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The Modelling AHP of Determining Riskable Regions in the GIS Environment in Order to Manage Crisis in Urban Areas: A Case Study of District 8 of Tabriz

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ABSTRACT

Today, the increasing population of the world in urban areas and in developing countries especially in metropolitan cities susceptible to earthquake has necessitated having a wider look at the natural events and tragedies resulting from them. Tabriz is considered to be one of the most susceptible cities to earthquakes due to the existence of active faults. Meanwhile, Tabriz district 8 municipalities as a cultural and historical municipality has historical valuable places with worn-out texture, heavy traffic, and large population which makes it of paramount importance to do research in the area of crisis management. In the present study, attempt is made to sort out risky levels of the region in district 8 using the weight overlap indexical model in the GIS environment. The layers used in this model include distance from faults, construction quality, population growth, and proximity to passages, proximity to open spaces, firefighting station, military places, gas station, and the topography of related area of study. The results obtained from the model indicate that only %13/94 percent of related area of study has optimal and a more optimal condition. %47/37 percent of the area was in normal condition in terms of risk ability in critical time. %38/69 of the area was in undesirable to most undesirable situation which necessitates careful and principled planning in before, during, and after the crisis on the part of authorities. It should be pointed out that this article has been extracted from the PH.D dissertation under the title of " The policies of crisis management in urban worn-out textures: A case study in district 8 Tabriz municipality.
KEYWORDS: Crisis, worn-out texture, Tabriz, Weight overlap indexical model, GIS.

INTRODUCTION

The study of district 8 of Tabriz is of paramount importance according to its historical texture and crowdedness. The occurrence of natural crisis and lack of suitable management planning causes lots of financial and vital losses in the district and the necessity of district separation becomes much more. This district attracts a wide population daily because of its central placement and the streets and connection passages of this district are in heavy traffic most of the day times. And this district is known as the most polluted district of the city.

Poormohammadi et.al [1] have studied the role of GIS in crisis management and rescue process in before, during and after the crisis in Tabriz under the title of the role and application of GIS in case studies of rural and urban residents of Tabriz. Asgari et.al [2] have considered the solutions to confront earthquake crisis and decrease its losses in district 17 of Tehran. They introduce GIS application in crisis management as an advantage for municipal planners. Adhami et.al [3] have considered the role of geography data system and its application in prevention and management crisis. He believes that in the case of GIS data and personnel optimized education, GIS can intensify the applicability and optimization of single crisis responding system. Ali Asgari et.al[2] analyzed the role and application of municipal services in crisis and accident management in an study in the title of " The Investigating Municipal Service Application in Crisis and Accident Management through GIS ". They have carried out demanded geography analyses via modern information technology such as geography information system. Also they have represented some samples of analyses related to districts of Tabriz in order to show its various aspects. Nesyani [4] in his dissertation has investigated district 8 of Tabriz through SDSS method in GIS environment according to its susceptible to earthquake. Hadizadeh [5] has studied the problems of metropolises specially of Iran's from natural jeopardies point of view in a study. She analyzes and compares different methods of confronting natural jeopardies in different countries. Soul Todis[6] has morphologically identified risky regions in Adena of Turkey through AHP model in GIS environment in order to suitable crisis management and has classified the city on the bases of desirable regions.

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Under Study Regions

Tabriz, the center of Eastern Azarbayjan province is located in 46, 15 eastern and 38, 8 northern in the width of 140 km^2. The city's height from sea level is 1340 m. District 8 is 260 hectare wide (2% of Tabriz's size) and is the smallest district of 8 districts. According to census of 1996, the population of this district of Tabriz was 18349 which in 2004 decreased to 9603[7].

MATERIALS AND METHODS

The aim of selecting research method is that the researchers to clarify what method they are choosing for reaching an exact, easy and quick response to research's questions which is depended on performance facilities, nature, aim and the subject matter of research[8].

