Investigating Factors Affecting Urban Growth of Large Cities in Iran

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Abstract

The present paper focuses on determining the most important factors affecting urban growth in large cities of Iran through modeling and comparing the common and diverse points of urban growth obtained from other studies. For this purpose, by reviewing the theoretical concepts associated with urban growth, quantities and measurable variables are developed as proper frameworks to study the influencing factors on urban growth. This paper describes the urban growth model through "logistic regression[i]" by using both physical and socio-economic driving forces analysis and urban spatial pattern evaluation. Three large cities in Iran were selected as the cases to fulfill the tasks and two series of influencing factors for large cities of Iran's urban growth were introduced: 1) Factors with favorable effects including bare lands, crop/ grass lands and less populated areas. 2) Factors with unfavorable effects including: lands covered with trees (forests) and distances from roads and industrial centers.

***Keywords*:**Urban growth, Factors of urban growth, Logistic Regression, Large cities (Kermanshah, Rasht, Urmia), Iran

1. Introduction

The growth of large cities and its consequent spatial effects have led to the alteration of vast rural lands to urban areas and has influenced and dominated the life patterns of many countries during recent centuries. Urban growth in Iran has been accelerated during last decades by mass immigration of rural population to urban regions. In 2011 the urbanization rate was obtained 69.1 % (higher than that of 1996 and 2006) and based on United Nations it will increase to 70.6% and 78.2% by 2020 and 2050 respectively (United Nations, 2011).

What the system of urban growth is, how the system should be analyzed and understood, what the factors influencing urban growth of large cities in Iran are, and if it is possible to reach an agreement between those factors and urban growth pattern, are problems to be discussed so that could be utilized as a precise tool to control urban growth and its consequences by urban planners and managers.

Since the factors of urban growth are unique for a given case and past studies were not concentrated on driving factors in Iran's large cities and comparative analysis of urban growth, the present research focuses on determining the most important factors affecting large cities growth through Logistic Regression (LR) modeling and compares the common and diverse points of urban growth in large cities for Iran with other studies and determines the most important urban growth factors in large cities of Iran.

To make a reasonable evaluation of urban growth at different scales, this paper proposes an urban growth assessment model and selects three cities in Iran as a case study to fulfill the tasks. The rest of the article is organized as follows: Section 1 reviews the existing literature on urban growth; section 2 describes characteristics of study area; Section 3 explains selected variables associated with urban growth pattern; Section 4 (Materials and methods) lists out the data used for modeling and explains methodology and the framework of LR model; Section 5 (Theory/calculation) analyzes the data; Section 6 presents the results of urban growth simulation in the cities and summarizes the paper with discussion and finally, section 7 concludes the paper.

1.1. Urban growth

"Urban form itself is mainly referred to as a property of a city and therefore static for a given point in time, while urban growth is a dynamic process that alters urban form" (Schwarz, 2010). Urban growth is a complicated process involving the spatiotemporal changes of all socio-economic and physical components at different scales.

1.1.1.Urban growth pattern

The urban growth pattern is an uncertain wide concept that can be subdivided into various types of physical properties.

Harvey and Clark (1965) described ribbon and leap-frog development. Ribbon development, as "segments compact within themselves but which extend axially and leave interstices undeveloped." and leap-frog as "the settlement of discontinuous, although possibly compact, patches of urban uses."

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Batty and Longley (1994), recognized two classes for urban growth: organic (natural) and planned (artificial) growth which is different in patterns and control over the building process. Forman (1995) described two land transformation processes, dissection as the "carving up or subdividing of an area using equal-width lines" and fragmentation as the" breaking up of a habitat or land type into smaller parcels" which apply to linear branch.
In Clarke and Gaydos (1998) urban growth patterns classified as spontaneous, organic, spread, road-influenced and diffusive which are controlled by five coefficients. Meanwhile, Wu (2000) categorized urban growth in two classes: spontaneous and self-organizing. Which refer to small-scale and scattered development and large-scale and high-density one, respectively.
Wilson et al (2003) identified three categories of urban growth through modeling as follows: (i) infill growth as" a non-developed pixel being converted to urban use and surrounded by at least 40% existing developed pixels." (ii) expansion growth (metropolitan fringe development or urban fringe development) as" a non-developed pixel being converted to developed and surrounded by no more than 40% existing developed pixels". (iii) Outlying growth (development beyond the urban fringe) as "a change from non-developed to developed land covering occurring beyond existing developed areas…is broken down into isolated, linear branch, and clustered branch". The first is defined as "one or several non-developed pixels some distance from an existing developed area being developed", a linear branch is also "New road, corridor, or a new linear development that is generally surrounded by non-developed land and is some distance from existing developed land" and clustered branch defined as "neither linear nor isolated, but instead, a cluster or a group".
Mubareka (2011) proposed leapfrogging, branching and ribbon development as three indicators to measure sprawl: the first refers to" how tight urban land is with respect to the core areas "branching defines as "growth of residential areas around a core, but not connecting cores"; and the last defines as "linear features, segments of developed land compact within themselves … they usually follow existing roads".
Sprawl is also one of the urban growth patterns for which many types of research have been achieved.
As Ewing (2008) pointed out, regardless of the classic type of development (whether scattered, leapfrog, strip, ribbon or continuous low-density), sprawl is a pattern that is mostly defined in terms of undesirable land-use pattern.

