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Resilience management in the face of natural hazards: Perspectives of local rural managers in Kermanshah province

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Abstract

Iran is faced with a multitude of disasters and damages, emphasizing the significance of resilience in mitigating the impacts of these events. This study aimed to explore resilience management in the face of natural hazards through the local managers' perspective in rural areas of Kermanshah Province. The research adopted a descriptive research approach, utilizing a questionnaire as the primary data collection tool. The study's population encompassed villagers, local officials of the province, and members of the Islamic councils of the studied villages. A comprehensive sampling method was employed, involving all available local officials, resulting in a sample size of 111 individuals. The reliability of the research instrument was assessed using Kornbach's alpha coefficient, with an average value of 0.78. Moreover, the validity of the study was confirmed through consultation with rural development and planning experts. The findings indicated that although some variables within the 10 management principles showed a positive status of resilience, there were still significant shortcomings in some cases. Additionally, employing the ORESTE model enabled the ranking of counties within Kermanshah Province. The results revealed that Kermanshah County had the highest and most robust level of resilience management, while the weakest status is observed in Paveh County.

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Introduction

Throughout the course of history, natural disasters have been an inevitable aspect of human life. These calamities occur sporadically on various scales worldwide, resulting in human casualties, property destruction, and large-scale displacements. Among the most devastating disasters globally and specifically within Iran are earthquakes. As a recurring phenomenon throughout the planet's existence, earthquakes pose a significant development risk, particularly in developing countries. There is evidence that developing nations are more susceptible to natural hazards, as demonstrated by the occurrence of eleven natural disasters in the 20th century with a frequency of 16689 that caused death of 10052401 individuals and resulted in approximately $631 billion in damages. Developing countries are significantly affected by the impact of these disasters

(Bryan, 2007). Asia, with its massive population of approximately four billion people, has been profoundly affected by numerous large-scale natural disasters in recent decades. The region accounts for 39% of the world's total natural disaster occurrences, with 53% of global casualties and 88% of all affected individuals originating from Asia (Kaku & Held, 2013: 5). Generally, it is estimated that an average of three million individuals are annually left homeless due to natural disasters, with 80% of these cases resulting from earthquake-induced destruction of residential structures (Asfi et al., 2015: 57). In rural areas, the vulnerability to natural hazards, particularly earthquakes, is more pronounced compared to other communities. This heightened vulnerability can be attributed to the close interaction with the natural environment and the limited capacity to address environmental threats. Consequently, rural areas are among the most susceptible to earthquake incidents. The occurrence of earthquakes in villages worldwide is a recurring phenomenon, causing significant damage and posing substantial challenges to the development of rural regions. Factors contributing to this vulnerability include the fragility of the rural economy, insufficient physical and social infrastructure, extensive physical deterioration, narrow village roads, limited access to communication routes, utilization of inappropriate structures, and the use of less durable materials (Rumian et al., 2013: 94). The development of rural areas encounters significant obstacles due to the aforementioned vulnerabilities. The high population density in developing countries rural areas, coupled with the use of substandard materials and aging buildings, further emphasizes the necessity of crisis management and attention to the vulnerability of these regions (Tsai & Chen, 2012). People's participation, as a crucial social component, has been identified as a key factor contributing to the vulnerability of villages against earthquakes. The engagement of local communities can have a significant impact before, during, and after an earthquake. Resilience, as a means to strengthen communities, is proposed as a strategy that utilizes current local capacities. Various definitions, approaches, indicators, and measurement models have been developed to conceptualize resilience (Sadeghloo&Sojasi,2015:39).

Strengthening resilience can effectively reduce damages and casualties, thereby minimizing the subsequent costs associated with post-disaster reconstruction. It ultimately leads to the creation of a high-quality life for local communities. Hence, the key research question of this study is: What are the perspectives of local rural managers in Kermanshah Province regarding resilience management against natural hazards?

Theoretical Framework

Resilience is commonly defined as the capacity to withstand shocks and disasters. According to the Oxford Dictionary, it refers to the ability of individuals or societies to return to a suitable state following disastrous events such as shocks or damages, and so on. It also encompasses the ability of materials to revert to their original state after being subjected to bending, stretching, or compression. The term "resilience" was introduced by Holling, an ecological theorist, in 1973 (Pertui et al., 2015: 101).

The etymology of the word "resilience" can be traced back to the Latin term "resilio," which translates to "jumping back." In essence, resilience is employed in the context of developed environments within social systems and human-environmental systems, emphasizing ecosystems, society, and the integration of the social-ecological system. The meaning and concept of resilience entail various interpretations, including:1- Flexibility as a biophysical characteristic, a social feature, and a specific feature of regions; 2- Flexibility as a biophysical feature in terms of biodiversity and key characteristics of systems; 3- Flexibility as the level of disturbance that a system can experience during a crisis while maintaining the ability to preserve pre-existing system changes; and 4- Flexibility as the ability of the human community to withstand external shocks or infrastructure disruptions (Zhou, 2010:23).

The term resilience was initially applied in practical contexts by Timmerman, who played a significant role in exploring society's resilience to climate change and linking the concept of resilience to vulnerability. Resilience was employed as a metric to assess the capacity and robustness of a component or system to revert to its original state following an incident (Mohammadi Serin Dizej et al., 2016: 94).

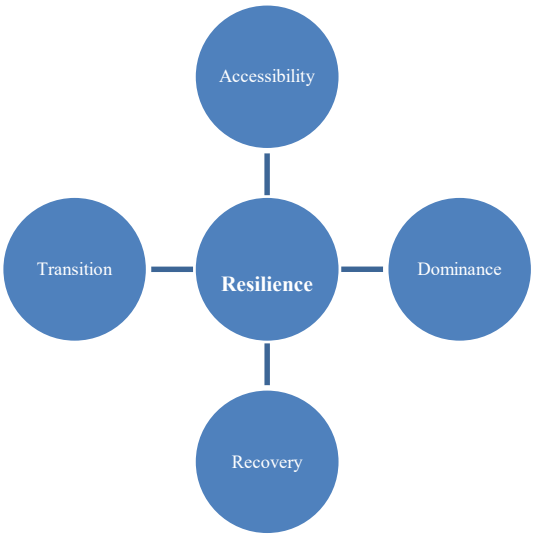

Figure 2. Resilience and its concepts (Abadalezadeh Maleki et al.: 2016: 267)

There are several approaches involved in understanding sustainability and resilience: Approach A: Sustainability: This approach has expanded from ecological studies, which define resilience as the ability to return to a previous state. Resilience is defined as the level of disturbance that a system can tolerate or absorb before transitioning to a different state.