In current study which is firstly carried out according to library studies, the affective criteria of locating risky regions during crisis occurrence are gathered in the form of:

1. The distance from danger centers like; gas station, supplies such as water, gas.
2. The distance from 1st degree passages and connection nets (2nd degree streets of entrance and exit and 3rd degree of local streets).
3. Population density (the more the population density, the more susceptible to damage).
4. The accessibility to open spaces (the more the accessibility to open spaces, the less the damages).
5. Topography (the more the up hills, down hills and slopes, the more the damages).
6. The distance from faults (the more this distance, the less the damages).
7. The distance from military centers
8. The quality of structures
9. The distance from health centers and hospitals
10. The distance from firefighting

Preparing Information Layers

According to above mentioned criteria, there needs to prepare information like ground applicable maps, faults, population density, in order to manage worn-out textures and decrease of damages during crisis occurrence. This map of Tabriz was procured from urbanism office then the region under study in the GIS environment was separated from the whole map and was utilized for extracting related layers to official, commercial centers, population density, passages, structure quality and other layers. Also the maps related to faults and topography was procured from natural resource office of province.(Fig1-8)

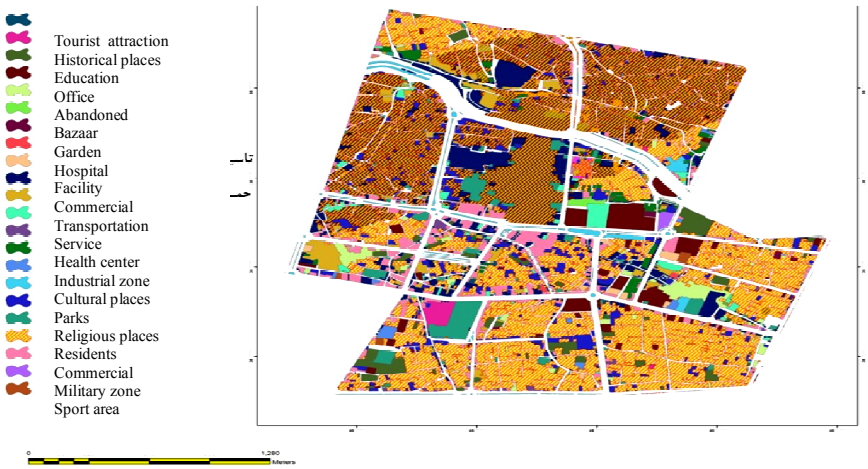


Fig 1; Applicable map of District 8 of Tabriz

Standardizing Information Layers

In crisis management process of crisis region, the extract of demanded information layers during crisis occurrence is the first stage of practical stages of research. Most of the layers are separated and initialized for criteria and sub-criteria of placing sensitive regions in front of natural crisis through creating buffer or Query Builder. Various layers in the level of under study limitation are drawn and saved in information base in the form of raster layers. The layers are created on the base of buffer and the present users are prioritized and standardized into 3-6 levels. The resulted layers are as following order:

