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Rereading the 1990 Rudbar-Manjil Earthquake Recovery through Oral Historical Narratives

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ABSTRACT: Iran is one of the most hazard-prone and vulnerable countries to disasters, with recurrent earthquakes causing severe human and economic losses. Yet, recovery has often been shaped by emergency-driven decisions, inadequate documentation, and weak institutional memory. The 1990 Rudbar-Manjil earthquake, the first major disaster to occur after the Islamic Revolution, marked a turning point in disaster management and reconstruction history. While significant, most existing studies have centered on official perspectives, overlooking the lived experiences of affected populations and practitioners. This study addresses that gap by revisiting the earthquake through oral history to preserve intangible heritage and extract lessons for future recovery. Using a qualitative approach, 63 semi-structured interviews were conducted with officials, decision-makers, and residents between July 2021 and February 2022. Purposive and snowball sampling were used to identify participants until data saturation was achieved. Transcriptions were systematically coded and thematically analyzed. This process produced a multi-perspective narrative of recovery, revealing both achievements and enduring challenges across institutional, social, and community dimensions. The Rudbar–Manjil case shows that durable disaster recovery depends on preparedness, effective governance, and community engagement. Preparedness requires pre-disaster frameworks and a process-oriented approach linking response and recovery. Strong governance relies on streamlined, transparent institutions, inter-agency coordination, and systematic information management. Embedding risk reduction throughout recovery ensures sustainability. Ultimately, community involvement is crucial: striking a balance between local participation and technical oversight enhances legitimacy and resilience. Addressing technical, institutional, and social dimensions together creates more effective and enduring recovery outcomes.

Keywords: *Oral History, Disaster Recovery, Post-Disaster Reconstruction, Earthquake, Iran.*

INTRODUCTION

Iran, due to its geographical situation, is prone to various disasters. These disasters have consistently resulted in significant human, economic, and social losses and will likely continue to do so. Decisions and actions after each disaster occur under critical and complex conditions. They are often fundamentally different from the usual procedures in normal circumstances. Therefore, the experience of facing crises and the decision-making processes in such contexts can provide valuable guidance for future disaster management. Officials, executive forces, and the people present in these situations carry unique experiences, often acquired through trial and error at a heavy cost. Over time, as these individuals pass away, their knowledge will also be lost, and the opportunity to benefit from it for the future will disappear.

In recent years, efforts have been made in Iran to document and revisit certain disasters, including the Bam earthquake (2003) and the Lorestan earthquake (2006). However, these attempts have mostly been scattered, unsystematic, and largely confined to official narratives. What has often been neglected are the lived experiences of the affected people and the narratives of the executive forces who directly participated in disaster management processes. Neglecting this intangible heritage not only reduces the possibility of reconstructing the

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past realistically but also leads to repeating similar mistakes and shortcomings in subsequent crises.

At the international level, oral history has gained recognition as a scientific method in disaster studies and post-disaster recovery. Experiences of revisiting the 1995 Kobe earthquake in Japan (Shaw & Goda, 2004), the 2008 Wenchuan earthquake in China (Wu, 2014), and Hurricane Katrina in the United States (Sloan, 2008) demonstrate that oral narratives not only contribute to documenting individual and collective experiences but can also serve as a foundation for policy reform, enhancing social resilience, and revising disaster recovery plans (Chansky, 2024). Nevertheless, in Iran, such an approach has received little attention, with research remaining primarily focused on official and statistical studies. This knowledge gap highlights the need for theorization and systematic application of oral history within disaster recovery studies.

Among contemporary disasters in Iran, the 1990 Manjil-Rudbar earthquake holds a special position. As the first massive and destructive disaster after the Islamic Revolution, it not only caused widespread human and economic losses but also became a turning point in the history of disaster management in the country. Its geographical scale, the severity of its damages, and its social and structural consequences further emphasize its significance. Moreover, the passage of more than three decades since the event has created a valuable opportunity to collect and analyze the narratives of stakeholders, as many survivors and officials are still alive and able to convey their experiences.

Thompson (2015) traces the emergence of oral history to Columbia University in the mid-twentieth century, emphasizing its rapid development into a comprehensive research method. Central to this approach is the reliance on eyewitness accounts, accessed primarily through interviews. As Sommer (2009) notes, in-person interaction is what distinguishes oral history from written testimonies or monologues. Taken together, these perspectives underscore why interviews are not only a technical tool but also the epistemological core of oral history: they enable researchers to capture the immediacy of lived experiences, which is especially crucial in reconstructing the complex social and spatial processes of post-disaster recovery examined in this study.

Scholars argue that oral histories can serve as powerful tools for strengthening the agency of disaster-affected communities, enabling them to transform memory into practical strategies for survival and recovery (Klaebe, 2013). Documenting the oral history of disasters also highlights the lessons learned for future disaster mitigation. One concrete example is the case of Simeulue Island in Indonesia. There was an oral history of a massive 1907 tsunami in the Island that advised running to the hills after "significant" shaking for one minute. The inhabitants were aware of this knowledge, and it saved countless lives from the devastating tsunamis of 2004 and 2005 (McAdoo et al., 2006). This demonstrates the power of oral history and local knowledge, which sometimes may have a greater impact than high-tech warning systems.

In 2021, the Natural Disasters Research Institute of Iran initiated the Oral History of Major Disasters in the country, with the 1990 Rudbar-Manjil Earthquake as the initial project. This paper outlines the methodology and process of the endeavor, then provides a new narrative of the events based on the analysis and comparison of interview content.

The present study aims to record and analyze the experiences of stakeholders of the Manjil-Rudbar earthquake in recovery through the method of oral history. This study seeks not only to fill the gap in the national literature but also to present narratives from the perspectives of the people and practitioners, revisiting them in light of global experiences. The main contribution of this article lies in two aspects:

1. Documenting oral narratives as part of the collective memory and as a resource for research in disaster recovery.
2. Analyzing these narratives to extract lessons learned and to propose recommendations for improving policy-making and planning for recovery in future disasters.

Accordingly, the main research questions of the article are:

- What were the experiences of stakeholders in managing the 1990 Manjil-Rudbar earthquake recovery?
- What are the lessons learned from this experience for the future of disaster recovery in Iran?

MATERIALS AND METHODS

This study employed a qualitative approach, utilizing the oral history method, to document and analyze the recovery process following the 1990 Rudbar-Manjil earthquake. Oral history was selected because it allows for capturing lived experiences and diverse perspectives of those directly involved in disaster recovery. By collecting first-hand narratives from both decision-makers and affected populations, the research aimed to reconstruct how recovery unfolded, what challenges emerged, and what lessons can be drawn for future disaster management.

