstruction and repair of damage after the floods, participation in the relief and rescue of victims during the floods, cooperation in setting up emergency shelters during and after the floods, obtaining public and state aid, both in cash and in kind, and passing it on to the population. Injured people, use the help of doctors and psychologists to treat and restore the morale of the injured
Prevention	New plans to reduce flooding in the region, building dams before the floods, moving residential houses in the floodplain, using dams water, and rivers before the rainy season for agriculture

TABLE 4 The status of social capital and resilience in the studied groups.

Variables	Category	Social capital (%)			Resilience (%)		
		Low	Medium	High	Low	Medium	High
Age	Lowest than 20 years	22	38	40	31	43	26
	20–40	16	43	41	23	39	38
	More than 40 years	13	37	150	16	42	52
Gender	Men	17	39	44	13	44	43
	Female	12	51	37	15	49	36
Annual income (tomans)	Lowest than 150 million	22	34	46	24	43	33
	100–150	19	37	44	13	46	41
	More than 150 million	20	39	41	8	37	55
Number of family members	Lowest than 3 people	14	23	63	18	38	44
	3–5	13	27	60	15	42	43
	More than 3 people	19	25	57	22	39	39

TABLE 5 The results of fitting the research measurement model.

Constructs	Measurement item	λ̂	*t*	Reliability and validity
Social networks	SN1	0.752	23.587	AVE: 0.621 CR:0.841 α: 0.758
	SN2	0.698	12.360	
	SN3	0.845	45.042	
	SN4	0.827	38.521	
Social solidarity	SS1	0.627	32.520	AVE: 0.607 CR: 0.862 α: 0.790
	SS2	0.866	66.361	
	SS3	0.805	54.287	
	SS4	0.744	48.699	
Social trust	ST1	0.784	88.631	AVE: 0.611 CR: 0.901 α:0.840
	ST3	0.746	74.635	
	ST3	0.805	95.362	
Social awareness	SA1	0.822	74.632	AVE: 0.680 CR: 0.942 α:0.854
	SA2	0.652	33. 250	
	SA3	0.761	51.249	
	SA4	0.808	66.523	
Participation and collection action	PCA1	0.755	67.635	AVE: 0.771 CR: 0.958 α: 0.877
	PAC2	0.882	88.360	
	PCA3	0.869	77.586	
	PCA4	0.878	84.685	
Preparation	PR1	0.638	29.687	AVE: 0.590 CR:0.866 α:0.746
	PR2	0.758	35.690	
	PR3	0.837	49.663	
Response	RE1	0.608	41.680	AVE: 0.635 CR: 0.885 α: 0.812
	RE2	0.855	74.157	
	RE3	0.890	89.249	
	RE4	0.628	24.453	
Rehabilitation and recovery	RR1	0.844	86.630	AVE: 0.605 CR: 0.856 α: 0.786
	RR2	0.758	45.781	
	RR3	0.885	102.63	
	RR4	0.863	98.672	
	RR5	0.784	74.625	
Prevention	PRE1	0.793	56.871	AVE: 0.572 CR: 0.803 α: 0.755
	PRE2	0.803	87.658	
	PRE3	0.673	41.875	
	PRE4	0.759	50.693	

Furthermore, the average extracted variance (AVE) for all constructs in the proposed research model exceeded 0.50. Consequently, all latent variables within the proposed research model demonstrated favorable reliability and validity (Table 5).

3.2.3 Discriminant validity

The findings displayed in Table 6 revealed that the average square root of the variance extracted for the research constructs ($0.781 < AVE < 0.878$) exceeded the correlation between them ($0.352 < r < 0.635$). These results indicate that the discriminant validity of the established structures in the proposed research model was substantiated.

TABLE 6 Correlations with square roots of the AVE.

Constructs	1	2	3	4	5	6
Social norms	0.788					
Social solidarity	0.425	0.799				
Social trust	0.352	0.634	0.781			
Social awareness	0.624	0.527	0.422	0.824		
Participation and collection action	0.528	0.475	0.628	0.521	0.878	
Resilience	0.635	0.526	0.471	0.421	0.536	0.860

TABLE 7 Summary of goodness of fit indices for the measurement model.

Fit index	SRMR	D-G1	D-G2	NFI	RMS-Theta
Suggested value	<0.1	>0.05	>0.05	>0.90	≤0.12
Estimated value	0.08	0.425	0.635	0.99	0.08

3.3 Evaluation of the research structural model

To check the fit of the structural model, various indicators were used (Table 7). Based on the suggested values of the provided indicators, it can be concluded that the model has a good fit.

Once the research measurement model was validated, the path analysis method (structural model evaluation) was employed in the subsequent phase to examine the research hypotheses within the proposed research model. Figures 2, 3 illustrate the research path model, showcasing standardized factor loadings that are statistically significant.

3.3.1 Evaluation of effects

At this stage, the results of the final impact of social capital components on the resilience of rural households are presented. Bootstrapping method was used to check the effects. The results showed that all relationships were significant. Also, the results showed that the components of social capital are able to explain 68.1% of the resilience of rural households in dealing with floods (Table 8).

