Int. J. Urabn Manage Energy Sustainability, 1(4): 33-45 Autumn 2020
DOI: 10.22034/IJUMES.2017.18.12.029

CASE STUDY

Evaluation of the Level of Urban Social Resilience to Earthquakes Using a Good Urban Governance Approach (Case Study of Zanjan City)

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Received 02 May 2020 revised 24 Aug 2020 accepted 01 Oct 2020 available online 25 Nov 2020

ABSTRACT: Resilience is one of the most important factors to achieve sustainable management and good urban governance and it is a way towards the improvement of communities building upon their capacities. Therefore, in present research social resilience of Zanjan city to earthquakes was evaluated using a descriptive-analytical method. The present study employed a database (Geographical Information System (GIS), an analytical-spatial model (social resilience evaluation model) and a decision-making model (Quantified Strategic Planning Matrix (QSPM)). Factors that contribute to the level of social resilience studied in the present research consisted of four criteria and twenty-eight sub-criteria. They were weighted based on their importance using an analytic hierarchical process (AHP); then GIS was used to address the level of social resilience of Zanjan city to earthquakes and finally vulnerable areas and neighborhoods were identified. Findings suggest that about 40% of Zanjan city area is of a low resilience to earthquakes and the most vulnerable areas include the old texture of such neighborhoods as Islam Abad and Kooye Farhang in District 3, Bisim in District 5 and such neighborhoods as Sabzeh Meidan and Davoud Qoli road located in Districts 1 and 2. In the next step, QSPM was used for decision making and selection of optimal strategies in order to prioritize strategies to implement in areas with high vulnerability and low social resilience.

Keywords: Earthquake, Social Resilience, Good urban governance, Sustainable management, Zanjan city

RUNNING TITLE: Urban Social Resilience to Earthquakes

INTRODUCTION

Earthquake is one of the most well-known natural disasters in the world because of the wide range of areas vulnerable to this phenomenon, and the extent and intensity of damages caused by it (Maleki, 2007: 114). Today with the growth and development of urbanization, various facilities are available but it should be considered that crisis factors also increase with urbanization (Nakabayashi,1994:226). Reduced vulnerability of urban communities to earthquake only realizes when protection against earthquake is considered at all planning levels (Habibi et al., 2008). Given the unexpected nature of earthquakes and need for quick and correct decisions and actions, the relevant fundamental and theoretical bases have developed a knowledge known as crisis management resulting in reduced impacts of undesirable events and vulnerabilities. Urban vulnerability to natural hazards including earthquakes is a function of human behaviors and represents readiness or non-readiness of socio-economic and physical systems in urban areas affected by natural hazards (Ebert, 2008: 2). Up

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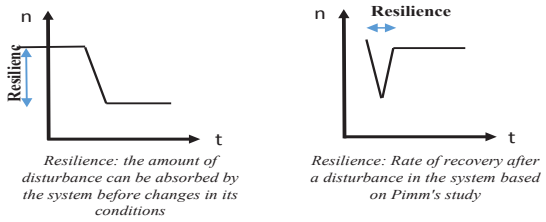
to now various assumptions have been made in relation to crisis exposure and management in relevant literature and significant attitude shifts can be seen in this respect. Crisis management initially was only an instantaneous response and reaction after happening of crisis or undesirable event. However, in the 20th century, accelerating growth of cities and accumulation of huge investments in them resulted in highly increased damages and losses due to crises. In this way, the inefficiency of this method for crisis management revealed. After that period, crisis management assumptions were highly changed and the most distinctive change was the emergence of the urban resilience to crisis literature. Indeed, resilient communities are capable of managing the city after happening of crisis. In fact, resilient communities have a high social capability to quickly estimate, prepare for, respond to and recover form crisis and it means that quick recovery from crisis impacts is not the only function of a resilient community, but it is able to learn from, deal with and adapt to the hazards (Mayunge, 2007: 4). To achieve resilience management and create resilient communities it is necessary to reach a good governance in the city. Good urban governance implies necessity of government participation in development of local communities and emphasizes on synergetic interaction between government and private sector and civil society to improve life quality of citizens, enhance participation and social cohesion, increase resilience, develop coordination between managerial aspects to reduce risk of disasters and formulate urban and local development based on disaster risk reduction principle. On the other hand, seismologists argue for a probable severe earthquake in Zanjan city in the future because this city is located in a seismic zone. Studies show that Zanjan city as a whole is considered as a high-risk seismic zone with the probable occurrence of medium or higher level earthquakes. Natural bed of present urban texture of Zanjan city is subject to main and even secondary faults and because of this fact, it is necessary to conduct comprehensive studies to evaluate the resilience of the city.

