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PHYSICAL QUANTITY MEASURES OF ZAHEDAN CITY WITH EMPHASIS ON QUANTITATIVE MODELS

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Abstract

Most cities of Iran several decades before were having balanced growth, But in recent decades due to the presence of the adsorbent factors in the cities and push factors in villages has suffered a serious challenge for city growth. Zahedan city in its life span of 90 years has experienced different processes of physical development and has suffered imbalanced growth. This research work is based on cross sectional and library study with the help of Moran, holder and extracting GIS layers to evaluate the physical form of assessing the city. The results show that Zahedan city didn't have any aggregate growth: Based on the results obtained from the Holden model 78% of the physical growth from 1365 to 2011 occurred due to population growth and 22% for the remainder are horizontal and Aspral, these are biased coefficient of Moran towards the negative sign of growth of the town. However, given the current growth pattern of the city, which is more sporadic and In order to prevent and mitigate such problems with urban growth, which is influenced by the pattern of its spread a radial pattern desired to focus its future expansion was predicted. To research this aspect one should use time and place priority as well as focus on development with context of user using smart compact city model, cross communicational and diagonal models. In this case, the reversal of the current trend of urbanization will take precedence over the city.

Key words: Physical form, Zahedan, Holdern model, Moran coefficient.

1. Introduction

In recent decades, the growth of cities in Iran is an issue of concern, particularly given the necessity of physical needs which is quite important in its scientific context (bagheri 2001:6). However nowadays most of developing countries are not satisfied with their process of expansion in its space and inhabitants (zabardast 2004:24). In fact, development and growth of cities with proportion to their size has caused many issues such as marginalization (shiea 2006:24). The main problems of uncontrolled urban growth of suburban development has created problems such as Physical abnormalities, malformations facilities, economic damage and environmental pollution (Ali Akbarie 2004:49). So despite these flaws, urban spaces were unable to appropriately responding the needs of rapid urbanization. As the government's lack of basic urban planning growth and urbanization, this process has led to retardation as growth planning is not only building homes and housing peoples but is to meet their daily needs and requirements such as welfare, education, health, recreation etc. (Meshhadizadeh dehghane 2004:421).

There is been a rapid growth in the global population since past few decades. During the time period from 1990-1950 global population has tripled rising from 730 million to 302 billion people. Keeping this in mind it's predicted that global population in between 1990-2020 will rise up to 6.4 billion peoples. It is estimated that about 93 percent of this population increase will occur in developing countries (Davos and Werkodi 2014:1-3). Therefore, it is necessary to take drastic measures for accommodating this additional population.

Zahedan city has civil services, industry, economy growth factors which makes it attractive to peoples and as one of the main poles of population attraction in the region, it has grown considerably in recent years. This growth is driven by a growing population of immigrants, leading to unplanned constructions and large changes in the structure of space - the physical expansion of the city and surrounding farmland. It seems that in the future, as in the case of implementing a specific strategy and direction in determining the optimal expansion. It seems that in the future, as in the case of implementing a specific strategy and direction in determining the optimal expansion of cities, not only many agricultural lands surrounding cities will go under construction but also providing services and facilitating public infrastructure needed by citizens will also be difficult.

These changes are the main cause of important problems in urban planning as due to population growth and lack of infrastructures are the main causes. Optimal switching directions of development and how the current needs and anticipate future requirements should be thoroughly studied. But in practice, in most cases this expansion is due to the lack of appropriate tools and only relying on visual observations and traditional methods in urban planning due to lack of proper insight of optimal guidance and in some cases is far from the truth. It is the first attempt to determine the pattern of the city growth using geographic information systems (GIS) and different models as a complementary tools to study different ways of development of the city. This will help to protect farm lands surrounding the city from land speculation and to prevent any problems in providing civil services and infrastructures to citizens. As it' s practically proven that a guided and thoughtful urban growth planning will reduce many problems in future.

2- Geographical and climatic characteristics of the city (area of study)

2-1- Condition

Zahedan is located in Sistan-Baluchestan province of Iran, towards east it's attached to Afghanistan and Pakistan and from north it's attached to Zabol city, from north-west to Kerman province, from south west city or Iranshahr and from khash situated to the city of khash. The approximate area of Zahedan city is 7,300 hectares with longitude of 60 degrees 51 minutes 25 seconds east and latitude of 29 degrees 30 minutes 45 seconds towards north and is 1999 meters above sea level. Map (3.1) shows the provincial location of Zahedan city. The political and geographical location of Zahedan city is quite suitable for growth and development.