Data Collection

Data were gathered primarily through in-depth, individual interviews, as this format provided the opportunity to explore personal experiences in detail. Group interviews were avoided except in cases where they were necessary. The primary research tools included semi-structured interview guides, tailored to the role and position of each participant, and audio recordings to ensure accuracy. A combination of purposive and snowball sampling was used to recruit participants, which included both authorities responsible for reconstruction and community members who directly experienced the aftermath of the disaster. In total, 63 interviews (37 with decision-makers and executive bodies, and 26 with individuals) were conducted between July 2021 and February 2022. The sample size was determined according to the principle of data saturation,

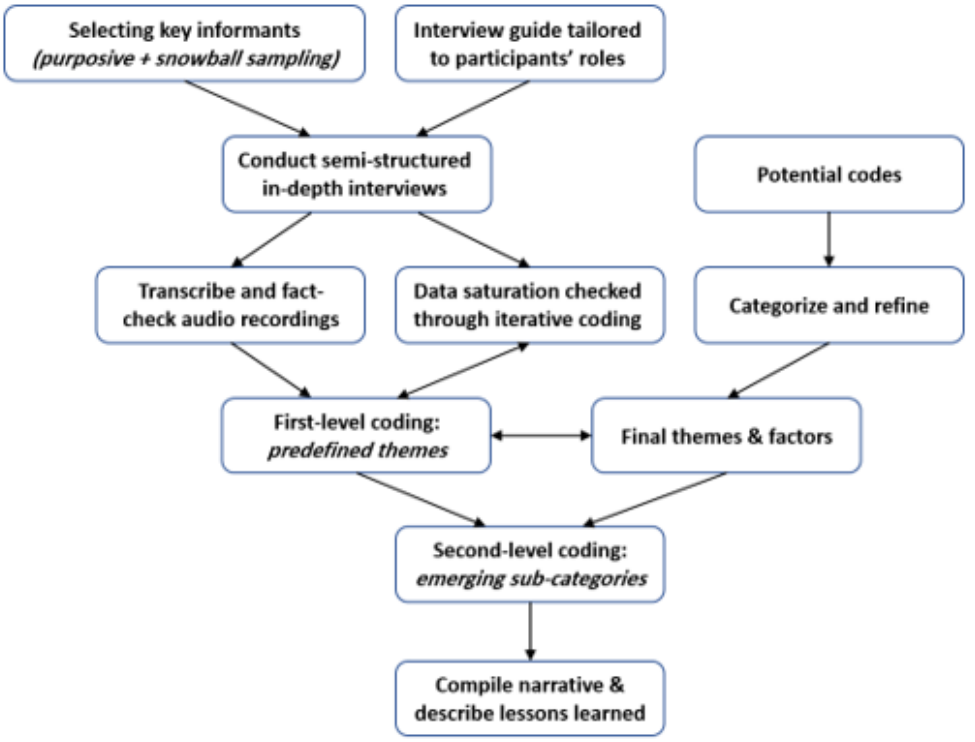

Fig. 1: Process of Research

meaning interviews continued until no new themes emerged and the information became repetitive. All interviews were transcribed, cross-checked, and archived with the participants' informed consent.

Data Analysis

The analysis was framed within a pragmatic qualitative paradigm, which emphasizes both structured comparison and openness to emergent insights in the study of disaster recovery. A thematic analysis with deductive content analysis was conducted, beginning with the application of first-level coding based on the predefined themes. Furthermore, a second-level coding was applied to define subcategories based on the extent to which the interviewees expanded on the subject. The narrative of the oral history was then compiled by connecting the categories, taking into consideration the perspectives of the major players in government and the affected populations, without privileging one over the other. Where applicable, the differences and contradictions in opinion were highlighted. Key resource persons and consultants were also consulted for their feedback and comments. This first-hand narrative provided insight into aspects of disaster management that had previously gone unnoticed. As this study focused exclusively on recovery processes and lessons learned, no architectural or spatial analysis was undertaken (Figure 1).

Literature Review

Recovery after disasters is now frequently analyzed as a multi-dimensional and nonlinear process involving social, economic, institutional, environmental, and cultural aspects. Recent studies emphasize that recovery pathways differ significantly across contexts and are influenced by patterns of power, governance, community agency, and institutional capacity (Mahmodi et al., 2025; Okunola & Werners, 2024). For example, Okunola and Werners (2024) propose a framework of disaster recovery pathways that includes components such as community capacity, institutional relationships, and system interactions, demonstrating how recovery is shaped not only by what is physically reconstructed but also by how communities, institutions, and actors interact over time.

Khorshidian and Fayazi (2023) examined past housing reconstruction programs and identified factors such as the timeliness of assistance, appropriateness of building materials, community participation in reconstruction decisions, and clarity in policy direction as key to successful recovery outcomes. Moreover, the literature is paying more attention to equity, power, and participatory decision-making in recovery. Tuhkanen (2023) explored how participation processes may

shift power relations in recovery, highlighting the importance of capacity-building, relational trust, and the inclusion of local voices, which are increasingly seen as equally important as technical or financial inputs. Holistic and multi-risk perspectives are also gaining attention. Mohammadi et al. (2024) reviewed frameworks in urban multi-risk settings and pointed out that many recovery plans still treat risks separately rather than considering their interactions (for example, seismic risk, flood risk, and infrastructure vulnerability). Finally, in terms of policy instruments, tools like those of the UNDP (2020) affirm that early recovery must begin even during humanitarian responses and include the restoration of governance, livelihoods, infrastructure, and psychosocial dimensions, not just shelter and physical reconstruction.

Dimensions of Disaster Recovery

Losses and damages. Key factors contributing to earthquake damage include the strength and duration of ground shaking, local soil conditions (such as liquefaction risk), construction quality and compliance with seismic codes, as well as the building's age, materials, and maintenance. These elements collectively shape structural vulnerability and inform post-disaster reconstruction strategies (Allali et al., 2018).

Need and Damage Assessment. Contemporary recovery frameworks recommend integrating loss and damage assessments into planning, ensuring that social and livelihood losses are addressed alongside asset replacement (Mohammadi et al., 2024; UNDP, 2020). Post-disaster needs assessments (PDNAs) should capture multi-sectoral impacts and recovery needs (governance, social, infrastructure), forming the baseline for costed recovery plans (UNDP, 2020).

Emergency Management. Emergency management ensures operational conditions, such as safety, access, and coordination networks, through which recovery actions can proceed efficiently. It also enables the flow of critical information to recovery planners and embeds early recovery considerations into response plans (FEMA, 2011, 2024). Effective linkages between response and recovery are characterized by timeliness, flexible coordination, minimization of duplication, inclusive stakeholder engagement, and adaptability to evolving risks (AIDR, 2020; Organization, 2019). Early recovery, in particular, bridges humanitarian relief and reconstruction by restoring essential services and livelihoods as soon as stabilization occurs, reducing secondary risks and strengthening social cohesion (UNDP, 2019; UNDP/IRP, 2024).

Reconstruction Management and Planning. Reconstruction management and planning are most effective when recovery is structured around phased timelines, clearly defined roles, and coherent policies. Evidence shows that recovery unfolds in nonlinear stages, progressing from immediate stabilization to early recovery and long-term development. Well-sequenced plans with clear milestones and financing strategies can prevent delays and inequities (Okunola & Werners, 2024; UNDP, 2019). Dedicated recovery authorities or coordination bodies strengthen accountability and inter-agency collaboration, while national leadership provides coherence and local actors ensure contextual relevance (Hallegatte et al., 2018). Policies rooted in the principle of "building back better" emphasize not only physical reconstruction but also risk reduction, social inclusion, and sustainability, with participatory planning and flexible financing highlighted as key to resilient outcomes (Heffernan et al., 2025; Khorshidian & Fayazi, 2023). Together, these approaches underscore that integrating timelines, roles, and inclusive policies ensures more equitable, timely, and adaptive disaster recovery.

Reconstruction Strategies and Approaches. International guidance notes emphasize context-appropriate, owner-driven, or community-supported housing options, flexible financing, and pathways that strike a balance between speed, quality, and safety (Bank, 2015/2017; Finegan et al., 2024; Heffernan et al., 2025). Evidence from comparative case studies also shows that reconstruction outcomes are shaped not only by technical standards but by the institutional environment, financing mechanisms, and social equity considerations (Hallegatte et al., 2018).