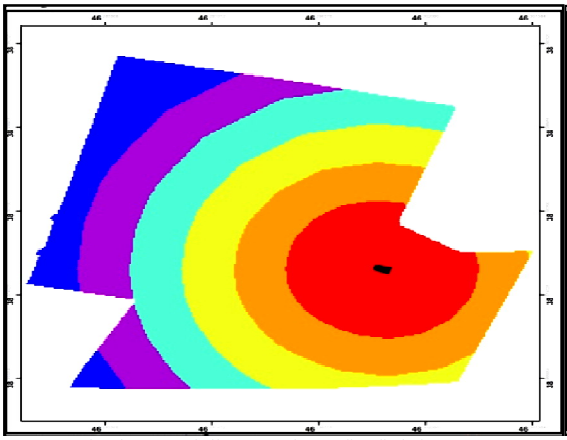


Fig2: Standard map of distance from firefighting center

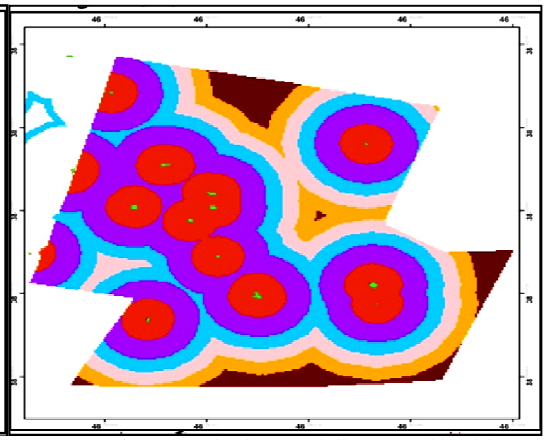


Fig 3 Standard map of distance of health center

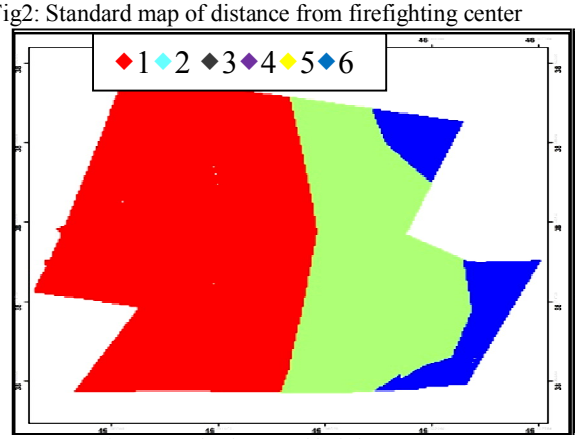


Fig5: Standard map of height spaces

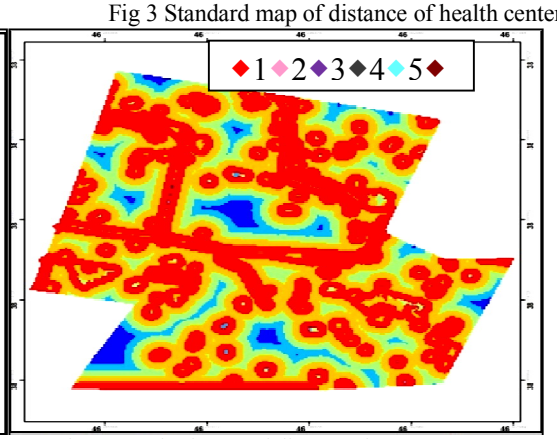
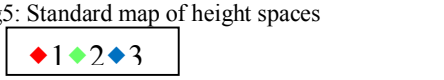


Fig4: Standard map of distance from open



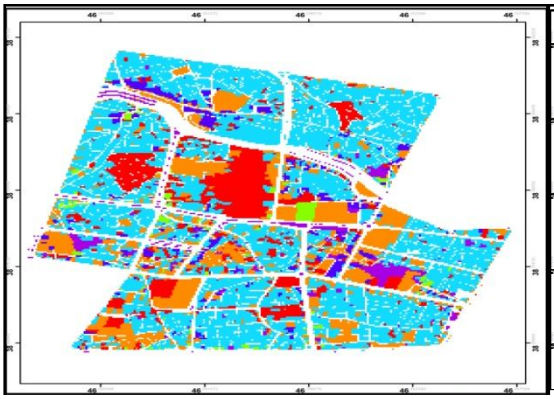


Fig7: Standard map of structure quality

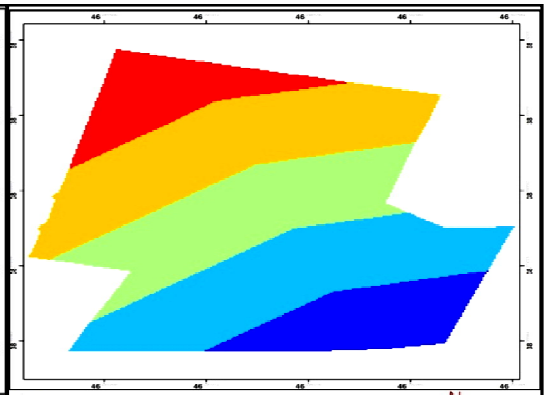
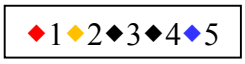