4 Discussion

This study represents one of the initial efforts in Iran to enhance the resilience of rural households against floods. The previous studies in Iran mainly have focused on assessing the vulnerability of rural households to floods, while limited attempts have been made to strategies for increasing the resilience of rural households. Therefore, the results of this study not only contribute to closing the research gap but also provide new insights for policymakers in this area to improve the resilience of rural households in flood-prone areas. Our findings indicated that social capital can explain 68.1% of the variance in resilience. These results align with those of Hudson et al. (2020), Karunarathne and Lee (2019), Matthews et al. (2020), Rustinsyah et al. (2021), Tammar et al. (2020), Zhang et al. (2020) and emphasize the significance of social capital in mitigating the impacts of climate change. Rural residents are often suddenly exposed to floods, losing their livelihoods without sufficient resources for recovery (Fahad and Wang,

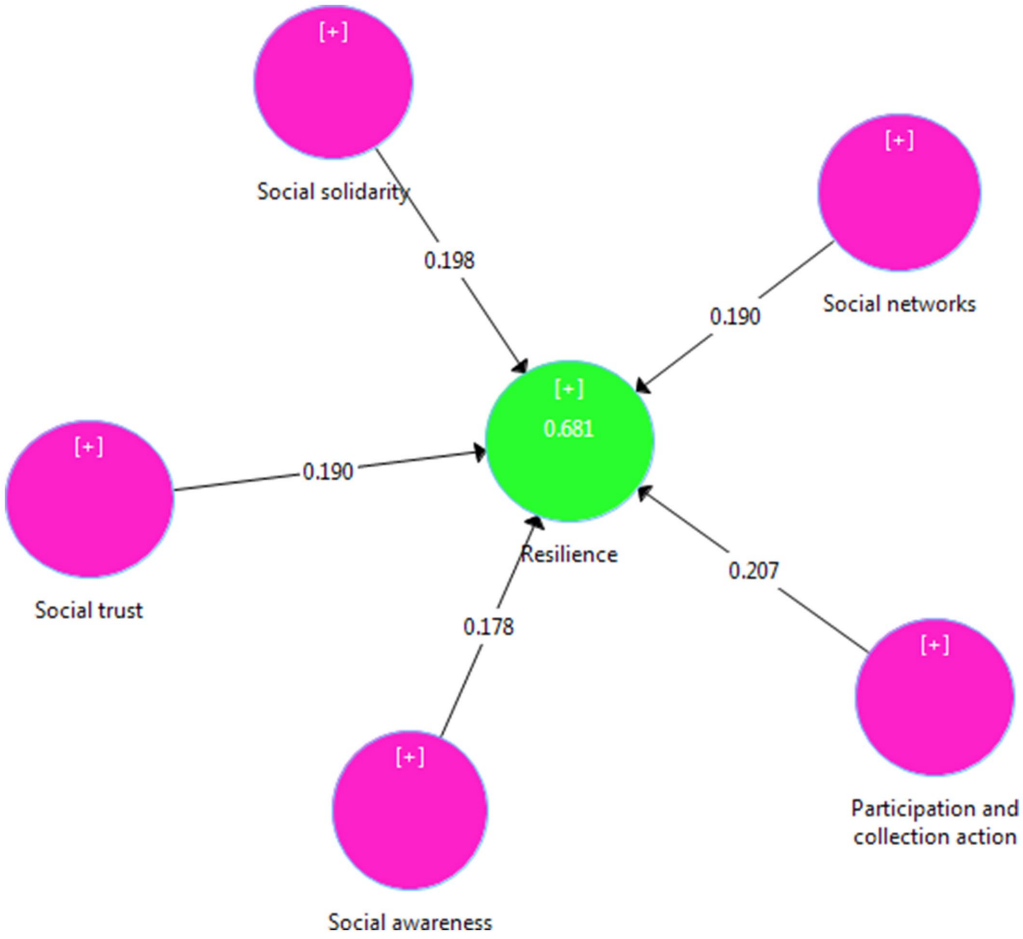

FIGURE 2
Structural model with standardized path coefficients.

2018; Huong et al., 2019). Therefore, effective strategies to mitigate the effects of climate change, such as social capital, play a crucial role due to its potential to influence economic, social, and psychological aspects (Bourdieu, 1986; Coleman, 1988; Putnam, 1993; Saptutyningsih et al., 2020). Furthermore, social capital can help minimize the damages caused by floods by enabling community members to collaborate and reduce the threats posed by such disasters (Woolcock and Narayan, 2000; Bowles and Gintis, 2002). Hence, social capital emerges as one of the most important solutions for flood reduction. The following section discusses the effectiveness of social capital components on resilience.

The results highlighted that social networks significantly influence the resilience of rural households in facing floods. In other words, social networks, such as friends and family, can influence individuals' attitudes toward adapting to climate change (Nam et al., 2012), enrich their knowledge (Fankhauser et al., 1999), and facilitate collective actions (Adhikari and Goldey, 2010). These networks play a crucial role in determining the adaptive capacity within communities (Woolcock, 2001). This can be explained by the fact that communities with strong internal and external relationships can mobilize resources and collectively respond to a common goal (Agnitsch et al., 2006; Cinner et al., 2018). Social networks are a vital component in disaster management, linking communities with support agencies, where people can express their needs and provide recovery support (Aldrich, 2012; Carpenter, 2013; Islam and Walkerden, 2015). In addition, the recovery and sustainable management of assets are possible when active social networks are in place (Harrison et al., 2016; Cohen-Salgado et al., 2021). Social networks connect individuals to supportive organizations such as banks, governmental and non-governmental institutions, schools, and housing authorities, contributing to the social and economic development of affected households (Woolcock, 2002).

The second effective component in improving individuals' resilience against floods is social awareness. Information can be shared through formal mechanisms such as newsletters and informal mechanisms namely oral communication (King et al., 2012; Lu et al., 2013; Chen et al., 2014). Sharing knowledge is considered a significant advantage of perceived social capital, which can create a foundation for enhancing individuals' resilience (Savari, 2023). Moreover, it can be noted that many rural households are not aware of flood risk reduction methods and coping strategies (Rustinsyah et al., 2021). In this context, social capital can enhance their resilience by facilitating information sharing (Savari, 2023). Additionally, as natural disasters increase in various communities, there is a continuous search for the discovery and invention of solutions to control or minimize the damages caused by unexpected events such as floods. In other words, the main goal is to control these disasters, and social awareness can provide the basis for this management.