1.1.2.Urban growth factors

For modeling urban growth, the most important task is to define the main factors of land use transformation and to find the relationships between them. Several studies have proved that there is no universal set of factors which can explain the process of urban growth, as each case is unique (Achmad et al, 2015,. Inouye C E N et al , 2015,. Al-sharif1 A A, Pradhan Biswajeet, 2015,.Akin A, Sunar F and Berberoğlu S, 2015 ,. Tayyebi A and Pijanowskib B.C ,2014 ,. Zhang et al ,2013,. Hui-Hui et al, 2012,. Yu & Qingyun, 2011,. Cetin, Demirel, 2010,. Poelmans, VanRompaey, 2009,. Huang et al, 2009,. Batisani, Yarnal, 2009,. Luo, Wei, 2009,. Xie et al,2009,. Bahrainy, 2015,. Jalali et al, 2019). Moreover" variables that influenced residential development were not necessarily those responsible for the expansion of industrial/ commercial land area" (Braimoh et al, 2006).
According to Shafizadeh-Moghadam H (2015), in spite of a large number of possible drivers, the majority of empirical studies operationalize environmental (e.g., distance to transportation infrastructures) and, if available, socio-economic determinants(e.g., household incomes), in order to explain urban growth processes.
There are a variety of factors affecting urban growth in different researches and different approaches towards the classification of urban growth factors as well.
Dubovyk concluded that choice of the classification of factors depends on the main aims of the study and authors such as how the factors are incorporated in models, their natures and both of them (Dubovyk, 2010). Verburg et al (2004), Hu, lo (2007) & Poelmans, Rompaey (2009) described five factors that can be used to explain the spatial patterns of land-use change: biophysical factors, social factors, economic factors, spatial policies, spatial interactions and neighborhood characteristics.
Driving factors on urban growth according to theories presented by urban growth researchers, are shown in table (1).

Table 1
Overview of the explanatory variables used in recent urban studies

Urban growth factors	Sources
Slope	-Tayyebi, A., -Pijanowskib, B.C., -Akin, A.,Sunar, F.,Berberoğlu, S., -Inouye, C.E.N., -Al-sharif1, A.A., -Pradhan, Biswajeet., -Poelmans, VanRompaey., -Hu, L.o., -Huang, et. Al., -Clarke, et. Al., -Batisani, Yarnal., -Braimoh, Onishi.,

	-Fang, et. Al.
Crop/ grass / agricultural lands	-Tayyebi, A., -Pijanowskib, B.C., -Rudel., -Wood., -Porro., -Levia., -Nelson., -Platt., -Batisani.,Yarnal., -Hill., -Verburg, et. Al., -Doos., -Yin, et. Al., -Luo.,Wei., -Fang, et. Al., -Cetin.,Demirel., -Hu, L.o.,
Bare/wetlands	-Tayyebi, A., -Pijanowskib, B.C., -Hu.,Lo., -Cetin.,Demirel., -Shamsuddin.,Yaakup.
Forests	-Tayyebi, A., -Pijanowskib, B.C., -Hu.,Lo., -Luo.,Wei., -Braimoh., -Onishi., -Poelmans., -VanRompaey., -Fang, et. Al., -Cetin.,Demirel.
Distance to industrial sites	-Cheng.,Masser., -Hu.,Lo., -Poelmans.,VanRompaey., -Xie, et. Al., -Shen, et. Al., -Luo.,Wei., -Braimoh.,Onishi.
Distance to roads, high ways, and subways	-Achmad, et. Al., -Tayyebi, A., -Pijanowskib, B.C., -Akin, A., -Sunar, F., -Berberoğlu, S., -Inouye, C.E.N. et. Al., -Al-sharif1,A.A., -Pradhan, Biswajeet., -Hui-Hui, et. Al., -Liao.,Wei., -Yu.,Qingyun., -Hasyim, et. al., -Cheng.,Masser., -Hu.,Lo., -Huang., -Poelmans.,VanRompaey., -Xie, et. Al., -Batisani.,Yarnal., -Shamsuddin.,Yaakup., -Shen, et. Al., -Luo.,Wei., -Wu.,Yeh., -Fang, et. Al., -Cetin.,Demirel

Distance to commercial sites	-Cheng.,Masser., -Hu.,Lo., -Huang., -Poelmans., -VanRompaey., -Xie, et. Al., -Batisani.,Yarnal., -Braimoh.,Onishi.
Distance to CBD and other city's centers	-Achmad, et. Al., -Al-sharif1, A.A., -Pradhan, Biswajeet., -Hui-Hui, et. Al., -Yu.,Qingyun., -Xiaoqing, et. Al., -Hu.,Lo., -Huang., -Poelmans.,VanRompaey., -Shamsuddin., -Yaakup., -Luo.,Wei., -Wu.,Yeh., -Cheng.,Masser., -Braimoh.,Onishi., -Cetin.,Demirel.
Distance to residential sites	-Huang., -Xie, et. Al.
Distances to nearest urban clusters and cities	-Akin, A., -Sunar, F., -Berberoğlu, S., -Tayyebi, A., -Pijanowskib, B.C., -Hu.,Lo., -Poelmans.,VanRompaey., -Batisani.,Yarnal.
Distance to the historical area	Achmad, et. Al., -Yue., -Chang, et. Al.
Distances to green open space	-Achmad, et. Al., -Chang, et. Al.
The density of water bodies and distance to water bodies	Achmad, et. Al., -Luo.,Wei., -Allen.,Kang., -Braimoh.,Onishi., -Fang, et. Al., -Cetin.,Demirel., -Batisani.,Yarnal.
Income	-Hu.,Lo., -Braimoh.,Onishi.
Population density	-Achmad, et. Al., -Hui-Hui, et. Al., -Yu.,Qingyun., -Omsongwang.,Saravisutra., -Xiaoqing, et. Al., -Hu.,Lo., -Huang., -Xie, et. Al., -Batisani.,Yarnal., -Shamsuddin.,Yaakup., -Huang., -Cai., -Braimoh.,Onishi.
Price of land	-Mustafa, et .al.
Poverty rate	-Hu.,Lo.