Approach B: Recovery; This approach focuses on society's ability to recover from changes or pressures and return to its original state. The measure of recovery is often assessed by the time it takes for a society to fully recover from the impacts of a change.

Approach C: Transition; This approach is closely related to social resilience and society's capacity to respond and adapt to change. Instead of simply reverting to the previous state, transition emphasizes the possibility of moving towards a new state that is more stable within the current environment. This approach emphasizes adaptation and the ability of societies to adjust to and thrive amidst disruptions. In a resilient social-ecological system, disruptions can create opportunities for innovation, development, renewal, revitalization, and self-organization (Maguire & Hagan, 2007:1; Holling, 2004: 5).

Resilience can be conceptualized through four stages, including I, mitigation which defines as activities aimed at reducing or eliminating the impacts of a crisis and minimizing the adverse effects of an earthquake; II, preparedness: this stage involves activities aimed at saving lives and reducing injuries by preparing individuals to respond appropriately during times of crisis. III, a response that encompasses activities carried out during or immediately after an earthquake to provide essential assistance to affected individuals and communities. It focuses on the provision of emergency services, and efforts to minimize the likelihood of secondary accidents. The goal is to swiftly address the immediate needs and facilitate the recovery process. IV, recovery which involves the implementation of individual and collective aid programs designed to accelerate community recovery. It includes temporary housing solutions, various types of loans, and initiatives to support the restoration of infrastructure and essential services (Morao, as cited in Ramzanzadeh, 2015: 34).

Resilience encompasses social, economic, institutional, and physical dimensions, which are outlined as follows:

Social dimension: This component of resilience is influenced by the varying social capacities across different societies. In other words, it refers to the ability of social groups and communities to return to their pre-disaster state or effectively respond to disasters. Social capital, a crucial concept in the fields of risk and disaster, plays a significant role in enhancing the resilience of communities. Understanding, accessing, and utilizing different forms of capital are essential for the success and stability of communities in managing and increasing their resilience to risks.

Economic dimension: In this context, resilience is defined as the inherent response and adaptability of individuals and societies to risks. It enables them to minimize potential losses and maintain stability in economic growth and income distribution among the population.

Institutional dimension: This component relates to risk reduction, planning, and the experience gained from previous disasters. Resilience in this dimension is influenced by communities' capacity to mitigate risks, engage residents in risk reduction efforts, establish organizational linkages, and improve and safeguard social systems within the community (Patton, Rose, Norris, as cited in Ramzanzadeh, 2015: 36).

Physical-Environmental (Infrastructural) Dimension: This dimension focuses on evaluating the society's response and recovery capacity after a disaster in terms of physical infrastructure. It includes factors such as the availability of shelters, vacant or rented residential units, and healthcare facilities. These indicators provide a general assessment of the extent of private infrastructure that may be vulnerable to permanent damage, as well as potential economic losses. Fragile homes are particularly susceptible to catastrophic events and are considered a critical element of vulnerable infrastructure (Rezaei, 2010:10).

Among the various dimensions of resilience, the economic dimension holds significant importance. It allows for the assessment of economic structures by identifying the strengths and weaknesses of the economic system, to enhance economic resilience in the face of both human-made and natural disasters (Sasan Puro et al., 2016: 87).

Furthermore, resilience can be understood from four perspectives, including I, strength referring to the ability of a system to withstand specific stressors without losing functionality; II, redundancy representing the number of elements and systems available to replace or supplement the existing ones; III, problem identification, prioritization, and resource mobilization, and IV, speed and capacity to achieve goals. Indeed, a resilient system reduces the probability of failure and damage, minimizes the consequences of failure, and expedites the recovery process in the event of unique incidents (Zhou, 2010:24).

Literature review

Riahi et al. (2019) conducted a study titled "Crisis management investigation and Providing an optimal model emphasizing vulnerability". The study found that causal models, such as the crunch and diffusion models, emphasize the causes of crises by highlighting vulnerability from a different perspective. The crunch model elucidates the root causes and insecure conditions that lead to vulnerability and the onset of crises.

Abdi et al. (2019) carried out research titled "Crisis management model in rural areas: A case study in the Qarchak County". The results revealed that the majority of people had experienced hazards and knew the definitions and actions related to crises. The analytical findings demonstrated a significant relationship between the awareness level among local managers regarding their role in planning for reducing natural hazards and their performance in this field. The attitudes and knowledge levels of local managers in crisis management influenced their performance in developing plans to mitigate natural hazards.

Furthermore, Wegscheider et al. (2011) conducted a study titled "Evaluating the risk of tsunami at the community level: the

basis for planning and implementing risk reduction strategies." The study found that community members be sufficiently aware about tsunami risks, were aware of warning signs, knew evacuation routes and shelter locations, and actively engaged in relevant exercises. However, due to limited resources, prioritization of specific activities was necessary, as competent authorities were unable to simultaneously perform the same activities in different locations.

In a research study titled "Designing real scenarios for qualitative models of disaster management" Vargas et al. (2011b) proposed an approach based on analyzing various scenarios to develop qualitative models for disaster management. One of the scenarios they examined was the occurrence of an earthquake of a specific intensity in a particular area, and they aimed to determine its consequences on logistical and human factors.

In another study, Becken et al. (2013) titled "Tourism communication on the structure of crisis management to reduce risk", highlighted the importance of effective communication in crisis management within the tourism industry. Given the increasing global interest in tourism and the potential risks associated with it, the research emphasized the need to establish strong links between tourism stakeholders and risk management practices to minimize the impact of crises on the tourism sector, especially in areas with heavy dependence on tourism.

Heydarifar et al. (2017) conducted a study on measuring the components of urban resilience in the Kermanshah metropolis. They used a document-survey-based approach to evaluate and analyze the significant factors influencing urban resilience. The findings indicated that the physical- management factor had a higher priority in enhancing urban resilience.

