Int. J. Architect. Eng. Urban Plan, 27(2): 137-151, December 2017
DOI: 10.22068/ijaup.27.2.137

Research Paper

Changing Regional Spatial Structure of the Population and Activity (The Case of West Azerbaijan Province, Iran)

H. Dadashpoor[1,*], N. Ghasemi[2]

[1]*Associate Professor, Urban and Rgional Planning, Faculty of Art, Tarbiat Modares University, Tehran, Iran*
[2]*Expert Tarbiat Modares, Urban and Rgional Planning, Faculty of Art, Tarbiat Modares. Tehran, Iran*

Received: 5 September 2016, Revised: 5 August 2017, Accepted: 15 August 2017, Available online: 30 December 2017

Abstract

Functional and structural changes of regional system are ongoing spatial changes that form patterns of spatial organization, depending on dominant regional forces and factors. Spatial structure of West Azerbaijan province experienced significant changes during 15 years; thus, the present research aim to investigate the manner of spatial distribution of two variables of population and activity, and correlation of these variables with spatial structure of the province during the years from 1996 to 2011. Quantitative method was employed for this aim and urban rank-size index was used to analyze settlement pattern of West Azerbaijan province; Kernel density and Moran method was used to analyze population data; general and local Moran data were used to analyze activity data; and regression method was used to see the degree of correlation between these variables. The results showed that spatial structure of west Azerbaijan was monocentric in 1996 while the of spatial distribution trend of the population and activity indicated decentralization tending toward clustered spatial pattern during 15-year period of time, due to high correlation between the given variables. In other words, some kinds of decentralized convergence took place. Such trend would change the spatial structure in West Azerbaijan province and needs to be properly oriented in the future planning of urban and regional development.

Keywords: *Spatial structure, Population, Activity, West Azerbaijan province.*

1. INTRODUCTION

Experts in urban and regional studies believe that uncontrolled and expedite regional development eliminates urban and regional boundaries [11], which affects population distribution of regions and forms population and activity concentration poles (due to increasing economic concentration in population poles) [27]. The study of spatial dispersion of population and activity occupies a major ground in geographic studies of spatial structure [28]. Despite the fact that space (in continuation) takes organization, this space organization does not necessarily mean optimal space organization [2], taking into account that regions face various challenges such as unbalanced growth and distribution of population and activity over the region and province, lack of economic growth and development in some regions, manner of distribution of population, and etc. Ahmadi Poor et al [1], Hajipoor and Zebardast [15] Paying not enough attention to dispersion system of settlement centers and its manner in regional scale and underestimating influential factors cause disconnection and inconsistency in regional spatial structure. Bertaud [5] On the other hand, population and activity development of any kind and scale requires especial spatial structure and organization [22]; this necessitates identifying and directing influential factors on formation of spatial structure of the region and taking into account environmental potencies to create desirable and appropriate spatial structure [30].

West Azerbaijan province experienced meaningful up and downs during recent decades in terms of demographic growth. The province experienced its higher demographic growth during 1986 to 1996, which was due to the encouraging policies of population growth in the early years after the Islamic revolution. With implementation of population growth control policies in 1990s, population growth of the province decreased to 2.4 percent during 1986 to 1996. This rate fall to 1.3 during 1996 to 2006 and finally reached to 1.4 the period of 2006-2011.

This study selected activity and population dimensions as the main variables in spatial structure of the province since population and activity growth changed during the given 15 years while other variables remained almost untouched. However, rapid formation and change of spatial structure pattern of West Azerbaijan province [41] made the researchers to study the manner of distribution of

** Corresponding author: H-dadashpoor@modares.ac.ir*
Tell: +982182883764; Fax: +982188006544

the two variables of population and activity and examine their correlation with spatial structure pattern of the province during 1996 to 2011. Thus, the main question addressed in the article was that:

- Which pattern did spatial distribution of activity and population nodes follow in West Azerbaijan province during 1996 to 2011?
- Was there any meaningful relationship between spatial distribution of population and activity in spatial structure of West Azerbaijan province during 1996 to 2011?

Research hypothesis were as follows:

It seems that there is meaningful relationship between population and activity variables in spatial structure of West Azerbaijan province during the studied period.

2. Research literature

2.1. Spatial structure

Spatial structure is the outcome of spatial process organized by social, economic, and natural processes, influencing main components of spatial dispersion. Position of each component in regard to other components and, simultaneously, position of each component in relation to all components form spatial organization. In fact, spatial structure arises from arrangement and organization of phenomena resulting from natural, social, and economic processes [39]. Changes in spatial patterns and its structural and functional dynamics which manifests in physical relations among regions - urban and rural networks - relate to the forces that underlie the actual mechanisms of attracting, directing and transferring flows of capital, work force, employment, and population [20]. This variability which is widely seen in intra-regional structures as physical expansion of structures and physical and functional changes, radically changes spatial structure of regional network system in regional and sub-regional space and peripheral relations [33].

Experts usually focus on two dimensions when analyzing spatial structure: 1). Morphological dimension which relates to the size and spatial distribution of settlements in the region; 2) Functional dimension which examines inter-regional relations in the region [7]. In morphological analysis, spatial structure is identified by employing two methods: A) Using population data; B) Using predicted employment data and their manner of distribution in territorial domain [12].

2.2. Spatial structure of activity

Various theories were proposed on spatial structure of activity; some of the most important ones are mentioned here. Proponents of Neo-Keynesian theory with economic basis divide the theory of regional economic activities into core (export) and non-core. In their view, income coming from export section is the driving force of the region's economy [35], which imply that development of the region depends on export. Export is realized as the only variable the amount of which determines the region's growth and development and is considered as the only driver for economic growth of the region [37]. Peter Hall believes that the main objective of regional economic policy to decrease inequities is to create employment that helps reduce unemployment and migration-sending in the region, and consequently, leads to its growth and development [16]. Theories of Hirschman and Myrdal include elements named growth pole. Theory of growth pole basically tends to economic efficiency which is more dynamic than static analyses of neoclassic theory. Growth pole theory argues that development can be increased through advantages of agglomeration (reducing the costs of the factors considered external in accordance to the corporation, but internal in accordance to polar space) [31]. It is emphasized that it is possible to strengthen development of growth poles and gain some interconnected interests [18]. In this strategy, priority is given to cities, so that the socio-economic development of cities leads to the socio-economic development of villages, and cities mobilize the agricultural production in their neighboring areas through the conventional mechanism of "expansion". The evidences reveal that cities failed to provide the required services and mobilize rural areas through implementation of "growth pole" strategy [17].

To understand spatial structure of regions and predict development trend of changes, Friedman proposed center-periphery pattern. He stated that "any geographic system includes two sub-systems": one is center which is pivotal heart of the system; the other is periphery that can be considered as the rest of the system, which is dependent on or under domination of the center [21]. This relation can be seen as a colonial relation. Polarized structure is usually accompanied by displacement of some of the main production factors from the margin to the center [31]. Based on Lee, spatial structure results from employment centralization indicators by which we can show the degree of centralization and dispersion of employment, the rate of fluctuation and density of traditional centers, sub-urban centers, and finally the manner of spatial pattern changes [26]. Other experts such as Vinoth believe that spatial systems especially regional system with agricultural or industrial or even service production have certain characteristics which differ from other spatial organizations generated by other types such as climate and etc. since spatial structure figured by activity system highly reflects spatially in the structure of society and demographic and spatial system; thus, spatial structure of the region must be examined by using indicators of employment degree in agricultural, industrial, and service sectors [43].

Based on Schwanen, Deileman and Dijst, spatial structure of activity is formed by relations of cities with their sphere of influence and level of employment in service sector of neighboring towns [38]; however, Batten relates formation of this structure to network and industry-based relations among centers, industrial competitiveness and complementary and cooperative relations among regions [4]. In Harvey's opinion, activity structure system is not the study of existence of political rights or physical artifacts; It is rather the study of the process of capital cycles, changing flow of working force, employment, goods and financial capital, spatial organization of production, change of spatial relations, and etc [19].