MATERIALS AND METHODS

Sustainable management can be considered a result of life style evolution and achieve to ideal conditions in economic, social and cultural fields and this implies realization of equity and social and cultural dynamism concepts. Natural crises including earthquakes are considered as a hurdle to sustainable management and the occurrence of crises always act as an obstacle to economic, social and construction development (Ziari et al., 2017: 98). Crisis consists of "a situation resulted from natural or human-made disasters in which social system in one geographical area is disrupted and need for special care and life essential supplements become important" (Ziari, 2017: 2). Today, the wide extent of damages and losses due to unknown crises reveals the necessity for addressing the resilience concept more than ever (Chardon, 2006:7). As mentioned earlier, an earthquake is one of the natural crises. Particularly, earthquake incudes release of seismic energy which is transferred from a deep level to the surface of the earth and this seismic powerful force usually causes shear, tensile or compressive failures (in horizontal, vertical and circular directions) in the earth crust (Habibi, 2009: 50). Vulnerability to a natural hazard has various aspects including physical, economic, social etc. (Birkmann, 2005: 3). According to Breton et al., the vulnerability of a society to environmental hazards is a function of three worlds: 1. physical environment; 2. human environment; 3. actions taken to resist hazards (Cutter et al, 2008: 600). Social vulnerability is partly a result of social inequalities. Characteristics of communities and built environments including urbanization level, growth rate, and economic life contribute to the social vulnerability of places (Cutter and others, 2003). Social vulnerability is defined based on social groups' policies to deal with hazard impacts and also their sustainability or ability to recover themselves (Cutter and Emrich, 2006). Social vulnerability to natural hazards is defined at four different layers: an individual in the family (dependent upon personal characteristics), community (dependent upon our interactions with those surrounding us), geographical area (dependent upon our distance from services) and organizational/administrative level (dependent upon budget allocated to the undesirable event

and risk reduction studies) and present research only focuses on two dimensions of personal characteristics and distance from services (Dwyer and other, 2004: 20). Indeed, resilience and vulnerability in the crisis management field are two faces of the same coin and one decreases with an increase in the other. This definition initially proposed by Holling in 1973 can be compared to engineering resilience which defines this concept as the time needed to return to the favorable condition after a disturbance (Allen et al., 2016: 4). Figure 1 shows the main difference between these two viewpoints.



Resilience: the amount of disturbance can be absorbed by the system before changes in its conditions

Resilience: Rate of recovery after a disturbance in the system based on Pimm's study

Fig 1. Diagrams related to the concepts of two resilience definitions (Pimm 1984) and (Holling 1996)

The term resilience in various fields gradually evolved into a concept usable by policy makers and academicians and during this period, various interpretations were provided for definition of this concept (Ainuddin and Routray, 2012: 5). From some scholars' viewpoint, resilience means a return to a steady state after a disturbance. This opinion argues for a steady state in terms of stability, efficiency and/or an ability to absorb pressure or change without or with minimum disturbance (Schuetze and Cheleeri, 2013: 3). Other groups of scholars defines this concept in terms of multiple equilibrium points and in their opinion resilience includes passing through these points (Allen et al., 2016: 3). In the late 1990s, resilience shifted from natural ecology towards human ecology (Alexander, 2013: 3) and it may be said that it was first introduced by Timmermans to the hazards field (Gunderson, 2009: 35). Indeed, the introduction of the word resilience to disaster and crisis management can be considered as a new cultural turning point in that field (Kazemi, 2015: 12). In the World Conference 2005 with a focus on disaster risk reduction, it was emphasized that resilience has the potential for more contribution to disaster risk reduction at both practical and theoretical levels. Douglas and Wildavsky (1982) defined resilience from crisis perspective as "the capacity to use change to better cope with the unknown; it is learning to bounce back" and emphasized that "resilience stresses variability" (Ainuddin and Routray, 2012:5). Furthermore, from urban crisis perspective resilience addresses the capacity of a region or urban system to resist against shock and stress (Agudelo – vero et al., 2012:6). In disaster and crisis management literature, resilience is addressed in various dimensions including economic, organizational, ecological. social and physical ones and the common characteristic of them is "ability to resist and positively react to pressure or change" (Rafieian et al., 2010:5) and present study investigated social resilience. In this respect, Mileti proposed the development of disaster-resilient communities as a new rational way to reduce natural disaster and risks (Mileti,1999: 9). The extent of adaptability of a community to change is related to its resilience (Cangelosi, 2015: 2). For most communities, resilience in short-term means bouncing back to original life infrastructure including food, water and shelter and in long-term it refers to returning of families and businesses to a self-efficient state (Carpenter, 2015: 1). At the community level, characteristics of the built environment and social features of the community contribute to the reduction of vulnerability and recovery of facilities. The extent of adaptability of a community to change is related to its resilience (Allan and Bryant, 2012: 2-7). Based on this, a resilient community is one that not only tolerate shocks and impacts of risks so that they do not result in disasters, but also it has the ability to bounce back to its normal condition during and after disasters and also it is capable of and has opportunity to change and adapt after disasters (Rezaei et al., 2015: 4). Social resilience has been defined as the capacity of a community to bounce back and use its own resources to recover. Social resilience is built upon internal resources and competencies to manage demands, challenges and changes during disaster time (Ainuddin, 2012:26). To achieve resilience and develop resilient

