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A Study on Spatial Distribution of Young Rural Population of Iran during Three Censuses of 1996, 2006 and 2011 Using Gis

[1]Ammar Rahmani, [2]Abdolreza Farajirad (PhD) and [3]Bizhan Rahmani (PhD)

[1]PhD Student in Geography and Rural Planning, Islamic Azad University, Science and Research branch, Tehran.
[2]Faculty Member, Department of Geography, Islamic Azad University, Science and Research Branch, Tehran.
[3]Faculty Member, Shahid Beheshti University, Tehran.

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ABSTRACT

Among the typical features of developing countries is inflamed Wertheim's index, that is, a high percentage of population aged lower than 15. Inflamed Wertheim's index is faced by the developing countries as a complex social problem. Such condition both has immediate negative effects that are felt in current life of people, and results in impaired implementation or failure of many long term plans in future (Saei Orsi, 2009: 115). Given spatial distribution of population is one of the important factors determining population structure (Mohajerani, 2010: 45), knowledge of how young and aged populations are distributed in different years, and the results from the study of the trends of such distribution can be used in macro economic planning. The present research studies trend of spatial distribution of population by study of Wertheim's index of Iran's rural population as measured in three censuses of 1996, 2006 and 2011, using GIS. The results from this research showed that these three censuses followed a cluster pattern, which means that, in terms of Wertheim's index, young population was more densely concentrated western, southern and southeastern part of Iran, with young population not being distributed in Iran in a balanced manner; and, as the time have passed, young population's density and concentration has decreased in the said regions.

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INTRODUCTION

Ageing population and young population pose different problems in terms of social and economic planning, and especially national investments. The age group of 15-64 constitute the active population of every country, and it is this group that takes part in national production, and other age groups, i.e., children aged under 15, and elderly people aged 65 years and older, are usually mere consumers, and therefore, the government has to use the outcome of production and work of the age group of 15-64 to provide for educational, health and medical services and employment for youths and social security services for the age group of over-65 years old [6].

Given Iran's population is distributed in an imbalanced manner [26], therefore, regional demographic information are necessary for planning regional development, and demographic features of each region constitute the bases of the planning for socio-economic development of that region [3].

Due to their vital role in the country, and also, because a significant portion of population resides in these regions, rural areas require careful planning so that these regions would be developed comprehensively [16]. Therefore, this research aims to study the Wertheim's index of Iran's rural population, and evaluate its distribution trend across the country in the period from 1996 to 2011.

Main Questions of Research:

This research aims to answer to three main questions:

1. Is there spatial difference in Iran in terms of Wertheim's index?
2. Does the spatial difference in terms of Wertheim's index is between the center and the periphery?
3. Does the spatial difference in terms of Wertheim's index is increasing over time?

Method:

Spatial analysis is a series of analysis methods, the results of which vary as the location of the studied objects changes [20]. Spatial analysis is the heart of GIS, because the whole operation related to transformation

Corresponding Author: Ammar Rahmani, PhD Student in Geography and Rural Planning, Islamic Azad University, Science and Research branch, Tehran
E-mail: rahmani.ammar@gmail.com

and combination of methods, which can be applied to geographical data for use of GIS as a support for decision making and identifying patterns and anomalies of data, are implemented in this process. In fact, it can be said that spatial analysis is a process by which raw data are converted to useful information, creating added value for original data. Among the most important objectives and achievements of spatial analysis are contributions to better and more effective scientific discovery and decision making [20].

In this research, library source, and statistical data were used. Statistics on Iran's rural population in 1996, 2006 and 2011 were obtained from census bureau, and ArcGIS 10.2 software was used for objective data analysis. Statistical data were then connected to urban areas using this software. Demographic indices were surveyed and analyzed using this software in three following steps:

1. Spatial Autocorrelation:

One of the interesting and growing branches of spatial statistics is spatial autocorrelation. Autocorrelation concerns the relation between residual values along the regression lines. Strong autocorrelation occurs when values of a variable, which are geographical close, are related to each other. If the features, or their associated values, are randomly distributed in the space, there must apparently be no relation between them [19].