2-2-The evolution of the population in Zahedan

According to table (3-3) population of Zahedan city according to census of 1956 were 17495, according to 1966 census 39731 which has reached the number of 93740 according to census of 1976 which is 2.5 time more than controlled growth predictions. The population growth rate in these periods were 55/8 percent. In the census of 1986 this figure reaches up to 281,923. These figures show that in this census the population growth has be tripled and reached the percentage of 64/11. In the 1996 census the city's population had reached up to 419,518, compared to the previous period, the population increased 5.1-fold. Hence the population growth in this period was 38/5 and in a rare occurrence the population rate rises up to 560,725 people with growth ratio of 25/0 percent (Census of Population and Housing 1335-1390). Collectively, the above figures in all periods have an increase in population growth of city up until the population and housing census of 2011 where the

Zahedan city population drastically decreased to 560,725 with negative growth ratio. Important factors of this decline were leaving of refugees to their homeland and migration of people to adjacent provinces.

Table 2-1: Population and average annual growth during 1956-2011 in Zahedan

Statistical years	1956	1966	1976	1986	1996	2006	2011
Population	17495	39732	93740	281923	419518	567449	560725
Percent average annual growth over the decade	-	55/8 %	96/8 %	64/11 %	05/4 %	07/3 %	0/24 %

Source: Statistic report of sistan and Baluchistan province 1386, General Census of Population and Housing 2011 and author's calculations.

According to statistics, in 1966 the total population of Zahedan was 39,732 people, among which 19376 were female and 20,356 were male which shows a sex ratio of 105 between them. .

3- Analysis of research findings

One of the basic methods for identifying ill-fitting urban growth is Holdern method. Using this method, we can determine how much city growths are due to urban population and how much is caused by ill-fitting. The model is as follows:

$$(1)\ A = \frac{A}{P}$$

In equation (1) gross capital (a) is the result of dividing the land area (A) to the population (P). According to equation (1) we can derive that land occupied by an urban area (A) is equal to the product of the per capita gross (a) and population (P) in that case we have:

$$(2)\ A = P \times a$$

Based on Holdern If within the period (Δt), the population growth rate (ΔP) increases and per capita land consumption (ΔP) changes hence total metropolitan area (ΔA) is increased by replacing the equation (2) thus we get the following:

$$(3)\ A + \Delta A = (P + \Delta P) \times (a \times \Delta a)$$

Substituting equation (2) and (3) and dividing it by (A) we can obtain conversion of area (ΔA / A) into city during a time interval (Δt). Hence we get:

$$(4)\ \frac{\Delta A}{A} = \frac{\Delta P}{P} + \frac{\Delta a}{a} + (\frac{\Delta P}{P}) \times (\frac{\Delta a}{a})$$

Therefore according to Holdern model, equation (4) states that the percentage growth of a city (ΔA / A × 100) with the sum of population growth rate (ΔA / A × 100) and percentage of GDP per capita growth (ΔA / A × 100) is equal. In other words, equation (4) is equal to

5- Percentage of GDP per capita growth+ percentage of population growth = the total area expansion of the city, according to Holdern total population growth compared to total land (Aspral) compared to change in total population percentage in one period to the change of percent of land in the same period is obtained. We can define the phenomenon as below:

6-Share-growing land (percentage of total growth) / (the percentage of land area)

The same can be applied to per capita land

7-Share-growing land (land use of per capita growth of ROE) / (percentage of land area)

Holdern on the basis of population growth model, introduce a common growth model in order to complete its own model

$$(8)\, P_{(T)} = P_O(1 + g_P)^t$$

In equation 8, P (t) population in time t, P_O initial population, Gp population growth over that time span. Gp can be used to solve the following equation:

$$9\text{-}Ln(1 + g_P) = \left(\frac{1}{t}\right) Ln\left(\frac{P_{(t)}}{P_o}\right)$$