Median housing rent	-Hu.,Lo.
Racial percentage	-Hu.,Lo.
Employment rate	-Hu.,Lo., -Poelmans.,VanRompaey.
Protected areas	-Inouye, C.E.N et, al., -Cheng.,Masser., -Hu.,lo., -Landis.,Zhang., -Shamsuddin.,Yaakup.
Environmental hazards	-Shamsuddin.,Yaakup.
Zoning status	-Inouye, C.E.N et, al., -Huang., -Poelmans.,VanRompaey., -Batisani.,Yarnal., -Shamsuddin.,Yaakup.
Spatial policies	-Clarke, et .al., -Poelmans.,VanRompaey., -White.,Engelen., -Cheng.,Masser., -Verburg., -Batisani.,Yarnal., -Huang, et .al., -Shamsuddin.,Yaakup.
The proportion of urban (or density of built upland)	-Tayyebi, A., -Pijanowskib, B.C., -Hu.,Lo., -Verburg., -Xie, et. Al., -Luo.,Wei., -Wu.,Yeh., -Cheng.,Masser., -Hagoort, et. Al., -Braimoh.,Onishi.

2. Study Areas

In Iran, the cities populated by 500000 to 1000000 are categorized as large cities (Zebardast, 2004). So according to this classification, Ahvaz, Qom, Kermanshah, Urmia, Zahedan, Rasht and Kerman are large cities. Due to the convenient accessibility of data, Rasht, Kermanshah, and Urmia are chosen in this paper.

The city of Rasht is the center of the Guilan Province in the vicinity of the Caspian Sea. Most factories and firms are located in Rasht and its Industrial City that cause it to play a more important and strategic role in the region (Iran Amayesh Consulting. eng, 1990). Fig (1) shows urban growth between 1926 and 1986. Urban growth tends to polycentric form and new trends in the establishment of settlements and residential complexes are in the south of the city near Lakan road (Tarh & Kavosh Consulting. eng, 2005). During the third master plan of Rasht, the area of the city regardless of agricultural lands was about 7500 ha. (Tarh & Kavosh Consulting. eng, 2005: 4) and the surrounding fertile farmlands; 70% of which best suit for agriculture purposes are vanishing due to constructions.

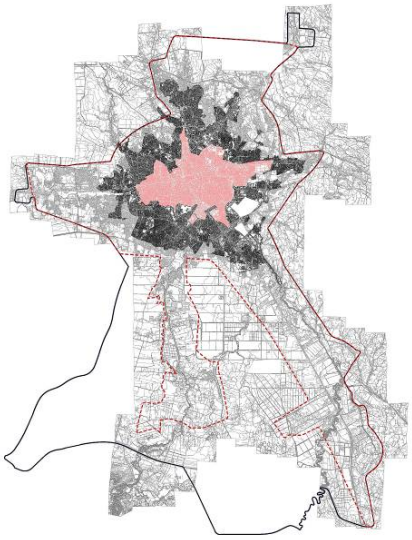

Fig. 1. Urban growth in Rasht (1926- 2005)
Source: Tarh & Kavosh consulting. eng, 2005

The rate of the population growth in Rasht between 1956-2006 increased by up to 3.31% per year. This is much higher than the normal growth rate which is due to immigration and merging of the small villages with the main city (Tarh and Kavosh Consulting. eng, 2005: 23).

The city of Kermanshah is the center of Kermanshah Province which has a 200 kilometers borderline with Iraq. The damages caused during the Iran- Iraq war resulted in unbalanced and discontinuous development, destruction of economical basis and increases of informal settlements. The urban growth pattern is linear along with the road networks. The growth is scattered and widespread. Fig (2) shows urban growth between 1941 and 1996.

Due to topographic constraints, the main direction of urban growth has been from north to south. In the early ’70s, Kermanshah expanded toward the outskirts and consequently the most fertile lands, villages and natural elements vanished. As a result, further development of the city has been limited since then (Tarh & Amayesh consulting. eng, 2002). The population growth between 1956- 2006 increased 6 times and according to the revised master plan of 2001, the area of the city was 9568.6 ha.