2.3. Spatial structure of population

The term "demography" means study of population. It consists of two Latin words: "Demos" meaning people and "Graphos" meaning writing. Demography is a sub-field in social sciences, which focuses on the study of population structure in various scales, statistic description and analysis, examination of population movements, interconnected relations among demographic phenomena from economic, social, and environmental aspects [14].

According to researchers such as Borsdorf, spatial structure of population can be studied from two dimensions: population dispersion per unit (population density) and population changes and movements [6]. Kim believes that spatial structure of activity can be analyzed through two indexes of agglomeration and clustering; the index of agglomeration shows fluctuation of population distribution during several periods while the index of clustering reveals degree of centralization or decentralization in spatial tendencies [10]. Guy argues that distribution and dispersion of population in terms of age, gender, geography, marital status, employment, education, and other similar issues fall into population dimension. Manner of distribution and dispersion of population over the earth is called "spatial distribution". Population of any country has disproportionately distributed and dispersed all over its area. "Geographic dispersion of population" and "density of population (relation between the region's area and the number of population)" is calculated and analyzed in order to examine distribution, differences, and its regional variations [14].

According to Kostaki, Agorastakis, and Agorastakis, one of the main parts of population studies is to examine dispersion of population in spatial domain by using the indicators of natural growth, number of households, and population movements and change [24].

In regard to changes of settlement pattern following population changes, Singh's theory is one of the theories that can be raised. He believes that spatial structure of population provides environmental capabilities (natural and human) and grounds for establishment patterns of human settlements in geographic spaces; in this regard, indicators of households and its dimensions and population growth rate based on difference in mortality and birth rate must be used [40]. In view of Samie Nasab and Torabi (2010), it is necessary to study spatial structure of population since through which we can understand population changes in terms of number, sex, totality and quality of age groups over time [36] Table 1.

Table 1 Summary of the indicators of population, activity and their impact on the spatial structure of the region (Source: Authors)

Dimensions	Authors	Variables and Indicators physical, social
Spatial structure	(Shakoui, 2007)	and economic indicators
	(Healey, 2004)	Relationship between centers and peripheral relations
	(Pontes, 2009)	Physical structure and functional and physical changes
	(Burger and Meijers, 2012)	Functional dimension and relationships between settlements
		The size and distribution of spatial settlements
The spatial structure of activity	(Green, 2007) (Sbagh Kermani, 2001)	Distribution of population data and employment, and how they are distributed in the territory of the land
	(Sarafi, 2000)	Income from exports Export -
	(Hall, 1992)	Economic Growth Employment in the economic sector Economies of accumulation
	(Papoli Yazdi, Ragabi Senajerdi, 2003)	(Reducing the cost of factors that are foreign compared to firms, but in contrast to the internal polar space)
	(Hanson et al, 1997)	Economic Growth Poles
	(Hamsi, 1981)	Development of centers in terms of social and economic
	(Hilhorest, 1991)	Increase agricultural production
	(Lee, 2007)	Economic Development of Center and the Settlement System
	(Vinoth, 2007)	Employment aggregate index
	(Schwanen et al., 2004)	The concentration and dispersion of employment
	(Batten, 1995)	Employment rate in agriculture, industry and services
	(Harvy, 2006)	Employment in the service sector
		Employment in the industrial sector
		Investment, employment, labor, capital, money, organization of production space
Population spatial structure	(Borsdorf, 2004)	Distribution of population per unit area (population density) and other population changes and movements
	(Glaster et al., 2001; Hess et al., 2001)	Two aggregation and clustering indicators population
	(Guy, 1992)	distribution in terms of age, gender, geography, marital status, employment, education
	(Kostaki et al., 2009)	Natural growth, number of households and population growth and population indicators
	(Singh, 2014)	Household Indicator and its Dimensions, Calculate Population Growth Based on Difference Between Mortality and Birth Rate
	(Samii Nasab and Torabi, 2010)	Number, gender, generality and quality of age groups

3. BACKGROUND OF RESEARCH

Cindy and Scott (2003) analyzed the influence of employment and population on spatial structure of the provinces of China, based on the indicators of activity and population density and by using assessment indicators of geographic concentration, natural advantages of regions, share of provinces from total population and employment of the entire industry, cost of using primary resources, and migration; using a multivariate regression, they concluded that population and migration significantly relate to economic growth rate, in addition that locating various functions of activity determines the pattern of population distribution [8].

Guerrero and Sero (2010) analyzed spatial distribution of economic and population activities in Badajoz, Spain, by employing indicators of density of convergence and cohesion of activity in the region, total population of the region, and natural growth. They used various methods of spatial statistics to show the considerable influence of economic activities concentration on spatial structure of population. The result showed that population decentralization was the result of dispersed development of employment in the main city center [13].

Kloosterman & Lambregts (2001) examined changes in segmental and spatial patterns of employment and population in Randstad to see spatial distribution of the region. For this aim, having analyzed data and indicators of population and activity and determining the age structure of the population, grouping the population into age groups, and calculating the household size in the region, they examined influential factors on growth patterns of Randstad during 1993 to 2001 and categorized them into two groups of centralization and dispersion; they came to this conclusion that the process of spatial structure of activity was highly influenced by population dimension and its dispersion, turning the region into one of the most populous regions [23].

Dadashpoor et al (2010) studied spatial organization of urban systems in southern part of Iran and explained population distribution of the region in a 40-year period; they reflected balanced distribution and centralized distribution by using three primary urban categories of indicators. Their results revealed that centralization and primary urban indicators were significantly high during 1979 to 1989, which indicates unbalance. Equilibrium indicator implied relative decrease of centralization in the next decade, which shows polarization of the region. They suggested some measures to solve regional disequilibrium, such as implementing employment policy, effective use of environmental capacities of small and middle towns in coastal cities, creating necessary facilities and infrastructure to maintain the existing population, attracting manpower and capital, focusing on advantages of agglomeration, attracting individuals and enterprises to locate in the region, and ultimately economic development of southern coastal areas [9].

Rahnema (2010) analyzed decentralization trend in Khorasan Razavi province in Iran. He, first, studied grounds for spatial inequity by employing UN-proposed human development indexes of life expectancy at birth, literacy rate, and per capita income, in 19 towns of Khorasan Razavi province. Then, the position of Mashhad metropolis was determined in urban network and in urban hierarchy system by using rank-size order, which indicated disequilibrium in urban hierarchy system and dominance of urban primate pattern in Khorasan province. Also, the analysis of migration flows inside and outside the province toward Mashhad metropolitan area showed migration-sending of the cities of Quchan and Neyshabur in the province and the provinces of South and North Khorasan and Sistan and Baluchestan outside the province, which shows monocentric pattern of Khorasan Razavi province [34].

Based on the studies, we can say that a set of variables and population and activity indicators are required to investigate the changes in spatial structure of the study area, According to the theoretical framework and research background, it is assumed that there is more significant relationship between the two variables of population and activity and the spatial structure.

4. METHODOLOGY

The present study is an applied descriptive-analytical research which used combination of spatial and quantitative methods to examine the collected data and examines the relation between two dimensions of activity and population. Population indexes included natural growth of population, average age of population, population percentage of major age groups, and number of households; activity indexes included the region's share of the reviewed activity, share of employees in the one section to the whole, share of employment, and concentration of employment. The related data were obtained in the scale of villages and cities for years 1996, 2006, and 2011. Parametric method of rank-size was used to analyze settlement system of West Azerbaijan; non-parametric method of kernel density and Moran method were used to analyze spatial distribution system of population and highlight the existence of population clusters; Moran method was used for different sub-sections to analyze distribution system of economic activities; and finally, spatial correlation was used to analyze correlation of two variables of population and activity.

4.1. Rank-size method

Rank-size method which is proposed to analyze settlement and urban hierarchy system argues that according to the population of the primate city of the region, the population of other cities must be 2.1, 3.1, 4.1, etc. times of the primate city; its formula is

$$b = \frac{\log P_1 - \log P_n}{\log R} \quad (1)$$

$$Y = bx + a \quad (2)$$

in which "a" is a fixed amount and "b" line slope, R is rank of city in the province, P_1 is population of first city in the province, Pn is population of the city of desired level, Y

is Logarithm of the population size of the city, x is logarithm of city rank [42].