Spatial autocorrelation is a valuable tool in the study of how spatial patterns change over time. The results from analysis of spatial patterns provides a full knowledge of how such patterns have changed since a time in the past to the present, and will change from now until a time in future. This statistic gives a numerical space (z-score), which can be used to measure the degree to which features or spatial data tend to be clustered together or dispersed.

If these values are calculated for different years, and compare them, it can be seen if the variations in the intended phenomenon tend towards further dispersion or further clustering [19]. When data shows spatial clustering, there are in fact certain spatial processes behind such clustering, which cause such autocorrelation [19].

Statistical Bases:

This tool in fact calculates Moran's statistic or Moran's index, and evaluates significance of the calculated index using z-score and p-value. Moran's index for spatial autocorrelation is calculated as follows:

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} wijzizj}{S_o\sum_{i=1}^{n} Z_i^2}$$

Here, z_i denotes difference between eigenvalue of feature i and its mean value ($x_i - \bar{X}$). It is spatial weight between features i and j. n denotes the total number of geographical features existing in the used stratum, and S_O represents to sum total of spatial weights.

$$S_o = \sum_{i=1}^{n}\sum_{j=1}^{n} wij$$

Standard z_I score for Moran's statistic is calculated as follows:

$$z_I = \frac{I - E[I]}{\sqrt{V[I]}}$$

Where

$$E[I] = -1/((n-1))$$
$$V[I] = E[I^2] - E[I]$$

(Asgar, 2011: 60).

2. High/Low Clustering Analysis:

High/low clustering analysis refers to measuring density and clustering of high or low values of a variable within the studied area. For example, this analysis can be used to study number of referrals to emergency ward of hospitals and to predict probability of occurrence of a particular disease or health conditions in some parts of the studied region [19].

If z-value is positive, then, it is concluded that high values of the studied parameters have been clustered in the studied regions. If z-value is negative, then, it is concluded that low values of the studied parameters have been clustered.

3. Hot Spot Analysis:

Hot spot analysis calculates spatial statistic of Getis-Ord Gi for all features existing in data. Z-score calculated shows where in the data the high or low values are clustered. This tool in fact looks at each feature within the framework of the features that located in its neighborhood. If a feature has a high value, it will then be interesting and important, while a hot spot in itself may be statistically insignificant. For a feature to be considered as a hot spot, and statistically significant, both that feature and its neighboring features must have high values. Local sum of a feature and its neighbors are relatively compared with sum total of the features.

When local sum of a feature and its neighbors is highly and unexpectedly different from the expected local sum, and when the difference is so much that it may not be considered to be caused by accident, then, z-score is obtained[19].

Statistical Bases:

Getis-Ord Gi statistic is calculated as follows:

$$G_i = \frac{\sum_{j=1}^{n} wijxi - \bar{X}\sum_{j=1}^{n} wij}{s\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{ij}^2 - \left(\sum_{j=1}^{n} wij\right)^2\right]}{n-1}}}$$

Here, X_j denotes eigenvalue of feature J, X_j is spatial weight between i and j, and n and j are equal to total number of features.

$$\bar{X} = \frac{\sum_{j=1}^{n} xj}{n}$$

$$s = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2}$$

Since G_i is itself a type of z-score, there would be no need for calculation [19].

Analysis of these results showed that statistic G_i, which is calculated for every feature existing in data, is a type of z-score. For positive and statistically significant z-score, the higher the z-score, the more highly the high values are clustered, and the higher number of formed hot spots is. For negative and statistically significant z-score, the lower the z-score, the more highly the low values are clustered, and the higher number of formed cold spots is [19].

Statistical Population:

In this research, statistical population comprised all rural areas in Iran in 1996, 2006 and 2011, which rural areas were studied according to the latest administrative divisions in Iran, and Wertheim's index and ageing index were calculated for them.