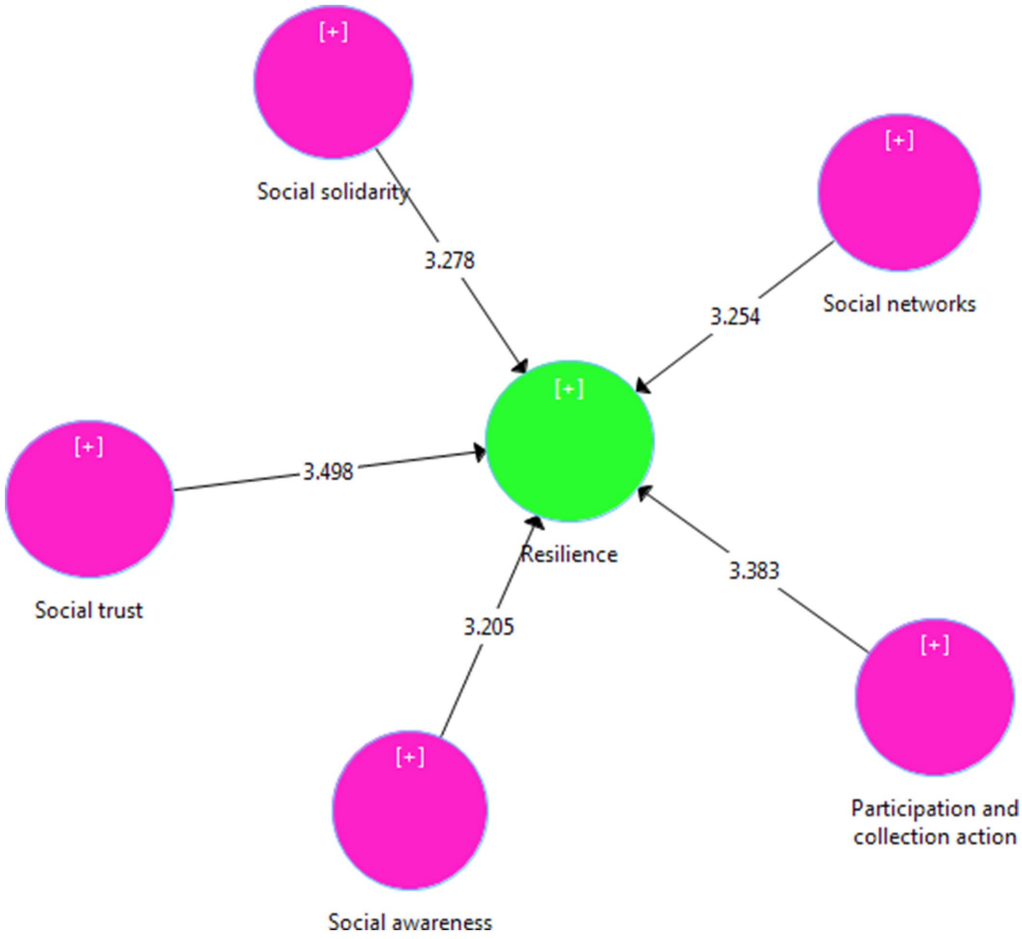

FIGURE 3
The model along with the *t*-values.

The third effective component in enhancing the resilience of rural households is participation and collective action. Social capital, encompassing dimensions such as awareness, trust, solidarity, network contribution, and relationships between members, plays a valuable role in collective action for protection and coping with environmental challenges (Pumcave, 2016). Social capital improves the flow of information among individuals, making activities more visible and serving as a framework for future collaboration (Fikret, 2018). Colmen proposed that social capital encompasses aspects of social structure and facilitates the actions of agents (Vasylchenko et al., 2018). Therefore, it helps beneficiaries collaborate and commit to group obligations, aiding in the execution of protective programs (Bourdieu, 1977; Vadapalli, 2012). Moreover, many flood mitigation activities require social support and collective action, as individuals alone may not be able to undertake activities such as building embankments and protective walls.

The fourth effective component in improving the resilience of rural households against floods is social solidarity. This factor, as one of the dimensions of social capital, involves a strong link between people's participation in protective activities (Niazi, 2011) and establishes a foundation for social unity and solidarity (Savari, 2023). Expanding social capital leads to increased social solidarity, and social convergence, enhanced individual and group social-economic participation, and creates opportunities for the formation of organizations (Blackburn, 2013). The organizations' establishment can contribute to increased resilience against floods in two ways: (1) Social groups provide a platform for exchanging information and awareness among rural households, fostering discussions on flood mitigation methods, and identifying the most critical solutions collaboratively. (2) Many social groups, such as microcredit funds, have an economic nature and are formed by rural households to assist each other with minimal resources. These funds can be effective in the economic recovery of individuals during natural disasters.

TABLE 8 Results of research structural models.

Hypothesis	ƛ	*t*	Result	R^2
H1: Social networks → Resilience	0.190	3.139	Confirm	0.681
H2: Social solidarity → Resilience	0.198	3.206	Confirm	
H3: Social trust → Resilience	0.190	3.242	Confirm	
H4: Social awareness → Resilience	0.178	3.018	Confirm	
H5: Participation and collection action → Resilience	0.207	3.204	Confirm	

Ultimately, the fifth effective component in improving the resilience of rural households is social trust. Trust is defined as the expectations in a society for consistent, honest, and participatory behaviors based on common norms among its members (Fukuyama, 1996). This factor, as conceptualized by Putnam and Coleman, is one of the social capital components. Coleman believes that in a group where members are trustworthy and have high mutual trust, they will be able to accomplish much more than in a group lacking trust (Colman, 2008). Honesty and trust encourage individuals to engage in cooperative and collaborative activities, fostering an environment for growth and advancement (Savari, 2023). Additionally, during floods, when individuals lose their economic capabilities and require more support, mutual trust allows them to help each other more effectively and obtain essential resources. Savari and Abdeshahi (2019) documented that trust in rural communities leads to increased resilience in rural households. In rural communities, reciprocal activities, exchange of goods, and financial assistance are more effective when relationships are based on trust, helping to mitigate the impacts of natural disasters.

