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Operational site selection for disaster management bases in Tehran, Iran

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सार – प्राकृतिक आपदाएँ मानव जीवन में मुख्य भूमिका निभाती हैं। यह ध्यान में रखा जाना चाहिए कि इन आपदाओं के होने का पूर्वानुमान करना असंभव है, लेकिन इन आपदाओं से निबटने के लिए एक अच्छी पहल से शहरों में होने वाली क्षति के बाद होने वाले नुकसान को कम करने के लिए एक अच्छा समाधान हो सकता है। प्राकृतिक आपदाओं की रोकथाम, तैयारी और संकट से निपटने के मामले में आपदा प्रबंधन प्रतिष्ठान विशेष रूप से तेहरान में, सही समय पर महत्वपूर्ण भूमिका निभाता है। इसमें कोई संदेह नहीं है कि इन प्रतिष्ठानों के उच्च स्तरीय और कुशल कार्यों का शहरी और क्षेत्रीय दोनों स्तरों पर एक तरह से परस्पर संबंध है, जो सेवा के आधार पर आपदाओं से निबटने में सुरक्षा प्रदान करने के अलावा संकटग्रस्त क्षेत्रों के लिए अच्छी सेवाएं प्रदान करने में सक्षम हो पाते हैं। इस शोध पत्र में इन प्रतिष्ठानों की प्रभावशीलता का आकलन करने के लिए मल्टी क्राइटेरिया डिसीजन मेकिंग (एमसीडीएम) तकनीक और स्थानिक विश्लेषण पद्धति का उपयोग करने की कोशिश की गई है। मूल्यांकन के आधार पर आपदा प्रबंधन प्रतिष्ठानों को तेहरान में सहज रूप से वितरित किया गया है और ये अनुप्रयुक्त स्थानों पर स्थित हैं। इस प्रकार जीआईएस विश्लेषण के साथ एमसीडीएम का उपयोग करते हुए, अध्ययन के लिए सबसे अच्छे स्थान प्रस्तावित किए गए।

ABSTRACT. Natural disasters play a main role in human life. It should be taken into consideration that it is impossible to predict these disasters from happening, but preparation for a good response for these disasters can be a good solution to decrease post-damage casualties in the cities. Herein, Disaster Management Bases in terms of prevention, preparation and dealing with the crisis play a key role, especially in Tehran and in times of natural disasters. There is no doubt that a high level and efficient function of these bases has a striking correlation with the way they are located in both an urban and regional level in a way that in addition to providing security of the bases against disasters, based on the service area they could be able to provide good services for the areas of crisis. This paper tries to use Multi Criteria Decision Making (MCDM) techniques and spatial analysis method in order to assess the effectiveness of these bases. Based on assessments Disaster Management Bases have spontaneously distributed in Tehran and have located in inappropriate places. Thus using MCDM with GIS analysis, the best locations in case study area was proposed.

Key words – Natural disasters, Disaster management bases, Region 18 of Tehran, Spatial organization.

1. Introduction

The danger of natural disasters has increased dramatically in recent decades all over the world (Uitto, 1998). These natural disasters are diverse and different and are a threat to human settlements such as cities. These disasters easily turn into crises (Tavakkoli, 2011). Natural disasters have been long existed through life on earth and have and will be regarded as a threat for development (Parishan, 2011). Social life developments, especially civilization and daily expansion of cities, have also made the effects of these disasters even greater in a way that, to efficiently tackling this crisis is one of the most necessary concerns of urban managers and citizens (Mohajerani, 2007). Cities which have fragile social and economic systems are very vulnerable to natural disasters and are places for different accidents; hence the decrease in urban spaces' vulnerability toward these crises would be key in decreasing the natural hazard oriented costs (Armas, 2012). The location of the city of Tehran is seismic and the importance of this city in different aspects such as economic, political, demographic and so on is clear to all. The level of casualties resulted from a big earthquake in Tehran would be much greater than what would initially be expected in other metropolitan areas in developed countries which are placed in a seismic areas such as Japan and European countries (Zangi Abadi *et al.*, 2011).