Demographic Indices:

Knowledge of population composition and distribution plays a decisive role in its comprehensive growth and development. Such data and statistics enable governments to organize micro and macro plans on social, economic, cultural, and even administrative affairs of society [1]. If demographic indices are not considered in regional and national policy making and planning, capabilities of a region will not be consistent with its population, which, in turn, poses many difficulties to achievement of balanced development on national scale [8]. Therefore, given the important role of demographic indices in population studies, it is necessary here to provide a definition of Wertheim's index.

Theoretical Framework:

Wertheim's Index:

Wertheim's index is given by dividing population of people aged 0-14 by the total population.

Young Population:

Today's youth have an important role to play in achieving the country's development because they want to survive and live in the community. Recently, many organizations and governments have focused their attention on the youth of their community as the young population is considered as one of the indicators of sustainable development [24].

Sustainable rural development literature suggests that rural youth have been considered from various aspects such as citizenship, human rights and the right to residence, the right to development, quality of life, sustainable livelihoods, basic needs, as well as vulnerability, social justice and poverty perspective, and the role of youth in the development process, resources and benefits; to the extent that the youth are said to the drivers of development process and architects of the Home (land, territory and village) [2].

Decreased median age of population, especially from 1976, intensified problems resulting from increasing growth of population. Statistics from different censuses show that Iran's population had a young population composition, which composition gradually become more imbalanced by 1966, that is, percentage of active population (people aged 15-64) decreased from 53.8% to 50% of total population in 1966. This resulted in increased burden of financial support requirements, and increased investment in different areas related to youths. However, adoption of certain population control policies, which had a rather encouraging nature (first population control program, 1967), reduced fertility rate to a significant extent, so that annual growth rate reduced from 3.1% in 1956-1966 period to 2.7% in 1966-1976 period. Simultaneously, percentage of active people increased from 50% to 52% of total population in the same period, which suggests that not only the

population became more balanced, but also fertility rate reduced, and basis of population pyramid became smaller. However, from 1976, population growth increased at a more rapid pace, resulting in increased Wertheim's index and reduced active population. After 1978 Islamic Revolution, this trend continued even at a more rapid pace until the end of Iran-Iraq war, and the start of the second population control program. From 1988 onwards, population growth gradually reduced. However, Iran still has a young population, which has consequences [10].

Rural-Urban Migration of Youths:

Failure to distribute services and facilities logical, and lack of well-though plans result in imbalanced geographical distribution of population, which, in turn, results in unreasonable use of natural resources, investments, and consequently, movement of skilled and unskilled manpower, and unequal distribution of provincial, urban and rural services and facilities [15]. Given urban population-rural population ratio has inverted, and a large portion of urban population comprises rural migrators, rural-urban migration has become very important. Having migrated to urban areas, the rural population that had been a productive population until three decades ago, is now doing official jobs or unofficial jobs such as pedlary and dealership [21]. Rural-urban migration results in increased number of young male population in large cities, unbalancing male-female ratio of urban and rural populations [11]. Also, youths' abandoning of the rural areas results in low manpower efficiency, and low efficiency of agriculture, and abandonment of farmlands, and therefore, underuse of resources and installations [18].

Drivers of Rural-Urban Migration of Youths:

Drivers of Migration vary from one person to another depending on environment and temporal and spatial conditions. Such drivers of migration come from both destination and point of origin (Lahsaeizadeh, 1989: 82).

Such factors as reduced financial resources, low attention to agriculture sector, mechanization of agriculture, and consequently, limited job opportunities in this sector, and excessive unemployment, lack of proper facilities for flourish of individual and social creativities, frequent natural disasters and shortage of livelihood and welfare facilities [5], unemployment, low income, lack of recreational amenities, etc., all of which prevent rural youths from living a good life, contribute to rural-urban migration of the youth [23]. Attractions are mainly better employment opportunities, higher income, the existence of cultural activities, entertainment centers, living and working environment as well as good conditions of housing and welfare services and vocational training, which are rather concentrated in cities [5]. These factors are among the most important drivers of migration of rural youths to other residential centers in Iran [17].

According to the above said, despite the weakness of infrastructure in villages of Iran, which have been an issue since the past and have persisted to date, and lack of jobs for rural youth, the young, active, dynamic, life-saving power of rural development unfortunately become a burden due to the current conditions, and therefore, migrate from, or better to say, flee their villages, to save themselves. But the question remains what problems continuation of such condition will create.