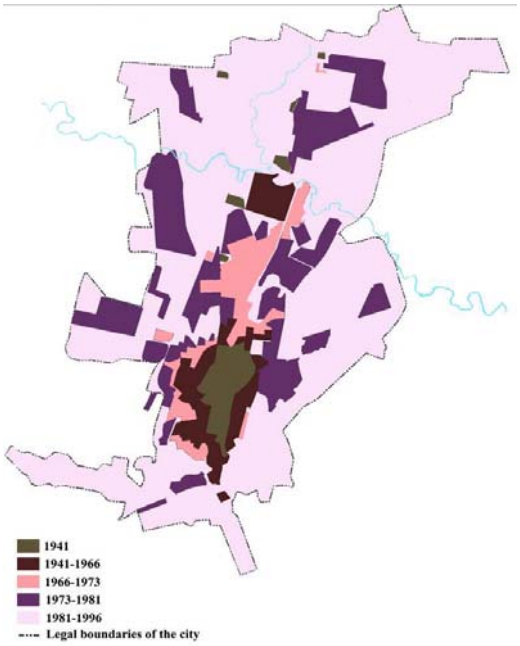

Fig. 2. Urban growth in Kermanshah (1941- 1996)

The city of Urmia is the center of the Western Azarbaijan Province which is located within a 70*30 km plain and 18 kilometers far from Urmia lake. According to the 2006 census, the population was 583255 that shows a 30% increase during a decade. Borderlines with Iraq and Turkey, mild climate, strategic position, and natural resources are the preferences that make further developments possible. Fig (3) provides a snapshot of the historical growth of Urmia up to 2003. The growth of the city is not only because of immigration and overpopulation but illegally the merging of new lands with the city as well (Tarh & Amayesh Consulting. eng, 2010). According to the revised master plan in 2010, the city area was about 8577.3 ha. In this plan due to the limitation of continuous urban growth to small and scattered areas, discontinuous urban growth policy in Golman areas has been suggested.

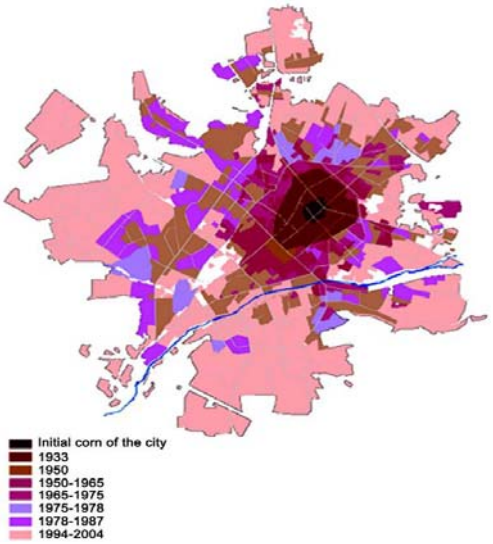

Fig. 3. Urmia's urban growth (1933- 2004**)**
Source: Tarh & Amayesh Consulting. eng, 2010: 90

3. Selecting Variables Associated with Urban Growth Pattern Using a Conceptual Model of Urban Growth

Urban growth is a complicated system including a variety of economical-social, physical and ecological combinations with different time and spatial scales . From Cheng's point of view (2003), urban growth pattern has two aspects: one is the urban growth system itself, the other is a part of a larger system. The first only includes new development units and the last is composed of not only urban growth but also the three other systems:” 1- Developed Urban System (complex social and economic system), 2-Planned Urban System (results from a spatial planning scheme), 3-Developable Non-Urban System (physical and ecological system).” Fig(4)

Reviewing different studies shows several approaches to urban growth pattern analysis, selection of different variables and different results. This is because of different physical, economic and social contexts in different cities . Hence, selecting each series of factors individually may lead to ignoring other aspects of the case or inconsistency with the situations of large cities in Iran. So, some quantitative and extendable variables regarding the availability of the mentioned cities' data were chosen to compare with the factors of other large cities' growth in Iran and were considered in the model of Iran's large cities growth analysis.

Then by studying the relationship between the mentioned factors and urban growth according to the literature review and the past researches (Table 1), the affecting factors on urban growth were investigated and the expected effects of different variables on Iran's large cities growth were shown. (Table 2)

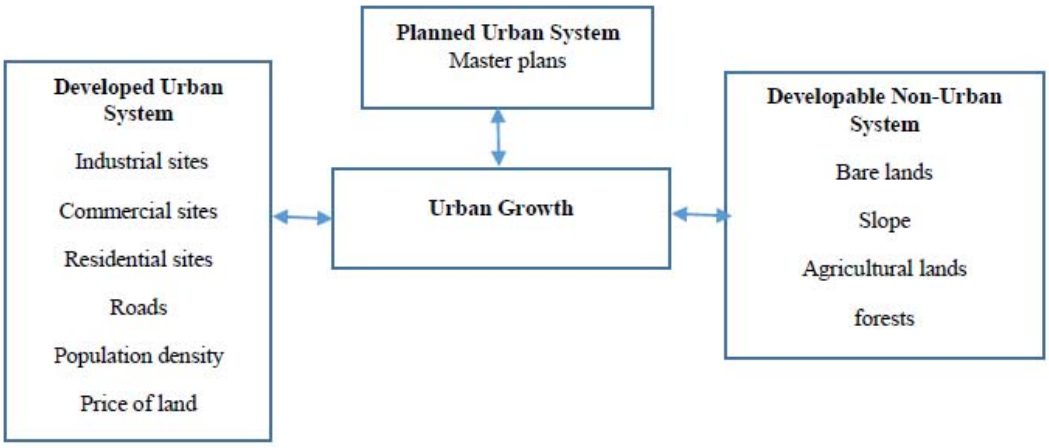

Fig.4. Conceptual model of urban growth

Table 2
Expected effects of variables on Iran's large cities growth (Source:Authors)

Variables	The expected effect on urban growth based on Expert's theories
Slope	Unfavorable
Distance to roads	Unfavorable in most cities
Distance to residential sites	Unfavorable
Distance to commercial sites	Unfavorable in most cities
Distance to industrial sites	Favorable
Crop/Grass or agricultural lands	Favorable in most cities
Forests	Unfavorable in most cities
Bare lands	Favorable
Population density	Favorable in lower population density
Price of land	Unfavorable especially for high-density developments

4. Materials and Methods

The workflow of the study can be summarized in three main stages: (i) preparation of the spatial variables in GIS (ii) logistic regression modeling, and (iii) comparison of the different results for the study areas with each other and with the expected ones according to theories presented by urban growth researchers.