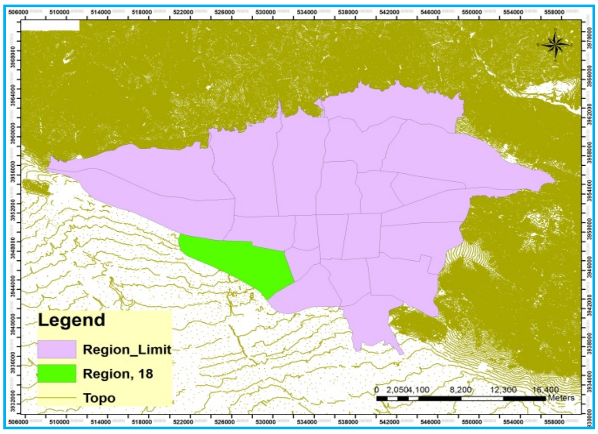


Fig. 1. The area of study in Tehran

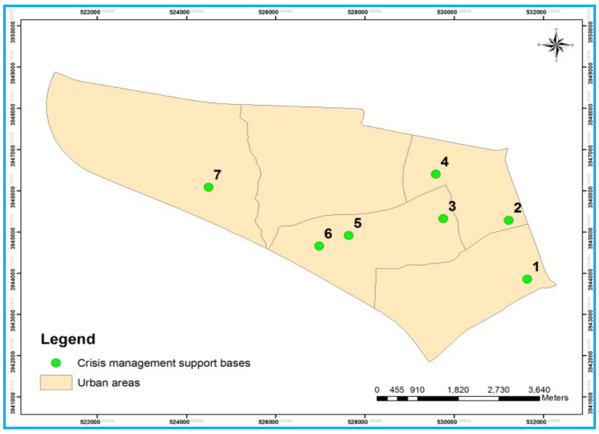


Fig. 2. The location of disaster management bases in Tehran region 18

One of the serious problems after an earthquake is the delay in emergency help. In the metropolis of Tehran, due to its size and diversity and the lack of appropriate circumstance for emergency help for such crises, the citizens would face different difficulties which cause an increase in the number of casualties and the probable victims (Tavakkoli, 2011). When an earthquake occurs, several actions are on the agenda for those who have suffered from the hazard, these actions include: introducing a haven, medicine preparation, initial reconstructing and defining temporary residence and emergency services at the times of crisis. It is worth mentioning that all these measures are designed for minimizing casualties. In this realm, Disaster Management Bases are in the prevention phase, preparation and opposition in different crises, especially great natural disasters such as earthquake in the city of Tehran, play the key role and enable emergency services to respond in the initial hours of a crisis. The first idea of establishing such an organization started in the previous decade. What matters most in locating and building these bases for providing better service is the functional and locative area of these bases, in a way that, in addition to appropriate access of the location for these bases, should be in a way that the building is not exposed to any type of danger. With regard to the fact that bases play a key role at the times of crises in organization and management, therefore, it seems necessary to choose an appropriate location for these land uses by means of comprehensive study and detailed planning in order to take required measures to increase their effectiveness. For implementing such an operation, a comprehensive information system with information layers and the ability to make decisions and analysis should be provided. Therefore, one of the acceptable issues before building these bases is by studying, assessing and deciding the best place to build the site. A site that is a safe place at the times of crises and can be effective and efficient for locating support bases. Thus, the main purpose of this research is identifying the indicators for the locating of Disaster Management Bases and the optimum site selection for these bases.

Region 18 of Tehran was added to the city of Tehran in 1980 and it has a population of 411840 according to the last census in 2016 with regard to annual growth of 0.08% from which 391368 live inside the area and 20742 (about 5%) live in the surrounding areas. This region ranked 6th in Tehran in terms of population and has a pure density of 760 men per hectare and impure density of 100 men per hectare. Highly compact, fine-grained residential texture with low pass accessibility is one of the physical features of this texture. Fig. 1 indicates the area of study.

In reality there are 7 bases in region 18 which include one special base in Shahid Bahrami-Asgari Street, 5 multipurpose bases located in sub region 1 and one under construction base in sub region 2. Fig. 2 indicates the location of Disaster Management Bases in Tehran region 18.

2. Methodology

The methodology of this paper is descriptive-analytical with a practical entity. In this paper, at first for assessing the pattern of spatial distribution of bases, "the Nearest Neighborhood" method is used. Then effective indicators in identifying appropriate locations for disaster management are listed. The use of multi attribute decision making methods and the capability of spatial analysis by geographical information system (GIS) analyze and assess the data and the location of Disaster Management Bases in Tehran region 18.

The first stage focuses on trying to define the exact issue. Then by using information from library documents, the effective indicators and factors are extracted. Since the