Problems caused by Rural-Urban Migration of Youths:

Given the youth tend to migrate more than any other age group, such tendency has important long term effects for rural communities, because as the youth migrate, fertility rate decreases in rural communities, and therefore, dynamic rural population decreases in rural areas, which results in reduced production, weakened economy, and static social and cultural condition in rural areas [21]. Such pattern of migration causes many problems both in point of origin, and in destination, which include many disorders resulting from additional pressure on sources and facilities, unemployment, and insufficient job opportunities, shortage of residential and educational spaces, air and environmental pollution of urban communities, substitution of aged and female manpower for young and male manpower, reduced young manpower, and reduced population growth, increased economic dependency of rural areas, etc. [22]. Overall, it can be said that migration empties rural area of valuable human capitals [4].

Wertheim's Index Findings:

Moran's Spatial Autocorrelation Analysis:

As seen from diagram 1, in 1996, Moran's value for Wertheim's index is 0.648240, which is positive and close to 1. If this data was supposed to be normally distributed in the space, it must take value of -0.002551. Therefore, it can be concluded that has spatial autocorrelation. Also, z-high score and very low p-value suggest autocorrelation of the data. As seen from diagrams 2 and 3, Moran's index for 2006 and 2011 is also positive, which shows the data had autocorrelation in these two censuses; further, high z-value and low p-value suggest high autocorrelation between the data. However, trend of diagrams suggest reduced z-score in 2006 and 2011; therefore, although Moran's index for Wertheim's index is still in cluster state in graphical terms, which means

data of these three censuses are densely and closely clustered, z-value suggest Wertheim's index is shifting from cluster patter to random and dispersed pattern.

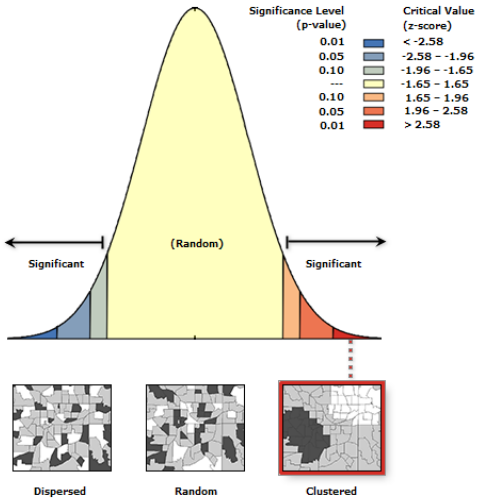


Diagram 1: Spatial correlation of Wertheim Index in 1996.

Global Moran's I Summary	
Moran's Index:	0.648240
Expected Index:	-0.002551
Variance:	0.000406
z-score:	32.292162
p-value:	0.000000

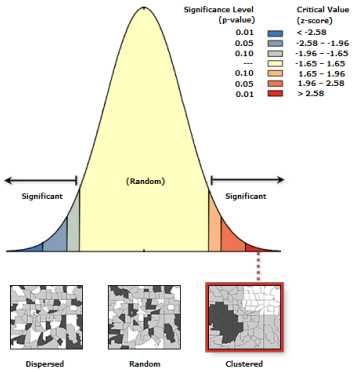


Diagram 2: Spatial correlation of Wertheim Index in 2006.

Global Moran's I Summary	
Moran's Index:	0.453581
Expected Index:	-0.002551
Variance:	0.000407
z-score:	22.620184
p-value:	0.000000

High/Low Clustering Analysis:

High/low clustering analysis measures density and clustering of high or low values of a variable within the studied area. Having calculated Moran's index, we want to see if values that have created in sex index include the high values or the low ones. If z-value calculated is positive, it is concluded that that high values, or values higher than the mean of studied parameter have been clustered in the studied area. If z-value calculated is negative, it is concluded that that low values, or values lower than the mean of studied parameter have been clustered in the studied area. As seen from diagrams 4-6, given value for years 1996, 2006 and 2011 are negative, and considering negative z-value in this research means low value, therefore, this analysis suggest that the highest number of clusters constituting this index in Iran are low values. In graphical diagram also, clustering is located in low area.