5 Conclusion and limitations

In conclusion, this study aimed to explore the role of social capital in improving the resilience of rural households against floods in the southwest of Iran. The results demonstrated that social capital components (social networks, social solidarity, social trust, social awareness, participation and collection action) can explain 68.1% of the resilience of rural households. Floods have a severe negative impact on the livelihoods of rural households who need emotional, economic, physical, and other forms of support that social capital can provide, making it easier for them to cope with such conditions. Despite the valuable results of the study, it is imperative to recognize three limitations: First, while explaining only 68.1% of the variance is considered acceptable in the context of social research, suggests potential for enhancement through the identification of additional dimensions of social capital. Second, the research only focused on social capital; future studies should consider other variables such as economic, cultural, and psychological factors. Third, caution is warranted in generalizing the results to other areas worldwide, given the variability in the effects of floods across different regions attributable to numerous factors.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

All interviewees were informed about data protection issues by the enumerators and gave their consent orally at the beginning of each interview. Informed consent was obtained from all individual participants included in the study. All materials and methods are performed in accordance with the instructions and regulations and this research has been approved by a committee at Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Author contributions

MS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review editing. AJ: Methodology, Software, Writing – original draft. AS: Project administration, Resources, Writing – original draft.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The current paper is adapted from a research assigned in Agricultural Sciences and Natural Resources University of Khuzestan, with a Grant Number of 1402.01, and financially supported by the university; thereby we declare our appreciation for their help.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Adger, W. N. (2010). Social capital, collective action, and adaptation to climate change. *Econ. Geog.* 79, 327–345. doi: 10.1007/978-3-531-92258-4_19

Adhikari, K. P., and Goldey, P. (2010). Social capital and its "downside": the impact on sustainability of induced community-based organizations in Nepal. *World Dev.* 38, 184–194. doi: 10.1016/j.worlddev.2009.10.012

Agnitsch, K., Flora, J., and Ryan, V. (2006). Bonding and bridging social capital: the interactive effects on community action. *Community Dev.* 37, 36–51. doi: 10.1080/15575330609490153

Aguirre, B. E., Wenger, D., Glass, T. A., Diai-Murillo, M., and Vigo, G. (1995). The social organization of search and rescue: evidence from the Guadalajara

gasoline explosion. *Int. J. Mass Emerg. Disasters* 13, 67–92. doi: 10.1177/028072709501300105

Ahmadi, S., Ghanbari Movahed, R., Gholamrezaie, S., and Rahimian, M. (2022). Assessing the vulnerability of rural households to floods at pol-e Dokhtar region in Iran. *Sustain. For.* 14:762. doi: 10.3390/su14020762

AIDR (2017). *Managing the floodplain: A guide to best practice in flood risk management in Australia (Australian disaster resilience handbook 7, in: Australian Institute for Disaster Resilience (AIDR), third ed. ed., 2017)*. Birmingham: AIDR.

Aldrich, D. P. (2012). Social, not physical, infrastructure: the critical role of civil society after the 1923 Tokyo earthquake. *Disasters* 36, 398–419. doi: 10.1111/j.1467-7717.2011.01263.x

Aldrich, D. P. (2014). *The externalities of strong social capital: Post-tsunami recovery in Southeast India. In social capital and economics*. London: Routledge.

Alhassan, H. (2020). Farm households' flood adaptation practices, resilience and food security in the upper east region, Ghana. *Heliyon* 6:e04167. doi: 10.1016/j.heliyon.2020.e04167

Alhassan, H., Kwakwa, P. A., and Adzawla, W. (2019). Farmers choice of adaptation strategies to climate change and variability in arid region of Ghana. *Rev. Agr. Applied Econ.* 22, 32–40. doi: 10.22004/ag.econ.285928

Ali, A., and Rahut, D. B. (2019). Localized floods, poverty and food security: empirical evidence from rural Pakistan. *Hydrology* 7:2. doi: 10.3390/hydrology7010002

Allo, M., and Loureiro, M. L. (2014). The role of social norms on preferences towards climate change policies: a meta-analysis. *Energy Policy* 73, 563–574. doi: 10.1016/j.enpol.2014.04.042

Azad, M. J., and Pritchard, B. (2023). Bonding, bridging, linking social capital as mutually reinforcing elements in adaptive capacity development to flood hazard: insights from rural Bangladesh. *Clim. Risk Manag.* 40:100498. doi: 10.1016/j.crm.2023.100498

Béné, C., Mehta, L., McGranahan, G., Cannon, T., Gupte, J., and Tanner, T. (2018). Resilience as a policy narrative: Potentials and limits in the context of urban planning. *Clim. Dev.* 10, 116–133.

Blackburn, M. R. (2013). The co–worker training mode. *J. Intellect. Dev. Disabil.* 26, 143–159,

Bourdieu, P. (1977). The economics of linguistic exchanges. *Soc. Sci. Inf.* 16:645668. doi: 10.1177/053901847701600601

Bourdieu, P. (1986). *The forms of social capital. Handbook of theory and research for the sociology of education*. Westport, CT: Greenwood.

Bowles, S., and Gintis, H. (2002). Social capital and community governance. *Econ. J.* 112, F419–F436. doi: 10.1111/1468-0297.00077

Bubeck, P., Kreibich, H., Penning-Rowsell, E. C., Botzen, W. J. W., de Moel, H., and Klijn, F. (2017). Explaining differences in flood management approaches in Europe and in the USA–a comparative analysis. *J. Flood Risk Manag.* 10, 436–445. doi: 10.1111/jfr3.12151

Carpenter, A. (2013). *Social ties, space, and resilience: Literature review of community resilience to disasters and constituent social and built environment factors. FRB Atlanta community and economic development discussion paper (2013–02)*. Atlanta: FRB Atlanta Community and Economic Development.