Methodology

This study is conducted as descriptive-analytical research. The statistical population comprises two distinct groups. The first group comprises heads of households residing in villages within the Kermanshah province, where the number of households exceeds 50. The second group encompasses local managers, encompassing Islamic councils and villagers residing in villages with more than 50 households within the same province.

Consequently, the statistical community involved in this research encompasses planning officials, academics, experts, as well as the rural community. To collect the requisite information for this study, the Delphi method was employed in the first scenario, while the method of surveying and employing questionnaires were utilized to gather data from the rural community in the third scenario.

In this research, the unit of analysis for local administrators comprises both village governers and members of Islamic councils. The reliability of the research findings was determined to be 0.78, as indicated by the average score obtained from the Kornbach's alpha coefficient. Additionally, the validity of the research was confirmed based on the expert opinions of individuals specializing in rural development and planning. The indicators utilized in this study encompass several sub-components, primarily devised to analyse and compare the studied items (Table 1).

The county's ranking was derived from the ORESTE multi-indicator decision-making approach model. If a decision-making problem involves multiple indicators, the objective is to rank a set of “m” options based on “k” indicators. For each indicator, a weak order is established for the options, while the relative importance (weight) of each indicator is expressed through another weak order. Accordingly, ORESTE, is regarded as one of the most effective Multiple Attribute Decision Making (MADM) methods. This method provides a comprehensive ranking of decision options, thereby revealing conflicts that may arise between the options (Mohamedpour and Asgharizadeh, 2017: 219).

The ORESTE model comprises the following steps:

1. Projection of the intervals of options $d(0, m_k)$: Projection in the ORESTE method is performed using a hypothetical matrix

known as the position matrix. Each column of the matrix represents the sorted decision options, from the most favorable to the least favorable, based on each indicator.

2. Global ranking of the options intervals $R(m_k)$: This stage involves the computation of the Global rankings of the options, considering all indicators collectively.

3. Aggregation stage: Once all the global ranks have been calculated and determined, the global ranking for each indicator is separately aggregated across all options. In other words, the final aggregation is computed for each option, denoted as "m".

Table 1: Investigated variables from the local managers perspective

Ten principles	Component	Variables of each principle
Principle 1	Organization and coordination	Knowledge, experience, rules and regulations, inclusive participation, stories of vulnerable local communities
Principle 2	Allocation of Budget and Financial Resources for Rural Residents Living in Hazard-Prone Areas	Sufficient financial resources, savings plans, credits and insurance schemes, cash assistance, and investment in risk reduction for households and businesses.
Principle 3	Updating information related to hazards and vulnerabilities.	Vulnerability assessments and risk assessments.
Principle 4	Management and Protection of Infrastructures	Prohibition of construction in river and flood zones, land use policies, communications, public facilities, protection of flood barriers and similar structures
Principle 5	Security of schools and healthcare facilities	Security of schools, hospitals, and healthcare centers, regular disaster preparedness exercises in schools, hospitals, and healthcare centers
Principle 6	Laws of Construction and Land Use	Building and construction laws, health and safety regulations, requirements for setback and relocation of buildings, technical standards, construction principles and patterns aligned with riverbank zoning and land use change plans, supportive and incentivizing programs such as housing loans for resilience and rehabilitation.
Principle 7	Education of local communities.	Awareness and educational programs on risk mitigation, educational programs for local authorities and community leaders, evacuation plans, and drills.
Principle 8	Environmental Conservation	Prohibition of natural resource destruction, including vegetation cover, deforestation, strategies and implementation plans by local government, sustainable management and protection of forests and pastures, participation in conservation, and sustainable management of ecosystem services.
Principle 9	Crisis management alert systems	Emergency shelters, emergency operations centers, and emergency communication systems
Principle 10	Reconstruction measures	Reduction of psychological-social impacts, allocation of resources and an expert workforce to assist victims, and psychological-social rehabilitation of professions

Results

Principle 1: Organization and coordination principle

The analysis of perspectives of 111 local managers reveals that the components of the first resilience principle, with a focus on the role of managers, are in an average state. However, the obtained averages indicate a significant difference among the internal indicators. For instance, in response to the question posed by the Council and rural municipality regarding the extent of equipped disaster risk reduction and disaster management capacities (including knowledge, experience, laws, and regulations), the mean value of 2.3 falls below the desirable median. Similarly, when assessing the level of partnership between communities, the private sector, and local authorities in reducing vulnerability, the obtained average of 2.4 suggests a similar situation. On the other hand, the remaining two items of this principle, namely "To what extent do

councils and rural municipalities participate in planning to reduce the risk of natural disasters?" and "To what extent do councils and rural municipalities support vulnerable local communities (especially women, the elderly, and children)?" show a favorable condition with an average of 3.4. It should be noted that this favorable condition can be attributed to the rural nature of the studied area (Table 2).

Table 2: Descriptive status of the ten principles of resilience management from the point of view of managers (the first principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent are councils and rural municipalities equipped with disaster risk reduction capacities (knowledge, experience, laws, and regulations)?	111	2.3	.99934	0.09485
To what extent is there participation from communities, the private sector, and local authorities in disaster risk reduction?	111	2.4	1.08598	0.10308
To what extent do councils and rural municipalities participate in the planning of natural disaster risk reduction?	111	3.4	1.10111	0.10451
To what extent do councils and rural municipalities support vulnerable local communities (especially women, the elderly, and children)?	111	3.4	1.18155	0.11215

Principle 2: Allocation of funds and financial resources for villagers living in the danger zone

The obtained averages indicate an unfavorable situation for all items related to the allocation of budget and financial resources for villagers residing in high-risk areas. Accordingly, the average values for these items were all below 3. It is crucial to highlight that financial factors play a significant role in the process of enhancing resilience in settlements, with the second principle of resilience specifically focusing on economic factors and financial challenges. For instance, the lack of reliable financial resources for rural municipalities in the event of a natural disaster presents a challenge to their management performance and support provision. This is because managing various types of natural crises requires navigating administrative bureaucracy to access essential facilities.