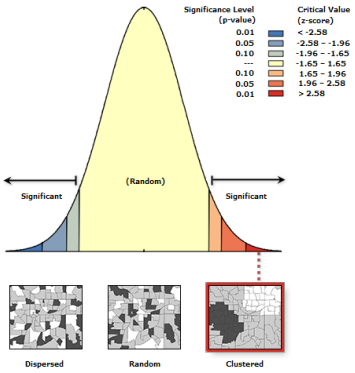


Diagram 3: Spatial correlation of Wertheim Index in 2011.

Global Moran's I Summary	
Moran's Index:	0.442019
Expected Index:	-0.002545
Variance:	0.000405
z-score:	22.090640
p-value:	0.000000

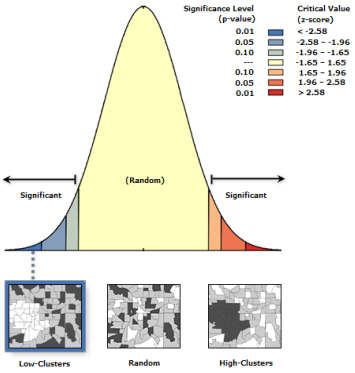
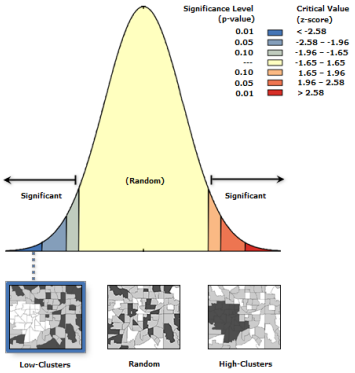


Diagram 4: high/low clustering of Wertheim's index in 1996.

General G Summary	
Observed General G:	0.000001
Expected General G:	0.000001
Variance:	0.000000
z-score:	-5.925872
p-value:	0.000000



Hot Spot Analysis, Getis-Ord Gi:

Having carried out the two above described analyses; this analysis was conducted, which shows the hot and cold spots of Wertheim's index in years 1996, 2006 and 2011. As noted above, hot spots are the highest and cold spots are the lowest values that have created cluster. Hot spots are represented by red spots, and colds ones with blue spots.

As seen from map 1, in 1996, the highest number of hot spots for Wertheim's index relates to small parts of the northeastern and eastern parts of Khorasan Razavi Province, and some parts of Northern Khorasan and Golestan Province; and the highest number of hot spots relates to the whole of Khuzestan, Kohkiluyeh and Boyerahmad, Sistan and Baluchestan, and Hormozgan provinces, as well as southern part of Fars, Kerman, Bushehr provinces, and some parts of Ilam, Lorestan, Kordestan, Kermanshah.

Diagram 5: high/low clustering of Wertheim's index in 2006.

General G Summary	
Observed General G:	0.000001
Expected General G:	0.000001
Variance:	0.000000
z-score:	-7.265113
p-value:	0.000000

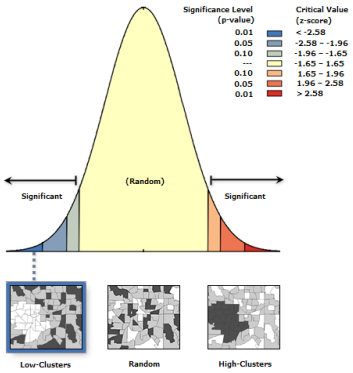


Diagram 6: high/low clustering of Wertheim's index in 2011.

General G Summary	
Observed General G:	0.000001
Expected General G:	0.000001
Variance:	0.000000
z-score:	-7.523821
p-value:	0.000000

These provinces had the highest Wertheim's index in 1996. However, the highest number of cold spots related to central and northern parts of Iran, provinces of Isfahan, Semnan, Tehran, Qom, Markazi, Alborz, Qazvin, Mazandaran, Gilan, and some parts of Ardebil, Zanjan, Yazd, and Southern Khorsasan provinces.