4.2. Kernel density

Kernel density is one of the most often used methods in the modeling of population density. Kernel density function calculates intensity of a variable over an area through calculating total number of points given within a search radius to a target point [29]. This non-parametric method modelizes the estimation of a variable by the minimum data [25]. Mathematically, we can present it as:

$$\gamma(x) = \sum_{i=1}^{n} \frac{1}{t^2} k\left(\frac{s - s_i}{t}\right) \quad (3)$$

in which γ(x) is the estimated intensity of spatial size of a point in place "s, and s_i" are the "i"th variable, and "k" is central weighing function, and "t" is the area of the region.

4.3. Moran method

Moran spatial correlation method has two global and local indexes; in the former, one number is calculated for the whole region, and in the latter [3], the formula is as bellow:

$$I = \frac{N \sum_i^n \sum_j^n W_{ij}(y_i - \bar{y})(y_j - \bar{y})}{(\sum_i^n \sum_j^n W_{ij}) \sum_i^n (y_i - \bar{y})^2} \quad (4)$$

I is the global Moran index. Weighted matrix is proximity or distance between observation of I and J; n is the number of observations and y is the numerical value of the examined variable that is compared with the mean value [32].

4.4. Spatial regression model for modeling spatial relation

Spatial regression analyses provide tools for test modeling and describing spatial relations, and can help to better understand the hidden factors of spatial patterns; these regressions are predictive models.

Y is dependent variable and X is an independent variable.

The regression line equation can be written as follows:

$$Y = ax + b \quad (5)$$

There are at least three reasons for using this model:

- Modeling certain phenomena to better understanding of them and help make better decisions about choosing the best response;
- Modeling some phenomena to predict in various places and times;
- To test the research hypotheses.

Spatial regression analysis has several basic elements that are important in recognizing their performance:

- Regression equation: It is a mathematical equation applied to independent variables to get the best estimation of the dependent variable. The mathematical expression of this equation is as follows:
- Dependent variable of Y is the variable or process which is to be modelized or predicted; Values of Y are often observed values.

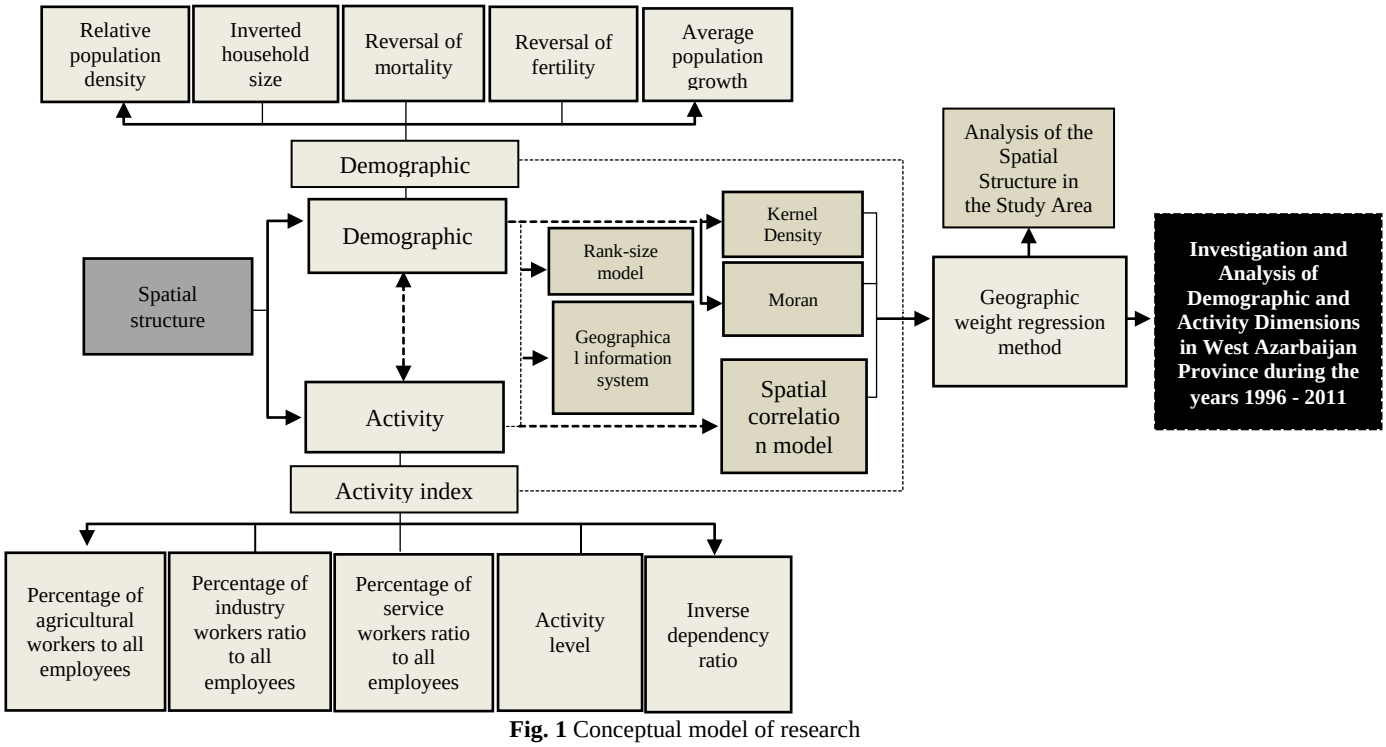


Fig. 1 Conceptual model of research

5. STUDY AREA

West Azerbaijan as one of the vast areas in northwest of Iran has a common border with three countries of Turkey, Iraq and Nakhichevan Republic. This province extending over 37412 km^2 includes population of about 3 million people and 17 counties. In regard to its demography, Urmia was the most populous one in 2011, with the relative share of 31.28 percent. The arrangement of settlements and industrial and service centers in West Azerbaijan Province is generally classified into four groups: (a) dense central industry and service region; (b) southwest area; c) northern area; and d) southern area. Agriculture is the main productive section of West-Azerbaijan province, which accounts for about 6% of the country's total production.

Fig. 2 Geographical location of west Azarbaijan province relative to Iran and separation of rural district (Statistical centers of Iran, 2009)

6. ANALYSIS

As mentioned, the objective of the research was to study the manner of spatial distribution of two variables of population and activity, and to analyze the degree of correlation among these variables and spatial structure of the province during 1996 to 2011. Thus, first, the system of population distribution was analyzed; then, spatial structure of centralization and activity distribution was examined; and finally, the relation of two variables of population and activity was studied.

6.1. The structure of spatial distribution of population in West Azerbaijan province

6.1.1. Analyzing population distribution and urban system by using rank-size logarithmic distribution method

Using Matlab and Excel softwares, rank-size logarithm distribution in West Azerbaijan province during the years 1375-1390 yielded the following results Graph 2:

- In years 1986, 1996, and 2011, there was strong reversed correlation between logarithmic rank of cities (x) and logarithmic size of cities (y). In fact, the more logarithmic number of cities increased, the logarithms of their populations were reduced.
- The value of the line factor or the gradient of the rank-size line with the balance line for the given years is as follows:

Linear equation in 1996: y= -1.31x + 5.2 (6)
Linear equation in 2006: y= -1.4x + 5.6 (7)
Linear Equation in 2011: y= -1.43x + 5.8 (8)

In regard to population indicators, in 1996, the distance between the primate city and other cities was considerably high and there was a large distance between Khoy and Mahabad cities with Urmia, in the one hand, and the other cities of the province, on the other. However, in 2011, we had a more balanced urban system with hierarchy of large, middle, and small cities, in which the cities of Urmia, Khoy, Bukan, Miandoab experienced significant growth Graph 2.

The three above-mentioned linear equations indicated that decentralization occurred in urban system of the province in the first studied period; distribution of the sizes of the cities, in addition to the first position of Urmia, was accompanied by a significant fracture in distribution of the cities; the gap and fracture decreased both in distance between Urmia (primate city) and the second cities and also between other cities.