Table 3. Descriptive status of the ten principles of resilience management from the point of view of managers (the second principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent do councils and rural municipalities have sufficient access to financial resources for implementing activities related to disaster risk reduction?	111	2.	1.11596	0.10592
To what extent do councils and rural municipalities allocate sufficient financial resources for implementing impactful activities in disaster risk reduction?	111	2.1	1.04893	0.09956
What are the available financial services (such as savings schemes, credits, and insurance) for vulnerable households before disasters occur?	111	2.2	1.09933	0.10434
To what extent are local funds, cash assistance, small loans, and loan guarantees available for affected households to recover from disasters?	111	1.9	1.04054	.09876
To what extent has economic incentive been created for investing in household and business risk reduction, such as insurance premium reduction for households and tax exemptions for businesses?	111	2.1	1.00669	0.09555
To what extent do local trade unions, such as chambers of commerce and similar organizations, support small businesses during and after disasters?	111	1.9	.95278	0.09043

However, this process increases community vulnerability to disasters and consequently reduces the level of resilience. Moreover, the assessment of insurance performance and support following the occurrence of natural disasters indicates low satisfaction among managers, with an average rating of 2.2. Insufficient awareness among villagers regarding the importance of insurance coverage is also evident (Table 3).

Principle 3: Updating information related to hazards and vulnerabilities

The third principle of enhancing settlements' resilience against hazards and natural disasters involves acquiring and updating knowledge and information among managers concerning environmental and natural disasters. However, the findings reveal that the overall condition of all five items associated with this principle is suboptimal. Accordingly, when assessing the performance of councils and rural municipalities in terms of risk evaluation, the level of effectiveness falls below the desired average (3), with an average rating of 2.9. Despite the employment of traditional risk estimation, local managers still lack accurate proficiency in this area. Regular risk assessments are essential for constructing resilient settlements. However, the results indicate an unfavorable situation concerning this aspect, as there isan average difference of 2.5 compared to the desired average of 3 (Table 4).

Table 4. Descriptive status of the ten principles of resilience management from the point of view of managers (the third principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent do councils and rural municipalities conduct risk assessments for key vulnerable sectors within their respective areas?	111	2.9	1.12379	.10667
How regularly are risk assessments updated, such as on an annual or biennial basis?	111	2.5	1.10156	.10456
In what manner and with what level of organization do councils and rural municipalities communicate with the community regarding local hazard trends and risk reduction measures (e.g., through a risk communication program) including timely hazard warnings?	111	2.5	1.00621	.09550
To what extent do the risk assessments conducted by councils and rural municipalities align with the risk assessments conducted by surrounding villages and the risk management programs of the national or provincial government?	111	2.5	1.06704	.10128
To what extent are disaster risk assessments adequately incorporated into all relevant local development planning?	111	2.9	3.17649	.30150

Principle 4: Management and protection of infrastructure

From the perspective of settlement resilience, the management and protection of various infrastructures, including water supply networks, public buildings, schools, banks, stations, fire brigades, security centers, electricity networks, and, most importantly, road networks, are crucial. In rural areas, another significant type of physical structure is the houses of villagers, which can play a vital role in disaster management during crises by changing their functions. Regarding the determination of risk areas and the prohibition of construction in high-risk areas, this is recognized as a highly desirable practice by local managers in the Islamic council and rural municipalities, as evidenced by an average rating of 3.7 compared to the theoretical mean desirability rating of 3. On the other hand, when considering "land use policies and planning laws for house building and infrastructure development, to what extent do they incorporate current and future disaster risk plans?" local administrators noted the situation as favorable, with an average rating of 3.2. The monitoring of housing construction also reflects a

favorable condition, which can be attributed to the legal mechanisms in place for the duties of village governors or their performance. However, one of the major challenges in rural areas pertains to the implementation of measures to protect critical public facilities and infrastructure against damage during disasters. The results indicate an unfavorable situation in this regard as well (to Table 5).

Table 5: Descriptive status of the ten principles of resilience management from the perspective of managers (fourth principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
Determining hazard zones and construction prohibitions in high-risk areas	111	3.7	3.8	.36855
To what extent do land use policies and planning laws consider current and future disaster risk reduction measures in housing and infrastructure development programs?	111	3.2	1.1	.10677
Monitoring housing construction activities	111	3.4	1.2	.11912
To what extent have you invested in communication infrastructure (telephone, internet) in the villages under your jurisdiction?	111	2.5	1.13	.11148
To what extent are critical public facilities and infrastructure adequately established and assessed for hazards and security in high-risk areas?	111	2.4	1.0	.09945
What measures have been taken to protect critical public facilities and infrastructure from damage during disasters?	111	2.6	2.2	.21149

Principle 5: Security of schools and medical centers

Ensuring favorable conditions for medical facilities becomes even more critical during disasters, particularly in the case of natural calamities such as earthquakes. When establishing healthcare centers in local settlements, it is essential to prioritize the safety of these facilities. According to local managers, this item is considered to be in a medium condition, as the mean rating does not significantly differ from the theoretical mean of the variables (2.9). One aspect investigated regarding the role of local managers is the monitoring and measurement of the medical center's safety. Managers themselves acknowledge that this measurement is not conducted at an optimal level, with an average rating of 2.6. Several factors contribute to this unfavorable performance, including inadequate education and a lack of expertise in measuring the safety of medical centers and monitoring the protection of these buildings (Table 6).

Table 6: Descriptive status of the ten principles of resilience management from the point of view of managers (the fifth principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent are primary schools and healthcare centers adequately safe from disasters to ensure their operations can continue during emergencies?	111	2.8	1.21908	.11571
To what extent do councils, local governors, or other levels of government have programs in place to regularly assess schools, hospitals, and healthcare centers in terms of maintenance, adherence to construction standards, public safety, weather-related hazards, and so on?	111	2.6	1.14136	.10833
To what extent are regular disaster preparedness exercises conducted in schools, hospitals, and healthcare centers?	111	2.6	1.29087	.12252
To what extent are schools and healthcare centers capable of transforming into crisis management centers?	111	2.7	1.23191	.11693

Principle 6: Construction rules and land use regulations

The implementation of mitigation programs to enhance the resilience of local communities against natural disasters heavily relies on construction rules and land use laws. In rural areas, particularly in villages with over 50 households, construction rules have been established and are incorporated into the Hadi plans. The average rating obtained from the perspectives of local district managers confirms this situation. However, the extent to which these laws contribute to risk reduction is not deemed successful according to the views of local managers.

