

Research Paper

Explaining Factors Affecting Flood Evacuation From the Point of View of Stakeholders: A Content Analysis Study



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ABSTRACT

Background: Floods are a natural hydrological hazard that causes human and environmental damage. In the response phase, evacuation is necessary to reduce deterioration. This study explains the influential factors on flood evacuation based on the opinion of the stakeholders.

Materials and Methods: This is a conventional content analysis study conducted in 2021. A total of 27 participants were selected using the purposive sampling method. Data collection was performed using semi-structured interviews. Interviews continued until information saturation was reached. The recorded interviews were handwritten word by word and then analyzed. The criteria for entering the study included flood experience, the ability to communicate, and willingness to participate. The period of the interview was 40 to 70 min. Written consent was obtained from the interviewees for audio recording. The Granheim and Lundman method was used for data analysis. This study's reliability was based on the Goba and Lincoln method.

Results: Data analysis extracted four main categories with ten sub-categories, including human factors (a subcategory of individual characteristics and risk perception), social factors (a subcategory of cultural conditions and financial status), geographical factors (a sub-category of urban location and climate conditions), and infrastructure factors (a sub-category of facilities related to transportation tools and routes, urban constructions, communication infrastructure, and meteorological facilities).

Conclusion: Reaching a successful evacuation requires determining the relevant factors. These factors include human, social, geographic, and infrastructure factors. The findings of this study can help managers in flood management.

Keywords:

Emergency shelter, Floods, Disasters, Disaster planning

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Introduction

Floods are among the natural disasters that cause death, disease, and environmental damage [1-4]. According to the Emergency Events Databases report in 2022, floods are one of the ten most destructive disasters worldwide, with the highest number of deaths, total affected, and economic losses [5]. The most meteorological disasters in Asia are floods [3]. As one of the countries in the Middle East and South Asia, Iran is affected by floods; in 2019, almost 213 cities were involved, and 77 people died [6]. Floods cause people's migration and create economic and cultural challenges as they destroy farmland and residential homes [7]. Both structural and non-structural interventions, such as forecasting, warning, and emergency evacuation, help mitigate flood consequences; however, non-structural techniques are more efficient and cost-effective in decreasing flood consequences [7, 8]. Evacuation is especially important during the preparation phase. It is an essential and effective measure to move residents from high-risk locations to safer areas [6]. During flooding, early, timely, and safe evacuation is necessary to reduce the effects of the flood [9]. Although evacuation helps protect people, animals, and documents, individuals are unwilling to evacuate [10] voluntarily. Various factors, such as past experiences with disasters, risk assessment, and evacuation plans, can predict the behavior of communities toward evacuation [11]. Meanwhile, Factors such as a lack of an early warning system, resources, planning, risk perception, and cooperation are known reasons for delaying evacuation [12]. Successful evacuation is critical for saving lives from future floods, which can be accomplished by analyzing evacuation behaviors [13].

Although various factors are helpful in evacuation, limited qualitative studies have been conducted in this field [14, 15]. Knowledge of public risk perception helps to reduce flood risks, and qualitative research helps to understand these ideas [16]. This is the first study in Iran to discover the factors affecting evacuation in floods. Since few studies have been done on flood evacuation in Iran and the authors' experience with floods showed that people did not leave their homes despite the evacuation order, this research was conducted to explain the factors affecting flood evacuation.

Materials and Methods

Study design

Content analysis with a conventional approach was applied in the study. The steps used in this study include record, transcript, and coding. Then, information analysis was done to extract and categorize flood evacuation factors.

Study setting

The present study was conducted among stakeholders, including managers and citizens of Poldokhtar City, Iran. In 2021, Poldokhtar, one of the cities of Lorestan Province in Iran, was affected by floods (Figure 1).

Study participants

A total of 27 stakeholders, including 10 citizens and 17 executive managers, were selected by the purposive sampling method. Interviews were carried out in two categories, namely, people and managers. In selecting the subjects, the participants were chosen from flood-affected areas among people. In choosing the managers, people involved in flood management were chosen. These persons included individuals working in cooperative and support centers in disaster management, such as the Red Crescent, the Governorate, the municipality, and the Water and Sewerage Organization. In choosing the participants, the most diversity was considered. The criteria for entering the study included the flood experience and the ability to communicate.