Chen, H., Wang, J., and Huang, J. (2014). Policy support, social capital, and farmers' adaptation to drought in China. *Glob. Environ. Chang.* 24, 193–202. doi: 10.1016/j.gloenvcha.2013.11.010

Cinner, J. E., Adger, W. N., Allison, E. H., Barnes, M. L., Brown, K., Cohen, P. J., et al. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nat. Clim. Chang.* 8, 117–123. doi: 10.1038/s41558-017-0065-x

Coaffee, J., and Clarke, J. (2015). On securing the generational challenge of urban resilience. *Town Plan. Rev.*, 86, 249–255. doi: 10.3828/tpr.2015.16

Cohen-Salgado, D., García-Frapolli, E., Mora, F., and Crick, F. (2021). How does social capital shape the response to environmental disturbances at the local level? Evidence from case studies in Mexico. *Int. J. Disaster Risk Red.* 52:101951. doi: 10.1016/j.ijdrr.2020.101951

Coleman, J. S. (1988). Social capital in the creation of human capital. *Am. J. Sociol.* 94, S95–S120. doi: 10.1086/228943

Colman, J. (2008). *Social theoretical foundations, translated by: Manouchehr Bouri*. Tehran: Ni Publication.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., and Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Glob. Environ. Chang.* 19, 248–255. doi: 10.1016/j.gloenvcha.2009.01.002

Dolnicar, S., and Hurlimann, A. (2010). Australians' water conservation behaviours and attitudes. *Australas. J. Water Res.* 14, 43–53. doi: 10.1080/13241583.2010.11465373

Easterly, W., Ritzen, J., and Woolcock, M. (2006). Social cohesion, institutions, and growth. *Econ. Polit.* 18, 103–120. doi: 10.1111/j.1468-0343.2006.00165.x

El Zahed, H., and Habib, M. (2020). Social capital water conservation behavior among university students in Egypt. *Arab J. Media Commun. Res.* 2020, 152–170. doi: 10.21608/JKOM.2020.156736

Eze, J. N., Vogel, C., and Ibrahim, P. A. (2018). Assessment of social vulnerability of households to floods in Niger state, Nigeria. *Int. Lett. Soc. Humanist. Sci.* 84, 22–34. doi: 10.18052/www.scipress.com/ILSHS.84.22

Fahad, S., and Wang, J. (2018). Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan. *Land Use Policy* 79, 301–309. doi: 10.1016/j.landusepol.2018.08.018

Fankhauser, S., Smith, J. B., and Tol, R. S. (1999). Weathering climate change: some simple rules to guide adaptation decisions. *Ecol. Econ.* 30, 67–78. doi: 10.1016/S0921-8009(98)00117-7

FAO, IFAD, UNICEF, WFP, WHO (2018). *The state of food security and nutrition in the world 2018. Building climate resilience for food security and nutrition*. Rome: FAO.

Fielding, K. S., and Roiko, A. H. (2014). Providing information promotes greater public support for potable recycled water. *Water Res.* 61, 86–96. doi: 10.1016/j.watres.2014.05.002

Fikret, M. R. (2018). Harnessing difference: a capability-based framework for stakeholder engagement in environmental innovation. *J. Prod. Innov. Manag.* 35, 254–279. doi: 10.1111/jpim.12394

Fukuyama, F. (1996). *Trust: The social virtues and the creation of prosperity*. New York, NY: Simon and Schuster.

Gawith, D., Daigneault, A., and Brown, P. (2016). Does community resilience mitigate loss and damage from climaterelated disasters? Evidence based on survey data. *J. Environ. Plan. Manag.* 59, 2102–2123. doi: 10.1080/09640568.2015.1126241

Hagedoorn, L. C., Brander, L. M., Van Beukering, P. J. H., Dijkstra, H. M., Franco, C., Hughes, L., et al. (2019). Community-based adaptation to climate change in small island developing states: an analysis of the role of social capital. *Clim. Dev.* 11, 723–734. doi: 10.1080/17565529.2018.1562869

Harpham, C., and Dawson, C. W. (2006). The effect of different basis functions on a radial basis function network for time series prediction: a comparative study. *Neurocomputing* 69, 2161–2170. doi: 10.1016/j.neucom.2005.07.010

Harrington, D. (2009). *Confirmatory factor analysis*. Oxford: Oxford University Press.

Harrison, J. L., Montgomery, C. A., and Bliss, J. C. (2016). Beyond the monolith: the role of bonding, bridging, and linking social capital in the cycle of adaptive capacity. *Soc. Nat. Resour.* 29, 525–539. doi: 10.1080/08941920.2015.1103389

Hillig, Z., and Connell, J. (2018). Social capital in a crisis: NGO responses to the 2015 Nepalese earthquakes. *Asia Pac. Viewp.* 59, 309–322. doi: 10.1111/apv.12201

Hoyle, R. H. (2012). *Handbook of structural equation modeling*. New York: Guilford Press.