communities, good urban governance should be realized (Barak Pour, Asadi, 2011: 188) and it is considered as a branch of sustainable development and sustainable management approach. Governance is a type of process. This process ensures an integrated system covering both government and society. Accountability, appropriateness, and foresight in governance, ability to deal with current issues in an effective way and prediction of events not only depend on formal organizational networks but also some informal ones. The latter networks enable people to do the required works when formal ones get into trouble (Mcloughlin, 1973: 249-250). Competent governance follows an effective decentralized urban management to achieve urban social and physical resilience and in the case of occurrence of disasters, coordination and cooperation between government and private entities and the public represent correct crisis management and is considered as a feature of resilience (Rafieian et al., 2011: 93).

Principles and Characteristics of Good Urban Governance: UNDP (United Nations Development Program) of UNESCO (United Nation Educational, Scientific and Cultural Organization) proposed eight characteristics for good governance (Nobari and Rahimi, 2010: 17). Those characteristics include the following. Participation i.e. involvement of the public in decision-making process directly or indirectly through legitimate representatives and institutions. Rule of law i.e. establishment of a good governance system requiring fair legal frameworks (formulation of rules and regulations related to the resilience of buildings, infrastructure, environment, etc.). Transparency, i.e. free flow of information and easy access for all users. Responsiveness, i.e. good governance implies that decision-making processes and institutions provide required services to all stakeholders in a reasonable time frame. Consensus orientation, i.e. the more the diversity of the viewpoints in a community, the more the number of actors. Thus good governance requires that all interests and preferences are taken into account so that the interest of the community as a whole is realized. Equity and inclusiveness, i.e. in good governance, all people in the society should be provided with equal opportunities. To this end, all vulnerable groups should suitably be supported to improve their competencies. Effectiveness, i.e. good governance is realized when decision-making institutions and organizations take the public demands into account and use available resources efficiently. Accountability, i.e. both public and private institutions and civil society organizations should be held accountable to the public and stakeholders (e.g. for their potential corruption and rent-seeking behavior) (Rafieian et al., 2011: 95-96). Good governance emphasizes on the necessity for government to participate in development of civil society and synergetic interaction between government and private sector and civil society to improve life quality of citizens and increase participation and social cohesion (Abdollahi, 2011: 75), improve resilience, develop coordination between managerial aspects to reduce risk of disasters and formulate urban and local development based on disaster risk reduction principle. Given increased frequency of natural disasters and particularly earthquakes during recent centuries in various parts of the world and in turn increased financial damages and loss of lives due to these phenomena, addressing the issue of resilience to these disasters and preparation for them has drawn the attentions more than ever. Some examples of domestic and foreign disasters and results of the exploration of them are discussed as follows. Philip Breke et al., (2008) explored the development of resilient cities and provided a resilience model in human and ecological dimensions for addressing natural crises in Thailand. Gavin Smith et al., (2015) conducted a study on planning for resilience with a risk reduction approach and adoption of disaster confrontation law and provided a procedure for studies on urban resilience suggesting the planners resort to the legal system to improve resilience components. B. Miles Scott (2014) addressed modeling of central infrastructure resilience of urban communities to earthquake crisis using decision making support tools and a sub-set of algorithms based on Resil US simulation model to reflect community resilience and finally presented an empirical model for community resilience

to earthquakes in the form of a scenario. Farads Behtash et al., (2012) conducted a study titled "Clarification of Dimensions and Components of Islamic Urban Resilience with a Systemic Viewpoint" and investigated the relationship between resilience, vulnerability and adaptability and coping capacity and based on the studied models and frameworks suggested resilience components for Islamic cities. Salmani Moqaddam and Kavian (2014) explored the role of land use planning in the improvement of urban resilience to earthquakes in Sabzehvar city. Results showed that among 13 districts of this city, District 3 had a lower resilient to the earthquake. Rezaei and Hosseini (2015) conducted a study titled "Evaluation of the Extent of Physical Resilience of Urban Communities to Earthquake Using Questionnaire and SAW and ELECTRE Methods", explored the situation of selected neighborhoods in Tehran city in terms of physical resilience. Findings showed that Qale Morghi and Qeitaryieh neighborhoods respectively had the best and worst situation with respect to physical resilience. The aim of present study was to identify the factors influencing the social resilience of Zanjan city; to this end, the extent of resilience was assessed at urban level and after identification of highly vulnerable neighborhoods, some recommendations were provided to increase the social resilience of Zanjan city.