Organizational Structure of Reconstruction. An effective organizational structure for disaster recovery reconstruction is built on clear governance arrangements, including designated leadership roles, legal mandates, and inter-agency coordination platforms that align governmental, private, and community actors (UNDP, 2019; UNDP, 2020). Its effectiveness depends on guiding principles such as inclusiveness, timeliness, sustainability, and resilience supported by pre- and post-disaster planning, transparent resource management, and monitoring systems to ensure accountability. Crucially, community and stakeholder participation are integral, with mechanisms for communication and collaboration that foster trust and leverage local capacities. Together, these elements balance centralized leadership with inclusive coordination to optimize recovery outcomes (FEMA, 2011; UNDP, 2020).

Shelter/Housing after Disaster. In disaster literature and international guidelines, post-disaster shelter is understood as a continuous process that extends from emergency shelter to permanent housing, with overlapping and interdependent phases. What was once referred to as temporary housing or interim shelter is now increasingly described as transitional shelter, a term emphasizing its role in facilitating the movement of affected populations toward permanent housing. The International Federation of Red Cross and Red Crescent Societies (IFRC) conceptualizes this as a continuum including emergency, temporary, transitional, incremental, core, and permanent stages, while stressing that shelter design must not increase vulnerability to future hazards. Broader recovery processes also shape transitional shelter and, in turn, influence them; for instance, the absence of economic recovery programs can prolong transitional shelter or even render it permanent,

disproportionately affecting vulnerable groups who may be forced into inadequate living conditions (Quarantelli, 1995; Rohwerder, 2016; Tafti & Tomlinson, 2015). Moreover, studies have shown that the failure of permanent housing programs undermines the effectiveness of transitional initiatives (Tafti, 2017). Within this continuum, emergency shelter provides immediate refuge outside permanent homes, temporary shelter allows survivors to resume daily activities in units such as rental housing, mobile structures, and permanent housing marks the return of families to durable, long-term dwellings.

Relocating and Merging Villages. Relocating and merging villages after disasters is one of the most sensitive and complex aspects of recovery, as it directly affects housing provision, community cohesion, and long-term livelihoods. International guidance stresses that relocation should be evidence-based, participatory, and sensitive to livelihood needs to prevent social dislocation and inequity (Bank, 2015/2017; Mohammadi et al., 2024). Empirical studies have shown that forced or top-down relocation often disrupts social networks, exacerbates poverty, and yields inadequate housing outcomes (Cernea, 2000; Fernando Ramírez, 2011). In this regard, relocation is not merely a technical housing solution but a process deeply tied to social justice, governance, and sustainability of recovery, where the failure to align with community needs may transform recovery interventions into long-term vulnerabilities.

Debris Management. Debris removal is a critical enabler of early recovery that must be integrated with reconstruction logistics and environmental safeguards (Bank, 2015/2017; UNDP, 2020). International experience highlights several key principles and considerations: coordination among multiple agencies to avoid duplication and inefficiency, integration of debris operations with reconstruction supply chains, and compliance with environmental safeguards such as recycling, reuse, and safe disposal (Brown et al., 2011; Crowley & Flachsbart, 2018).

Resource Management. Scaling construction capacity requires orchestrating supply chains (including materials, labor, and finance) and facilitating private-public collaboration. Efficient management systems must integrate private-public collaboration, balancing government oversight with the flexibility and innovation of private actors to address urgent housing and infrastructure needs (Chang et al., 2010; Finegan et al., 2024).

Facilities and Assistance. Recovery policy mixes (including grants, loans, and technical assistance) should target the most vulnerable populations and incorporate social services to support psychosocial recovery (UNDP, 2019; UNDP, 2020). Research also indicates that without technical assistance and social services, financial aid alone often falls short: barriers such as complex bureaucratic procedures, unclear eligibility, delayed or inadequate compensation cause stress, reduce trust, and impede recovery (Brooks et al., 2024).

Community Participation. Power-aware participation enhances legitimacy and outcomes; scoping evidence shows participation can shift power relations when coupled with trust and capacity building (Tuhkanen, 2023). Iranian studies highlight barriers to effective participation that must be addressed to improve resilience (Mahmodi et al., 2025).

Rehabilitation and Recovery. Psychosocial, social, and economic rehabilitation and recovery after disasters is increasingly recognized in the literature as a multi-dimensional process, with long-lasting effects that may persist for decades after an event (Brooks et al., 2016). Other research demonstrates that social rehabilitation, achieved through strengthening social capital, fostering collective participation, and revitalizing local cultural activities, plays a protective role by reducing psychological distress and enhancing hope, identity, and control over daily life (Lee et al., 2022). However, the lack of psychosocial infrastructure, weak involvement of mental health specialists, and limited support for vulnerable groups (e.g., children, elderly, women, and low-income households) often result in persistent psychological and social problems in disaster-affected communities (Sheikhbardsiri et al., 2017).

Based on the discussions in the literature review, the conceptual model of this study has been developed to provide a coherent framework for analyzing and explaining the various dimensions of post-disaster recovery in the Rudbar-Manjil Earthquake (Figure 2).

Rudbar-Manjil Earthquake

At approximately 30 minutes past midnight on Thursday, June 20, 1990, local time, an earthquake with a magnitude of 7.3 on the moment magnitude scale occurred in the vicinity of Rudbar, northern Iran (Alizamani, 2007). The national reports record a death toll of 14,000, while international documents estimate the figure to be 40,000. The quake left 500,000 homeless and 2,600 orphans, and 150,000 households facing economic and social hardship (Shaditalab, 1994). According to the official records of the Program and Budget Organization of Iran, the cities of Rudbar, Manjil, and Lushan, as well as 700 villages, were destroyed. The number of damaged housing units registered in the Housing Foundation of Islamic Revolution (HFIR) reconstruction workstations was reported to be around 214,000 (Alizamani, 2007).

In the cities of Manjil and Rudbar, nearly all the houses were destroyed. In Rasht, buildings with five to eight floors were mostly damaged (Moeinfar, 1989). The historical fabric of Masouleh was also affected (Zandi, 1991). The inadequacy of construction regulations and the lack of code enforcement were identified as the primary reasons for the extensive destruction. Geological hazards resulting from the earthquakes contributed to secondary hazards such as landslides, rockfall, burial of several villages, liquefaction in some coastal areas, occasional subsidence, ground cracks, and surface ruptures (Amini Hosseini, 2009). The landslide destroyed rice silos, water towers, and dams, including Sefidrood Dam (Moeinfar, 1989).

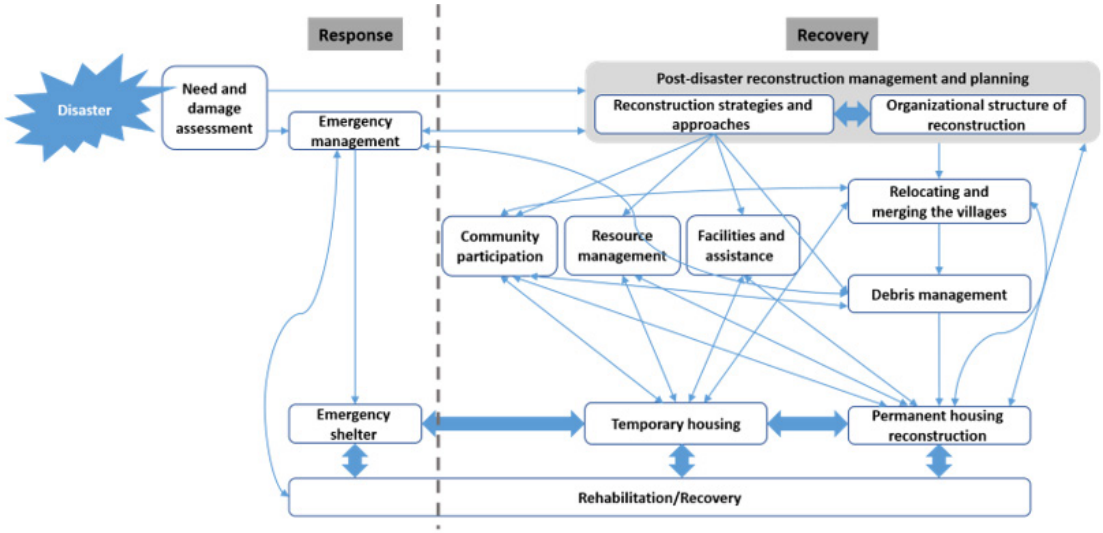

Fig. 2: Conceptual Framework

In addition, Rudbar's hospital was destroyed due to a landslide (Ghalibafan, 1991).