Fig 6: Standard map of the distance from fault



AHP Process

The method of dual comparison through L hour in the context of AHP process is represented. This method includes dual comparison in order to form a relation matrix which contains an entrance of dual comparisons and produces relative weights as exit [9]. AHP method can be advantageous in the investigation of complicated municipal matters according to its simplicity, flexibility, utilizing qualitative and quantitative criteria and compatibility in judgments[10]. Also, this method prepares a context for analyzing and changing complex problems into simple and logical AHP in the framework of which the planner can simply estimate the options through criteria and sub-criteria. A model which is used for combining mentioned information is a weighting model on the bases of AHP model. In this model, geometric matrix is constructed for each one of sub-criteria. A basic measure of 1-9 is used for detecting relative priority amounts in this method. At first it is

assumed that the compared matrix is two sided i.e. if scale A is prioritized twice scale B, scale B is half priority of scale A. Therefore, if scale A reached the score equal to 2 of B, the rating of B will be 0.5 of A. This logic is utilized for all the left sided matrix of dual comparisons. In every measure matrix, every measure leads to 1 with itself which is named equal priority. 1 is considered the main diameter of matrix [11]. The geometrical matrix will be completed. This method is utilized for scales lack of structure and the rating is on the bases of decision making priorities [12]. The sub-criteria are compared in the form of dual in order to highten accuracy and the relative weight of each scale is calculated.
The following stages are the estimation orders of relative weights of criteria and sub-criteria:
1. Collecting the amounts of each column of dual matrix
2. Dividing each factor of matrix on the collection of column
3. Estimating the average of factors in every row of normalized matrix i.e. dividing the normalized scores for each column on the number of criteria. These averages create an estimation of relative weight of compared criteria [11].

Investigating Compatibility in Judgments

In this stage it is clarified that the carried out comparisons are whether compatible or not. This stage is: 1) Determining weight vector through multiplying relative weight of the first criteria to the numeric of the first column of dual matrix and the second criteria to the second column and so on... and finally, gathering these amounts in rows. 2) Detecting compromise vector through dividing the vectors onto criteria relative weight in which the row is 1. After calculating compromise vector, λ and CI should be estimated. λ equals to the amount of compromise vector. In calculating CI, it should be considered that λ is always greater or equal to the number of under estimating criteria (n). If the dual matrix is of a compatible matrix so, n= λ.

$$CI = \frac{\lambda - n}{n - 1} \qquad (1)$$

CI is ad indicate of compromise deviation.

$$CR = \frac{CI}{RI} \qquad (2)$$

RI is random, ns are constant numeric. In dual comparisons CR <= 0/1 but if CR>=0/1 it shows incompatible which demands revision and correction of dual matrix[mahmod].

Table1. Random resistance index

(RI)	(n)	(RI)	(n)	(RI)	(n)
1.51	11	1.24	6	0.00	1
1.48	12	1.32	7	0.00	2
1.56	13	1.41	8	0.58	3
1.57	14	1.45	9	0.90	4
1.59	15	1.49	10	1.12	5

In AHP model the final matrix is created in order to placing after standardization which leads to the preparation of final layer and the riskable places are prioritized(table2). CR numeric of matrix equals 0 which shows desirable level of weighting results[Fig 8].