The present paper was an applied-development study with respect to its purpose and a descriptive-analytical one in terms of methodology.

a library survey is provided on the importance of variables effective in Social Resilience in the area studied using 1:2000 maps, satellite images for map updates and also the existing statistics and information considering research subject. According to figure 2, components of the system used in this research include a local data base of the studied area that is created and used by the researcher during the research as an informational sub-system to store and manage information. To create a database, first, the informational framework is specified and then information collection and preparation is carried out. Eventually, a data base selection and design are needed considering existing facilities and research requirements that are including codification informational framework and data collection and preparation. During the codification of the informational framework, the existing data in Zanjan were identified firstly, these data that are used in this study from contracture aspect contains two forms; spatial data and non-spatial data and descriptive. Spatial data is statics block of the census and extracting residential divided units from Zanjan maps in scale 1:2000 maps. Descriptive data is a bank of descriptive information of spatial data including; the population families of residential units, education, employment, gender ratio, age groups, and number of disable people, quality of dwelling, and 28 variables are used to evaluate social resilience include four main variables of population, dwelling, economic-social concept and access to facilities. In the next stage, these variables are combined by spatial data and attribute data and also, the impact of each variable is identified by using the AHP method. In AHP weighting the critical at each level based on binary comparison is performed. In order to calculate the weight of each of these criteria and sub-criteria, this matrix was formed by Expert Choice software. The application of multi-criteria decision analysis problems by using the analytic hierarchy process is designed to run on PCs. Has the great ability and in addition to the possibility of hierarchical decision-making and priorities graph and calculate the total weight, the sensitivity analysis to changes in the parameters of the problem also has to decide. After determining the weight of each criterion and sub-criteria, layers on each of the indicators for determining the weight is built by GIS. Finally, these layers are overlapped and presented Resilience map in an earthquake. This map contains four rank of low, intermediate, considerable and high resilience.

It seems necessary to Choose an appropriate method to provide a quantitative framework for the study with the aim of improvement of social resilience in areas with the most vulnerability. Accordingly, a SWOT analysis was used to develop a research framework. Finally, quantitative strategic planning matrix

(QSPM) was used to assess strategies and choose the superior alternatives. To this end, internal and external environments of areas with low and medium level of resilience were explored and to complete information from survey forms, 25 experts were selected among current urban managers, scholars and specialists to weight and rate existing situation for all internal (strengths and weaknesses) and external (threats and opportunities) factors and optimal strategies were determined based on weighting results. Figure 2 shows the research analysis model.