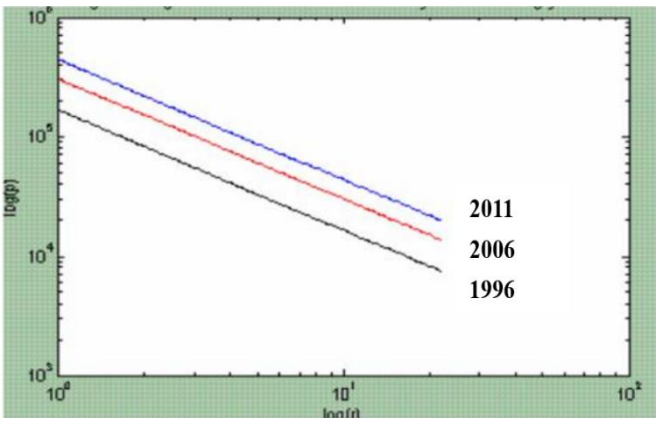


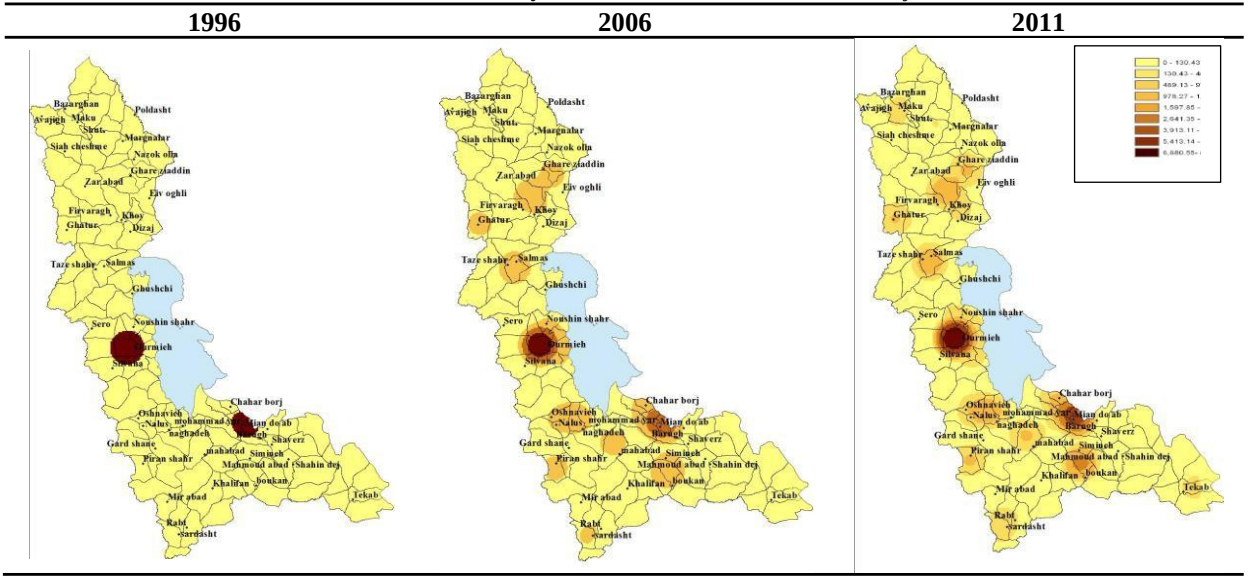
Fig. 3 Logarithmic distribution of the normal rank-size of cities in West Azerbaijan in 1996, 2006, 2011

6.1.2. Analyzing population dimension of distribution by using Kernel density method

Table 2 modelizes population density of West Azerbaijan province during the studied period. Based on the results, the population density of the area in 1996 was concentrated mainly in the villages of Bakashlouchay, Nazlouchay, North Nazlouchay, Rouzehchay, Barandozchay, South Barandozchay, Bashqala, and Turkman around the city of Urmia; outside the city of Urmia, concentration was denser in the districts of West and East Macrian, Karasani, Western Argorlou, Baroque and Zarinehrood located in the central part of the province, compared to other rural districts in the province.

In 2006, in addition to an increase in density rate in central areas of the province in rural districts of Bakshloo Chay, Nazloo Chay, Northern Nazloo Chay, Roze Chay, Barandooz Chay, Southern Barandooz Chay, Bash Gala, and Turkaman, there was an increase of density in rural districts of Western and Eastern Makriyan, Kura Sunni, Western Ajorlou, Barough, Zarrine Roud, Dizaj, Firoragh, Gara Ziya'addin, Akhtachi, and Eastern Akhtachi in northern and southern parts of the province. However, there was still more density in the central parts of the region. Exactly the same process continued to exist in a 5-year period, i.e. in 2011, with the difference that the rural districts of Urmia (Bekshlou Chay, Nazlou Chay, Northern Nazlou Chay, Roze Chay, Barandouz Chay, Southern Barandouz Chay, Bash Gala, and Turkman) became highly populated. Studying kernel density model revealed that villages locating in central part of West Azerbaijan province were under influence of the primate city and the metropolis of the region (i. e. Urmia), which caused density increase in central part of the province. However, density increased in northern and southern parts of the province due to an increase in the number of cities and villages in the period under study and growth rate of 1.13% in the population.

Table 2 Kernel density in 1996, 2006, 2011 in West Azerbaijan



6.1.3. Study and Analysis of the system of population distribution using Moran's method

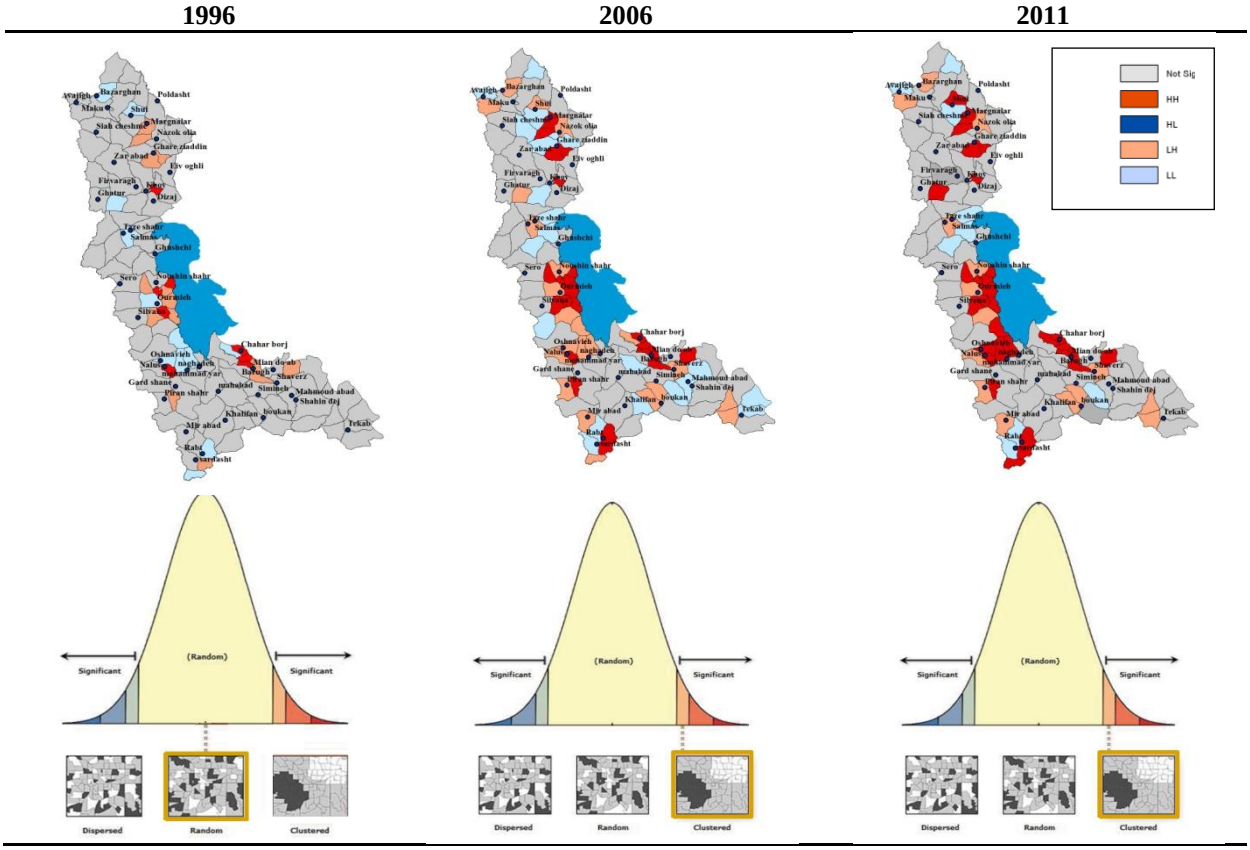
This section presents the results of global and local Moran method. Spatial auto-correlation measures the way elements are distributed in the space in connection to their surroundings. Thus, this method was used to analyze how populations was distributed in rural districts of West Azerbaijan. This index has general and local items; the first is used for quality of distribution, and the latter for distribution pattern.