4.1. Data compilation of the dependent variable and the drivers of urban growth

In this paper for the correct conclusion from comparing the growth of the mentioned cities, the model used data over close years between 1991- 2005. The data used in this study included land use, terrain data, demographic data and transportation network data. Historical land use/cover data of Rasht (1994-2005) were generated from aerial photographs in 1994 which was obtained from the National Cartographic Center (NCC) of Iran and the master plan of Rasht in 2005. Two scenes of land sat TM and ETM remote sensing images covering Kermanshah city in 1992 and 2002 for urban growth modeling and finally historical land use/cover data of Urmia (1999-2006) were acquired through the classification of Landsat ETM images and data derived from the master plan of Urmia. We classify the images under a 3-class classification system which includes: urban area / crop, grass land, forest/ barren land by employing the supervised classification method, a Support Vector Machine (SVM). The demographic data were obtained from the Iran Census's demographic studies in 1996 and in 2006. All the input data layers were geo-referenced to the local coordinate system and clipped to the same map extent. Predictor variables were compiled in ArcGIS 9.3 via the spatial analyst module based on 30m×30m cell size. A summary of these predictors is shown in table (3). The dependent variable is the binary transition of a pixel from non-urban to urban land cover. The drivers of urban growth were grouped into three categories: (1) Site-specific characteristics: includes bare lands, Crop/grass, and Agricultural lands, Forests and Slope. The percentage slope was computed from the digital elevation model (DEM) in ArcGIS 9.3. (2) Proximity variables: measure the minimum Euclidean distances to the nearest commercial, industrial and residential sites, and roads, respectively; and (3) Socioeconomic factors: indicate the population density and the price of land.

Table 3
Summary of predictor variables for the urban growth model(Source:Authors)

Variables	Description
Y	1: Urban use/ 0: Non urban use
X1	Distance from the cell to the nearest residential sites
X2	Distance from the cell to the nearest industrial sites
X3	Distance from the cell to the nearest commercial sites
X4	Forests
X5	Population density of the cell- low density (1: Low density areas, 0: Other areas)
X6	Population density of the cell- high density (1: High density areas, 0: Other areas)
X7	Population density of the cell- Medium density (1: Medium density areas, 0: Other areas)
X8	Land price of cell- high price (1: High price,0:Others)
X9	Land price of cell- Medium price (1: Medium price, 0: Others)
X10	Land price of cell- low price (1: Low price, 0: Others)
X11	Cropland/ Grass and agricultural lands
X12	Slope (%)
X13	Distance from the cell to the nearest road
X14	Bare lands