Data collection

This study used semi-structured interviews [17]. Interviews continued until information saturation was reached [18]. The absence of data addition for the study's development was the saturation criteria. The duration of each interview was between 40 to 70 min based on the participants' agreement. Individual interviews were conducted at the time and place accepted by the participants in places that they suggested. Written consent was obtained from the interviewees for audio recording. Interviews with citizens and managers were based on the central question of the research. Some questions are as follows:

1. Please describe your experience of flooding.
2. Please explain what factors you think are effective in an emergency evacuation.



Figure 1. Poldokhtar City, Iran

3. What is your suggestion to managers and people for the emergency evacuation of residents involved in floods?

Leading and exploratory questions were also used as follows:

Please explain more?

What did you mean?

Why?

These questions were used to discover the depth of the phenomenon. Interviews were implemented at the first opportunity and typed using the Word software, Version 23.

Data analysis

Content analysis was done to extract categories and themes by carefully and continuously reviewing primary data. Granheim and Lundman method was used for data analysis [19].

Rigor

Reliability was recognized as an alternative to validity and reliability [20]. In the credibility, the researcher has a long-term involvement with the subject. This involvement has been from initial conceptualizations to frequent meetings with participants, implementation, and processing of findings with experts in the crisis field. As an executive director, the researcher has 20 years of experience related to disaster management. Also, he has proper communication and interaction with the participants, which

has led to in-depth interviews and reliable data. In dependability, checking the findings was done by reviewing observers and participants. Supervisors reviewed the interviews, codes, and categories to check the analysis process and declare their accuracy. Qualitative research experts performed the process of coding and monitoring the themes. For conformability, the findings were given to participants who had not participated in the study to confirm appropriateness. For the transformability of the findings, the maximum diversity was done. The participants worked in organizations such as the Iranian Red Crescent, the governorate, the municipality, and the Water and Sewer Organization. They were different in terms of work experience, education, and gender. The generalizability of the study is cautious only for flood-prone areas, such as Poldokhtar (Iran). Lessons learned, outcomes, and methodology of the present study may be practical for mountainous regions with monsoon rains like Poldokhtar City, Iran. Finally, the experiences of participants were considered in this research. For this research to be repeatable, the processes were documented. The study processes were documented for reproducibility.

Results

Based on gender, most participants were male, with a maximum age range of 31 to 40 years and 5 to 10 years of experience in disaster management (Table 1).

Also, the number of initial codes gotten the interviews was 1057 (607 for executive managers and 405 for citizens). At first, the regulations were split into ten categories and 50 sub-categories. After content analysis, the codes were merged into four main categories and ten

Table 1. Demographic characteristics of study participants

Variables		No. (%)
Participants	Executive managers	17(62.96)
	Citizens	10(37.04)
Age (y)	<20	2(7.41)
	20-30	4(14.82)
	31-40	10(37.04)
	41-50	9(33.32)
	51-60	2(7.41)
Gender	Male	25(92.59)
	Female	2(7.41)
Disaster management experience (y)	<5	2(11.77)
	5-10	14(82.35)
	11-15	1(5.88)

sub-categories, including human factors (a subcategory of individual characteristics and risk perception), social factors (a sub-category of cultural conditions and financial status), geographical factors (a sub-category of urban location and climate conditions), and infrastructure factors (a sub-category of facilities related to transportation tools and routes, urban constructions, communication infrastructure, and meteorological facilities) (Table 2).

Human factors

Individual characteristics

The participants believed that individual characteristics, such as age, gender, and disability, were not considered during evacuation.

“They did not pay attention to the fact that it might be a child or a disabled or a deaf that did not understand the warnings...” (Citizen, male, 34 years old).

Risk perception

In the interviews, the lack of flood experience in the public’s mind, the lack of evacuation of offices near residential houses, and previous false warnings were misleading factors for evacuation. These factors made individuals mistrust the warnings.

«As elders and elderly people say, we have never experienced a flood of this magnitude... the officers told us to evacuate the house in previous floods, but nothing happened. The offices themselves were not empty either” (Citizen, male, 61 years old).

Social factors

Cultural conditions

Poldokhtar City, Iran, consists of a large and old multi-tribe settlement. The traditional context of kinship and nomadic relations has been one of the reasons for not welcoming tents. For the above reasons, people who decided to settle preferred to live in the homes of friends and acquaintances rather than in temporary camps.