Hudson, P., Hagedoorn, L., and Bubeck, P. (2020). Potential linkages between social capital, flood risk perceptions, and self-efficacy. *Int. J. Disaster Risk Sci.* 11, 251–262. doi: 10.1007/s13753-020-00259-w

Huong, N. T. L., Bo, Y. S., and Fahad, S. (2019). Economic impact of climate change on agriculture using Ricardian approach: a case of Northwest Vietnam. *J. Saudi Soc. Agric. Sci.* 18, 449–457. doi: 10.1016/j.jssas.2018.02.006

Iqbal, A., and Nazir, H. (2023). Community perceptions of flood risks and their attributes: a case study of rural communities of Khipro, district Sanghar, Pakistan. *Urban Clim.* 52:101715. doi: 10.1016/j.uclim.2023.101715

Islam, R., and Walkerden, G. (2015). How do links between households and NGOs promote disaster resilience and recovery?: a case study of linking social networks on the Bangladeshi coast. *Nat. Hazards* 78, 1707–1727. doi: 10.1007/s11069-015-1797-4

Ito, K., Ida, T., and Tanaka, M. (2018). Moral suasion and economic incentives: field experimental evidence from energy demand. *Am. Econ. J. Econ. Pol.* 10, 240–267. doi: 10.1257/pol.20160093

Karunarathne, A. Y., and Lee, G. (2019). Traditional social capital and socioeconomic networks in response to flood disaster: a case study of rural areas in Sri Lanka. *Int. J. Disaster Risk Sci.* 41:101279. doi: 10.1016/j.ijdrr.2019.101279

Kawamoto, K., and Kim, K. (2019). Efficiencies of bonding, bridging and linking social capital: cleaning up after disasters in Japan. *Int. J. Disaster Risk Sci.* 33, 64–73. doi: 10.1016/j.ijdrr.2018.09.010

Khoshmaram, M., Shiri, N., Shinnar, R. S., and Savari, M. (2020). Environmental support and entrepreneurial behavior among Iranian farmers: the mediating roles of social and human capital. *J. Small Bus. Manag.* 58, 1064–1088. doi: 10.1111/jsbm.12501

King, T. J., Ooi, D., Cary, J., Fisher, A., Schibeci, R., Murphy, K., et al. (2012). *Public perceptions of, and responses to, desalination in Australia: A report on findings*. Melbourne: Alfred Deakin Research Institute.

Klinenberg, E. (2015). *Heat wave: A social autopsy of disaster in Chicago*. Chicago IL: University of Chicago Press.

Kovacs, Y., Doussin, N., Gaussens, M., Pacoud, C. L., and Afd, O. G. (2017). *Flood risk and cities in developing countries*. Paris, France: French Development Agency.

Krejcie, R. V., and Morgan, D. W. (1970). Determining sample size for research activities. *Educ. Psychol. Meas.* 30, 607–610. doi: 10.1177/001316447003000308

Leichenko, R. (2011). Climate change and urban resilience. *Curr. Opin. Environ. Sustain.* 3, 164–168. doi: 10.1016/j.cosust.2010.12.014

Lu, Y., Ruan, D., and Lai, G. (2013). Social capital and economic integration of migrants in urban China. *Soc. Networks* 35, 357–369. doi: 10.1016/j.socnet.2013.04.001

MacGillivray, B. H. (2018). Beyond social capital: the norms, belief systems, and agency embedded in social networks shape resilience to climatic and geophysical hazards. *Environ. Sci. Pol.* 89, 116–125. doi: 10.1016/j.envsci.2018.07.014

Mamo, S., Berhanu, B., and Melesse, A. M. (2019). *Historical flood events and hydrological extremes in Ethiopia. In extreme hydrology and climate variability*. Amsterdam: Elsevier.

Marin, A., Bodin, Ö., Gelcich, S., and Crona, B. (2015). Social capital in post-disaster recovery trajectories: insights from a longitudinal study of tsunami-impacted small-scale fisher organizations in Chile. *Glob. Environ. Chang.* 35, 450–462. doi: 10.1016/j.gloenvcha.2015.09.020

Marschke, M. J., and Berkes, F. (2006). Exploring strategies that build livelihood resilience: a case from Cambodia. *Ecol. Soc.* 11:16. doi: 10.5751/ES-01730-110142

Martini, N. F., Nelson, K. C., and Dahmus, M. E. (2014). Exploring homeowner diffusion of yard care knowledge as one step toward improving urban ecosystems. *Environ. Manag.* 54, 1223–1236. doi: 10.1007/s00267-014-0368-x

Matthews, V., Longman, J., Bennett-Levy, J., Braddon, M., Passey, M., Bailie, R. S., et al. (2020). Belonging and inclusivity make a resilient future for all: a cross-sectional analysis of post-flood social capital in a diverse Australian rural community. *Int. J. Environ. Res. Public Health* 17:7676. doi: 10.3390/ijerph17207676

Mohanty, M. P., Mudgil, S., and Karmakar, S. (2020). Flood management in India: a focussed review on the current status and future challenges. *Int. J. Disaster Risk Sci.* 49:101660. doi: 10.1016/j.ijdrr.2020.101660

Mustafa, A., Bruwier, M., Archambeau, P., Erpicum, S., Pirotton, M., Dewals, B., et al. (2018). Effects of spatial planning on future flood risks in urban environments. *J. Environ. Manag.* 225, 193–204. doi: 10.1016/j.jenvman.2018.07.090

Nam, W. H., Choi, J. Y., Yoo, S. H., and Jang, M. W. (2012). A decision support system for agricultural drought management using risk assessment. *Paddy Water Environ.* 10, 197–207. doi: 10.1007/s10333-012-0329-z

National Disaster Management Authority NDMA (2022). NDMA floods (2022) SITREP - 2022. Available at: http://cms.ndma.gov.pk/storage/app/public/situation-reports/November2022/a4BcofAK8FXdNs2KJi1v.pdf

Ndue, K., Baylie, M. M., and Goda, P. (2023). Determinants of rural households' intensity of flood adaptation in the Fogera Rice plain, Ethiopia: evidence from generalised Poisson regression. *Sustain. For.* 15:11025. doi: 10.3390/su151411025

Niazi, M. H. (2011). A study on the relationship between the level of education and the lLevel of national and social coherence of citizens. *J. Nat. Stud.* 4, 31–50. doi: 10.22059/JRUR.2011.347730.1768

Noji, E. K. (1996). Disaster epidemiology. *Emerg. Med. Clin. N.* 14, 289–300. doi: 10.1016/S0733-8627(05)70252-2