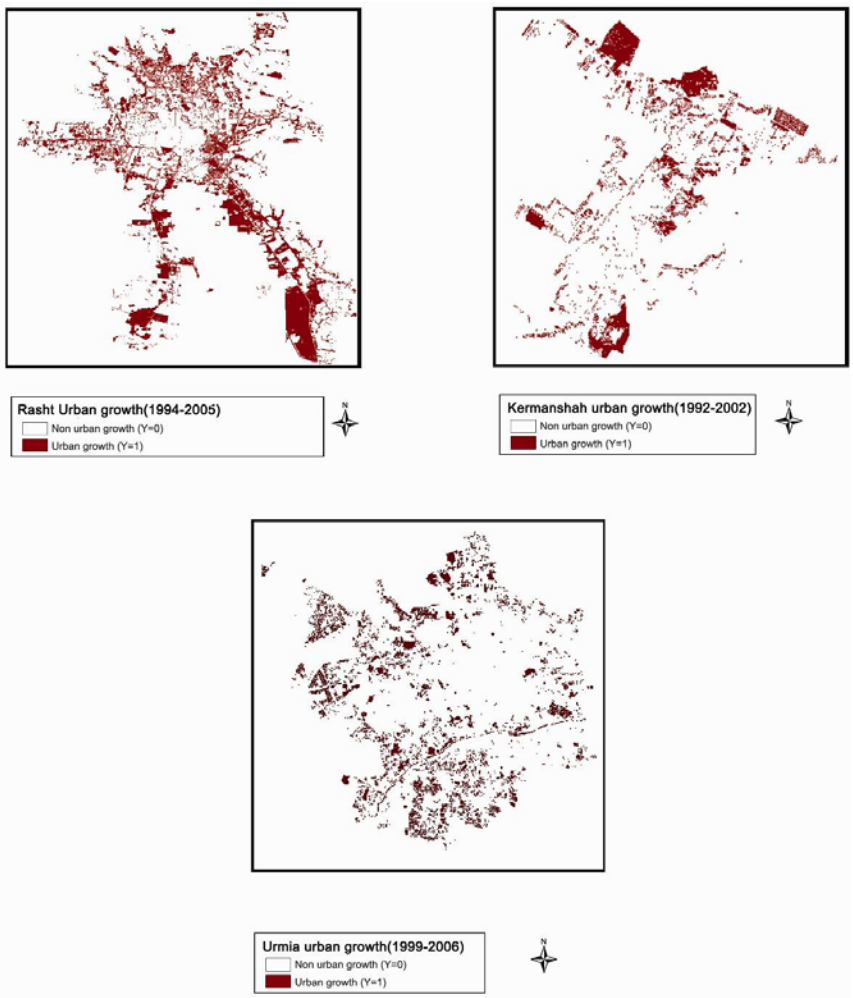

Fig. 5. Rasht, Urmia and Kermanshah urban growth

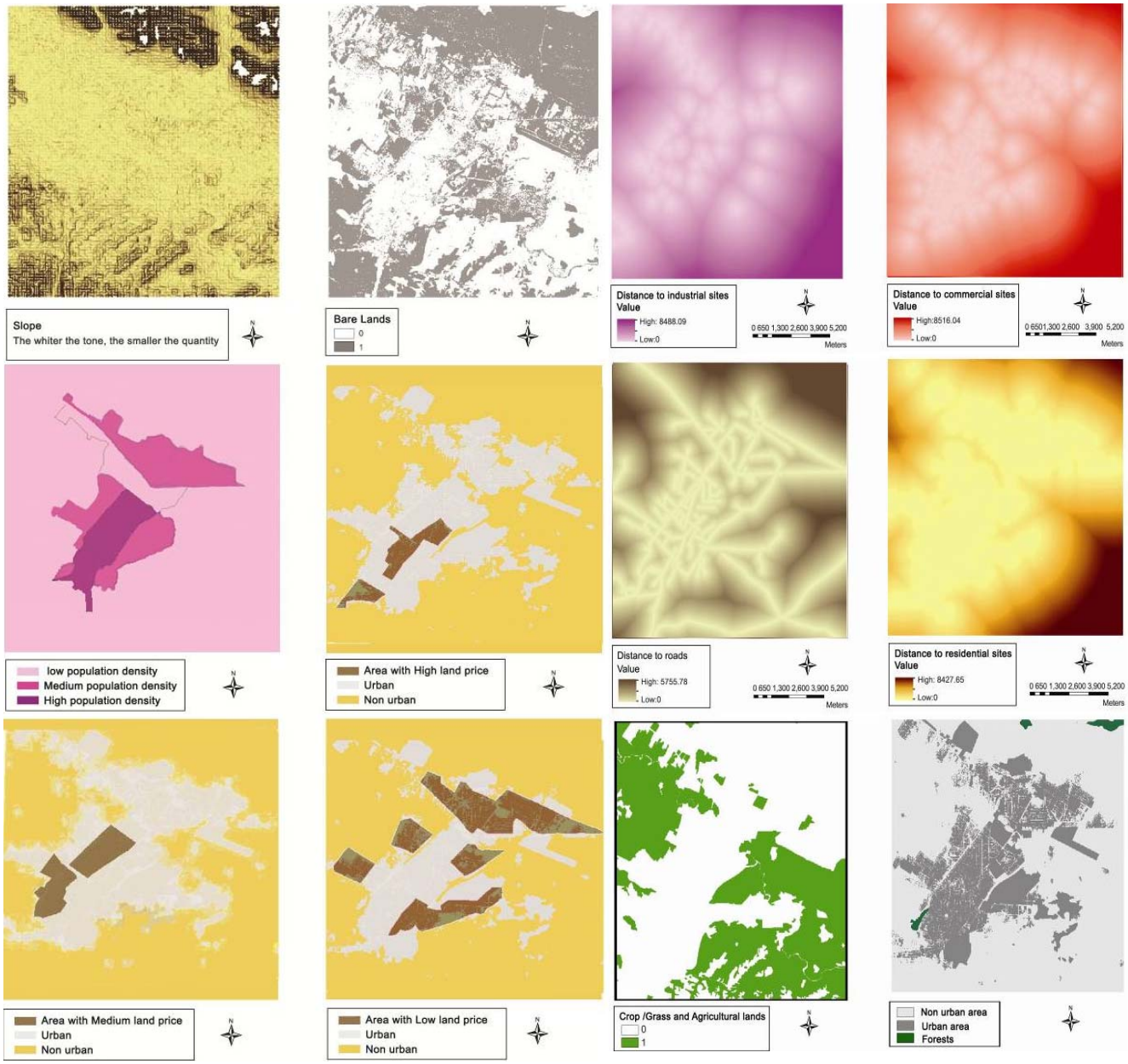

Fig. 6. Raster layers of independent variables of Kermanshah

4.2. Model framework

In this study, Logistic Regression (LR) model was used to accomplish evaluating the influence of driving forces on urban growth. The probability of a cell being urbanized can be estimated with the following LR model: where Y is a linear combination function of the variables (Eq. 1), Xi is an independent variable representing a driving factor, and bi is the coefficient for variable Xi. P (Y = 1|X1, X2, . . ., Xk) is the probability of the dependent variable Y (Eq. 2) and can be a nonlinear function (Eq. 3).

$$y = \alpha + b_1 x_1 + b_2 x_2 + \ldots + b_m x_m \qquad (1)$$

$$y = \log e\left(\frac{p}{1-p}\right) = \log it(p) \qquad (2)$$

$$p = e^{y}/(1+e^{y}) \qquad (3)$$

"The nature of the land use/cover change of a cell is dichotomous: either the presence of urban growth or absence of urban growth. If binary values 1 and 0 are used to represent urban growth and non-urban growth respectively and if it is assumed that the probability of a cell changing to urban use follows the logistic curve as described by the logistic function" (Hu, Lo, 2007). The LR model was estimated using the maximum likelihood algorithm.