RESULTS AND DISCUSSION

Losses and damages

Despite the introduction of modern building materials, widespread non-compliance with engineering and seismic safety standards significantly contributed to building collapses and high mortality rates. Structural weaknesses, such as unreinforced courtyard walls, created additional hazards by causing fatalities among individuals who attempted to escape into open spaces like courtyards and alleys. In contrast, vernacular settlements in rural areas displayed certain resilience characteristics: the lightness of traditional roofs and the flexibility of wooden structures reduced fatality rates, underscoring the protective value of locally adapted construction practices. For example, in Totkabon, while a reinforced concrete slab caused entrapments and casualties, a nearby barn built with the Zegali traditional method sustained only minor damage and was quickly repaired. Similarly, in villages such as Keleshtar, traditional techniques that anchored beams to surrounding hills prevented roof collapse. At the same time, adobe housing in some rural areas performed poorly, with structural instability amplifying the number of fatalities. Interestingly, contextual social factors also influenced outcomes: the simultaneous broadcast of World Cup football matches meant that many residents were awake and able to respond quickly to the earthquake, thereby lowering the overall casualty rate.

Need and Damage Assessment

Immediately after the earthquake, expert teams conducted a preliminary damage assessment, categorizing villages based on the severity of the destruction. However, this initial assessment was rudimentary, largely constrained by widespread poor construction quality and the absence of insurance coverage, which limited the availability of reliable data on asset and livelihood losses. Despite these limitations, the assessment provided a foundation for the subsequent reconstruction process. The Housing Foundation of the Islamic Republic of Iran (HFIR) compiled a technical report and submitted it to international organizations, facilitating external support and technical cooperation. A special mission from the United Nations was dispatched to Iran to evaluate the scale of destruction and explore opportunities for collaboration. With the approval of a World Bank loan, a more systematic needs assessment was conducted, enabling the preparation of a detailed inventory of machinery, equipment, and resources required for reconstruction. This sequence illustrates how post-disaster needs assessments (PDNAs) evolve from rapid, preliminary evaluations to more comprehensive assessments as resources, institutional support, and international collaboration become available.

Emergency Management

In the immediate aftermath of the earthquake, severe challenges in emergency management hampered effective rescue and relief operations. Initially, the misidentification of the earthquake's epicenter and the delayed dissemination of information resulted in significant delays in mobilizing rescue

teams. Road blockages, coupled with a lack of specialized equipment, meant that most search-and-rescue operations were conducted by untrained volunteers, often resulting in unintended harm to victims. Moreover, the absence of systematic information management created major gaps: survivors transferred to hospitals were not properly recorded, leaving families unaware of their relatives' conditions. Children were also displaced without proper registration, compounding the distress and uncertainty of affected families. In the face of high casualties, the shortage of land forced authorities to create mass graves, while many victims remained unidentified.

Relief distribution further reflected systemic weaknesses. Influxes of volunteers to disaster sites generated traffic congestion, delaying critical aid and medical transport. Provincial governments attempted to regulate distribution through the issuance of vouchers for essential goods, such as rice, sugar, tea, and canned food. Yet, the lack of a comprehensive needs assessment meant that international aid, although immediate, often failed to match survivors' actual requirements. Interview evidence highlights inequalities: communities closer to main roads received disproportionate support compared to remote villages, while heavily affected survivors, preoccupied with losses and livelihood restoration, struggled to access aid. Social dynamics also influenced relief uptake: some survivors refrained from seeking assistance out of self-respect, while others reported distress from receiving second-hand clothes or spoiled food, which undermined their dignity.

A turning point came when the government explicitly adopted a strategy to preserve the dignity of disaster-affected populations. By initially providing food and supplies for one month, followed by transitioning responsibility to survivors themselves, authorities aimed to support not only physical survival but also psychosocial recovery through self-reliance and restored self-esteem. This approach resonates with contemporary recovery literature, which emphasizes the integration of psychosocial well-being, equity, and dignity in humanitarian relief to foster trust, resilience, and long-term recovery (Brooks et al., 2016; UNDP, 2019).

Reconstruction Management and Planning

Before the earthquake, disaster preparedness in the affected region was limited by the absence of a comprehensive disaster management plan. In the aftermath, two major initiatives emerged: the Reconstruction Plan for the Rudbar-Manjil Earthquake-Affected Areas and the Assistance in Implementing the Post-Earthquake Rehabilitation Plan. The Reconstruction Plan was particularly influential, introducing principles of socio-economic recovery through community-based reconstruction and strengthening of local institutions, approaches that later became benchmarks for subsequent recovery initiatives. With financial support from the World Bank, the plan was expanded into a broader Rehabilitation plan, and a set of Guidelines for Earthquake Disaster Management was developed, aiming to provide holistic guidance for officials, planners, economists, architects, engineers, and scientists. This effort represented one of the earliest global attempts to establish comprehensive disaster management guidelines, integrating technical, institutional, and socio-economic perspectives.

The process was notable for its inclusiveness, with more than 20 international experts, 40 national specialists, and over 150 HFIR staff and affiliated professionals contributing. Despite this large-scale investment of expertise and resources, the plan's outputs were eventually archived, with limited implementation of its findings and recommendations. This outcome reflects a recurring challenge in disaster recovery planning: while well-designed strategies and guidelines can emerge in post-disaster contexts, institutional inertia, weak follow-through, and lack of political or financial commitment often undermine their integration into long-term governance and recovery systems.

Reconstruction Strategies and Approaches

The Gilan-Zanjan earthquake recovery marked the country's first systematic reconstruction effort, shifting from a purely physical focus to a multi-dimensional, people-centered process. Survivors played a central role, with government agencies providing technical and financial support while avoiding excessive intervention. Development Committees in villages facilitated communication with authorities, helping to address cultural and practical challenges. The approach emphasized local participation, vernacular construction practices, and collaboration with academics, whose involvement highlighted the need for seismic safety and resilience. Together, these strategies demonstrated that when decision-making is shared with communities, recovery outcomes are more sustainable and socially accepted.

Organizational Structure of Reconstruction

Following the devastating Rudbar-Manjil Earthquake, Article 127 of the country's Constitution was invoked for the first time, assigning the Minister of Interior overall responsibility for reconstruction. Subsequently, the then Minister of the Interior distributed the affected areas among various governors with the support of provincial forces and resources. Through interviews with those involved in the decision-making or implementation of the reconstruction, it was found that the apportionment of roles and the Minister of Interior's consistent oversight resulted in the Rudbar-Manjil reconstruction being one of the most successful experiences in the country.