Nugraha, I. G. P., Antara, I. M., Budiarsa, M., and Paturusi, S. A. (2021). The role of social Capital in Serangan sub-District, Denpasar-Bali. *J. Tour.* 8, 59–64. doi: 10.24922/eot.v10i2

Ohl, C. A., and Tapsell, S. (2000). Flooding and human health: the dangers posed are not always obvious. *BMJ* 321, 1167–1168. doi: 10.1136/bmj.321.7270.1167

Owusu, A. B., Jakpa, J. T., and Awere, K. G. (2016). Smallholder farmers' vulnerability to floods in the Tolon District, Ghana. *Interdiscip. Environ. Rev.* 17, 286–311. doi: 10.1504/IER.2016.080246

Panday, S., Rushton, S., Karki, J., Balen, J., and Barnes, A. (2021). The role of social capital in disaster resilience in remote communities after the 2015 Nepal earthquake. *Int. J. Disaster Risk Sci.* 55:102112. doi: 10.1016/j.ijdrr.2021.102112

Pelling, M., and High, C. (2005). Understanding adaptation: what can social capital offer assessments of adaptive capacity? *Glob. Environ. Chang.* 15, 308–319. doi: 10.1016/j.gloenvcha.2005.02.001

Pham, N. T. T., Nong, D., Sathyan, A. R., and Garschagen, M. (2020). Vulnerability assessment of households to flash floods and landslides in the poor upland regions of Vietnam. *Clim. Risk Manag.* 28:100215. doi: 10.1016/j.crm.2020.100215

Pumcave, P. V. (2016). Woman entrepreneurship in rural Vietnam: success and motivational factors. *J. Dev. Areas* 49, 57–76,

Putnam, R. (1993). *The prosperous community: social capital and public life*. The American, Fort Worth, TX.

Putnam, R. D., Leonardi, R., and Nanetti, R. Y. (1994). *Making democracy work: Civic traditions in modern Italy*. Princeton: Princeton University Press.

Queensland Reconstruction Authority (2011). *Planning for stronger, more resilient floodplains*. Brisbane: Queensland Reconstruction Authority.

Raghavan Sathyan, A., Funk, C., Aenis, T., Winker, P., and Breuer, L. (2018). Sensitivity analysis of a climate vulnerability index-a case study from Indian watershed development programmes. *Clim. Chang. Responses* 5, 1–14. doi: 10.1186/s40665-018-0037-z

Rockenbauch, T., Sakdapolrak, P., and Sterly, H. (2019). Beyond the local–exploring the socio-spatial patterns of translocal network capital and its role in household resilience in Northeast Thailand. *Geoforum* 107, 154–167. doi: 10.1016/j.geoforum.2019.09.009

Rustinsyah, R., Prasetyo, R. A., and Adib, M. (2021). Social capital for flood disaster management: case study of flooding in a village of Bengawan solo riverbank, Tuban, East Java Province. *Int. J. Disaster Risk Sci.* 52:101963. doi: 10.1016/j.ijdrr.2020.101963

Sadri, A. M., Ukkusuri, S. V., Lee, S., Clawson, R., Aldrich, D., Nelson, M. S., et al. (2018). The role of social capital, personal networks, and emergency responders in post-disaster recovery and resilience: a study of rural communities in Indiana. *Nat. Hazards* 90, 1377–1406. doi: 10.1007/s11069-017-3103-0

Sam, A. S., Abbas, A., Padmaja, S. S., Sathyan, A. R., Vijayan, D., Kächele, H., et al. (2021). Flood vulnerability and food security in eastern India: a threat to the achievement of the sustainable development goals. *Int. J. Disaster Risk Sci.* 66:102589. doi: 10.1016/j.ijdrr.2021.102589

Saptutyningsih, E., Diswandi, D., and Jaung, W. (2020). Does social capital matter in climate change adaptation? A lesson from agricultural sector in Yogyakarta, Indonesia. *Land Use Policy* 95:104189. doi: 10.1016/j.landusepol.2019.104189

Savari, M. (2023). Explaining the ranchers' behavior of rangeland conservation in western Iran. *Front. Psychol.* 13:1090723. doi: 10.3389/fpsyg.2022.1090723

Savari, M., and Abdeshahi, A. (2019). Analysis of the role of social capital to improve the resilience of rural households in drought conditions in the county of Divandarreh. *J. Rural Res.* 10, 214–229. doi: 10.22059/JRUR.2018.256365.1247

Savari, M., and Amghani, M. S. (2022). SWOT-FAHP-TOWS analysis for adaptation strategies development among small-scale farmers in drought conditions. *Int. J. Disaster Risk Sci.* 67:102695. doi: 10.1016/j.ijdrr.2021.102695

Savari, M., Damaneh, H. E., and Damaneh, H. E. (2023c). Effective factors to increase rural households' resilience under drought conditions in Iran. *Int. J. Disaster Risk Sci.* 90:103644. doi: 10.1016/j.ijdrr.2023.103644

Savari, M., Damaneh, H. E., and Damaneh, H. E. (2023d). The effect of social capital in mitigating drought impacts and improving livability of Iranian rural households. *Int. J. Disaster Risk Sci.* 89:103630. doi: 10.1016/j.ijdrr.2023.103630

Savari, M., Eslami, M., and Monavarifard, F. (2013). The impact of social capital on agricultural employees' job satisfaction, city of Divandarreh. *Int. Res. J. Basic appl. Sci.* 4, 291–295. doi: 10.5937/sjm13-14734

Savari, M., and Khaleghi, B. (2023). The role of social capital in forest conservation: an approach to deal with deforestation. *Sci. Total Environ.* 896:165216. doi: 10.1016/j.scitotenv.2023.165216