Based on Table 4, West Azerbaijan province did not experience any population spatial agglomeration (clustering) in 1996 except for a node of rural districts formed around Urmia. In regard to centralization, spatial - population pattern of West Azerbaijan followed monocentric pattern in 1996 and spatial agglomeration dominated the region. However, this pattern moved downward over the 15-year period of time and some cities such as Khoy, Mahabad, Miandoab, and Boukan held a considerable part of population within themselves, which reveals signs of decentralization in population pattern of spatial distribution in southern and northern parts of province.

Table 3 The general moran index of population distribution in West Azerbaijan

	1996	2006	2011
Moran coefficient	-0.000468	-0.000358	-0.000070
Expected Moran coefficient	-0.001515	-0.001515	-0.001515
Z-score	1.489611	1.802154	2.296751
P-value	0.136326	0.071521	0.021633
Result	Random	Clustered	Clustered

Table 4 Spatial distribution of population according to Moran's local model in 1996-2011



As the results of analyzing Moran model, several centers were identified as the main population kernels, which included rural districts in surroundings of Urmia, Khoy, Mahabad, Miandoab, and Boukan, mainly locating in central, southern, and northern parts of the province. Taking position in the group of HH points to the considerable difference of each center with other areas in the region, indicating that these centers held large share of population during the years from 1996 to 2011. A clustered distribution system was observed during 2006 to 2011 and other centers lacked significant pattern.

6.2. Study of distribution system of activity

This section analyzes the system and pattern of economic activities distribution in the province according to economic sub-sections. Local Moran tests the given place and modelizes hot spots based on their comparison with adjacent items.

Table 5 Moran's general index of activity in West Azerbaijan

Year	1996	2006	2011
Moran's General Index	0.11	0.17	0.21

Based on Table 5, local Moran increased in the period under study, indicating an increase in spatial distribution of employment and change in polar and central pattern. Data was divided into 13 parts, which are mentioned in Table 6, to measure the distribution and spatial concentration of economic activities in West Azerbaijan province during the years 1996-2011.

According to Table 6, majority of points are in the HH and HL pattern, which indicates that this section were clustered and centralized; it includes agriculture with sub-sections of animal husbandry, gardening and farming with the share of 4.9, 3.8, and 4.4 and service section (cross border services) with the share of 3.8 and industry section (cultivation and industry) with the share of 3.45 percent of all rural sections locating in central, southern, and northern nodes that cover central node of Urmia, northern node of Khoy, and southern nodes of Mahabad, Miandoab, and Boukan.

Based on the results of Moran method in diagnosing the sub-center or the spatial pattern of activity sub-sections in the region, the points with HL or HH clusters which held the largest share of employment for them and their neighbors in each subsection were selected, since these points were potential to be sub-centers in activity sub-section. Thus, we can consider these points as focus point of activity sub-section or spatial pattern in West Azerbaijan. This is because majority of such carriers are located in some important cities (Urmia, Mahabad, Miandoab, and Boukan) and the surroundings lack specific pattern.

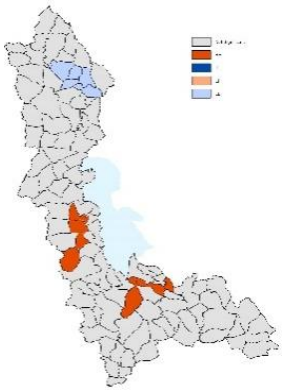
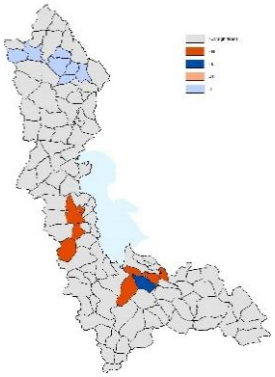
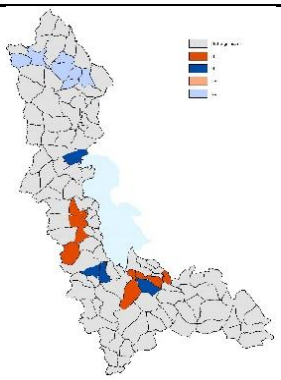
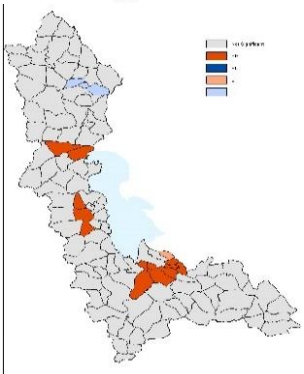
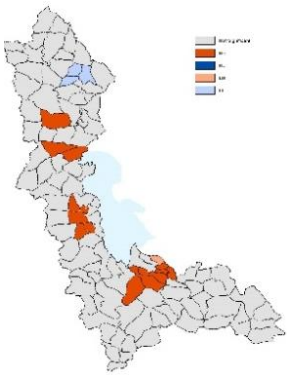
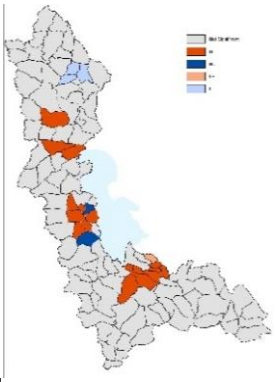
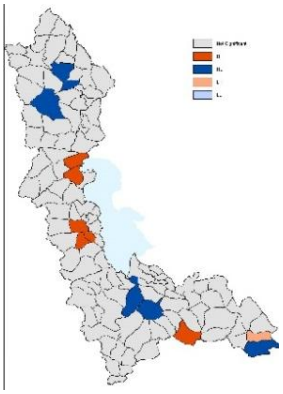
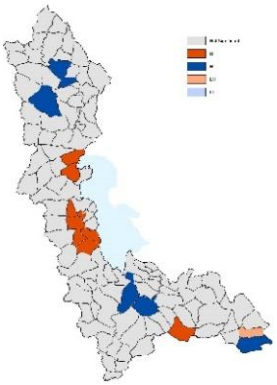
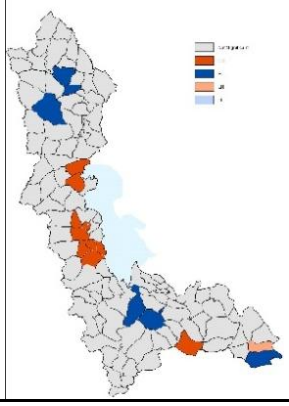
We can consider the sub-sections in the dispersed (LH or LL) section as the centers of capability and capacity in the relevant sub-section for planning and policy-making for future years and, accordingly, increase the employment rate and reduce their isolation through strengthening of each center's activity. Activities distribution in all activity sub-sections is seen as more accidental pattern (or pattern-less), in which dispersion of activities is the outcome of

hasty programming and policy-making for place of activities. Centers with accidental patterns can act as centers that decentralize Urmia, Khoy, Boukan, Miandoab, and Mahabad and disperse employment density in activity section Table 7.