In recent years, the provision of renovation and retrofitting loans has significantly contributed to improving the safety of rural houses against natural disasters. Consequently, rural managers evaluate the effectiveness of such loans in enhancing the safety of rural houses favorably, with an average rating of 4.2 (Table 7).

Table 7: Descriptive status of the ten principles of resilience management from the perspective of managers (the fifth principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent are land use regulations, building codes, and health and safety laws enforced in all construction activities?	111	3.2	1.22805	.11656
How effective are the existing regulations to support disaster risk reduction in your area?	111	2.8	1.03168	.09792
To what extent is there a requirement for setback and relocation of buildings from hazard-prone areas?	111	2.6	1.07697	.10222
To what extent are technical regulations, construction principles, and engineering designs adhered to?	111	3.1	1.29011	.12245
To what extent is the use of non-resistant materials prevented in vulnerable areas?	111	2.8	1.29226	.12266
In your opinion, how effective are the penalties for illegal construction?	111	3.8	1.22992	.11674
To what extent are supportive and incentivizing schemes, such as housing loans for retrofitting and rehabilitation, effective in implementation?	111	4.2	1.10468	.10485

Table 8. Descriptive status of the ten principles of resilience management from the perspective of managers (the seventh principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent does the government take measures to create awareness and implement educational programs on disaster risk reduction and preparedness for local communities?	111	2.9099	1.29017	.12246
To what extent does the government implement educational programs for local authorities and community leaders?	111	2.6306	.99934	.09485
To what extent do schools and universities include courses on disaster risk reduction (including climate-related hazards) as part of their curriculum?	111	2.6036	1.06412	.10100
To what extent are rural communities aware of evacuation plans and necessary drills?	111	2.1081	1.01221	.09607
Have you personally participated in crisis management and natural disaster training classes?	111	1.4505	.71017	.06741
If you have participated, to what extent have you found them effective?	111	3.3153	1.31413	.12473

Principle 7: Education of local communities

Education is now recognized as a fundamental principle across all levels of management. In the context of natural disasters, this principle assumes particular importance as it aligns with the implementation of mitigation programs.

However, according to Table 8, it can be observed that the effectiveness of training sessions is only desirable when they are conducted. When examining the perspectives of local administrators regarding the question, "To what extent do government actions prioritize awareness creation and educational programs aimed at reducing risks and enhancing disaster preparedness among local communities?", it was demonstrated that the government needs to develop more effective plans in this area.

Principle 8: Protection of the natural environment

Considering the specific types of hazards that have been affecting rural areas in Kermanshah Province in recent years, such as drought, frost, and earthquakes, special attention is given to the principle of protecting the natural environment. Prohibiting the destruction of vegetation is a crucial aspect that demands serious consideration to enhance resilience. This perspective is affirmed by the viewpoints of managers, with an average rating of 4.4. Additionally, the performance of village governors in safeguarding natural resources is considered favorable, given the increasing demands for the exploitation of these resources and land in rural areas.

The challenge of drought in recent years has posed significant problems in the rural areas of Kermanshah Province. The management of water resources is one of the strategies recommended by experts to ensure the livelihood of farmers in these regions. Local managers, in conjunction with effective government policies, play a vital role in water resource management. However, it is important to note that the efforts of non-governmental organizations also complement the activities of local managers (Table 9).

Table 9. Descriptive status of the ten principles of resilience management from the perspective of managers (eighth principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent is the prohibition of natural resource destruction, including vegetation cover and deforestation, effective in flood management?	111	4.4955	.94266	.08947
To what extent have disaster risk reduction policies, strategies, and implementation plans of local governments been integrated into environmental development programs and natural resource management?	111	3.1802	1.12167	.10646
To what extent do councils and rural municipalities support resource rehabilitation, protection, and management?	111	3.6036	1.17767	.11178
To what extent do councils and rural municipalities support sustainable rehabilitation, protection, and management of watersheds?	111	3.5405	1.21194	.11503
To what extent do councils and rural municipalities support sustainable rehabilitation, protection, and management of agriculture?	111	3.6306	1.20550	.11442
To what extent do councils and local governments support sustainable rehabilitation, protection, and management of water resources?	111	3.5495	1.22652	.11642
To what extent do civil society organizations and citizens participate in the conservation, protection, and sustainable management of ecosystems?	111	2.9730	1.11567	.10589
To what extent does the private sector participate in the implementation of environmental and ecosystem management programs in your region?	111	2.0991	1.08674	.10315

Principle 9: Warning systems and crisis management capabilities

The ninth principle assesses the level of resilience of settlements with regard to warning systems and crisis management

capabilities. In other words, the more up-to-date the warning systems are, the higher the resilience of the settlements. This principle consists of six components, including "To what extent do local institutions have access to financial reserves to support rapid and effective disaster response and recovery?", "To what extent are rapid warning centers established, equipped with manpower (or standby personnel) and necessary resources (personnel support, equipment, and so on)?", "To what extent do the warning systems facilitate community participation?", "To what extent do councils and rural municipalities have emergency operation centers or emergency communication systems with appropriate authority?", "To what extent are training exercises conducted involving relevant government entities, non-governmental organizations, local administrators, and volunteers?", and "To what extent are key resources for effective response, such as emergency supplies, emergency shelters, identified evacuation routes, and emergency plans, available at all times?" The results of the study indicated that local managers lack awareness and resources related to warning systems. They do not possess the necessary facilities, tools, or financial reserves to support rapid and effective disaster response and recovery (Table 10).