«We preferred to seek refuge in our relatives. Life in the tent or camp is not pleasant to us... relatives and friends who were in the safe areas of the city called us and invited us to their houses.... living in relatives’ house is better and easier than living in a tent ...” (Citizen, female, 55 years old).

Financial situation

Some participants stated that families with financial resources left their homes faster; however, people who did not have the cost of transportation or were afraid of steal-

Table 2. Inductive process of abstracting codes and categories of factors affecting emergency evacuation in floods

Categories (Factors)	Sub-categories	Initial codes
Human	Individual characteristics	- Demographic differences, such as age, gender, and individual disabilities - Individual disabilities, such as paralysis, deafness
	Risk perception	- Distrust people due to false alarms - Disbelief in the media and crisis managers
Social	Cultural conditions	- People's unwillingness to go to public shelters - The desire of people to live in the houses of relatives - The existence of the tribal culture of the region
	Financial situation	- A lack of economic ability to move home furniture - A lack of flood insurance - A lack of tax exemption for flood- affected businesses
Geographic	Urban location	- Flood- prone city of Poldokhtar (Iran) - Poldokhtar City in Iran is a city between two valleys
	Climate conditions	- Having historical records of floods - Monsoon rains
Infrastructure	Transportation tools and routes	- A lack of helicopter emergency medical - A lack of emergency vehicles - A lack of alternative roads - Impossibility of using bridges
	Urban constructions	- Construction around the river - Failure to widen the riverbed - A lack of dredging of the riverbed
	Communication infrastructure	- Destruction of telecommunication infrastructure - A lack of satellite communication equipment - A lack of GPS - Inadequacy of broadcast and early flood warning devices
	Meteorological facilities	- A lack of meteorological technology - A lack of flood forecasting technology

ing their property and livestock preferred staying in their homes. These cases were the reasons for not evacuating.

“Emptying home and shop objects and shifting of cattle needed a vehicle that we did not have ... we had to stay in the house because we had no car and we didn't have money for renting our belongings ... it was stolen from the neighbor's house when they were not there ...” (Citizen, female, 64 years old).

Geographic factors

Urban location

Mountain cities located at the confluence of rivers are immersed during monsoons.

“Our city is at the exit point of the catchments of Lorestan Province, Iran, and other provinces ... steep mountainous slopes without vegetation cause flood in these parts ...” (Executive manager, male, 44 years old, 15 years job experience).

Climate conditions

Poldakhtar City, Iran, has a warm climate, and although there is little rain, it is exposed to floods due to its location between two valleys and vegetation.

“It is true that our city does not rain much, but when it rains, it floods ...” (Executive manager, male, 50 years old, 25 years job experience).

Infrastructure factors

Transportation tools and routes

The lack of trucks to transport household items was one of the problems. People who did not have a car had to pay an immense cost for transportation. Also, there were no machines to remove the mud. In cities with only one entrance route parallel to the river and no alternative route, the relief process becomes difficult in case of heavy rains and the destruction of the main route. These cases were considered as reasons for non-evacuation.

“We did not have any car to take our household items out of the house to a safe place, and we did not have any tools to remove the mud from our house ...” (Citizen, female, 56 years old).

“One of the two bridges over the river, where people used to travel, was broken ... there was no other emergency route to leave the city ... the city was surrounded by water ...” (Citizen, male, 28 years old).

Urban constructions

The increase in population and the lack of land for settlement caused the construction along the river. On the other hand, most of the participants mentioned that the city had many drought years. Over the years, rivers have been changed to recreation centers.

“We didn’t have rain for many years, so we thought we could build on the riverside...” (Citizen, male, 70 years old).

Communication infrastructure

The destruction of the communication infrastructure due to the proximity to the river and the lack of a satellite communication network made it difficult to give information, early warning, and evacuation.

“The telephone lines were cut, and we didn’t know how to inquire about our relatives” (Citizen, male, 33 years old).

Meteorological facilities

There were no meteorological facilities for flood forecasting and river flow estimation. On the other hand, meteorological reports were received from meteorological stations in other provinces. The participants believed the delay and inconsistency in the notification were significant reasons for non-evacuation.

“We did not have a satellite network to find out about weather forecasts and to give early warning ... The news reached us so late or contradictory that we missed the time to pay attention to the early warning ... we had no source to know the amount of possible rainfall or the river’s flow.”(Executive manager, female, 39 years old, 8-year job experience).