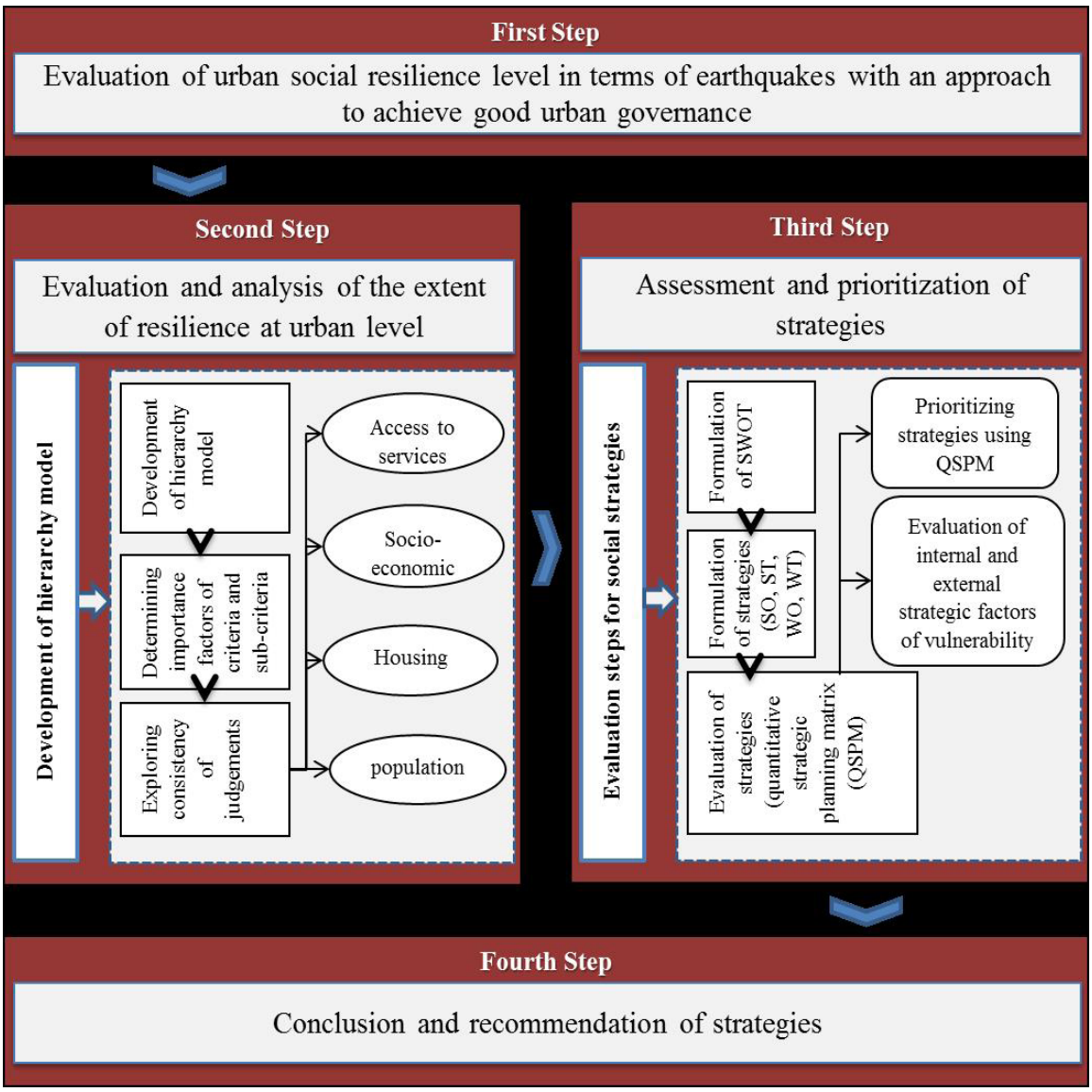


Fig2. Research structure

CASE STUDY

Zanjan in terms of urban divisions it includes six regions (with a predominance of residential use) and an area of agricultural. It is divided into twenty-four districts which figure one shows the city zoning divisions (Naghshe-e-Mohit consulting engineers, 2013: 373) Current natural substance context of zanjan is surrounded by two dangerous faults; Tabriz and Soltanieh, that's why it needs to study crisis management and micro-zonation in master plan (Zanjan preparations, 2010: 4). The population

of the city amounted to 400106 thousand which accounted for 35% of the province population (Iran Statistics Center, 2006). It's area of about 64612618 square meters. The city suffered earthquake damage and casualties. Low housing quality, high population density and high residential density, a high number of families in dwelling units, unsuitable passages width, and lack of attention to the regulations of zoning and separation of density areas will be added to the problem of these density tissues (Naghsh-e-Mohit consulting engineers, 2013: 40).

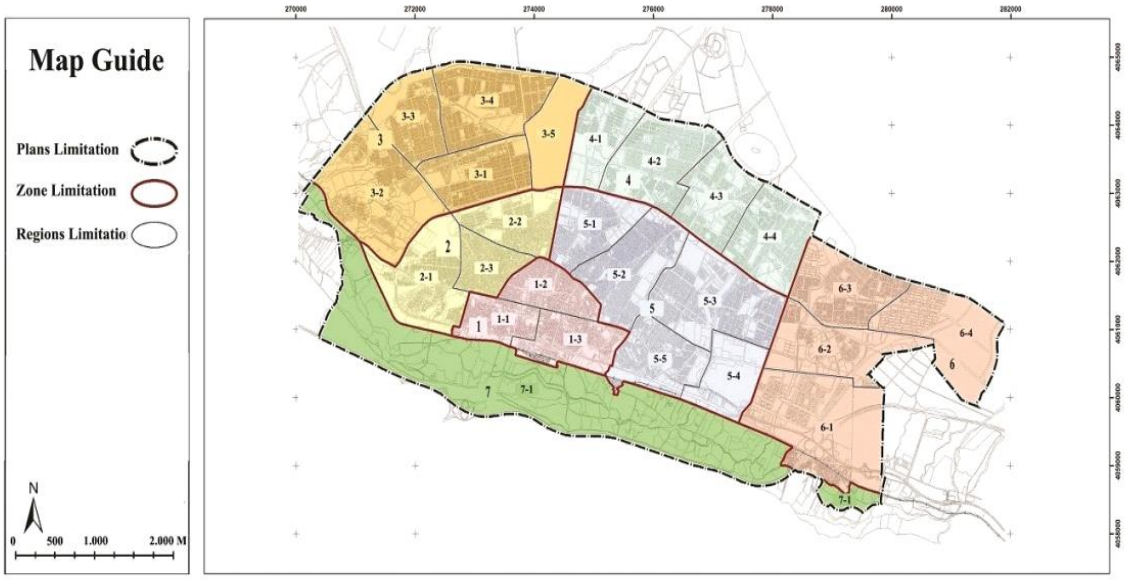


Fig 3: Physical divisions of Zanjan (Nagase-e-Mohit consulting engineers, 2013: 312)

RESULTS AND DISCUSSION

As mentioned in research methodology, the extent of the social resilience of Zanjan city is analyzed based on the resulted database (variables of the proposed model and collected data). In the following, the steps for social resilience study are provided.

First Step - Identification of Criteria Relevant to Social Resiliency

According to the proposed model for the study area, the extent of the social resilience of Zanjan city to earthquakes is explored. In previous sections, the variables influencing resilience were identified, the analysis model for Zanjan city resilience to earthquakes was descried, the research area was introduced and required materials were mentioned. In this section analysis of Zanjan city, social resilience to the earthquake is performed based on variables of the proposed model and collected data. Analytic Hierarchical Process (AHP) is a common method to analyze social resilience because social resilience analyses are influenced by several criteria which should be selected carefully in the first instance. Since AHP model is a well-known method in geographical studies, thus here it is not described in details and only criteria and sub-criteria, matrices and final results derived by its application to Zanjan city social resilience to the earthquake are addressed.