Table 10. Descriptive status of the ten principles of resilience management from the perspective of managers (ninth principle)

Items	Observations number	Mean	Standard deviation
To what extent do local institutions have access to financial reserves for supporting effective and rapid response and recovery efforts in disasters?	2.0721	1.04195	.09890
To what extent have early warning centers been established and adequately staffed (or have trained personnel) with resources (such as support personnel, equipment, etc.)?	1.9099	.98673	.09366
To what extent do the warning systems enable sufficient community participation?	2.6937	1.06850	.10142
To what extent do councils and rural municipalities have emergency operations centers and/or emergency communication systems?	1.9189	1.03691	.09842
To what extent are training exercises conducted with the involvement of relevant government entities, non-governmental organizations, local authorities, and volunteers?	2.2883	1.03912	.09863
To what extent are key resources for effective response, such as emergency supplies, emergency shelters, identified evacuation routes, and emergency plans, available at all times?	2.1351	1.03121	.09788

Principle 10: Reconstruction measures

The final principle in creating resilient spaces is the implementation of reconstruction measures, which are primarily employed in situations where natural disasters have caused destruction. To establish resilient spaces, this principle emphasizes the continuous attention given to strengthening financial resources. The results indicated an undesirable state of this principle from the perspective of local managers, as all the obtained averages suggest a value below the theoretical median (3). For instance, in response to the question "To what extent do councils and rural municipalities have access to financial resources to aid victims and reduce the psycho-social impacts of disasters?" the obtained average is 2, indicating a lower value compared to the number 3 (Table 11).

To understand the overall status of the organization and coordination principle, which should receive attention from local managers, Tables 6-11 revealed that the overall average (2.9) was lower than the theoretical median (3). However, the difference between the two statuses is only 0.1. Additionally, based on the lower bound (2.8) and upper bound (3.07), the average status is confirmed to be moderate. Therefore, it can be noted that the organization and coordination status is assessed as moderate. However, the calculated significance level (0.366) suggests that there is a significant agreement among the mental attitudes of local managers (Table 12).

Table 11. Descriptive status of the ten principles of resilience management from the point of view of managers (tenth principle)

Items	Observations number	Mean	Standard deviation	Standard error of the mean
To what extent do councils and rural municipalities have access to financial resources for assisting victims and reducing the psychological-social impacts of disasters?	111	2.0360	1.20550	.11442
To what extent do councils and rural municipalities have access to resources and expert personnel to assist victims and address the psychological-social consequences of disasters?	111	2.0360	1.11133	.10548
To what extent are disaster risk reduction measures incorporated into post-disaster recovery and rehabilitation activities (such as better reconstruction and livelihood rehabilitation)?	111	2.2973	1.11677	.10600
To what extent does the contingency plan (or similar plan) have an overall strategy for post-disaster recovery and reconstruction, including needs assessment and business recovery?	111	2.4234	1.04924	.09959

Table 12. T-test results to understand the overall status of the first principle

	Number	Mean	Standard deviation	Standard error
Principle 1: organization and coordination	111	2.9	.70648	.06706
	T-value	Sig.	Lower limit	Upper limit
	-.907	.366	-.1937	.0721

Theoretical mean = 3

The second principle has been analyzed, consisting of six components. To gain a comprehensive understanding of this principle, these six items were integrated and subsequently subjected to examination through the one-sample T-test. The findings indicate a noteworthy difference between the obtained average value (2.07) and the theoretical average. Furthermore, considering the lower limit (1.9), it is reasonable to assert that the current state of this management principle does not seem desirable. As financial resources are one of the crucial principles of resilience management, pose a persistent challenge in rural areas. This challenge becomes particularly pronounced in the context of natural disasters, where farmers are directly and indirectly vulnerable. This vulnerability is amplified by the fact that many farmers and villagers are reliant on single-crop farming, leaving them highly exposed to crop losses when natural disasters occur. Consequently, the allocation of funds and financial resources for such settlements should be considered differently compared to other types of settlements. However, the obtained results did not confirm this situation (Table 13).

Table 13. T-test results to understand the overall status of the second principle

The second principle: Allocating budget and financial resources for rural residents living in hazard-prone areas	Number	Mean	Standard deviation	Standard error
	111	2.07	.77612	.07367
	T-value	Sig.	Lower limit	Upper limit
	-12.576	.000	-1.0724	-.7804

Theoretical mean = 3

The third principle encompasses various aspects of managers' knowledge regarding natural hazards, specifically their level of expertise concerning the potential consequences of natural disasters. Through the examination of indicators consolidated within this principle, five components have been evaluated from the perspective of managers. According to the average score attained (2.7) and the difference observed in relation to the theoretical mean of this component, it can be claimed that it is rated at an intermediate level. Moreover, the statistical significance level calculated within the alpha domain (0.005) highlighted a consensus among the managers in terms of their collective perception (Table 14).

Table 14. T-test results to understand the overall status of the third principle

	Number	Mean	Standard deviation	Standard error
Principle 3: Updating information associated with risks and disaters	111	2.7099	1.07153	0.10170
	T- value	Sig.	Lower limit	Upper limit
	-2.852	0.005	-0.4916	-0.885

Theoretical mean = 3

This principle pertains to the establishment of resilient settlements aimed at safeguarding critical infrastructure and public buildings that can serve as medical centers, thining rooms, and even shelters during natural disasters. This principle encompasses various components, including the construction of houses for villagers, the strategic placement of public infrastructure, and the implementation of land use policies. To facilitate a comprehensive understanding, all six components of this principle have been combined and analyzed using the t-test. The results indicated that the average score obtained (3.003) signifies a slightly elevated level when compared to the theoretical average (3). However, the calculated significance level indicates a lack of consensus among managers. In other words, some managers have noted the adherence to these principles in their respective regions, while others have claimed that the status of this principle is unfavorable in the areas under their management (Table 15).

Table 15. Results of the t-test to understand the overall status of the eighth principle

	Number	Mean	Standard deviation	Standard error
Principle 4: Management and protection of the building	111	3.0030	1.02395	.09719
	T- value	Sig.	Lower limit	Upper limit
	.031	.975	-.1896	.1956

Theoretical mean = 3

Given the potential consequences of natural disasters, particularly earthquakes and floods, the public facilities security became important. Accordingly, medical centers and schools hold greater significance than other public spaces. Evaluating the opinions of local managers, it can be noted that the security level in these centers are not desirable. This claim is supported by the average score obtained (2.7), which is lower than the theoretical average. However, the calculated significance level indicates a common subjective agreement among the perspectives of local managers (Table 16).