Discussion

In this study, the factors influencing evacuation included human, social, geographical, and infrastructure issues. Human factors had two sub-categories, namely individual

characteristics and risk perception. Burnside, in a study investigating the influence of information and risk perception on the storm evacuation decision-making of New Orleans residents in the US, found that having the necessary information and understanding of the risk of disasters are essential factors in making decisions on evacuation [21]. Lechowska believes that the perception of risk as one of the human factors is effective in flood management [22]. People who ignore the flood risk face a big concern and challenge in flood management. Knowing the factors affecting the mental understanding of the flood risk can solve this trouble and create the necessary motivation in the residents of areas at risk to take measures to diminish the negative impacts of floods and increase the resistance of communities against the risk of floods [12, 23, 24]. Jang et al. also discussed the importance of knowledge, attitude, and evacuation behavior in terms of gender, education level, and local conditions of the region [25]. In the current study, individual factors and attitudes are factors influencing evacuation. People in flood-prone areas could not leave their residences due to their dependence on their place of residence, lack of vehicles to carry goods and livestock, and physical problems.

Social factors had two sub-categories: Cultural conditions and financial situation status. Heath believes that the lack of finances and the conditions of the families affect the emergency evacuation, such that the number of livestock, the presence of older people and children, and the lack of understanding of the conditions for leaving their property are effective on the speed of the evacuation process [26]. Emphasizing the importance of family financial conditions, Lim et al. showed that households should have suitable vehicles for long-term evacuations [27]. Armenakis et al. believe that a flood map alone cannot determine and assess risks, and socio-economic factors are critical to risk assessment. Therefore, an approach integrating flood maps, socio-economic parameters, infrastructure, and services is essential [28]. According to Munyai et al., social and economic elements are more vulnerable to floods than environmental elements, while social aspects are higher than economic ones [29].

In this study, the geographical factors had two sub-categories: Urban location and climate conditions. Yari et al. paid attention to the principles of urban and construction safety and the improvement of urban flood management by responsible and participating organizations to manage floods and reduce mortality [30]. Galateia et al. state that social vulnerability and community conditions can turn a natural event into a deadly disaster. Also, climatological factors, such as rainfall, hydrological parameters

(humidity and soil permeability), and geomorphological characteristics (housing, depth, and type of soil) are helpful in flood disaster management [31]. Ibarra believes that short-term and medium-term corrective measures are necessary to control floods. Geographic measures include structural and non-structural mitigation. Drainage channels in flood-prone areas are among these measures [32]. In the present study, the lack of suitable urban infrastructure, including the wear and low height of bridges, and the lack of alternative transportation routes were among the factors affecting the evacuation.

Infrastructure factors had four subclasses of facilities related to transportation tools and routes, urban constructions, communication infrastructure, and meteorological facilities. Lane believes that land use and urban development can control floods. He also refers to using appropriate emergency facilities and equipment [33]. Managers and urban planners should pay attention to the equipment supply plan in the planning stage before disasters [34-41]. In the current study, the lack of transportation and dredging equipment has caused problems in the emergency evacuation route. Botzen et al. showed that construction buildings' location and quality are essential in flood disaster management. These factors reduce the damage related to evacuation and prevent property damage. In addition, the inappropriate structure of the city is an influential factor in evacuation [42].

Conclusion

The human, social, geographical, and infrastructure factors were the influential factors of evacuation in the study; therefore, it is recommended that managers help the flood response stage by training manpower and increasing the risk perception, increasing the financial credit of cities exposed to floods, and providing meteorological equipment and an early warning system. It is suggested that future studies investigate the motivational factors of managers and people to improve the understanding of flood risk.

Study limitations

Since the interviews were conducted several years after the flood event, some experiences may have been forgotten. The small number of female participants, especially executive managers, was another limitation of this study.

Ethical Considerations

Compliance with ethical guidelines

This design has been approved by the Research Ethics Committee of [Hamadan University of Medical Sciences](#) (Code: IRUMSHA.REC.1400.039, No.: 140002281400).

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Authors' contributions

Conceptualization, methodology, data generation, data interpretation and writing the manuscript: All authors; Data collection: Changiz Ahmadi; Data analysis: Arezou Karampourian and Mohammad Reza Samarghandi; Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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