Since Ln (X + 1) is for the lower value of X, equation (9) can be written as follows:

$$10\text{-}\quad g_P = \left(\frac{1}{t}\right) Ln\left(\frac{P_{(t)}}{P_o}\right)$$

Such growth rates can be used to derive the land area (A) and per capita land usage (a) and can be written as:

$$(11)\, g_A = \left(\frac{1}{t}\right) Ln\left(\frac{A_{(t)}}{A_o}\right)$$

$$(12)\, g_a = \left(\frac{1}{t}\right) Ln\left(\frac{a_{(t)}}{a_o}\right)$$

Therefore on the basis of three population growth rate equations the Holdern equation can be written as:

$$(13)\, g_P = g_a = g_A$$

By substituting equation (10 to 12) for average development and beginning and ending values of the variables P, a, where A is the interval in equation (13) so we get:

Ln ((end of period) / (beginning of period)) + Ln ((End of GDP per capita) / (Beginning of GDP per capita)) = Ln ((period end in the city area) / (the beginning of city area))

For Zahedan city the variables for Holdern formula is replaced thus we have:

$$(15)\, Ln\left(\frac{560725}{281923}\right) + Ln\left(\frac{130/188}{107/15}\right) = Ln\left(\frac{7300}{3021}\right)$$

$$(16)\, Ln(1/988) + Ln(1/215) = Ln(2/416)$$

0/687+0/194=0/882 (17)

$$(18)\left(\frac{0/687}{0/882}\right)+\left(\frac{0/194}{0/882}\right)=\left(\frac{0/882}{0/882}\right)$$

0/78 +0/22=1 (19)

The results obtained from Holdern model shows that in Zahedan city during the period of 1365-1390 only 78% physical growth was related to population growth.

22 percent increase in the city's growth was the result of the horizontal and Aspral gross density of population and increasing per capita gross of urban land, which in turn is due to several reasons.

Excessive concentration of assets in land and housing, ethnic affiliation, religious beliefs, benefits from the construction of housing and high demand for real estate purchases by outside investors also afghan refugees has an impact on real estates.

The second hypothesis

There is a significant relationship between population distribution and area.

This factor potentially indicates the city space utilization and construction, and can be arranged as following values -1 to +1. The high value indicates high concentration of retail areas with a high density, near-zero means random accumulation whereas value 1 indicates the pattern of (distributed) for development.

$$\text{Moran} = \frac{N\sum_{i=1}^{N}\sum_{j=1}^{N} W_{ij}(X_i - X)(X_j - X)}{(\sum_{i=1}^{N}\sum_{j=1}^{N} W_{ij})(X_i - X)^2}$$

N = number of sub-regions, Xi population or employment sub-area i, Xj population or employment sub-region j, X average population or employment, Wij the weight between i and j identifies the sub-region.

In this study the area has been divided into 20 zones according to the study conducted by the consulting housing engineers (master plan Zahedan) where the population was projected as the basis to determine the continuity and distribution of the above indicators self-construction.

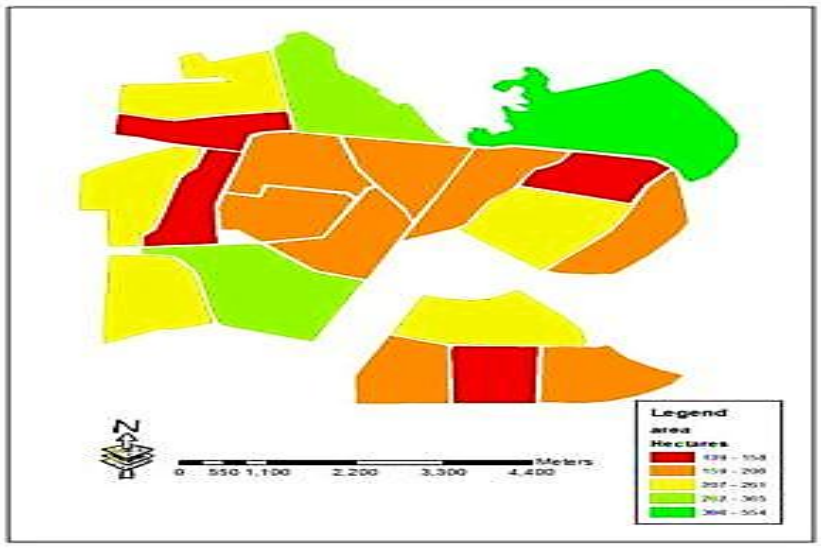
Table (3-1) the proposed and population areas of 20 districts in the city of Zahedan -92