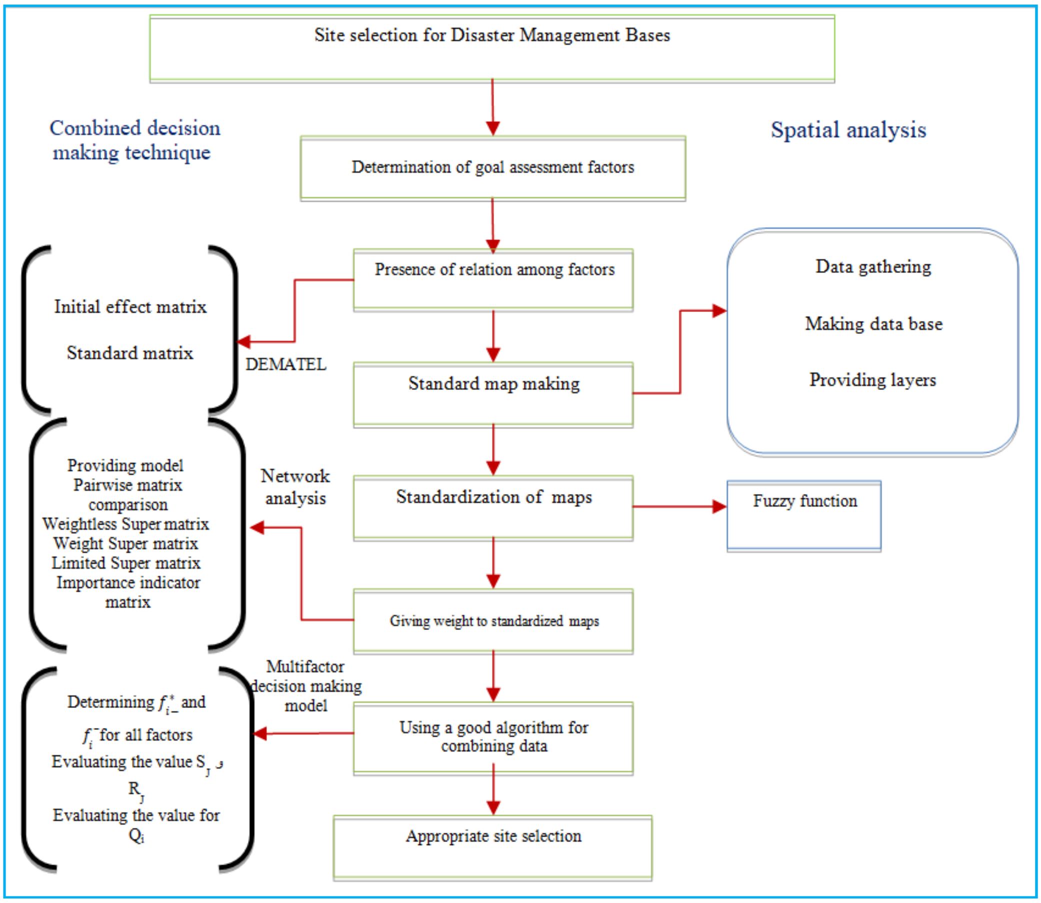


Fig. 3. The process of research operation

relation between factors and the effects of each of them have a different written goal. Two DEMATEL and analytical network process questionnaires are provide. When only traditional network analysis is used, the dependency of factors is solved through a pair wise value. However, DEMATEL method is closer to more realistic systems (Tahery *et al.*, 2014).

After identifying decision the making issue, it is necessary to show each factor as a layer in data bases of GIS. For this goal, standard and limitation maps in ArcGIS are provided and for the standardization of layers Fuzzy membership functions are used in IDRISI. Due to the Fuzzy membership functions have greater compatibility with urban systems, using this system for analyzing urban issues in decision making and decision taking would be more efficient.

In the final stage, by using the capabilities of GIS for joining and relating the layers, the "VIKOR[1]" method is used for organizing multipurpose bases for supporting disaster management. This method concentrates on ranking and choosing among a number of options and determines a valuable solution for a problem with paradoxical factors which can help decision takers to reach a final agreement. The advantage of using VIKOR Method is the presentation of a multifactor ranking indicator that is taken from special measurements. This method finally presents the closest way to an ideal situation (You *et al.*, 2015).

In this paper, the software programs used were: Excel, Matlab, Super Decisions, IDRISI and ArcGIS 10.1. Fig. 3 indicates the process of research operation.

3. Appropriate indicators for locating multipurpose disaster management bases

Due to the fact that disaster management bases have a vital organizational role in times of crisis. It is necessary to find a suitable location by means of detailed studies and comprehensive research which can generate response

[1] Vlse Kriterijumska Optimizacija I Kompromisno Resenje

TABLE 1

Indicators for locating disaster management bases

Indicator	Factor and sub factor		Criterion	Reference
Urban area features	Residential zone	Residential with low density(villa and residences with 2 or 3 stairs)	The bases should be located in places with lower densities than the rest of region	Authors
		Residential with medium densities (residences with 4 or 5 stairs)		
		Residential with high density (6 stairs)		
		Special residencies (9 stairs and special high rise buildings)		
	Deteriorated areas		Distance from outer edge of texture : 500 meter	Interview with risk management experts
	Permeability	Blocks with High access	The base should be located in an area with high access in comparison to the rest of the area	Authors
		Blocks with Medium access		
		Blocks with low access		
Inclusion	Green space and park land use		Green space and park area (1 hectare area)	Authors
	Reserved areas		The area of reserved areas	
	Sport land use		The area of sport land use (with one hectare area)	
Network access	A trial grade 1		200 meter radius	Interview with risk management experts
	A trial grade 2		100 meter radius	
	Collector and disseminator		50 meter radius	
Service provider land uses	Proximity to hospitals		1000 meter radius	Interview with risk management experts
	Proximity to therapeutics		500 meter radius	
	Proximity to military land uses		500 meter radius	
	Proximity to firefighting land uses		1500 meter radius	
	Proximity to parks		1000 meter radius	
	Proximity to education land uses		200 meter radius	
	Proximity to municipality buildings		200 meter radius	
Special land uses	Distance from dangerous land uses		200 meter distance	Interview with risk management experts
	Distance from gas markets		200 meter distance	
	Distance from industrial land uses		200 meter distance	
	Distance from gas stations (gas and gasoline)		200 meter distance	
Privacy observation	Watercourse privacy		15 meters from each side	Interview with risk management experts
	Water channel privacy		10 meter from each side	Interview with risk management experts
	Subway lines privacy		7.5 meter from each side	Interview with risk management experts
	Railway privacy		17.5 meter from each side	Interview with risk management experts
	Power post privacy		50 meter from each side	Railway and ways safety principle 1369
	Bistable lines privacy		51.5 meter from each side	Power study center 1369

TABLE 1 (*Contd*.)