Table 16. T-test results to understand the overall situation of the fifth principle

	Number	Mean	Standard deviation	Standard error
Principle 5: Security of schools and medical centers	111	2.7320	.93524	.08877
	T-value	Sig	Lower limit	Upper limit
	-3.019	.003	-.4439	-.0921

Theoretical mean = 3

The regulations pertaining to construction and land use play a pivotal role in crisis management within rural areas affected by natural disasters. To gain a comprehensive understanding of this principle, the seven components encompassing land use regulations, supportive measures for disaster mitigation, adherence to building location guidelines, compliance with technical standards and construction practices, utilization of robust materials, and the enforcement of punitive measures for non-compliance were integrated into a single component. Subsequently, the t-test was employed to analyze this component. Based on the average score obtained (3.2) and the significance level (0.001), it can be concluded that the sixth principle of resilience is in a favorable state (Table 17).

Table 17. T-test results to understand the overall situation of the sixth principle

Principle 6: Building regulations and land use policies	Number	Mean	Standard deviation	Standard error
	111	3.2561	.77247	.07332
	T-value	Sig	Lower limit	Upper limit
	3.493	.001	.1108	.4014
Theoretical mean = 3				

To ensure comprehensive and widespread participation, it is crucial to provide educational programs for all ages and social groups, without exceptions. Insufficient knowledge about natural disasters and the human-made environment, as well as the failure to recognize the importance and role of individuals in ensuring security, health, and relief during disasters, contribute significantly to the high number of casualties. Encouraging people's participation in disaster relief efforts can greatly accelerate the alleviation of suffering among victims, particularly when individuals possess adequate knowledge and awareness regarding relief operations.

However, the results obtained from the perspectives of local managers indicate that the educational situation for both local communities and the managers themselves is not favorable. This is evident from the obtained mean score of 2.5, which was less than the theoretical average of 3. It is worth noting that some of these training programs should be incorporated into the regular educational curriculum, while others should be conducted through special workshops (Table 18).

Table 18. T-test results to understand the overall situation of the seventh principle

Principle 7: Education of local communities	Number	Mean	Standard deviation	Standard error
	111	2.5030	0.63841	0.06060
	T-value	Sig	Lower limit	Upper limit
	-8.202	.000	-.6171	-.3769
Theoretical mean = 3				

The safeguarding of natural resources, particularly in flood-prone basins, represents a fundamental necessity for mitigating the destructive impacts of floods. The implementation of laws that impose limitations and prohibitions on the extraction of natural resources, coupled with the active involvement of all stakeholders in the preservation of water resources and the protection of nature, considers a crucial responsibility of effective management in establishing resilient settlements against natural disasters. According to the results presented in Table 19, local managers have demonstrated admirable implementation of this management principle, as indicated by a favorable rating of 3.3.

Table 19. T-test results to understand the overall status of the eighth principle

Principle 8: protection of the natural environment	Number	Mean	Standard deviation	Standard error
	111	3.3840	0.78547	0.07455
	T-value	Sig	Lower limit	Upper limit
	5.151	.000	.2363	.5318
Theoretical mean = 3				

While warning systems may prove ineffective in certain types of natural disasters, they hold significant value in mitigating hazards such as droughts and floods. The ninth principle, which pertains to the crisis management power of warning systems, comprises six components. The overall average score calculated for this principle was 2.1 at $p \leq 0.000$. Consequently, based on these findings, it can be acknowledged that the status of warning systems and crisis management capabilities in the study area is unfavorable (Table 19-6). One of the most important aspects of warning systems is conducting drills and training exercises. The government and non-governmental organizations need to collaborate in organizing such activities under this principle (Table 20).

Table 20. T-test results to understand the overall status of the ninth principle

	Number	Mean	Standard deviation	Standard error
Principle 9: Warning systems and crisis management capabilities	111	2.1697	0.75545	0.07170
	T-value	Sig	Lower limit	Upper limit
	-11.580	0.000	-.6882	-1.6432

Theoretical mean = 3

In Iran, the responsibility for reconstruction efforts primarily lies with the government and public institutions. For instance, local managers possess the potential to significantly enhance the process of reconstruction by effectively presenting comprehensive reports. Moreover, their understanding of the mental and psychological states of residents and local communities can play a pivotal role in overcoming various obstacles encountered during crisis management planning. However, the results indicate an unfavorable situation in the rural areas of the study area, as there was a significant difference between the obtained mean score (2.1) and the theoretical mean (3) ($p \leq 0.000$). These findings highlight the suboptimal management performance in terms of reconstruction measures in the rural areas of Kermanshah province (Table 21).

Table 21. T-test results to understand the overall status of the tenth principle

	Number	Mean	Standard deviation	Standard error
Principle 10: reconstruction measures	111	2.1982	.90272	.08568
	T-value	Sig	Lower limit	Upper limit
	-9.358	0.000	-.9716	-.6320

Theoretical mean = 3

Table 22. Decision matrix

	Principle 1	Principle 2	Principle 3	Principle 4	Principle 5	Principle 6	Principle 7	Principle 8	Principle 9	Principle 10
Kermanshah	2.7833	1.8333	2.5267	2.8944	2.3833	3.2762	2.3556	3.1500	1.8278	1.9667
Harsin	3.0714	1.8810	2.2286	3.2381	2.3929	3.2449	2.2619	3.5893	2.0238	1.6429
Ghasre shirin	3.8125	3.4792	3.8250	3.5833	3.8125	3.4821	3.4167	3.5625	3.2500	3.5000
Sarpol Zahab	3.3333	2.6944	4.0000	3.9861	3.4583	3.3214	2.8889	3.5938	2.6667	2.8542
Dalahou	2.3750	1.3333	2.5000	3.0000	2.6250	2.8571	2.1667	3.0625	2.0000	1.8750
Javanrud	2.6429	1.8571	2.2286	2.5952	2.3214	2.8980	2.1429	3.0000	2.0238	2.5357
Islamabad Gharb	3.1563	1.7083	2.6250	2.6667	2.9063	3.3393	2.4583	3.6094	2.2083	2.1563
Salas Babajani	2.1667	1.6667	1.6000	2.5556	2.0833	2.6667	2.1667	2.9583	1.6667	1.5833
Sahne	2.8750	2.9167	3.4000	3.4167	3.0000	3.6429	2.5833	3.8125	2.4167	2.0000
Ravansar	2.8929	1.9762	2.1429	2.6667	2.6429	2.8163	2.2857	3.1250	2.0952	1.9643
Kangavar	2.5313	1.5417	2.2250	2.6667	2.6250	3.3571	2.7083	3.9375	1.8542	1.6563
Gilangarb	2.7500	1.6667	2.8000	3.4167	2.8750	4.1429	2.5000	3.8125	2.1667	2.3750
Sanqar	2.8250	1.9333	2.5800	2.7333	2.5250	3.2857	2.1833	3.3625	2.0667	1.9250
Paveh	3.1500	2.5667	2.6800	2.6333	3.1000	3.4000	2.8333	3.4500	2.7333	2.5500