Table 6 The share of economic sub-sections from spatial patterns according to Local Moran

Sections		Services					Industry				Agriculture			
		Cross-border	Financial Services	Waste	Health and Medicine	Energy and Recycling	Goods	Mining Products	Equipment	Cultivation and industry	Fishing	Gardening	Husbandry	Farming
Clustered	HH	3.8	2.48	1.46	2.1	0.9	2.6	3.1	2.7	3.45	-	3.88	4.9	4.4
	HL	-	1.21	1.28	-	-	2.7	3.14	2.5	3.4	1.3	-	-	13.8
Scattered	LH	-	0.64	1.3	2.6	2.3	3.3	0.9	0.54	0.85	0.6	3.04	0.2	-
	LL	1.28	0	0.4	2.3	1.7	4.1	1.13	0.23	0.9	-	-	1.06	2.1
Random	Without a Pattern	96.2	95.67	95.5	93	95.1	87.3	91.7	94	90.9	98.2	93	93.8	79.8

Table 7 The distribution of activity in agriculture and service in West Azerbaijan, according to Moran's method in 1996-2011

	1996	2006	2011
Agriculture			
Industry			
Service			

6.3. Study of correlation between population and activity in West Azerbaijan province

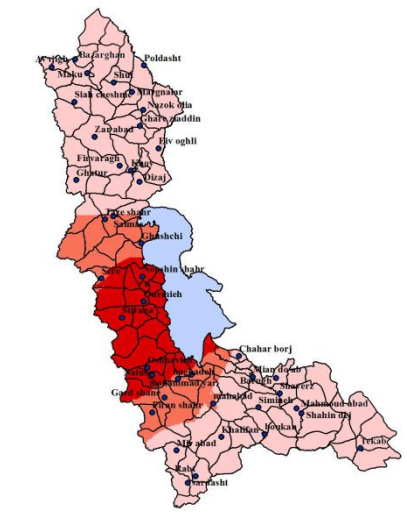
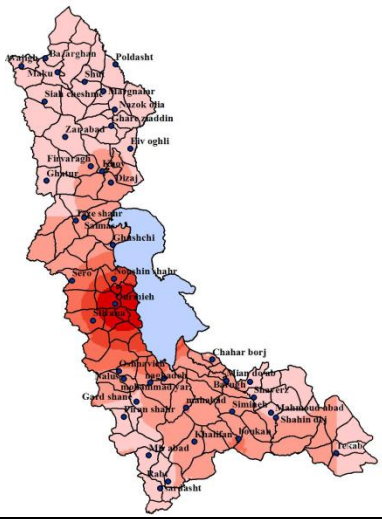
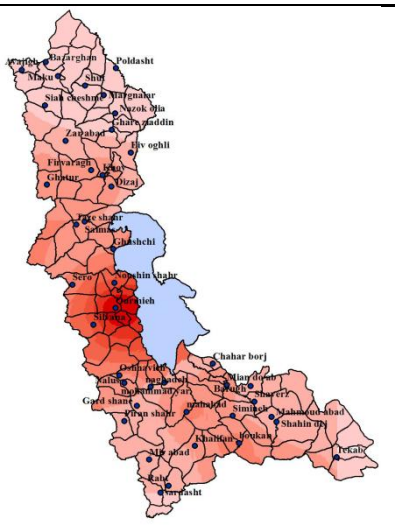
This section analyzes spatial structure resulting from the relationship between these two variables by using population and activity common data. Density of population and density of employment were among the main indicators employed in previous studies as analytical data, which can be easily compared to each other due to their common grounds (area). Thus, global value of Moran based on density were calculated in both dimensions of population and employment.

Table 8 Spatial distribution of population and activity in West Azerbaijan according to General Moran's Model in 1996-2011

Moran's Index	Year	1996	2006	2011
	Population	0.11	0.17	0.21
	Activity	0.02	0.21	0.28

The above table shows that centralization in activity system in 1996 was more than that in population system. From 1996 to 2006, decentralization in activity distribution was more significant, in a way that the degree of activity clustering was more than the degree of population clustering. In the second period, activity clustering in economic sections had an increasing trend while spatial distribution of population had minor changes; that was because the economy of West Azerbaijan province is mostly agriculture-based. Development in agriculture, animal husbandry, and garden products, increase in the share of knowledge-based products, expansion of the conversion and complementary industries in agricultural and husbandry sectors, qualitative development and gradual change of traditional patterns of production, structural reform in agricultural and husbandry activities, as well as conduct of industrial and service activities can cause displacement of population towards the identified sub-centers. In sum, it can be said that population and activity density of the region in 1996 was concentrated largely in rural districts of Bakshloo Chay, Nazloo Chay, Northern Nazloo Chay, Roze Chay, Barandooz Chay, Southern Barandooz Chay, Bash Gala, and Turkaman in surroundings of Urmia; outside Urmia, concentration was denser in the districts of West and East Macrian, Karasani, Western Argorlou, Baroque and Zarinehrood located in the central part of the province, compared to other rural districts in the province. In 2006, in addition to increase in density rate in central areas of the province in rural districts of Bakshloo Chay, Nazloo Chay, Northern Nazloo Chay, Roze Chay, Barandooz Chay, Southern Barandooz Chay, Bash Gala, and Turkaman, increase of density was seen in rural districts of Western and Eastern Makriyan, Kura Sunni, Western Ajorlou, Barough, Zarrine Roud, Dizaj, Firoragh, Gara Ziya'addin, Akhtachi, and Eastern Akhtachi; however, density is higher in central parts of the region. Exactly the same process continues to exist in a 5-year period, i.e. in 2011, with the difference that the rural districts of Urmia (Bekshlou Chay, Nazlou Chay, Northern Nazlou Chay, Roze Chay, Barandouz Chay, Southern Barandouz Chay, Bash Gala, and Turkman) changed to population and activity poles. From the analysis of growth trend of population and activity density during the period under review, it was also concluded that population and activity density tended to extend toward the northern and southern parts of the province with the dominance of the provincial capital Table 9.

Table 9 Map of spatial distribution of two variables, activity and population of West Azarbaijan province during the years 1996-2011

1996	2006	2011
		

Although this hypothesis that population and activity have a significant correlation might seem too obvious at first sight, analyzing the degree of correlation between these two variables can explain the structural differences during 1996-2011 in West Azerbaijan. Thus, correlation between population density and activity in West Azerbaijan was analyzed, which indicated their considerable change in the same period. As the results obtained from Moran's method indicated, there was a huge difference between the structure of population and activity in 1996, but the similarities in distribution of these two variables gradually increased and indicated a degree of

clustering. According to Table 11, correlation between the independent variable of activity and the dependent variable of population was 0.958 in 2011. The coefficient of determination was 0.917 in 1996, which indicates that 91% of spatial distribution of the population was influenced by activity. Thus, there was high correlation between the structure of population and employment in West Azerbaijan province and the important point is that this correlation increased over time.

In this research, the population variable is the dependent variable, and the independent variable. In simple linear regression, if y is dependent variable (population density) and x is an independent variable (activity).

Positive coefficient x indicates that the dependent variable directly correlated with the independent variable, and the negative coefficient means that the independent variable was not correlated.

The equation derived from the application of the geographic weighted regression model population and activity is as follows:

Table 10 Geographically weighted regression of population and activity

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2.016 E11	1	5.836E11	1422.133	.000[a]
Residual	9.7646 E10	112	4.104E8		
Total	6.296E11	113			

$$Y=2.02\ x +9.7765 \qquad (9)$$

In the above equation, the coefficient x includes indexes of population density, distribution of population centers, degree of employment in agricultural, industrial, and services sub-sectors and measures the existence of meaningful relation between population and activity variables for the study period; however, the equation of correlation between these dimensions in each period follows the following formula:

Table 11 The correlation equation in three years 1996, 2006, 2011

1996	R^2 = 0/9123	y = 0/2586x + 5/7543
2006	R^2 = 0/9378	y = 0/3182x + 4/543
2011	R^2 = 0/95463	y = 0/3539x + 4/6066

Also, impact factor of the variable of activity on the variable of population was analyzed; based on positiveness of the coefficient x and the positiveness of the median, we can conclude that the variable of population directly correlated with the dependent variable of activity in West Azerbaijan province.