The then president delegated the responsibility for coordination to the Ministry of Housing and Urban Development, and the responsibility for reconstructing residential and commercial units to the Housing Foundation of the Islamic Revolution (HFIR). To avoid creating parallel or redundant institutions in the earthquake-affected region, the HFIR relied on reinforcement from other provinces. The Main Operation

Center (Setad-e Kol) was established to coordinate activities, and the entire affected area was divided among seventeen Assistant Operation Centers (Setad-e Moein), staffed by units of the Housing Foundation from different provinces (Figure 3).

Each Assistant Operation Center set up its own headquarters in the assigned area and, depending on workload and geographic spread, established around thirty subsidiary centers or local workstations to facilitate access for residents. These centers were tasked with executing and supervising all stages of the reconstruction process, from damage assessment to the rebuilding of affected units. In difficult areas, workstations were established locally to reduce commuting for staff and residents. Regular meetings were held to coordinate and oversee the work of the Assistant Operation Centers. The Main Operation Center convened weekly sessions in rural or urban locations until the completion of the reconstruction, which proved instrumental in advancing the work (Figure 4).

The findings reveal that the level of coordination among responsible agencies was contested. On the one hand, the limited number of core institutions facilitated more effective interaction, with local organizations often resolving problems faced by Assistant Operation Centers. On the other hand, the role of the banking system emerged as a major bottleneck: despite the completion of damage assessment, debris removal, and budget allocation, banks at times refused to release funds, which significantly delayed reconstruction. Similarly, the division of responsibilities between the Housing Foundation (for dwellings) and the Ministry of Agriculture (for ancillary rural spaces such as livestock shelters and crop storage) proved impractical, as these functions are interdependent within rural life and cannot be separated.

Another key theme concerned the relationship between executive agencies and the academic sector. While officials claimed full alignment, scholars noted that reconstruction largely proceeded independently of formal research. Nevertheless, evidence shows that academic input was adopted informally, for example, the recommendation to utilize the vernacular "Zegali" construction method in Gilan, which was ultimately considered by decision-makers.

Emergency Shelter

Following the disaster, emergency accommodations were established in backyards, schoolyards, and vacant plots to provide immediate shelter for survivors. For safety and mutual support, residents tended to cluster their tents closely together. However, the rapid and often poorly coordinated distribution of resources led to significant inequities: some households received multiple tents while others were left without any. In certain instances, displacement was prolonged, with individuals remaining in tents for nearly two years. Prolonged reliance on tents exposed residents to multiple hazards; for example, a picnic gas explosion in one of Manjil's parks highlighted the heightened risk of fire and other accidents associated with makeshift shelter conditions.

Temporary Housing

In the aftermath of the Rudbar-Manjil earthquake, the policy framework guiding temporary settlements prioritized cost-

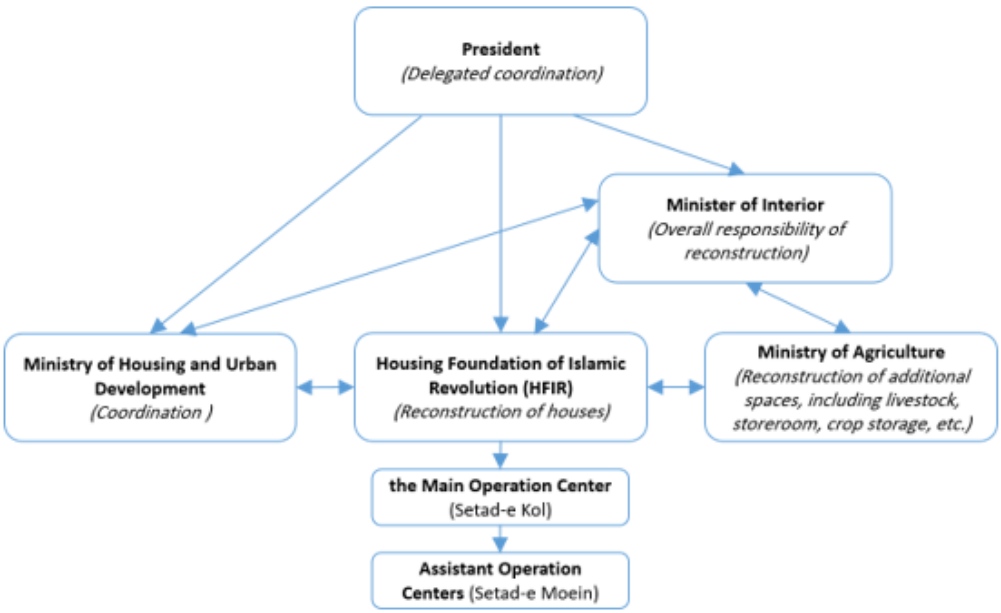

Fig. 3: Organizational structure of reconstruction after the Rudbar-Manjil Earthquake

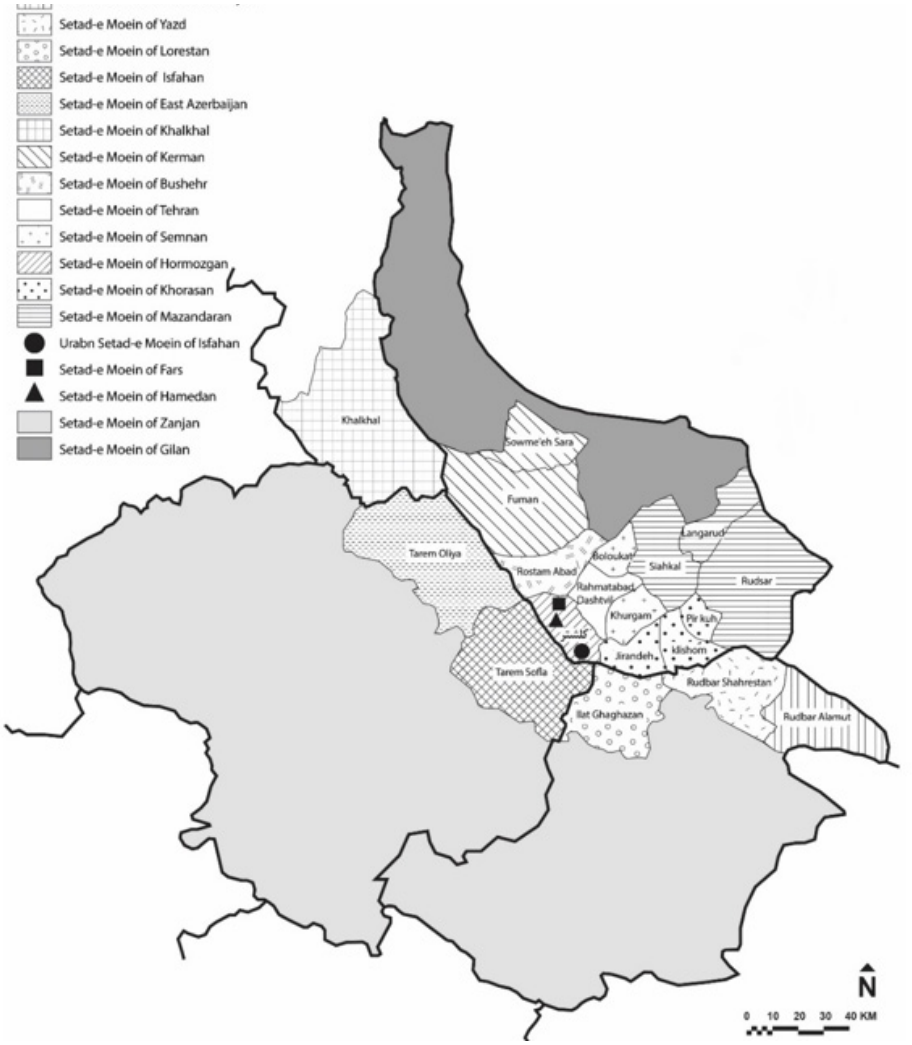

Fig. 4: Disaster Affected Area of Rudbar-Manjil Earthquake and Assistant Operation Centers

effectiveness and proximity to residents' original properties. Loans were made available only during the temporary settlement phase, reflecting an intention to accelerate recovery while containing public expenditure. Wherever feasible, temporary housing sites were established near the survivors' own land to preserve social ties and facilitate their eventual return. Nonetheless, some villages experienced unavoidable displacement.