Weighting Criteria

Figure 4 shows the criteria and sub-criteria and Table 1 shows the weights calculated for each of them.

Criteria	Dwelling	Population	Economic-social	Physical distance	Multiplication of the weights	Normal weights	Final criteria weights
Dwelling	495/0	75/6	27	3	3	3	1
Population	232/0	333/0	332/1	2	2	1	333/0
Economic-social	136/0	83/0	333/0	2	1	0.50	333/0
Physical distance	136/0	21/0	83/0	1	0.50	0.50	333/0
CR=0.066						7/187	1

Tab 1: compression of different factors (two o two) in social Resiliency

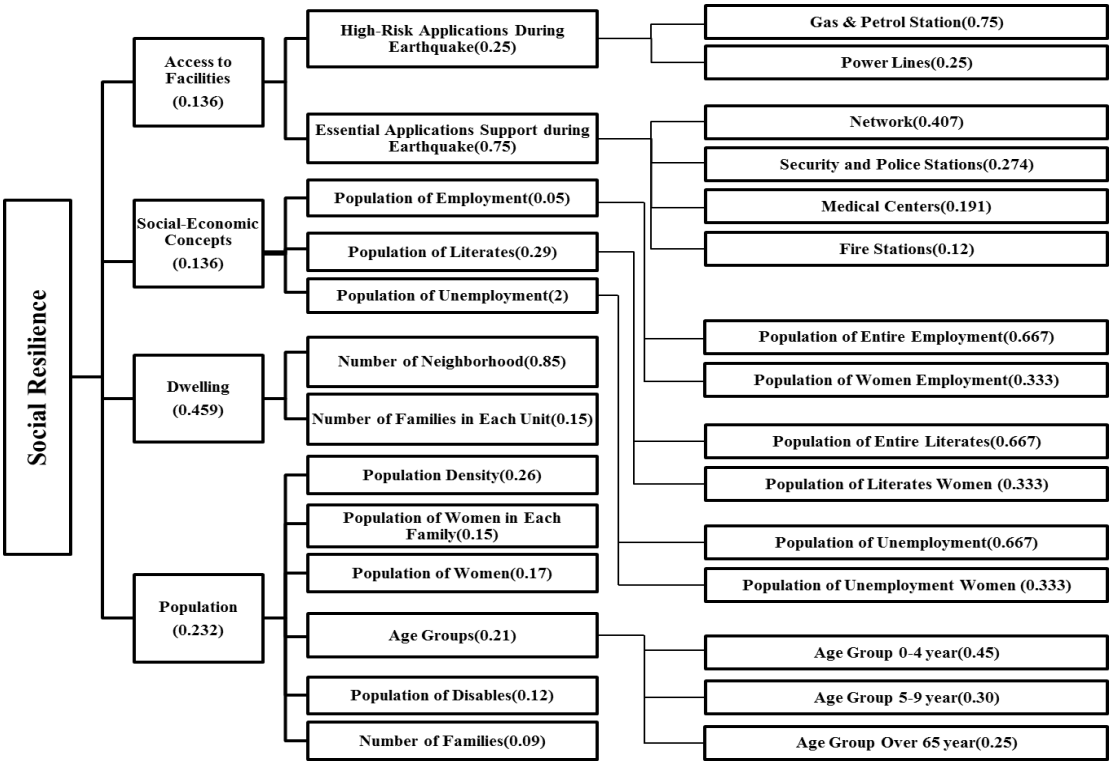


Fig 4: shows the criteria and sub-criteria and also, illustrates the calculated weights for each of them

Analysis criteria

In this stage of the study, the criteria include dwelling, population, social, economic and access to facilities are analyzed. By consideration the following criteria; the number of resident in each unit, number of neighbors the dwelling quality is investigated in the town of Zanjan. Based on the analysis of dwelling standards, it can be concluded that the city's central textures of the regions of 1, 2 and 3 are more low-quality housing. These problematic tissues such as Islam Abad, Bisim, airport regions etc. because of the unplanned growth of the city in comparison with other areas are considered as high-vulnerable areas of the earthquake. If the social and economical of these residential areas are studied, we would discover that these residents do not have a good dwelling quality because of lower income and number of families living in a unit. As a result, these are vulnerable to earthquake.

Population

According to the importance of the urban

population to the earthquake, in this study because of the access to data, like population density, age (three groups of vulnerable to earthquake), number of women, number of housewives, disable and elderly, family aspect are investigated to determine the level of population importance. The results show that Zanjan's areas are in different vulnerability because of spatial difference and unequal distribution of the population. According to population analyst, we can conclude that regions 1, 2 and 5 like Bisim, Islam Abad, Davood gholi and Sabze Meydan and in contrast, regions like Shahak Karmandan, Etemadiye, and Kuche Meshki are in high resiliency.