Table 12 The range of effects of each activity variable on the population variable

	1996	**2006**	**2011**
Minimum	-0.083	-0.579	-0.033
Median	0.09	0.012	0.026
Maximum	0.021	0.025	0.32

To examine correlation between two variables of population and activity, estimations was calculated separately for each rural district; and the impact of the related coefficients of activity and population variables were presented on the geographic map by GIS software. As it can be seen, the activity variable had the highest impact on population variable in central parts of the province in rural districts of Bakshloo Chay, Nazloo Chay, Northern Nazloo Chay, Roze Chay, Barandooz Chay, Southern Barandooz Chay, Bash Gala, and Turkaman; this impact was lower in rural districts of Western and Eastern Makriyan, Kura Sunni, Western Ajorlou, Barough, Zarrine Roud, Dizaj, Firoragh, Gara Ziya'addin, Akhtachi, and Eastern Akhtachi; the more we moved to other rural districts, the degree of the impact decreased.

Table 13 Correlation between population and activity dimensions during the years 1996-2011 in terms of village

Density of activity 2011	Density of population 2011	Density of activity 2006	Density of population 2006	Density of activity 1996	Density of population 1996	Sector (x=std)
Rozeh Chai Bar Anduz Chai Bash Ghalee (-2.37) Bar Anduz Chai (-2.29) South Bar Anduz Chai (-1.71) Gare Goyun East Ghachlerat (-1.99)						< -2.58 (Negative Correlation with the level of 99%)
West Akhtachi (-1.96) Torkaman Gare Su (-2) Rozeh Chai Zangbar (-1.71)	Rozeh Chai Zangbar (-2.31) Kenar Bourun Feiz Allah Beighi (-2.29) West Makrian	Rozeh Chai Bar Anduz Chai Bash Ghalee (-2.28) Bar Anduz Chai Dizaj	East Ghachlerat Zola Chai (-2.17) Koreh Sonni Lakestan (-2.11)	North Makrian (-2.15)	West Makrian (-2.08) Bigham Galee (-2.01) Zarrine Roud (-2)	1.96 <-x< -2.58 (Negative Correlation with the level of 95%)

Zola Chai Taftan (-2.29) East Ghachlerat Ansar (-2.37)	(-2.09) Bigham Ghalee (-2.021) Zarrine Roud (-2.5)	Feiz Allah Beighi (-2.28)				
Cheshme Sara North Hajilar (-1.79)	Kenar Bourun (-1.87)				Middle Marhamat Abad (-1.87) (-1.68)	1.65 <-x< 1.96- (Negative Correlation with the level of 90%)
Marhamat Abad (1.76)						1.96 <+x< 1.65+ (Positive Correlation with a Confidence level of 90%)
	Dasht (2.01)	Lakestan (2.53)	Dizaj (2.53)	Marhamat Abad (1.74) North Hajilar (1.85) East Manghevar (2.12) South Bar Anduz Chai (2.37)	Yolaghaldi (2.52)	2.58 <+x< 1.96+ (Positive Correlation with a Confidence level of 95%)
Oshnavieh (3.26) Solduz (5.93)			Eyv Oghli (3.06) Choras (3.7)	South Chalderan (3.01) Bradust (5.38) Bash Ghalee (7.68)	Dizaj (2.7) Nazlou Chai (3.7) Feiz Allah Beighi (5.48)	2.58> +x (Positive Correlation with a Confidence level of 99%)

7. RESULT AND CONCLUSION

The present study aimed to examine the manner of spatial distribution of two variables of population and activity, and also to analyze the degree of correlation between these variables based on spatial structure of the province during 1996 to 2011. For this aim, empirical background on the application of population and activity variables was studied; then, based on theoretical background of the study, rank-size method was used to analyze settlement system of West Azerbaijan; kernel density and Moran methods were used to analyze population data; and local and global Moran were used to analyze activity data; and finally, regression method was used to analyze correlation of the two variables of population and activity.

The study of variables of population change, population density, and activity variable (employment in agriculture, industry, and service sections) during 1996 to 2011 revealed their remarkable impact on analysis of trend of change in spatial structure pattern derived from these two variables because the result of rank-size and kernel density method showed that distribution of population and urban system in West Azerbaijan province changed during the studied period from monocentric in 1996 to clustered in 2011. That is because rural districts locating in central part of West Azerbaijan were under influence of the primate city and the metropolis of the region (i. e. Urmia), which caused increase of density in central part of the province. However, density increased in northern and southern parts of the province due to the increase in the number of cities and rural districts in the period under study and the growth rate of 1.13% in the population. The results of spatial auto-correlation analysis of the population showed clustered distribution of the population with concentration on three urban areas in center, south, and north of the province; these clusters turned from one urban center (Urmia) to three centers. In section 2, spatial structure of activity was measured by using local and global Moran. Accordingly, the distribution system of activity, like the population, shifted from centralized to clustered over time, while the total number of global Moran declined from 0.02 in 1996 to 0.28 in 2011. This means that activity structure of the province did not have an accidental, dispersed, and monocentric pattern although activity system in three sections of agriculture, industry, and service was clustered. We can explain this trend in this way that the relation between activity and population changes during the reviewed period was meaningful during the reviewed period although people's tendency toward centralization in northern and southern parts of the province increased. As the result, the first hypothesis was confirmed.

On the other hands, examining the correlation of two variables of population and activity with spatial structure revealed that the impact of activity sub-sectors especially sub-sectors of agriculture on spatial structure of the province was more than the influence of population

variable; since, correlation between the independent variable of activity and the dependent variable of population was 0.954 in 2011. The coefficient of determination was 0.917 in 1996, which indicates that 91% of spatial distribution of the population was influenced by activity. Thus, there was high correlation between the structure of population and employment in West Azerbaijan province; the important point is that this correlation increased over time. Development change trend of settlement centers in the studied area tended to decentralized convergence, which accompanied by the increase in population and activity density. Decentralized pattern of population density in this area was due to an increase in employment in economic activities to benefit from agricultural lands and industrial resources and services, which confirmed the second hypothesis implying the impact of population and activity variables on the spatial structure of West Azerbaijan province.

Based on the results of the research methods, it can be said that the spatial structure of West Azerbaijan was influenced by two variables of population and activity, transformed from absolute centralization to a degree of clustered in both dimensions during the years 1996 to 2011. Due to the evolution of homogeneous population and operational spatial structure, it is possible to improve the spatial structure of the province by strengthening the dimension of activity in other centers, changing it to a multi-centric structure.

8. SUGGESTIONS

The trend of spatial changes in the studied area had fluctuations during 1996 to 2011; thus, it is necessary to manage regional development through codifying urban and regional programs to improve quality of life in the given area. Suggestions are given regarding each policy in the studied area:

- Utilizing peripheral capacities for private sector investment, establishing export-oriented industries, establishing downstream industries of mining and other activities in order to diversify the labor market of the province and contribute to the productive and sustainable employment, and ultimately, development of the province and country.
- A number of activity sub-centers have considerable economic power in West Azerbaijan, which can accommodate many jobs and people. Thus, decentralization policies can be oriented in a way so as to direct jobs and people towards these centers.
- The spatial structure of population and activity in the province is moving towards a clustered pattern. Thus, a multi-centered structure can be reached by identifying sub-centers capable of economic activities.

Such a multi-centered structure would definitely need basic infrastructures in sectors of industry, agriculture, service, and other planning areas. With the advent of activity sub-centers, as well as decentralization of the population, regional management should lead the population to the activity centers in order to prevent the formation of informal settlements of regional centralization.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

REFERENCES

[1] Ahmadi Poor Z, Hafezniya M, Mohammadpoor A. The economic and social impact of reopening the borders (Sample: the Extortioners at the Border of Iran and Turkmenistan), Quarterly Journal of Human Geography, 1997, Vol. 65, pp. 1-22.

[2] Anas A, Richard A,Kenneth AS. Urban spatial structure, Journal of economic literature, 1998, Vol. 36, Issue 3, pp. 1426-1464.

[3] Anselin L. Spatial Dependence in Linear Regression Models with an Introduction to Spatial Econometrics, 1995, pp. 237-289.

[4] Batten DF. Network Cities: Creative Urban Agglomerations for the 21st Century, Urban Studies, 1995, Vol. 32, pp. 313-327.