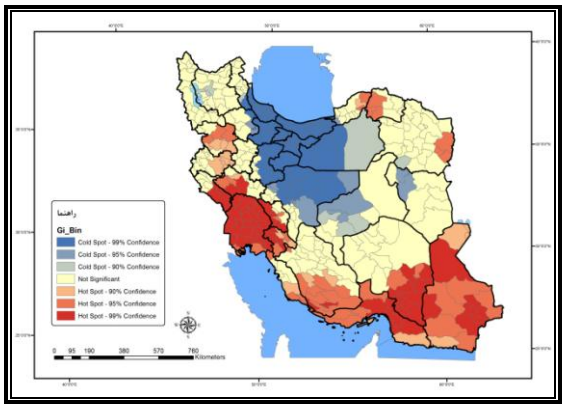
In 2006, hot spots were concentrated in western Iran, in Khuzestan Province, and hot spots increased to some extent in northeast of Iran. The highest number of hot spots related to southeast of Iran, that is, the whole of Sistan and Baluchestan, most parts of Hormozgan and south of Kerman. However, in this year, cold spots decreased to some extent in central regions of Iran. In 2009, in provinces of Isfahan, Semnan, Gilan, Mazandaran, and Markazi, natural growth rate of population was lower than 1%.

Except for Sistan and Baluchestan Province, which holds the record high population growth of over 2.6%, as in the past years, other provinces had population growth of 1-2%.

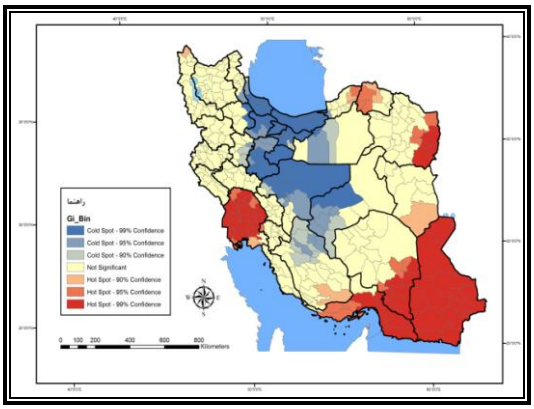
Such trend continues until 2011, when hot spots related to Khuzestan, southern parts of Kerman and Hormozgan in the west, and eastern part of Khorasan Razavi, and some parts of Northern Khorasan and Golestan provinces in the east. However, in this year, the number and dispersion of cold spots increased, to the extent that in addition to central and northern parts of Iran, they appeared in western Iran as well.

These three maps show that in central, and northern part of Iran, as well as some of its western part, Wertheim's index is at its lowest. In other words, the population of people aged 0-14 is very low in these regions, which can be explained by low fertility rate, and rural-urban migration.

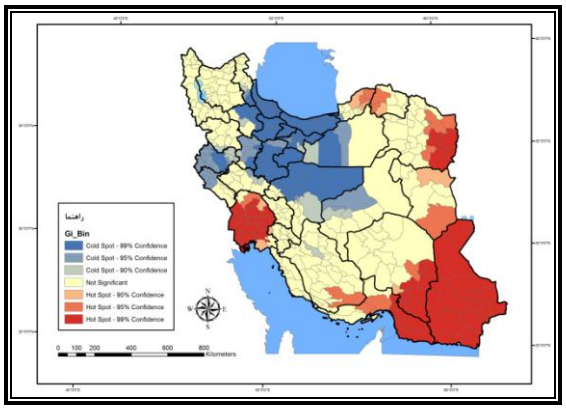
However, in some parts of western, southern and southeastern Iran, as well as some of its eastern parts, young people account for a large percentage of population, which shows that fertility rate is very high in these regions. But the question remains why these regions have a high fertility rate? The answer lies in the fact that these are among poor ones, and also, the fact that tribal beliefs are common in these regions, so the most important reasons for increased Wertheim's index and high fertility rate are poverty and religious and tribal beliefs. However, the extent to which the said reason account for the high Wertheim's index may vary from one place to another.