Indicator	Factor and sub factor	Criterion	Reference
Geological features	Under ground water level	The support base should be located in an area with lower level of underground water than the rest of region	Authors
	Geological systems	The support base should be located in an area with higher levels of mechanical persistence than the rest of region	Interview with risk management experts
	Earth’s Slope	The maximum slope should be 8%	Interview with risk management experts
	The maximum acceleration of ground surface	The base should be located in an area with lower earthquake acceleration than the rest of region	Authors
Demographic features	Population density in neighborhoods	The bases should be located in areas with lower population density than the rest of region	Authors
	The areas attracting populations with high areas of green space	The bases should be located in areas with more green and open spaces	Authors
	Density of female population	The bases should be located in areas with high female population density	Authors

efficiency. However, it is not enough just to find the best location for these bases in order to increase their efficiency. With regard to the functions of these bases (disaster management function during times of crisis and training and sport functions, these bases should be organized in a way that not only provide safe places during crises, but also can provide good services during ordinary times. This issue has a great dependency on the way these bases are distributed in space. It bears mentioning that in choosing the locating indicators and organizing these bases, the priority role of these bases should be management during times of crisis. Therefore, it is necessary to pay greater attention to the safety issue (especially against earthquakes) more than mobility at ordinary times in the form of female activities.

In this paper, indicators used for organizing disaster management bases are presented in the form of 8 main factors and 34 criteria (Table 1).

4. Findings

4.1. *The analysis of the distribution of bases with average nearest neighborhood method*

The nearest neighborhood method is the most important method in urban land use distribution assessment. This method is used to show the way objects are distributed and states the way these objects are distributed within a special organization. The number of this indicator shows the way that phenomena and components are distributed in a case study. According to this formula, when the indicator is between 0 and 0.5 the distribution type is cluster, when it is between 0.5 and 1.5 it is accidental and when it is between 1.5 and 2.15 the distribution type is standard and organized (Ali Akbari and Emadodin, 2012). Fig. 4 shows graphical display of disaster management bases distribution in region 18 of Tehran.

4.2. *The explanation of numeric results of nearest neighborhood analysis*

According to numeric results, the observed nearest neighborhood among Disaster Management Bases is 1344 meters and the expected nearest neighborhood distance is 1163 meters. Therefore, the nearest neighborhood ratio is 1.15 which shows a random distribution of bases in region 18. For understanding the difference in observed number with random distribution, Z-Score is used. The quantity of this value is 0.787194. According to this quantity and the assumption that the distribution pattern is random, the assumption is accepted with a confidence level of 95% and there is no meaningful difference between observed distribution and random distribution. The *P*-value with a factor of 0.431169 shows the credibility of the observations.

The results of nearest neighborhood analysis show that the distribution is not appropriate and doesn’t follow a logical base in the case study. This issue gives rise to the notion that these bases must be organized these bases. Table 2 shows standardization of fuzzy functions for equipment and facilities.

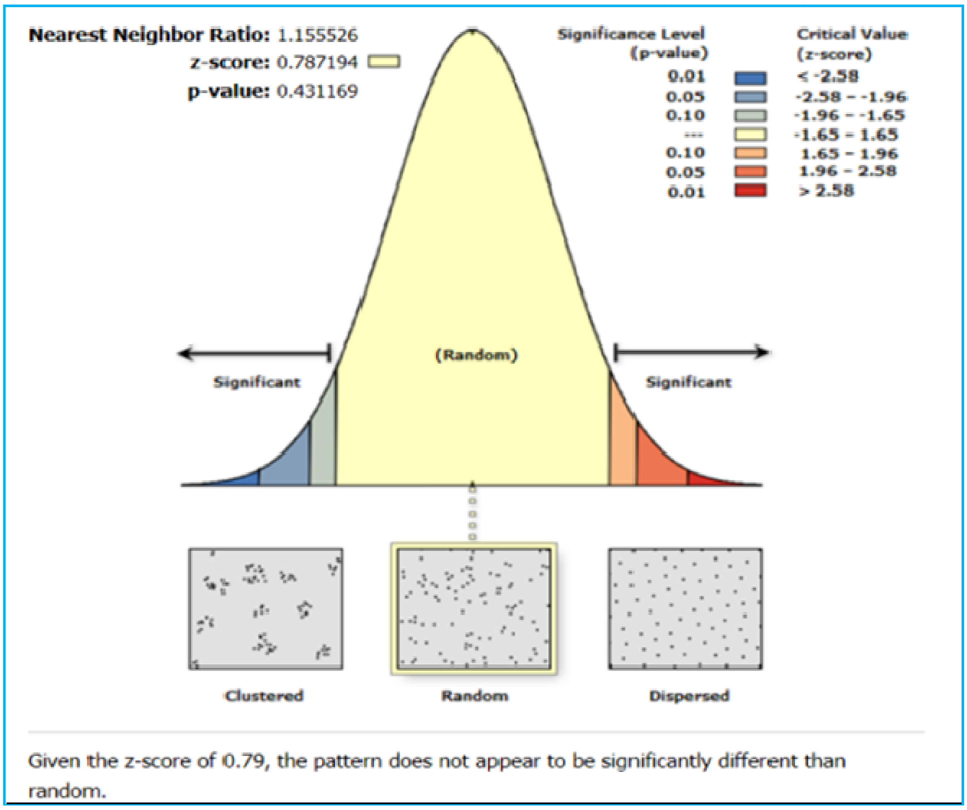


Fig. 4. Graphical display of disaster management bases distribution in region 18 of Tehran