[5] Bertaud A. The spatial organization of cities: deliberate outcome or unforeseen consequence?, Unpublished paper, 2004.

[6] Borsdorf A. On the way to the post-suburba? Changing structures in the outskirts of European cities, Insights on Outskirts, 2004, No. 26.

[7] Burger M, Meijers E. Form follows function? Linking Morphological and functional polycentricity, Urban Studies, 2012, Vol. 49, Issue 5, pp. 1127-1149.

[8] Cindy Fan C, Scott JA. Industrial Agglomeration and Development: A Survey of Spatial Economic Issues in East Asia and a Statistical Analysis of Chinese Regions, 2003, Vol. 79, Issue 3, pp. 295-319.

[9] Dadashpoor H, Rafi'iyan M, Afagpoor A. An introduction to the fundamentals of urban development, Deputy of Education and Research of Urban and Rural Management, Organization of municipalities and government agencies, Institute of Art and Culture Jahad University, 2000, No. 14, pp. 1-14.

[10] Galster G, Hanson R, Ratcliffe MR, Wolman H, Coleman S, Freihage J. Wrestling sprawl to the ground: defining and measuring an elusive concept, Housing policy debate, 2001, Vol. 12, Issue 4, pp. 681-717.

[11] Greca P, Barbarossa L, Ignaccolo M, Inturri G, Martinico F. The density dilemma. A proposal for introducing smart growth principles in a sprawling settlement within Catania metropolitan area, Cities, 2011, Vol. 28, pp. 527-535.

[12] Green N. Functional poly-centricity: a formal definition in terms of social network analysis, Urban Studies, 2007, Vol. 44, Issue 11, pp. 2077-2103.

[13] Guerrero DC, Sero MA. Spatial distribution of patents in Spain: determining factors and consequences on regional development, Regional Studies, 2010, No. 31, Vol. 4, pp. 381-390.

[14] Guy D, Hapkinz M, Mac Granahan D. Human Index assessment and society development, Translation of Search and Assessment of Countries Problems, Country & Development, 1992, No. 4.

[15] Hajipoor K, Zebardast E. The analysis and presentation of a model for the urban system of Khuzestan province, Journal of Geography and Regional Development, 1995, Vol. 23, pp. 1-12.

[16] Hall PG, Pain K. The polycentric metropolis: learning from mega-city regions in Europe Routledge, 2006.

[17] Hamasi M. Discussion Based on effective factors of man

power migration in Iran, Iranian Geography's Association Publication (Review), First Period, 1981, No. 3.
[18] Hansen N. Region Politics of Changing World, Translation of Parviz Ejlali, Publication of Plan & Budget Department, 1997.
[19] Harvey D. City and surplus, The Concept of the City, Translated by Behrouz Mangadizadeh, Tehran, Urban and Regional Studies Group, 2006.
[20] Healey P. The treatment of space and place in the new strategic spatial planning in Europe, International Journal of Urban and Regional Research, 2004, No. 28, Vol. 1, pp. 45-67.
[21] Hess G, Daley SS, Dennison BK, Lubkin SR, McGuinn RP. Morin VZ, Wrege BM. Just what is sprawl, anyway, Carolina Planning, 2001, Vol. 26, Issue 2, pp. 11-26.
[22] Hilhorest G. Region planning, translation of Qolam Reza Shiraziyan, Plan & Budget Department, Tehran, 1991.
[23] Kazemian GR. Explaining the relationship between governance structure and urban power with space organization, PhD. thesis in Geography and Urban Planning, Faculty of Humanities, Tarbiat Modares University, 2004.
[24] Kloosterman RC, Lambregts B. Clustering of economic activities in polycentric urban regions: the case of the randstad, Urban Studies, 2001. No. 38, Vol. 4, pp. 717-732.
[25] Kostaki A, Byron K, Agorastakis M. Effects of Immigration on Population Growth and Structures in Greece – A Spatial Approach, 2009, pp. 167-195.
[26] Krugman P. Increasing returns and economic geography, 1991, Vol. 99, pp. 483-499.
[27] Lee B. Edge or edgeless cities? Urban spatial structure in US metropolitan areas, 1980 to 2000, Journal of Regional Science, 2007, Vol. 47, Issue 3, pp. 479-515.
[28] Lewis G, Brabec E. Defining the pattern of the sustainable urban region - development of regional measurement methods, Washington, International Study Group for the Multiple Use of Land Bellingham, 2002.
[29] Lomeli L, Toezer T. Actors and factors – bridging social science findings and urban land use change modeling, Paper presented at the International Congress on Environmental Modelling and Software Integrating Sciences and Information Technology for Environmental Assessment and Decision Making, Barcelona, Spain, 2008.
[30] Lu DS, Tian HQ, Zhou GM, Ge HL. Regional mapping of human settlements in southeastern china with multi sensor remotely sensed data, Remote Sensing of Environment, 2008, Vol. 112, No. 9, pp. 3668-3679.
[31] Nemati M. Analysis of physical development in three areas of the city of shushtar by using the hybrid Model: TOPSIS – AHP, Zagros Geographic Quarterly, 2014, Vol. 6, Issue 20, pp. 59-74.
[32] Papoly Yazdi MH, Rajabee Sanajardy H. Urban and Suburb Theories, Samt Publication, Tehran, 2003.
[33] Poelmans L. Complexity and performance of urban expansion models, 2009, Vol. 34, pp. 17-27.
[34] Pontes J. A nova Geografia Económica, 2009, Vol. 21, pp. 54-58.
[35] Rahnema M, Biranvandzade M, Sorkh-Kamal K. Comparative analysis of the spatial structure of Razavi, North and South Khorasan Province, with an emphasis on urban centers, Geography Quarterly Journal, 2000, pp. 1-19.
[36] Sabagh Kermani M. Analysis of regional inequalities of employment in Iran's provinces, Modares of Humanities Journal, 2001, Vol. 5, No. 19, pp. 1-21.
[37] Samie Nasab M, Torabi M. Indicators and demographic policies in Iran Journal of Second Harvest/ Seventh Year)new period(serial numbers 11 and 12, 2010, pp. 1-10.
[38] Sarafi M. Fundamentals of regional development planning, Tehran: Organization for Management and Planning of the Country, 2000.
[39] Schwanen T, Deileman FM, Dijst MJ. The impact of metropolitan structure on commute behavior in the netherland: a multilevel approach, Growth and Change, 2004, Vol. 35, pp. 304-334.
[40] Shakoui H, Ashaf ol Sadat B. Function of middle cities in regional development - case of Najaf Abad and Khomeini Shahr, Modarres Magazine, 1998 , No. 8, Tarbiat Modarres University.
[41] Singh R. Urban development challenges, risks and resilience in asian mega cities, 2014, pp. 1-488.
[42] Statistical Centers of Iran. General Census of Population, Agriculture, Industry, Services Culture of Countries, West Azerbaiijan Province, Plan and Budget Department, 2003.
[43] Veneri P, Burgalassi D. Questioning polycentric development and its effects. Issues of definition and measurement for the Italian NUTS-2 regions, European Planning Studies, 2012, No. 6, pp. 20-37.
[44] Vinoth K. Spatial-temporal analysis for monitoring urban growth, a -case study of Indore city, Journal of the Indian Society of Remote Sensing, 2007, Vol. 35, pp. 1-15.

AUTHOR (S) BIOSKETCHES

H. Dadashpoor., *Associate Professor, Urban and Rgional Planning, Faculty of Art, Tarbiat Modares, Tehran, Iran*
Email*: H-dadashpoor@modares.ac.ir*

N. Ghasemi., *Expert Tarbiat Modares, Urban and Rgional Planning, Faculty of Art, Tarbiat Modares. Tehran, Iran*
Email: *Nasim.ghasemi67@gmail.com*

HOW TO CITE THIS ARTICLE
H. Dadashpoor., N. Ghasemi., (2017). Changing regional spatial structure of the population and activity, the case of west Azerbaijan Province, Iran. Int. J. Architect. Eng. Urban Plan, 27(2): 137-151, December 2017.

URL: http://ijaup.iust.ac.ir/article-1-207-en.html