District Number	Area	proposed population	District Number	Area	proposed population
1	255.6	43144	11	237.1	35013
2	312.6	67355	12	172.3	24408
3	596.1	84811	13	194.3	30006
4	223.2	44332	14	218.2	37427
5	283.3	57821	15	395.9	59905
6	158.1	36253	16	260.3	42054
7	195.1	24018	17	271.1	40212
8	190	34206	18	196.9	54875
9	223	33448	19	174.4	34560
10	160.9	37634	20	207	41400
			Total	4925.5	862882

Source: Zahedan Comprehensive Plan 2003

After obtaining the SHP-File, data were given to GIS software which yields map of population density and area.

Map (3-1) the distribution area of comprehensive plan in 20 districts 92 horizontal in the horizon, the results of data were processed by Moran model in GIS environment.



Spatial Autocorrelation Report

Moran's Index: -0.021836 Spatial Autocorrelation Report
Given the p-value: 0.860266 the pattern does not appear to be significantly different than random

Global Moran's I Summary

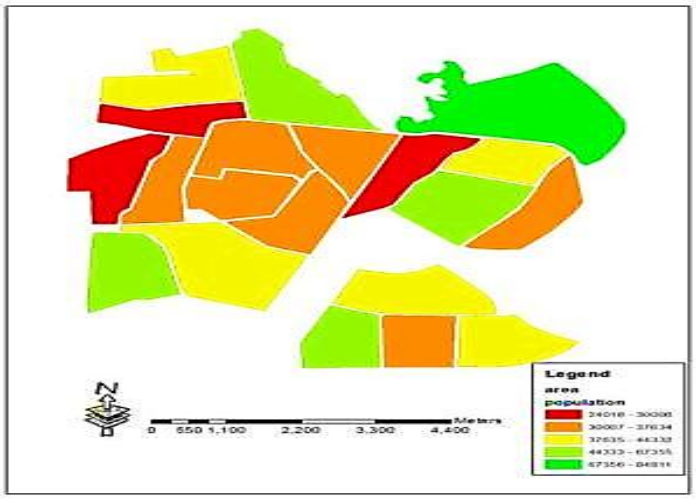
Moran's Index:	-0.021836
Expected Index:	-0.052632
Variance:	0.030603
z-score:	0.176036
p-value:	0.860266

Dataset Information

Input Feature Class:	navahi
Input Field:	HECTARES
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
Row Standardization:	False
Distance Threshold:	1643.1601355
Weights Matrix File:	None

Source: author

Map (3-2) the distribution population of comprehensive plan in 20 districts 92 horizontal in the horizon, the results of data were processed by Moran model in GIS environment.



Spatial Autocorrelation Report

Spatial Autocorrelation Report

Moran's Index: -0.079684

Given the [illegible] the pattern does not appear to be significantly different than random. p-value: 0.522470

Global Moran's I Summary

Moran's Index:	-0.079684
Expected Index:	-0.052632
Variance:	0.042804
z-score:	0.639543
p-value:	0.522470

Dataset Information

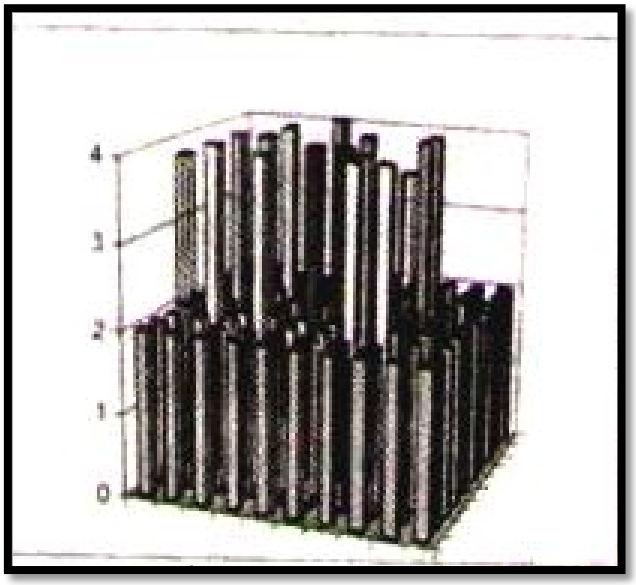
Input Feature Class:	navahi
Input Field:	POPULATION
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
Row Standardization:	False
Distance Threshold.:	1643.1601355
Weights Matrix File:	None