Social-economic

These elements can include different factors like the level of income in each family, education, and employment. As there was not accurate data for family's income available in the census of Zanjan, the other factors like the ration of employment women, ration of employment, illiterate women, unemployed and unemployed women have been checked to the analysis of social-economic vulnerability.

Access to facilities

Studies in urban communities show that residents of all metropolitan areas have equal access to urban facilities and may not be based on social and economic characteristics of residential neighborhoods in the city, the formation of the city and unplanned growth of cities, distribution facilities several metropolitan areas to also have significant differences. For an instant, we can refer to the inappropriate distribution of high-risk applications such as petrol stations, high voltage power lines and installations dangerous cross into the urban compact texture that these elements are leading to increasing casualties to the earthquake.

Second Step: Results from Application of AHP to Determine Social Resiliency

When weights were identified for all criteria and sub-criteria chosen by GIS, informational layers of each of them were formed with determined weights. Then, maps for each of criteria and sub-criteria were produced using GIS analytical capabilities; consequently, these layers were overlapped and final map of the social resilience of Zanjan city to earthquakes was obtained. Figure 5 and Table 2 show the extent of the social resilience of Zanjan city to earthquakes. Findings from the application of AHP on the studied criteria shows that given the difference in criteria values and different social features of various urban areas, each of these areas has different resilience level compared to others. As can be seen in Figure 5, areas with illegal settlement have low resilience to earthquakes because of high population, lack of suitable housing, low economic indices and lack of access to necessary facilities in the case of earthquakes; thus planning and reorganization of these areas by urban managers and planners are necessary. The old texture of Zanjan city has high social vulnerability because of very old buildings. Figure 3 shows that the lowest social resilience is found in the central texture of Zanjan city ad this part is the most disaster-prone area with respect to the earthquake. As seen in Table 2, about 12.10% of the studied area has low social resilience and 36.21% of the urban area has an intermediate level of resilience. Approximately 30.43% of Zanjan city area has high resilience level and 36.21% of this area is of considerable resilience. Considering the low and intermediate level of resilience, about 40% of Zanjan city area has the poor social resilience to the earthquake. As seen in Figure 5, the least resilience belongs to old texture of such neighborhoods as Islam Abad and Kooye Farhang in District 3, Bisim in District 5, such neighborhoods as Sabzeh Meidan and Davoud Qoli road located in Districts 1 and 2 and a small part of District 6 because of a high density population, lack of suitable access of high populated residential areas to health and relief centers, lack of appropriate access networks, deficiency of police and security facilities, etc. The most resilience level is found in areas with newly-constructed buildings and infrastructure including Karmandan town, Etemadyieh, Koucheh Meshki, etc. located in Districts 4 and 7 with low population density.

Resilience Rang	Areas Ratio	(Areas (Km²	Number of Units
high Resilience	30/43	21841999	23389
Considerable Resilience	21/26	16220193	16985
Intermediate Resilience	36/21	19419444	20630
low Resilience	12/10	4161012	9236