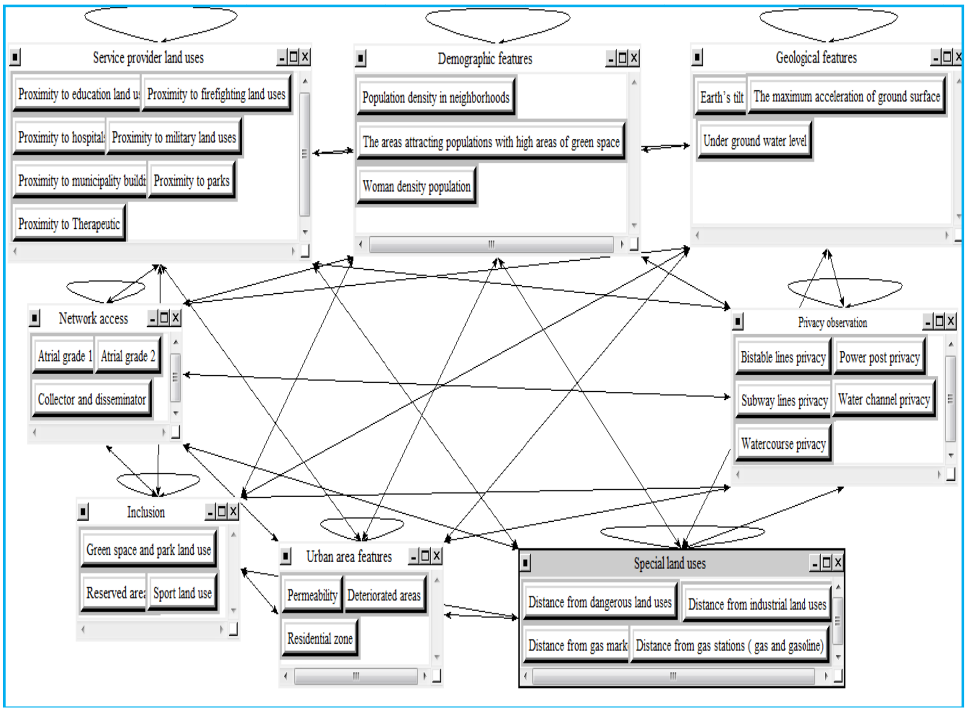


Fig. 5. Structural conceptual model

TABLE 2

The results of nearest neighborhood for analysis of the bases

The observed average distance	1344.169388 meters
The expected average distance	1116.253749
The average nearest neighborhood distance factor (R)	1.155526
Standardized score (Z)	0.787194
P-Value	0.431169

TABLE 3

The weights produced by DEMATEL and network analysis for organizing disaster management bases

Factor	Final weight	Factor	Final weight
Population density in neighborhood	0.150159	Deteriorated areas	0.013902
Reserved areas	0.121664	The maximum earth's slope	0.012703
Parks and green space	0.114605	Remedial land use	0.01225
Grade 1	0.069823	Educational	0.011152
Parks	0.06854	Military	0.0092
Areas attracting population with the superiority of green space	0.066117	The center of region	0.006505
Grade 2	0.054793	Gas filling market	0.005856
Dangerous facilities	0.038834	Gas station	0.003808
Residential areas	0.036313	High voltage power lines	0.003287
Collector	0.035594	Geographical systems	0.00301
Fire fighting	0.033152	Watercourse	0.002609
Density of female population	0.023229	Power post	0.001894
Industrial	0.022548	Subway lines	0.000815
Hospitals	0.022032	Earth's slope	0.000359
Sport	0.020741	The level of underground water	0.000274
Municipality buildings	0.017194	Water channel	0.000242
Permeability	0.016766	railway	0.000031