Source: author

With respect to density and spatial distribution, the output were calculated in the form of tables.

The result of the Moran coefficient for surface area of 021 836/0 to the Moran coefficient for population is 079 684/0. The coefficients obtained in both population and area shows a wide dispersion. As the tendency is towards value- 1, which shows pattern of scattered population in urban area, which is a sign of random distribution. Practically the targets (Table 5-1) are not acquired, as the metropolitan area has an area of about 8,000 acres and the population is 000/600 in 92 which shows some sign of positivity in our hypothesis.

Fig (3-1) unfocused distribution



References: Tsai, 2005

Shannon entropy models*:*

This model is used for the analysis and identification of ill-fitting phenomenon of urban growth. The overall structure of the model is as follows: (Source formula Hekmatnia and Mousavi, 2006)

$$H = \sum_{i=1}^{n} p_i \times Ln(P_i)$$

In the above equation: H: Shannon entropy value; P_i: built area ratio (Total Residential Density), i is the total area of all regions; n: The total area of the Shannon entropy values from zero to Ln (n). Zero represents the physical development which is dense (compact). While the amount of Ln (n) represents the sparse physical development of the city. The value of the entropy Ln (n) represents the physical development of the city and when the value of Ln (n) is more shapeless urban growth (Aspral) happens.

Table (3-2) Calculating the value of entropy in three district urban areas of Tehran in 1986

District	Area (Acers)	P_i	$Ln(P_i)$	$P_i \times Ln(P_i)$
1	235/4	0/2258	-1/4881	-0/3360
2	502/3	0/4819	-0/7300	-0/3517
3	304/5	0/2921	-1/2306	-0/047
Total	1042/2	$\sum P_i = 1$	$P_i \times Ln(P_i) = 1$	-1/047

047 / 1H = 65

Table 3-3. Calculating the value of entropy urban areas in three districts of Zahedan in 2006.

District	Area (Acers)	P_i	$Ln(P_i)$	$P_i \times Ln(P_i)$
1	450/31	0/2571	-1/3582	-0/3498
2	700/25	0/3998	-0/9167	-0/3664
3	600/91	0/3430	-1/0700	-0/3670
4	1751/47	$\sum P_i = 1$	$P_i \times Ln(P_i) = 1$	1/0825

85H=1/0825

Tables 3-2 and 3-3 show that the entropy of 047/1 was in 1365, while the maximum value of Ln (3) is 070/1. The value close to the maximum of entropy indicates the spread of urban physical development. These values in 2006 were equal to 0825/1 which shows that in ten years, physical development has been sporadic and non-condensing.

4. RESULTS:

Actually the ultimate goal of urban planning is to achieve continuous and permanent welfare of citizens. Thus one of the main issues of urban planning is identifying how future physical expansion of urban development should lead to a specific meaning. In this study, the physical form of the city at various periods of time has been studied and analyzed using different models given the prevailing conditions of period from 1300 to 1365 which showed growth. Physical expansion and compression of city growth were alongside the growth of population but from 1365 onwards spiral population growth was observed in Zahedan. According to physical model of city which is scattered and fragmented, by using Moran and Holdern model, radial pattern which is centered to prevent the growth and spread of growth in future. Regarding the factors affecting the growth and development of urban areas, suitable sites for future expansions are south and east respectively.

5- Guideline:

5-5-1- Tax on vacant Lands (1LVT):

These tax collection are the responsibility of land and home owners which may commenced for city management and construction this also helps in doubling the structural processes and prevent rise in stock markets.

5-5-2- Land transfer via a person or a trustee.

5-5-3- Encourage vertical development of the city.

5-5-4-internal development (Reform and Modernization).

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