The construction of temporary settlements was carried out either entirely by the Assistant Operation Centers or, more commonly, by the residents themselves. To capitalize on local skills and expedite construction, the vernacular Zegali system was adopted in several areas. Prefabricated units were primarily distributed in the cities of Manjil and Rudbar; however, most interviewees regarded this approach as unsuccessful, particularly because the prefabricated camps were located far from residents' original homes, thereby disrupting community cohesion.

During the reconstruction phase, temporary settlements took various forms, including core housing, on-site structures, and prefabricated units. A notable strategy was the development of core housing: partially permanent units with access to water and electricity that could serve as the nucleus of future permanent homes. In cases where existing dwellings could be partially restored, a designated portion of the structure was adapted as temporary accommodation. This approach offered multiple benefits, including continuous occupation of familiar spaces, protection against adverse weather conditions, and significant savings in time, money, and resources. With approximately 214,000 units built or restored, the strategy imposed minimal fiscal burden on the government while supporting community stability (Figure 5).

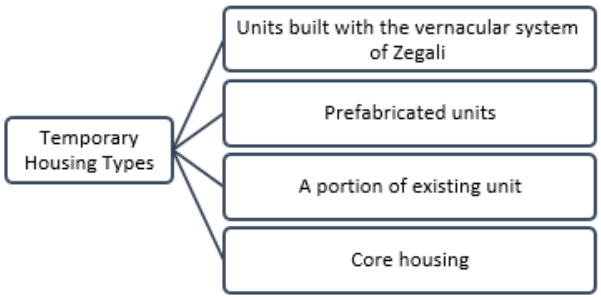

Fig. 5: Temporary Housing Types after Rudbar-Manjil Earthquake

Permanent Housing

Following the Gilan-Zanjan earthquake, the responsibility for constructing permanent housing was largely delegated to residents, particularly in rural areas under minimal government oversight. Although this approach encouraged local initiative and expedited rebuilding, it also created safety challenges, as households were free to choose their own materials and structural methods, which occasionally resulted in unsafe buildings. In cities, reconstruction and labor were likewise managed by residents, but government assistance and private-sector technicians helped advance the process. To curb contractor fraud, local authorities promoted the use of supervised contracts.

A formal system of technical supervision was introduced in urban areas. Engineer shortages were addressed by bringing in professionals from other cities, and supervision was linked to phased financial aid. However, delays in payments and the limited availability of engineers sometimes weakened oversight. Wealthier homeowners occasionally rebuilt without supervision and neglected basic safety standards. In rural areas, the Housing Foundation oversaw construction; however, in regions such as Upper and Lower Tarom, residents reported a lack of effective monitoring, resulting in structurally unstable or poorly designed homes.

Most damaged buildings lacked the structural integrity needed for simple repairs. For moderately damaged units, determining whether to demolish or reinforce posed a persistent challenge. To reduce costs and conserve materials, reinforcement was generally prioritized. Consulting firms developed structural solutions, and Rasht witnessed the first large-scale application of building reinforcement methods in Iran. Yet in cities like Lushan, high costs pushed many residents to favor demolition despite government advocacy for reinforcement.

Urban planning also underwent significant changes. Narrow alleys were widened to improve accessibility, although some residents criticized the rebuilt urban fabric for its poor vehicular access and lack of a coherent cityscape, particularly in Rostamabad. Housing reconstruction introduced a new building typology, and advisory plans were distributed to the villagers. While local materials and climate considerations informed design, many villagers ultimately built without formal plans after receiving temporary housing.

In urban centers, housing designs were tailored to plot size and household needs. In Rudbar, architects from Fars province prepared customized plans; however, some residents complained that they had to design their own homes due to outdated or overly generic templates. In Rostamabad, uniform housing designs led residents to modify homes after construction. The lack of attention to everyday lifestyle needs, such as space for livestock, forced some to adapt their homes or abandon traditional livelihoods.

The earthquake catalyzed major reforms in national construction policy. The Engineering System Law, seismic standards (Code 2800), and national building regulations were developed to institutionalize earthquake-resistant practices. Fault mapping and seismic microzonation became policy priorities, while new institutions were established to enforce building safety and ensure compliance. Tie-beam structures were made mandatory, and the Housing Foundation committed to continuous rural housing upgrades, introducing technical models to guide future construction.

Reconstruction also familiarized communities with modern materials and techniques. Villagers increasingly favored lightweight wooden structures, while urban residents preferred steel frames. Some homeowners reinforced portions of their homes for added security, though fear of future earthquakes occasionally prompted excessive measures. Public awareness of construction safety improved significantly, although inconsistent messaging from officials sometimes undermined compliance with standards.

Unlike earlier reconstruction efforts, residents enjoyed considerable freedom in choosing construction methods.

Traditional techniques, such as Zegali, were not only preserved but also technically refined to enhance durability, demonstrating how local practices can be adapted within modern safety frameworks.

Relocating and Merging the Villages

Although the primary objective of the reconstruction program was to rebuild villages in their original locations and preserve their rural fabric, several settlements were ultimately relocated. Residents were generally reluctant to move, and relocation often occurred only after authorities employed various incentives and pressures, such as loans, infrastructure provision, and other policy levers, to influence decisions. In Jirandeh, Keleshtar, and Chahar-mahal, many residents initially resisted displacement; in several cases, households eventually returned to their original sites despite official efforts. Chahar-mahal represents a particularly notable case, where four villages were merged into a single settlement, a decision whose social, economic, and cultural consequences remain the subject of scholarly inquiry even three decades later.

Site selection for new villages typically considers technical factors, including landslide and flood buffers, as well as proximity to former settlements. However, when these decisions were made without meaningful community consultation, they were often met with strong resistance from local populations. Most academics and government officials expressed reservations about the relocation and merging schemes, emphasizing their potential to disrupt cultural identity, undermine psychological well-being, and weaken socio-economic networks. The deep sense of place attachment and belonging within these rural communities frequently motivated residents to return to their original lands, further challenging top-down relocation efforts.

Debris Management

The volume of debris generated by the earthquake was exceptionally high. Because some Assistant Operation Centers were present in the region from the earliest stages of the temporary settlement phase, demolition and debris removal began during this period. Special care was taken to preserve property boundaries, thereby preventing future disputes over land ownership. Debris removal required careful handling to avoid damage to surviving structures and neighboring properties. Where buildings had completely collapsed, verifying property boundaries and ownership proved particularly challenging. When owners were alive and present, they could assist in the process; in their absence, however, work was suspended until ownership issues were resolved. In areas such as Harzevil and Keleshtar, the steep terrain and landslide risk rendered debris removal infeasible. Interviews revealed that some villages, such as Jirandeh, still contain remnants of debris from the 1990 earthquake, underscoring the long-term nature of the challenge.