Source : Author's findings

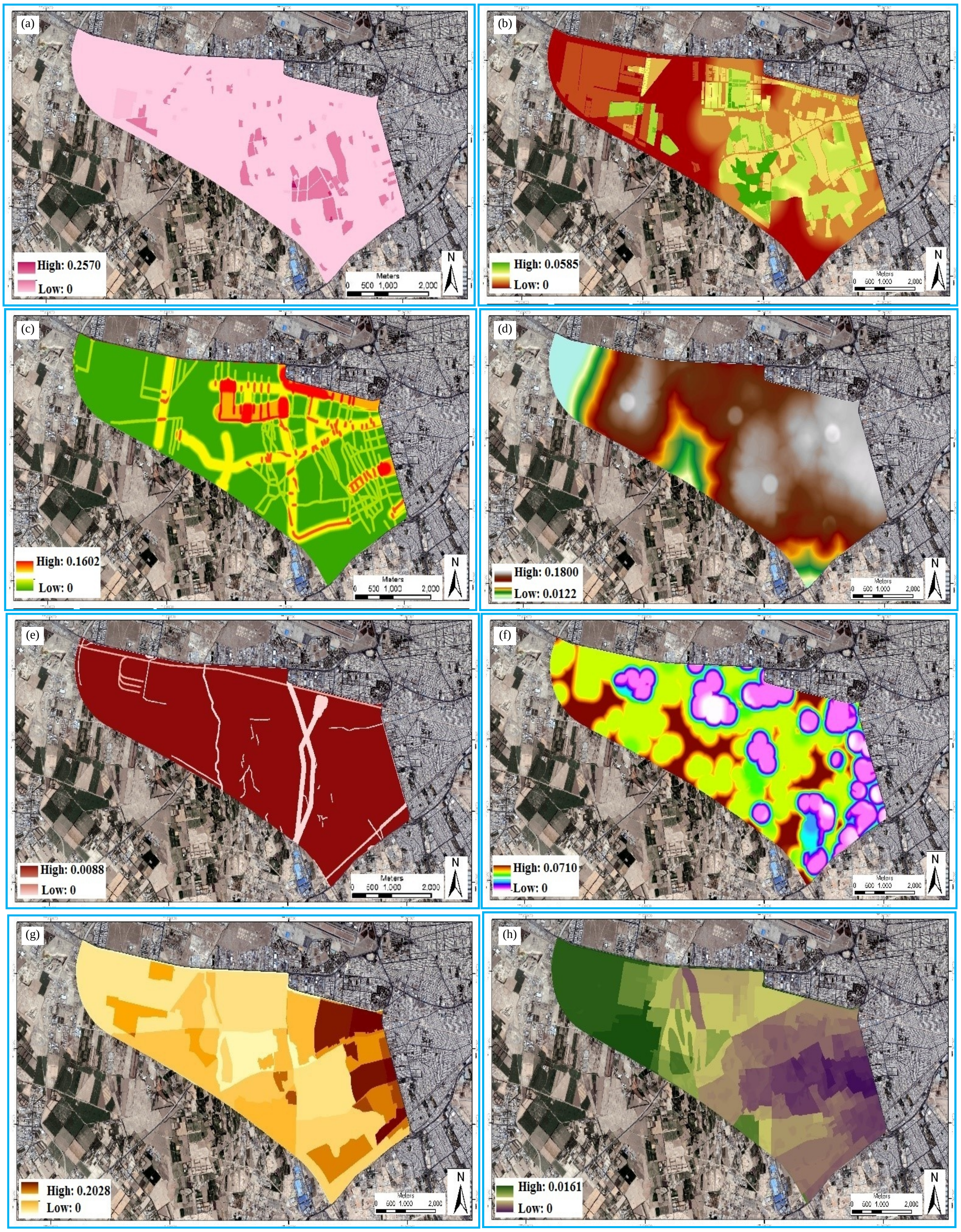
4.3. *Location assessment of disaster management bases in region 18 of Tehran (Model making and turning the issue into a network structure)*

In this stage, the decision making issue would be analyzed into a network structure. For such an analysis, DEMATEL questionnaire is used, the number of questionnaires is 15 and the questions are produced for determining the relations between nodes in order to locate appropriate locations for risk management centers.

As it is anticipated in the DEMATEL method, amongst 1156 available relations, 520 relations were of a greater importance among factors. These factors were identified and were inserted into Super decision software and then the internal relations between factors were recognized creating the base for following discussions. Fig. 5 shows the inner and outer relations among factors. Table 3 represents the weights produced by DEMATEL and network analysis for organizing disaster management bases.

4.4. *Establishing the pair wise comparison matrix and determining priority vectors*

After determining the relation among nodes and clusters that is explained by DEMATEL method, degree of importance of factors by using Analytic Network



Figs. 6(a-h). Disaster Management Bases assessment factors from right to left respectively. (a) urban area features factors, (b) inclusion features factors, (c) network access factors, (d) service provider land uses factors, (e) special land uses factors, (f) respecting privacy factors, (g) geological features factors and (h) population features factors

TABLE 4

A comparison among current bases factor in comparison to assessment Criteria

Special land use factors	Urban area features factor	Geological feature factor	Network access factor	Privacy respecting factor	Population features factor	Service provider land use factor	Inclusion features factor	The number of risk management support base
0.14	0.55	0.28	0.41	1	0.57	0.9	0.09	1
1	0.38	0.19	0.39	1	0.21	0.95	0.44	2
0.13	0.55	0.29	0.47	1	0.82	0.92	0	3
0.8	0.24	0.3	0.5	1	0.43	0.96	0.44	4
0.8	0.55	0.46	0.3	1	0.43	0.92	0	5
0.75	0.18	0.8	0.56	1	0.46	0.8	0	6

Process. These stages are done through Super Decision software.

In the analytic network process, similar to pair wise comparison in Analytic Hierarchy Process, decision nodes in any of clusters are symbolized with a number between 1 and 9 according to inner relations. These priorities are recognized by designing questionnaires and presenting them to experts. In this stage, it should be taken into consideration that the incapability factor shouldn't be more than 0.1. The number of questionnaires in second stage is 30, which was examined by Consistency Rate and answers with error more than 0.1 were removed. The rest of the answers were summed up together, the average was anticipated and after normalization the final answer was found.

4.5. *The formation of super matrix and its turning to limit super matrix*

In the analytic network process, three super matrixes were formed. In the first stage, weightless super matrix is formed directly through produced weights from pair wise comparison matrix. In the second stage, weighted super matrix is formed by multiplying the above values (weightless matrix) in the appropriate group weights. In the final stage, the limited super matrix is anticipated.

In the final, due to the relations between factors in network structure, the priorities of factors are presented in Fig. 5.

According to the analysis by DEMATEL and the analytic network process, population density, reserved areas and parks factors are of greater importance and earth's slope, the level of underground water, water channels and railway privacy are of less importance among the factors.