Prioritization (ranking) of the counties in Kermanshah Province based on resilience principles using the ORESTE technique

To initiate the ranking process, two types of priority structures were created for the set of indicators and options. For the indicators, the opinions and expertise of specialists in the field were utilized to establish a priority structure. Similarly, for the set of options, a priority structure was created based on all the indicators, using the decision matrix data. The initial ranking of the options was determined through the average Bessoren ranks method (Table 1-7). Subsequently, the direct linear estimation method was employed to estimate intervals for each option based on the ranking

obtained from each indicator. These results were further ranked using the mean Bessoren ranks method to obtain the global ranks of R(mk) for each option. After calculating R(mk) for all options in all indicators, the aggregation was performed and R(m) with equivalent values to the sum of R(mk) for each of the options was calculated (Table 22).

Table 23: P matrix (initial ranking of options based on individual indicators ar_k (m)

	Principle 1	Principle 2	Principle 3	Principle 4	Principle 5	Principle 6	Principle 7	Principle 8	Principle 9	Principle 10
Kermanshah	9	9	8	7	12	9	8	10	13	8
Harsin	5	7	10.5	5	11	10	10	6	9.5	13
Ghasre shirin	1	1	2	2	1	3	1	7	1	1
Sarpol Zahab	2	3	1	1	2	7	2	5	3	2
Dalahou	13	14	9	6	8.5	12	12.5	12	11	11
Javanrud	11	8	10.5	13	13	11	14	13	9.5	4
Islamabad Gharb	3	10	6	10	5	6	7	4	5	6
Salas Babajani	14	11	14	14	14	14	12.5	14	14	14
Sahne	7	2	3	3.5	4	2	5	2.5	4	7
Ravansar	6	5	13	10	7	13	9	11	7	9
Kangavar	12	13	12	10	8.5	5	4	1	12	12
Gilangarb	10	12	4	3.5	6	1	6	2.5	6	5
Sanqar	8	6	7	8	10	8	11	9	8	10
Paveh	4	4	5	12	3	4	3	8	2	3

Table 24. Matrix R (global ranking of intervals R(m_k) with the method of average Bessoren ranks and results of R(m) for all options

	Principle 1	Principle 2	Principle 3	Principle 4	Principle 5	Principle 6	Principle 7	Principle 8	Principle 9	Principle 10
Kermanshah	61.5	63.5	52	42.5	112	73.5	71.5	100.5	134	100.5
Harsin	17.5	38.5	89.5	23.5	99	91.5	97.5	59.5	103.5	137
Ghasre shirin	1	2.5	7.5	12.5	17.5	29.5	36.5	71.5	61.5	75.5
Sarpol Zahab	2.5	7.5	5.5	10.5	19.5	53.5	38.5	57	67.5	77.5
Dalahou	116	130	67.5	32.5	65.5	113	121.5	119	115	124
Javanrud	95	49	89.5	120	123	102	136	127	103.5	82.5
Islamabad Gharb	5.5	77.5	29.5	82.5	31	44	58	55.5	70	91.5
Salas Babajani	129	96	131	132	133	135	121.5	138	139	140
Sahne	36.5	4	9	15.5	23.5	27.5	45.5	50.5	69	97.5
Ravansar	25.5	19.5	118	82.5	45.5	125	85.5	111	85.5	106.5
Kangavar	106.5	117	109	82.5	65.5	34.5	42.5	47.5	126	128
Gilangarb	75.5	108	14	15.5	34.5	25.5	53.5	50.5	73.5	87.5
Sanqar	47.5	27.5	40.5	55.5	87.5	59.5	105	93.5	93.5	114
Paveh	10.5	12.5	21.5	110	21.5	32.5	40.5	79	63.5	80

Table 25: Priority results of the Kermanshah Province counties based on the principles of resilience obtained from the ORESTE technique

No.	Ranking	Sum
1	Ghasre Shirin	315.5
2	Sarpol Zahab	339.5
3	Sahne	378.5
4	Paveh	471.5
5	Gilangarb	538
6	Islamabad Gharb	545
7	Sanqar	724
8	Harsin	757
10	Ravansar	804.5
11	Kermanshah	811.5
12	Kangavar	859
13	Dalhousie	1004
14	Javanrud	1027.5
15	Salas Babajani	1294.5

Conclusion

In conclusion, local managers play a crucial role in managing natural disasters and establishing resilient settlements. Their impact extends to various dimensions, including economic, social, environmental, and physical aspects. Based on the perspectives of local managers, the eighth principle, which involves protecting the natural environment, is in the most favorable condition with an average score of 3.4. Conversely, the second principle, concerning the allocation of budget and financial resources for residents living in high-risk areas, is in the least favorable condition with an average score of 2.1.

Our results revealed that the entire province is highly vulnerable to earthquakes, and agricultural drought also pose a significant threat to the region. In response to various disasters, including natural calamities, experts and scholars in this field have proposed diverse approaches worldwide, and one of the most recent and significant ones is the enhancement of resilience against natural disasters. Resilience refers to the capacity and competency of societies to restore themselves to their original state or their recovery method from damages and return to normal conditions. The results indicate a high level of awareness among rural communities in Kermanshah Province regarding the impacts and consequences of natural disasters. Accordingly, managers must devise plans aimed at boosting the resilience of the villagers themselves. By doing so, the heightened awareness among villagers can foster increased participation in the implementation of mitigation programs.

Another significant finding of this study was associated with the diminished satisfaction levels among the sampled community with the performance of managers, particularly councils and rural municipcalities. Despite the presence of multiple institutions offering services in rural areas, the focus in natural disaster management primarily revolves around construction projects and the provision of loans for renovation and improvement purposes. Other crucial aspects, such as educational programs, financial support, assistance funds for farmers, and even insurance coverage for housing, properties, and agricultural products, are not adequately addressed.

Conflict of interest

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

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