Efforts were made to recycle and reuse debris, thereby reducing both waste volume and the demand for new construction materials. For example, hardwood from damaged houses was repurposed for Zegali, a vernacular construction technique. In contrast, where buildings had been made primarily of adobe and mud, recycling was not feasible. To coordinate debris disposal, local authorities held meetings in mosques to explain the necessity of proper waste management and to identify appropriate landfill sites. Nonetheless, in several areas, residents expressed dissatisfaction with their limited involvement in selecting landfill locations and reported that they primarily monitored the process to ensure that their property boundaries were respected.

Resource Management

Human resources. One of the most critical factors in reducing human casualties during disasters, recognized within the Reconstruction Plan, was the strategic use and training of human resources. Building on Iran's existing rural health network and the expansion of health centers in preceding decades, planners proposed linking young people and adolescents to local health facilities to create a trained crisis-response network. Although this recommendation was never fully implemented, various forms of training were nonetheless delivered to a wide range of stakeholders. Rural builders and youth received technical and construction-related instruction, while government officials were offered disaster management education. Following the earthquake, some personnel from the Housing Foundation of the Islamic Republic (HFIR) enrolled in specialized disaster risk management courses, and short-term training programs were designed for provincial crisis managers.

Human resource management also emphasized the use of local labor. Residents were typically employed in service and non-specialized roles within the Assistant Operation Centers, while construction work largely relied on local builders. Employing local labor improved communication and coordination because workers shared the same cultural and linguistic background as the affected communities.

Financial resources. The reconstruction effort unfolded during the 1990 post-war economic crisis, which required innovative financing mechanisms. The Reconstruction Plan was designed to be funded through the banking system rather than the public budget.

Equipment and machinery. Much of the necessary equipment and machinery was secured through a World Bank loan, assets that remain in use more than three decades later. The private sector also contributed machinery, particularly in remote areas.

Materials. Construction materials for residential units were distributed through a systematic process: the required quantities were calculated, funds were deposited in a bank account, and landlords received remittances from the HFIR to obtain materials from designated warehouses or sales agents.

Facilities and assistance

Following the earthquake, substantial national and international aid was mobilized and directed primarily toward the most vulnerable groups. The Housing Foundation of the Islamic Republic (HFIR) served as the sole builder of housing for these groups, while in other cases, homeowners themselves undertook construction. Various organizations and agencies provided both monetary and non-monetary assistance, including incentives and essential services to support affected communities.

Unlike other post-disaster reconstruction plans in the country, the financing mechanism in Gilan-Zanjan was distinctive in that reconstruction loans were allocated based on household size. While this approach sought to match support with the scale of family needs, the long-term status of loan repayment remains unclear. Several interviewees reported that, even after three decades, there has been no consistent legal follow-up on the repayment of loan installments, creating ongoing uncertainty and a lack of transparency.

The increased availability of loans for urban households, compared with rural ones, had unintended consequences. In some large villages, residents sought to delay reconstruction to qualify for the higher volume of urban loans, effectively attempting to reclassify their villages as towns. This strategic behavior slowed recovery efforts and highlighted the complex incentives created by differential loan policies.

Community Participation

Village relocation following the earthquake was often accompanied by public dissatisfaction. In some areas, residents initially resisted moving but later accepted relocation after utilities such as water and electricity were installed at the new sites. In other cases, the absence of basic services in the original village was used as leverage to encourage residents to relocate. Reconstruction incentives also played a crucial role, as financial and material aid were often restricted to construction within the designated relocation areas.

Not all relocations were imposed from above; in some instances, communities initiated the process themselves. For example, residents of a village near the Sefidrud Dam, who had long been exposed to sandstorms from the dry riverbed, had already considered relocation, and the reconstruction program provided the opportunity to realize this plan. In Rostamabad, site selection occurred spontaneously through community initiative. In another village, the sheer volume of debris prompted residents to move onto nearby agricultural land: those who owned plots began building immediately, while others purchased land. Over time, the original village site was converted into orchards and utility infrastructure.

Officials maintained that community representatives participated in site selection and that relocations were coordinated with residents. In one case, after a relocation site had been identified but before construction began, villagers raised concerns about the harsh winter climate; their feedback led to the selection of a more suitable location. Koufel offers another positive example, where residents themselves selected the site, divided land parcels, and worked with the designated headquarters to construct roads. Agreement on land boundaries and neighborhood layouts enabled residents to resume normal life quickly.

Despite such examples of collaboration, public participation in relocation planning was generally limited. Top-down decisions often generated tension, while relocations involving meaningful community engagement tended to achieve more sustainable outcomes. In some regions, officials emphasized the importance of engaging residents, given their fragile emotional state, and reported minimal resistance when participation was prioritized. Elsewhere, however, necessary relocations faltered because of insufficient public acceptance. In one village, despite the completion of site selection and investment in infrastructure, residents ultimately refused to relocate, with some officials citing a lack of inter-agency coordination in building community support as a key barrier to relocation.

Residents also played a role in facilitating relocation by selling or donating agricultural land. In villages where people were already inclined to move, landowners often donated plots to neighbors or sold them at affordable prices, accelerating reconstruction efforts and easing the transition to new settlements.

Rehabilitation/Recovery

Psychological and Social Rehabilitation/Recovery

The psychological impacts of the Gilan-Zanjan earthquake, like those of many major disasters, remain deeply under-addressed both in Iran and globally. Survivors reported profound shock, emotional numbness, fear of the future, and an inability to bury the deceased, while repeated aftershocks intensified collective anxiety and despair. Symptoms such as memory loss, nightmares, obsessive thoughts, claustrophobia, and even psychosis were common. For some individuals, the trauma has endured for decades: in Rudbar, approximately 2,500 people still suffer from neurological and psychological disorders linked to the earthquake. Increases in suicide rates, particularly among women, and cases of premature aging were also documented.

During the emergency phase, certain relief practices inadvertently compounded trauma. Injured survivors were sometimes transported without informing their families, and children were separated from relatives, causing long-term psychological harm. Aid distribution methods such as throwing packages into crowds undermined dignity and excluded the most vulnerable. The distribution of used clothing and supplies further damaged survivors' self-esteem.

Despite these shortcomings, the presence of high-ranking officials offered some reassurance, while mutual support among survivors became an important source of healing. Formal psychological assistance was limited and often delayed,

typically provided by relief workers with wartime experience rather than trained mental health professionals. In the absence of structured mental health programs, active participation in reconstruction proved therapeutic. Survivors who remained in the affected region and engaged with their peers recovered more quickly than those who migrated to other areas. Positive interactions with officials, collective harvesting of crops, and locally initiated cultural activities, especially for children in Manjil, fostered emotional recovery and strengthened community resilience.

The earthquake also triggered profound social disruptions. Increased drug use, child marriage, child labor, and incidents of sexual violence, particularly in public restrooms, were reported. Migration to cities such as Tehran, Qazvin, and Rasht rose sharply. Women's needs were often overlooked due to limited public voice and representation. Rumors regarding the distribution of international aid, coupled with mistrust and perceptions of discrimination, fueled tension and eroded social cohesion. Psychological stress reduced tolerance levels, while policies such as village relocation intensified instability.