4.6. *Spatial analysis of data in Geographic Information System (GIS)*

After producing the importance factor of criteria, they must be assessed. For generating good information about appropriate locations for multipurpose disaster management bases, the data should be processed. This is done by GIS through assessment of all 34 criteria in the form of 8 main clusters. Since the standard maps are measured by different units (like slope or population density unit) they are not comparable, therefore they should be formed in a way that the comparison is feasible. Thus, they should be defined in a standard way. The standardization process in this paper is done by Fuzzy method.

In Fuzzy Logic, the membership of one component in a group is defined through a number in the spectrum 1 to 0, in which 1 expresses the full membership and 0 stands for the lack of membership. In this method, standardization of factors which have positive aspects is produced by this function:

$$n_{ij} = \frac{a_{ij} - a_i^{\min}}{a_{ij}^{\max} - a_i^{\min}}$$

And factors with negative aspects are produced through this function:

$$n_{ij} = \frac{a_{ij}^{\max} - a_{ij}}{a_{ij}^{\max} - a_i^{\min}}$$

It should be noted that n_{ij} function explains the quantity of pixel or [*i*] option in [*j*] factor.

TABLE 5

A comparison between current base factors with negative and positive ideal factor and the estimation of base distance from these two factors

Disaster management base number	Ideal factor	
	Base distance from negative ideal (R_j)	Base distance from positive ideal (S_j)
1	0.09	0.26
2	0.09	0.52
3	0.09	0.23
4	0.09	0.22
5	0.09	0.35
6	0.09	0.33
The best case	0.25	0.66
The worst case	0.04	0.1

Source : Author's findings

Membership degree is mostly explained by a membership function that might be linear, Gaussian, Near, etc. (Fazelnia *et al.*, 2014).

After standardization, each layer is given the weight according to its relative importance in locating the Disaster Management Bases. Then for assessing criteria, those factors affecting simultaneously according to the paper's goals are combined together by overlap spatial analysis and by joining them, new layers were made [Figs. 6(a-h)].

For assessment and evaluation of Disaster Management Bases, 34 nodes are combined in the form of 8 in the form of the aforementioned clusters and then are normalized in a 0 to 1 spectrum, in which the value 1 means that the factor is respected in the locating process and the value 0 expresses the lack of respect in the locating process. As it is shown in Table 4, privacy respecting is the only factor that is regarded in locating all Disaster Management Bases in the case study. Moreover, after that service, the provider land uses factor is most regarded in disaster management bases locating process. For the rest of factors, the findings show that they are considered less in the process and the inclusion factor is the one with lowest percent of consideration. This factor (*i.e.*, inclusion features) is among important factors in this paper in a way that in addition to providing the financial requirements of the land, it can be useful for keeping the safety of a support base by separating one region from a region with high potential. However, the findings show that this factor is not taken into consideration whilst locating the Disaster Management Bases in region 18 of Tehran.

TABLE 6

Negative and positive ideal factor

S*	S$^-$	R*	R$^-$
0.1	0.067	0.05	0.26

Source : Author's findings

4.7. *Criteria combination (information layers) by using VIKOR method*

In the first stage of using VIKOR method, the highest value for f_i^* and the lowest value for f_i^- in standard function is prepared. In the next stage, the distance of each option from ideal solution would be anticipated and then the sum of them all would be used according to its final value, according to function A for ideal and function B for negative ideal.

Function A:

$$S_j = \left(\sum_{i=1}^{n} wi\left(f_i^* - f_{ij}\right) / \left(f_i^* - f^-\right) \right)$$

Function B:

$$R_j = \max\left[w_i\left(f_i^* - f_{ij}\right) / \left(f_i^* - f^-\right) \right]$$

According to the results in the output layer for positive ideal (*Sj*), the level of location utility has differed in a spectrum of 0.66 to 1. This means that those pixels that are closer to 1 are better places for building disaster management bases in. As the value gets close to 0.1, it means that the pixel is not an appropriate place for building a disaster management base.

For the negative ideal layer the value of location utility is also between 0.26 and 0.05. This means that those pixels closer to 0.26 have a better location utility and pixels or places with value of 0.05 have the least utility for locating disaster management bases.

The best composition, *Sj* and the worst composition, *Rj*, according to VIKOR method, are ranked through distances from these two factors. These two factors are appropriate criteria for more detailed assessment of bases in the form of Multicriteria decision making techniques. The logic behind this technique is that as the ideal negative/positive factor lessens, the base is closer to an appropriate situation and as this distance increases the