4.3. Parameter specification

The complete list of variables is shown in Table (3). Fig (5) shows the maps of urban growth of three cities (Rasht, Urmia, and Kermanshah), which serves as the dependent variable Y and Figs (6) show the raster maps of the independent variables of Kermanshah.

5. Theory/Calculation

Before executing the LR analysis by using the statistical package SPSS version 13, the variables were checked for spatial autocorrelation. Therefore, it is necessary to omit those factors which have a correlation with each other.

"Variance Inflation Factor (VIF) is a common measure which is applied to test multicollinearity". (Eq.4) (Kutner et al, 2004)

$$VIF = \frac{1}{1 - R_i^2} \quad (4)$$

"Where R_i^2 is a square of the standard deviation of the explanatory variables. The value of VIF greater than 10 indicates the presence of strong multicollinearity". (Kutner et al, 2004).For Rasht, Urmia, and Kermanshah, as shown in table (4) those variables for which the corresponding values of VIF exceeded 10 were eliminated and the analysis was run by the rest.

Table 4
The result of multicollinearity diagnoses for independent variables of Rasht, Urmia, and Kermanshah(Source:Authors)

Variables	Rasht		Urmia		Kermanshah	
	Collinearity Statistics					
	VIF	Tolerance	VIF	Tolerance	VIF	Tolerance
X1	5.497	.182	10.701	.093	25.609	.039
X2	14.862	.067	3.161	.316	7.745	.129
X3	2.667	.375	8.772	.114	38.912	.026
X4	1.585	.631			1.103	.906
X5	16.465	.061	2.274	.440	1.327	.754
X6	2.885	.347	1.459	.686	3.044	.328
X7	14.777	.068	1.561	.640	2.386	.419
X8	1.505	.664	1.144	.874	1.691	.591
X9	1.701	.588	1.848	.541	1.960	.510
X10	1.482	.675	1.872	.534	1.704	.587
X11	3.848	.260	1.898	.527	2.145	.466
X12	1.477	.677	1.500	.667	1.341	.746
X13	13.098	.076	5.792	.173	1.639	.610
X14	2.888	.346	2.552	.392	1.734	.577

The results of LR for different factors are summarized in Table 5. One way to assess the goodness-of-fit of LR is to calculate the percentage correctly predicted (PCP). Then, PCP's were compared to determine the estimation parameters of LR. The sign of the coefficient B indicates a positive or negative correlation to the urban growth and based on the Wald statistics calculated for each parameter, the major determinants of the spatial pattern of urban growth are defined.

Table 5
Parameter estimate of the LR for urban growth in Rasht, Urmia, and Kermanshah(Source:Authors)

step	Rasht					Urmia					Kermanshah				
	variables	B	Sig.	Wald	Exp(B)	variables	B	Sig.	Wald	Exp(B)	variables	B	Sig.	Wald	Exp(B)
1	X1	5.866	.000	1690.915	352.829	X1	47.024	.000	2921.989	2.644E20	X1	-.346	.001	10.550	.707
	X3	-1.111	.000	918.775	.329	X2	.539	.000	21.334	1.715	X2	2.357	.000	751.210	10.560
	X4	-.014	.774	.082	.986	X5	.598	.000	343.875	1.819	X4	-1.135	.000	15.111	.321
	X6	-.531	.000	36.643	.588	X6	.741	.000	170.240	2.098	X5	.960	.000	1140.472	2.612
	X7	-.402	.000	160.073	.669	X7	2.229	.000	410.447	9.292	X6	1.228	.000	1142.654	3.416
	X8	-.042	.099	2.716	.959	X8	.711	.000	103.149	2.035	X7	2.263	.000	11707.580	9.608
	X9	-.142	.000	44.391	.867	X9	.706	.000	245.716	2.026	X8	-.273	.000	26.418	.761
	X10	-.228	.000	134.899	.796	X10	.777	.000	382.836	2.176	X9	-.672	.000	224.129	.510
	X11	1.069	.000	1450.748	2.912	X11	21.007	.899	.016	1.328E9	X10	-.402	.000	434.370	.669
	X12	.888	.000	954.590	2.431	X12	.074	.799	.065	1.076	X11	.243	.000	161.175	1.275
	X13	8.983	.000	10694.041	7963.432	X13	3.362	.000	389.828	28.838	X12	-7.495	.000	925.722	.001
	X14	3.015	.000	13145.054	20.399	X14	21.512	.896	.017	2.202E9	X13	1.540	.000	332.649	4.663
											X14	2.551	.000	20651.837	12.824
	Constant	-16.014	.000	16572.522	.000	Constant	-73.404	.656	.198	.000	Constant	-7.499	.000	7478.793	.001
	PCP (%)			90.2		PCP (%)			95		PCP (%)			89.4	
2	X2	9.149	.000	9298.795	9408.862	X3	10.840	.000	1980.618	51027.739	X3	1.488	.000	140.291	4.429
	X5	.243	.000	59.455	1.276										
	PCP (%)			89.6		PCP (%)			94.5		PCP(%)			89.4	