Table2. The weighting of criteria on the bases of dual comparison

Relative weight	height	Gas station	Military centers	Fire fighting	Health centers	Open spaces	Passages	Population density	Structure quality	fault	scale
0.271	9	8	7	6	5	4	3	2	2	1	**fault**
0.2002	8	7	6	5	4	3	2	2	1		**Structure quality**
0.152	7	6	5	4	3	2	2	1			**Population density**
0.112	6	5	4	3	2	2	1				**passages**
0.082	5	4	3	2	2	1					**Open spaces**
0.059	4	3	2	2	1						**Health centers**
0.043	3	2	2	1							**Fire fighting**
0.033	3	2	1								**Military centers**
0.025	3	1									**Gas station**
0.017	1										**height**
CR= 0											

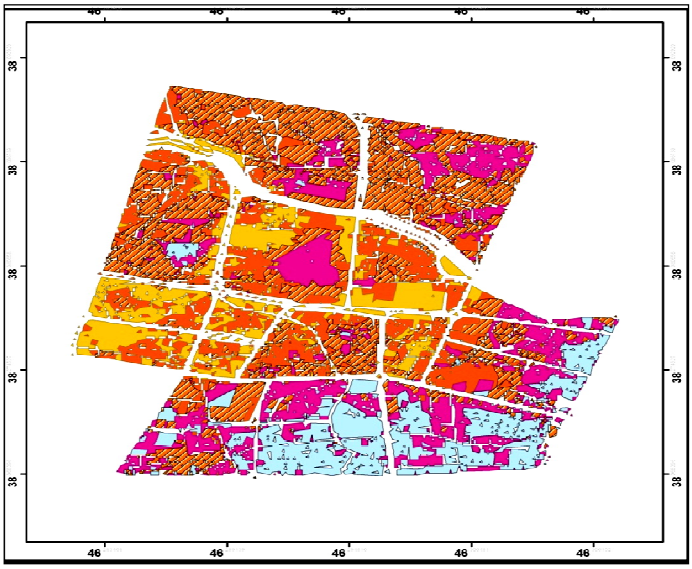
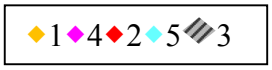


Fig.8. The map gained through AHP method



DISCUSSION AND CONCLUSION

Today, considering natural accidents management or crisis management is not as unknown as it was in the past, especially after Bam calamitous earthquake. In the past, even most of the managers of service organizations were not aware of crisis management, preserve, preparation, confronting, educating people, but these days everyone is gaining the demanded information and knowledge related to this management. According to the scientific point of this management, this critical task of preparation comes back to the managers, planners and experts. Tabriz is a risky place because of its geographic, natural and position and most of the common natural accidents have occurred in there. Population growth and cities development have increased their susceptible to damage. Therefore, there needs to be quick decision making and responding to the various accidents which are occurring in Tabriz in order to confront crisis for preserving people, open spaces and residents health. In current study district 8 was investigated because of its special position and some other factors which are listed as following:

• District 8 is the smallest district of Tabriz with 2% of city size which is located in the city center.

• Historical monuments such as Tabriz Bazar, Alishah Arg, Friday Mosque, Sahebolamr Mosque, Kabud Mosque, Maghbarato Shoara, Tabriz Museum, are located in this district.

• The significance of district because of specific commercial centers (Bazar), offices and political places (governor offices, governorship and municipal) and somr residents like Daraee, Khaghani, Tarbiat, Amin, Shariati, Raste kuche, Khorma, Shams, Seyyed Hamzeh and Sa'at.

Above mentioned places show the old history of this district of Tabriz. With a look at the catastrophes of this city, there need to make serious decisions and divide the risky parts in order to preserve possible failures in worn-out textures before, during and after crisis. The riskability map of district 8 was prepared through AHP method which represents that 32.93% of under study area is of optimal to more optimal condition, 32.06% of average risky and 35.01% is of undesirable to very undesirable condition. According to investigated carried out on layers related to firefighting station, its performance radius is 1250-1650m whereas the mentioned service does not cover western-northern part. So, establishing spread firefighting stations are proposed. There should be transportation system has the less affect on worn-out textures and the system that improves tourism. All the attempts should be taken into act so, this significant district will tolerate at last the less amount of ruin.

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