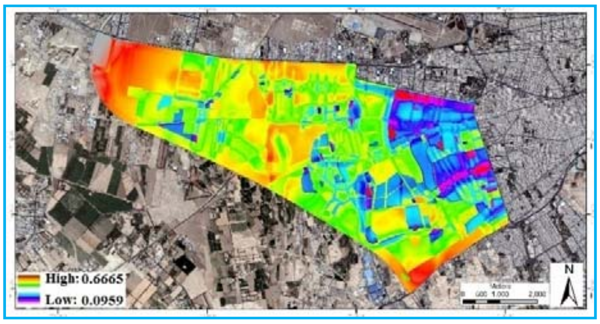


Fig. 7. The estimation of distance from positive ideal

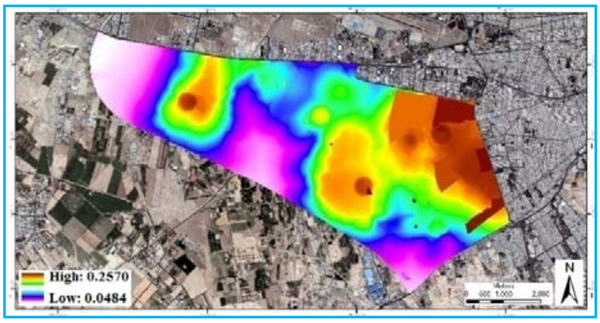


Fig. 8. The estimation of distance from negative ideal

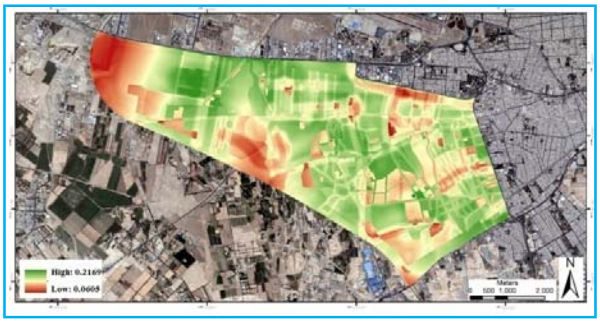


Fig. 9. Spatial organization of risk management support bases in Tehran region 18

base suffers a huge gap between its current situation and its ideal situation.

The positive ideal factor in this paper is 0.66, while the average distance between current bases in relation to this factor is 0.32. In the case of negative ideal, the desirable limit is 0.25, however, the average distance between bases from this factor is 0.9.

This issue shows the existence of a distance and gap between the locations of current bases with their ideal situation. This distance gets intensified in the case of the positive ideal factor (the best composition) and in the case of base No. 2 this difference is about 0.52. This shows a large difference between the current situation and ideal situation.

As it is shown in Figs. (7-9), all of bases have a meaningful distance from the negative and the positive ideal moreover in case of negative ideal, the factor of all bases is in an undesirable condition that is just a little more than the average level. This issue causes the bases not to be able to perform efficiently at the times of disaster. Table 5 shows a comparison between current base factors with negative and positive ideal factor and the estimation of base distance from these two factors.

Furthermore, for estimating location utility value for spatial organization of disaster management bases in region 18 of Tehran, Q_i factor is predicted by the following formula (Opricovic, 2009):

$$Q_i = V\left[\left(S_j - S^*\right)/\left(S^- - S^*\right)\right] + \left(1 - V\right)\left(\frac{R_j - R^*}{R^- - R^*}\right)$$

$$S^- = \max S_j \quad S^* = \min S_j$$

$$R^- = \max R_j \quad R^* = \min R_j$$

Table 6 represents negative and positive ideal factor.

After analysis done by VIKOR method for spatial ranking for finding appropriate places for locating disaster management bases in the case study, Q factor is anticipated in a spectrum of 0.06 and 0.21**.** The analysis of this factor in spatial multifactor decision making analysis expresses that as location value of a pixel is higher that place is a better option for locating a disaster management base and as this value decreases that place loses its suitability for being a support base.

5. Conclusions

The broad concerns of casualties and problems caused by natural disasters in different cities all around the world has triggered researchers to start lines of investigation in how to adequately protect cities from crises. Disaster Management Bases in cities are a basic solution for dealing with these disasters and they can decrease Tehran's vulnerability. One of the most important duties of urban planners in every system is executive planning, locating and organization of these bases. But what matters most in locating these bases for a better emergency service is the way they are distributed and how their location is decided. Not only should the ability for these bases to provide services be taken into consideration when locating them but also bases should not be exposed to any type of danger. In other words, disaster management bases can play their administrative role at the time of crisis only when they can take big measures to decrease the casualties of the city. However, if bases are precariously located within a site that could exacerbate dangers during a crisis, then these bases will not only be able to perform their function but they may also increase the number of casualties. Therefore, due to the important role of these bases, appropriate organization of them is a key point for disaster management and should be regarded as one of the most important policies for decreasing vulnerability.

For analyzing the distribution pattern of bases the Nearest Neighborhood method was used as it lends to the understanding of spatial patterns of urban phenomena before assessment. Thus, this generates a number of useful criteria and factors which can lead to a good initial analysis. The results of Nearest Neighborhood show the inappropriate distribution of disaster management bases in the study area. With regard to standardized scores, the random pattern of distribution hypothesis with a 95% level of significance is confirmed. So, for reorganizing the inappropriate distribution of these bases used from 8 criteria in ANP technique, such as factors including: urban area features, inclusion features, network access, service provider land uses, special land uses, respecting privacy, geological features, population features in the form of 34 sub criteria. According to the research, the privacy factor is the only factor that is regarded in deciding the place for bases, in relation to the rest of factors, this factor has a lower value. Finally, regarding the factor of inclusion, it reaches its lowest value and expresses the fact that the location of disaster management bases in region 18 of Tehran, the required attention to the factors that are necessary requirements of locating such places is not allocated.

The best composition, *Sj* and the lowest value, *Rj* that are anticipated from the factors of multiple factors of VIKOR method are used to estimate the distance and difference of the current situation of bases with their ideal situation. According to the results found, almost all the bases have a considerable difference in comparison to the positive and negative ideal and this trend is more intensified regarding positive ideal or the best composition.

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