A strong government presence in early recovery raised public expectations, with many residents perceiving the state as solely responsible for rebuilding. This sometimes created resistance when communities were later asked to help maintain public infrastructure. Social rehabilitation, though limited in the immediate aftermath, gradually emerged once competition over resources subsided. Collective efforts to rebuild homes, rooted in the region's agricultural traditions, fostered a sense of solidarity. Without extensive external intervention, people resumed their daily lives: a local teahouse reopened, and women returned to the rice fields, signaling a slow but organic process of social recovery.

Economic Recovery

The region's agriculture-based economy, centered on olive and rice production, suffered severe disruption. Water sources were damaged, prompting the Ministry of Agriculture to restore irrigation channels. The Sefidrud Dam, which had cracked and posed a serious risk, was repaired in cooperation with its French builder. Many farmers lost their harvests, though collective efforts in some villages enabled partial crop sales, supported by volunteers from neighboring areas. Road reconstruction improved agricultural trade, and crop insurance was legally established through public-government collaboration.

Livestock farming also declined: some families lost animals outright, while others abandoned the practice due to water shortages. In Rostamabad, residents sold livestock in bulk. Villages relocated to new sites often lacked adequate grazing land, forcing some households to become wage laborers or return to their original homes despite hardships.

The reconstruction program's emphasis on local responsibility generated job opportunities for both unemployed and skilled villagers. By encouraging self-reliance and home-based labor, the official rebuilding plan kept financial circulation within local communities. The use of local materials, such as wood, for temporary housing stimulated related trades and youth employment.

Commercial recovery was supported by government policies aimed at restoring essential services and reducing economic dependence. In Manjil, priority was given to businesses supplying basic goods such as bread and water. Industrial revival complemented these efforts: damaged factories were repaired or relocated to industrial zones, the Lushan power plant was rebuilt, and the National Shoe Factory in Ganjeh reopened after privatization. Trade unions, such as the aluminum workers' union, provided housing aid and production loans, some of which were later forgiven. However, not all facilities were successfully revived; the closure of the Lushan cement factory and the Sangroud coal mine led to persistent unemployment and slowed economic diversification.

CONCLUSION

The findings from the Rudbar–Manjil earthquake demonstrate that disaster losses and damages are shaped not only by building materials but also by compliance with engineering principles, the resilience of traditional construction methods, and social factors that influence human behavior during disasters. For recovery planning, this underscores the importance of integrating vernacular knowledge with modern engineering and ensuring community adherence to safety standards to reduce future risks. Early needs assessments, even when limited, proved crucial for initiating recovery planning and attracting international support; however, effective reconstruction required a transition from rudimentary assessments to systematic, multi-sectoral evaluations that incorporated both physical and socio-economic dimensions. Strengthening assessment methodologies and institutional capacities is therefore essential for ensuring evidence-based, equitable, and adequately resourced recovery plans.

The case also illustrates how failures in emergency management, such as inadequate information flow, weak coordination, and inequitable aid distribution, can intensify disaster impacts. In contrast, strategies that incorporate dignity, equity, and psychosocial considerations into relief processes help mitigate secondary trauma and establish a stronger foundation for recovery. Linking emergency response more systematically with recovery planning is thus a critical enabler of timely, inclusive, and dignified outcomes. The Rudbar-Manjil Reconstruction Plan itself highlighted both the potential and the pitfalls of recovery planning: while it pioneered community-based and institutional approaches, the failure to institutionalize and operationalize its outputs limited long-term impact. This experience highlights the importance of integrating recovery frameworks into governance structures, financing mechanisms, and institutional practices to ensure

sustainability and resilience in future contexts.

The experience further underscores the value of streamlined institutional structures backed by constitutional authority, provincial engagement, and clear coordination mechanisms. At the same time, systemic bottlenecks, such as financial disbursement delays and weak linkages with academia, impeded effectiveness. Embedding participatory and interdisciplinary approaches into formal reconstruction frameworks could enhance both technical quality and social legitimacy. In housing, the experience shows that inadequate emergency accommodation planning magnified vulnerabilities during the early recovery phase, while approaches integrating temporary and permanent strategies, such as core housing and on-site adaptation, proved more sustainable and cohesive than prefabricated camps. These lessons demonstrate the importance of treating housing recovery as a process that spans from emergency to permanent shelter, linking physical continuity with social, cultural, and economic stability.

Community-led rebuilding accelerated recovery and fostered local ownership, yet insufficient technical oversight led to uneven adherence to safety standards. Nevertheless, the disaster spurred transformative reforms, including the introduction of seismic codes and national building regulations, which laid the foundation for a culture of earthquake-resilient construction. Similarly, relocation efforts underscored that hazard assessments alone are insufficient; without genuine community engagement, relocation risks social and cultural disruption. Successful strategies depended on meaningful participation in decision-making, striking a balance between safety and identity, livelihoods, and the deep sense of belonging that underpins resilience.

Other key domains also highlight the integration of technical and social dimensions. Debris management highlighted the challenges of technical complexity, property rights disputes, and inadequate consultation, underscoring the importance of participatory approaches and context-specific recycling strategies. Human resource development and innovative financing proved central: technical training for builders and crisis managers enhanced preparedness, while the use of banking systems and international loans facilitated large-scale recovery despite fiscal constraints. Yet, aid distribution and financial instruments, while innovative in linking loan amounts to household size, faced governance and equity challenges due to weak monitoring and urban–rural disparities, illustrating the need for accountability mechanisms and careful attention to incentives.

Finally, the earthquake exposed long-term psychological, social, and economic consequences, from mental health disorders and migration to persistent unemployment. Community-based coping strategies, cultural activities, and participation in reconstruction supported emotional recovery and social cohesion, while the restoration of agriculture and industry stabilized livelihoods, albeit with uneven progress. These findings highlight that durable recovery depends not only on technical planning and infrastructure but also on trust-building, community empowerment, and the integration of psychosocial support and livelihood restoration. Collectively, the Rudbar–Manjil case demonstrates that resilient recovery emerges from linking physical and non-physical processes in a continuous, interdependent cycle, underscoring the necessity of embedding lessons learned into disaster governance and policy frameworks for the future of disaster management in Iran.

This study highlights that durable disaster recovery necessitates a combination of preparedness, effective governance, and robust community engagement. From the Rudbar–Manjil experience, several guiding principles can be distilled. First, preparedness and planning must extend beyond immediate response, supported by clear pre-disaster plans, frameworks, and guides, as well as systematic approaches that guarantee the implementation of developed plans after disasters. A process-oriented perspective is essential, ensuring that response and recovery are treated as interconnected phases within a comprehensive disaster management process. Embedding disaster risk management into both response and recovery phases strengthens resilience and ensures long-term sustainability. Second, governance and institutional arrangements play a decisive role. A streamlined and transparent institutional structure, supported by inter-agency coordination and systematic information management, is vital for effective recovery management. Ultimately, social and community dimensions are crucial to the effectiveness of recovery. Successful strategies recognize the interaction between physical and non-physical dimensions, strike a balance between community-led rebuilding and the need for technical oversight, and emphasize meaningful public participation. Actively involving affected populations in decision-making not only enhances social acceptance but also ensures that recovery outcomes are both technically sound and locally legitimate.

AUTHOR CONTRIBUTIONS

Mahsa Bashiri performed the literature review, conducted some interviews, and prepared the manuscript text. Ameneh Karimian was involved in data analysis and manuscript preparation. Seyed Amirhossein Garakani managed the overall research and contributed to manuscript preparation. Mitra Hashemi designed and managed the interview and oral history process, conducted the interviews, and was involved in the data analysis. Farnaz Garousi conducted interviews, transcribed recordings, and contributed to data analysis.

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CONFLICT OF INTERESt

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the authors have acknowledged the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy.

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