6. Results and Discussion

This paper has contributed to improving the understanding of urban growth of large cities in Iran through studying three cases: Rasht, Urmia, and Kermanshah based on the recent developments in GIS and spatial modeling. An LR model has been developed to integrate a set of spatial determining variables to analyze spatial patterns and underlie factors of urban growth in mentioned cities. As shown in tables (2, 6) the effects of driving factors on the growth of the given cities are compared with the expected ones according to theories presented by urban growth researchers. The results demonstrate that:

1)The effect of variables: distance to roads, distance to residential sites, fertile/agricultural lands, forests, bare lands. lower population density and price of lands for Rasht complies with the expected effect on urban growth.
2) The effect of variables: distance to roads, distance to residential sites, distance to commercial sites, fertile/agricultural lands, bare lands and population density for Urmia conforms to the expected effect on urban growth.
3) The effect of variables: slope, distance to roads, distance to commercial sites, fertile/agricultural lands, forest, bare lands, population density and price of lands for Kermanshah complies with the expected effect on urban growth.

Table 6
The effects of driving factors on the growth of the given cities(Source:Authors)

Variables	Effect on Rasht	Effect on Urmia	Effect on Kermanshah
Slope	Favorable	Favorable	Un favorable
Distance to roads	Unfavorable	Unfavorable	Unfavorable
Distance to residential sites	Unfavorable	Unfavorable	Favorable
Distance to commercial sites	Favorable	Unfavorable	Unfavorable
Distance to industrial sites	Unfavorable	Unfavorable	Unfavorable
Fertile/Agricultural lands	Favorable	Favorable	Favorable
Forests	Unfavorable	-	Unfavorable
Bare lands	Favorable	Favorable	Favorable
Population density	Favorable in lower population density	Favorable	Favorable
Price of lands	Unfavorable	Favorable	Unfavorable

7. Conclusion

The comparative analysis of the results obtained from modeling factors that influence the growth of Rasht, Urmia, and Kermanshah as shown in table (5) demonstrate that:

1) The most important driving factors that influence the urban growth of Rasht are: bare lands, vicinity to main roads and residential areas, respectively whereas, in Kermanshah not only bare lands but also less and medium- populated areas have a significant effect on Kermanshah's urban growth. In addition, the slope is one of the main unfavorable effects on Kermanshahs'urban growth. Compared with Rasht and Kermanshah, the most important factors in Urmia are vicinity to residential areas, medium- populated areas and vicinity to roads, respectively.
2) Regarding the effect of bare and agricultural lands on urban growth in Rasht and Kermanshah, the emergence of urban growth in bare lands is more than what is seen in agricultural lands while it shows the equal amount in Urmia.
3) Vicinity to industrial sites has favorable effects on urban growth probability of each city which is supported by the fact that the most observed urban growth is in the southern part of Rasht toward industrial town and the main direction of urban growth has been formed along Sanandaj road toward industrial sites.
4) Vicinity to commercial sites has favorable effects on urban growth probability of Kermanshah and Urmia whilst it does not have a favorable effect on Rasht as in spite of locating commercial areas in the central and northern part of the city, the main emergence of urban growth is in the south.

Comparing the expected effect of driving factors on urban growth according to the theoretical framework shown in table (2) with their effects on the growth of given cities in the table (6) shows that:

1) The effect of distance to roads, distance to industrial sites, bare lands, fertile/agricultural lands and less populated areas on the urban growth of the whole cities conforms to the theoretical frameworks.
2) The effect of slope on the urban growth of Rasht and Urmia does not comply with the theoretical frameworks, which shows that slope has favorable effects on urban growth.
3) The effect of distance to residential areas on the urban growth pattern of Rasht and Urmia does not follow the theoretical frameworks whereas, it shows a favorable effect on Kermanshah's urban growth.
4) The effect of distance to commercial sites on the urban growth pattern of Kermanshah and Urmia follows the theoretical frameworks while it shows the favorable effect on Rasht's urban growth.

As discussed above, the influencing factors on urban growth play both an identity and a different role in the pattern of large cities growth in Iran; that is fertile/agricultural lands, bare lands, less populated areas, roads and industrial sites which increase the probability of urban growth and forests that decrease the probability of urban growth have the same effect on urban growth pattern whereas the slope, price of lands, residential and commercial sites do not have a common effect on urban growth for the whole large cities of Iran.

Finally, unlike the forests, agricultural lands are progressively changing into townlands that should be prevented through feasible and practicable planning and investigating the political and managing factors.

Less populated areas and barren lands as shown in this paper, affect the urban growth of the whole cities and it should be monitored by urban planners in the large cities of Iran to increase the fertile farmlands. (As shown in table 5, the positive value of the coefficient B of variables X5, X14 for Rasht: 0.243, 3.015; Urmia:0.598, 21.512 and Kermanshah:0.960, 2.551, indicate a positive correlation to the urban growth).

The common effect of industrial sites and roads on urban growth of the whole cities as shown in table 6 and the positive value of the coefficient B of variables X2, X13 for Rasht: 9.149, 8.983, Urmia: 0.539, 3.362 and Kermanshah: 2.357, 1.540 as shown in table 5, indicate that Industrial sites and roads are the common and major factors of large cities growth. It shows that locating industrial sites and the mutual effect pattern of land use _ transportation will play an important role in the future planning of the large cities in Iran.

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