Tab 2: Social Resilience due to combining elements

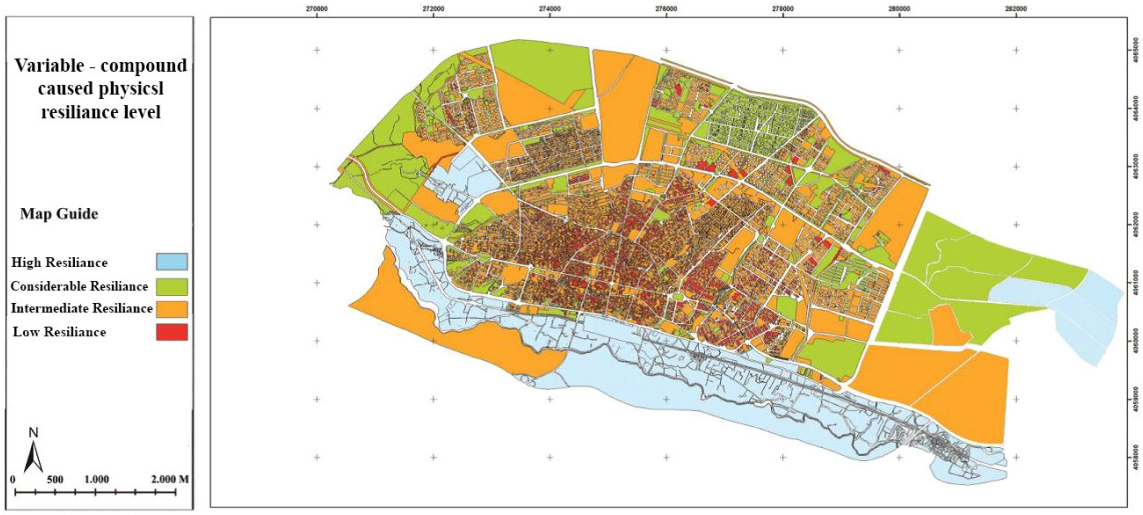


Fig 5: Map of Zanjan's variable-compound caused Social Resiliency

Third Step: Decision Making: Prioritization of Social Strategies Using QSPM

At this stage, with quantitative strategic planning matrix, all strategies are evaluated and prioritized. In fact, the strategic element of the strategy is measured and it is rated. Total points have been calculated in a table these concessions is the priority strategy. The various Zanjan strategy options are determined and prioritized with values and are comparable with each other. According to the table of quantitative physical strategic has been developed through separating SO, ST, WO, and WT. Strategy SO1 with the highest point 10/261, is known as the best social strategy in Zanjan to increase social resilience. that is organizing rescue team with helping earthquake disaster managers and strategy WT1 with point 9/721 is the second strategy which is identifying vulnerable residential groups, and planning to increase their ability and decreasing their vulnerability. Strategy WO1 (9/692) is suggested for using sources, talents and people's skills in a different level of resistant in high-vulnerable and low resilience region to the earthquake. It is the third suggestion of social vulnerability. Below Table 3 shows the priority of four social strategies to implement in high-vulnerable for the purpose of reducing social resilience to the earthquake.

Final Point	Prioritize	Composed social strategy to reduce social vulnerability to earthquake
10.261	1	SO1- Organizing rescue team utilizes powerful people specializing in earthquake disaster management
9.721	2	WT1-Identifying vulnerable groups and residents and action plan to increase capacity and reduce vulnerability
9.692	3	WO1- using people's skills and resources and different levels of resistance programs in areas with high vulnerability to earthquakes

9.662	4	WO2- Participation of private investors (NGOs) in development activities in the area with high vulnerability
9.035	5	SO2- Public education and the formation of focus groups of people enjoying strong
8.237	6	ST2- Simulation and using maneuvers against earthquake
7.430	7	WT2- Increase people's trust in earthquake disaster management plans
6.158	8	ST1- Effective distribution of goods and services at the time of earthquake disaster

Tab 3: Prioritize social mix strategies to reduce social Resiliency caused by the earthquake

CONCLUSION

Up to now, most efforts in the field of earthquake crisis management have been limited to building rehabilitation plans; while making the whole city earthquake-proof requires complete and accurate identification of urban elements and detection of causes and levels of vulnerability for each of them. Results from evaluation of social vulnerability of Zanjan city based on the final map shows that about 40% of Zanjan city area is of a poor resilience to earthquakes and the most vulnerable areas include old texture of such neighborhoods as Islam Abad and Kooye Farhang in District 3, Bisim in District 5 and such neighborhoods as Sabzeh Meidan and Davoud Qoli road located in Districts 1 and 2. This condition is due to a high-density population, lack of appropriate housing, lack of suitable access of high populated residential areas to health and relief centers, lack of appropriate access networks, deficiency of police and security facilities, etc. The most resilience level is found in areas with newly-constructed buildings and infrastructure including Karmandan town, Etemadyieh, Koucheh Meshki, etc. located in Districts 4 and 7 with low population density. Results from these evaluations shows that some obstacles to realization of a good urban governance in these districts include incompatibility between existing facilities and new requirements of crisis management, presence of a non-participatory management system, multiplicity of decision making and approval entities, lack of appropriate monitoring during implementation of plans, weakness of management system and lack of an integrated management system for dealing with earthquakes, deficiency of relevant specialists and scientific facilities, etc. Finally, it should be noted that in order to study the factors causing urban vulnerability to natural disasters in developing countries including Iran, then we should seek their roots in social inequalities, lack of appropriate planning and increasing growth of population and urbanization in these areas.

- *According to the above-mentioned, the following recommendations are provided to improve resilience:*

-The necessity of involving the public not only in providing first aids to the victims during earthquakes but also during collection and distribution of earthquake information and raising people awareness of earthquakes is felt more than ever.

-Formulation and implementation of comprehensive scientific plans for psychological and social rehabilitation of victims and technical and systematic reconstruction and rehabilitation of damaged areas.

- More focus on comprehensive and consistent research and scientific studies to identify and reduce the risk of earthquake crisis and organizing and supporting research and scientific centers to achieve good urban governance.

- One of the most important factors contributing to the reduction of social vulnerability in a fast and timely manner during crises is an integrated and coordinated crisis management. In this way, required coordination is developed between relevant organizations and various relief centers to prevent confusion and chaos during crises.

- It is necessary to prepare the grounds for providing required education to various groups in the society, raising public awareness and prepare people to deal with such crises. The advantage of an earthquake maneuver is its

significant role in achieving the required readiness to react to disasters in a correct and quick way which in turn leads to decreased losses due to earthquakes.

ACKNOWLEDGEMENTS

This work was supported by Faculty of Art and Urban Planning, Islamic Azad University, Tehran-North Branch, Tehran, Iran.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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