Savari, S., Shabanali Fami, H., and Daneshvar Ameri, Z. (2015). Rural women's empowerment in improving household food security in the Divandarreh county. *J. Res. Rural Plan.* 3, 107–121. doi: 10.22067/JRRP.V3I8.33836

Savari, M., Sheheytavi, A., and Amghani, M. S. (2023a). Promotion of adopting preventive behavioral intention toward biodiversity degradation among Iranian farmers. *Glob. Ecol. Conserv.* 43:e02450. doi: 10.1016/j.gecco.2023.e02450

Savari, M., Sheheytavi, A., and Amghani, M. S. (2023b). Factors underpinning Iranian farmers' intention to conserve biodiversity at the farm level. *J. Nat. Conserv.* 73:126419. doi: 10.1016/j.jnc.2023.126419

Savari, M., Zhoolideh, M., and Limuie, M. (2024a). Factors affecting the use of climate information services for agriculture: evidence from Iran. *Climate Serv.* 33:100438. doi: 10.1016/j.cliser.2023.100438

Savari, M., Zhoolideh, M., and Limuie, M. (2024b). An analysis of the barriers to using climate information services to build a resilient agricultural system in Iran. *Nat. Hazards* 120, 1395–1419. doi: 10.1007/s11069-023-06255-9

Semnan, A. F., Maqsood, T., and Venkatesan, S. (2023). Identification of motivating factors to help decision-making to minimise flood risk by applying private mitigation measures. *Int. J. Disaster Risk Sci.* 97:104038. doi: 10.1016/j.ijdrr.2023.104038

Seyed Akhlaghi, S. J., and Taleshi, M. (2018). Improving the resilience of local communities; future strategy for dealing with drought case study: Hablehrood watershed. *Iran Nature* 3, 60–68. doi: 10.22092/IRN.2018.116783

Shokati Amghani, M., Savari, M., and Choobchian, S. (2022). Vulnerability assessment of Iran's rural-farmer households during COVID-19 pandemic. *Front. Public Health* 10:994922. doi: 10.3389/fpubh.2022.994922

Smith, D. I. (1981). Actual and potential flood damage: a case study for urban Lismore, NSW, Australia. *Appl. Geogr.* 1, 31–39. doi: 10.1016/0143-6228(81)90004-7

Tammar, A., Abosuliman, S. S., and Rahaman, K. R. (2020). Social capital and disaster resilience nexus: a study of flash flood recovery in Jeddah City. *Sustain. For.* 12:4668. doi: 10.3390/su12114668

Thennakoon, J., Findlay, C., Huang, J., and Wang, J. (2020). Management adaptation to flood in Guangdong Province in China: do property rights matter? *World Dev.* 127:104767. doi: 10.1016/j.worlddev.2019.104767

United Nations University, WHO (2001). *Human energy requirements: Report of a joint FAO/WHO/UNU expert consultation*. Geneva: WHO.

Vadapalli, D. K. (2012). *Heterogeneity in associational memberships: A latent class approach to the empirics of social capital*. Case Western Reserve University.

Van Deth, J. W., and Zmerli, S. (2010). Introduction: Civicness, equality, and democracy—a "dark side" of social capital? *Am. Behav. Sci.* 53, 631–639. doi: 10.1177/0002764209350827

Vasylchenko, O. P., Lotiuk, O. S., and Gut, N. Y. (2018). *Civil society as the subject of formation of STATE policy in the sphere of subsoil use and protection*. Dnipro: Scientific Bulletin of National Mining University.

Wang, W., Zhao, X., Li, H., and Zhang, Q. (2021). Will social capital affect farmers' choices of climate change adaptation strategies? Evidences from rural households in the Qinghai-Tibetan plateau, China. *J. Rural. Stud.* 83, 127–137. doi: 10.1016/j.jrurstud.2021.02.006

Wasson, R., Saikia, A., Bansal, P., and Joon, C. C. (2020). Flood mitigation, climate change adaptation and technological lock-in in Assam. *Ecol. Economy Soc. INSEE J.* 3, 083–104. doi: 10.37773/ees.v3i2.150

Wiering, M., Kaufmann, M., Mees, H., Schellenberger, T., Ganzevoort, W., Hegger, D. L., et al. (2017). Varieties of flood risk governance in Europe: how do countries respond to driving forces and what explains institutional change? *Glob. Environ. Chang.* 44, 15–26. doi: 10.1016/j.gloenvcha.2017.02.006

Woolcock, M. (2001). The place of social capital in understanding social and economic outcomes. *Can. J. Policy Res.* 2, 11–17. doi: 10.4337/9781781950388

Woolcock, M. (2002). *Social capital in theory and practice: Where do we stand? In social capital and economic development*. Northampton, MA: Edward Elgar Publishing.

Woolcock, M., and Narayan, D. (2000). Social capital: implications for development theory, research, and policy. *World Bank Res. Obs.* 15, 225–249. doi: 10.1093/wbro/15.2.225

Wuepper, D., Yesigat Ayenew, H., and Sauer, J. (2018). Social capital, income diversification and climate change adaptation: panel data evidence from rural Ethiopia. *J. Agric. Econ.* 69, 458–475. doi: 10.1111/1477-9552.12237

Zhang, Y., Liu, X., and Vedlitz, A. (2020). How social capital shapes citizen willingness to co-invest in public service: the case of flood control. *Public Adm.* 98, 696–712. doi: 10.1111/padm.12646

Zhao, Y. (2013). "Social networks and reduction of risk in disasters: an example of the Wenchuan earthquake" in *Economic stress, human capital, and families in Asia: Research and policy challenges*. eds. J. Y. Wei-Jun and T. Y. Mui (Dordrecht: Springer Netherlands).

Zhou, H., Wang, J. a., Wan, J., and Jia, H. (2010). Resilience to natural hazards: a geographic perspective. *Nat. Hazards* 53, 21–41. doi: 10.1007/s11069-009-9407-y