Map 1: Spatial pattern of Wertheim's index for 1996.



Map 2: Spatial pattern of Wertheim's index for 2006.



Map 3: Spatial pattern of Wertheim's index for 2011.

Conclusion:

Overall, study of population distribution and density patterns is the most essential factor involved in geographical understanding of every territory [15]. Existence of spatial inequalities in term of enjoyment of economic, welfare, and infrastructural facilities has always been one of the most important factors involved in population movements. Iran's population distribution will tend toward serious imbalance on provincial, urban and rural scales in futures. In such case, much of governmental funds will inevitably allocated to construction of infrastructures and provision of services to populations residing in large cities, and therefore, other regions will be depraved of required investment, and spatial inequalities will be intensified. Such inequalities results in movement of manpower and capital [27]. Such uneven distribution and uncontrolled movement of population disturbs administration of urban and rural areas, and sex and age composition of population in different geographical regions, whether urban or rural, and in some cases, it even reduces quality of public health and medical services, *etc*. [15].

Given movements of rural population in Iran from the past times to date, studying movement trends of Iran's rural population is very important. Such studies help planners observe movements of Iran's rural population and also enable them to predict the future movements and take necessary measures.

The higher the old and young population of a country is, the middle age group (15-64) bears a heavier responsibility. Therefore, in low-growth countries, including Iran, where the young stratum, i.e., people younger than 20, constitute half of the population, a large part of creative work force of active population is directed toward supplying the livelihood for the large population of young people. This causes the middle age group to focus on procuring the livelihood, rather than, raising the life quality [6].

In this research, the results from Moran's analysis of Wertheim's index, exhibited in diagrams 1, 2 and 3, shows that the three censuses of 1996, 2006 and 2011 followed a cluster pattern, which means there is concentration in Iran in terms of Wertheim's index, and young population is not distributed in Iran in a balanced manner. Consequently, there is spatial difference in Iran in terms of Wertheim's index. However, although these three censuses show cluster pattern and concentration in terms of Wertheim's index, z-core is decreasing in this index, which means if such trend continues, intensity of concentration will reduce.

Also, the results from hot spot analysis of Getis-Ord Gi statistic, which are shown in maps 1, 2 and 3, suggest that there was spatial difference between center and periphery as the center has a low Wertheim's index and periphery has high Wertheim's index. As a result of such spatial imbalance, the center of Iran has an ageing population, and periphery has an increasingly young population, which causes many problems, including poverty, unemployment, and rural-urban migration. Therefore, birth promotion and prevention policies must be adopted for regions with low and high fertility rate, respectively.

According to the demographic evaluations, if life expectancy is assumed to be 75 years, and 1% in Iran, Iran's population will be 107 million in the last year of the 20-year prospect, of which 14.7%, that is, over 15,500,000 will be the elderly. In other words, it can be said that elderly population of Iran will almost triple within 20 years (2006-2026). According to scientific demographic sources, when 8% of population is accounted for by people aged 65 and higher, or when 12% of population is made up of people aged 60 and older, phenomenon of ageing population will occur. So, from 2021, Iran will be faced with social phenomenon of ageing population, which will be to detriment of the rural area. In the end, some suggestions are made regarding how to prevent migration of active and young population from rural areas, in order to prevent loss of population balance in rural areas.

Suggestions:

1. Understanding the rural young generation and allocating rural facilities and funds in line with expectations of this generation;
2. Development and expansion of crops conversion and packaging industries in rural areas;
3. Prevention of change of use of farmlands and prevention of environmental degradation in rural areas;
4. Payment of long-term and low-interest loans to youths toward creation of job opportunities and entrepreneurship;
5. Development of rural tourism in rural areas as a source of income and employment;
6. Further development of rural areas and provision of health, medical, educational, and insurance services, *etc*., in proportion to the current needs of youths;
7. Investment in agriculture sector, and material and intellectual support of investors;
8. Creation of job opportunities in rural communities in non-agriculture sectors such as small industries and rural industries;
9. Making provisions for future old population in rural areas and providing social security for them.

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