Evaluation of some indicators of urbanization in the city of al-Qaim in the Iraqi province of Anbar

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Abstract

Urban Balance is one of the important indicators that leads to an assessment of the urbanization process in a particular country , province or even a city that is multi-centered. By examining the data related to Anba province, it was found that the value of this indicator is equal to 0.96, which is less than the absolute one, and therefore the urbanization in the province is distributed collectively

The development of a mathematical or statistical model for estimating urban growth is a complex process due to the overlap between indicators or variables that can be adopted to calculate estimate growth rates Al-Qaim city has been considered as an example to develop a statistical method by which changes that may occur in the urban system when developing a particular industry are estimated according to a set of hypotheses. Using a hypothetical model, the amount of changes likely to occur in the urban system of the city was estimated, where the model showed changes in residential and some service land when assuming a number of jobs entering the labor market.

Keywords:

urban order, urban balance, urban modeling, urban growth.

تقييم بعض مؤشرات التحضر في مدينة القائم بمحافظة الانبار

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المستخلص

يعتبر التوازن الحضري احد المؤشرات المهمة التي تقود الى تقييم عملية التحضر في بلد معين او محافظة معينة او حتى في مدينة معينة تكون متعددة المراكز. من خلال معاينة البيانات التي تخص محافظة الانبار وجد ان قيمة هذا المؤشر مساوية الى ٠,٩٦ و هي قيمة اقل من الواحد الصحيح و بالتالي فان التحضر في المحافظة يتوزع توزيعا متجمعا

تعتبر عملية وضع نموذج رياضي او احصائي لتقدير النمو الحضري عملية معقدة و ذلك بسبب التداخل بين المؤشرات او المتغيرات التي يمكن اعتمادها لإجراء حساب نسب النمو التقديرية.

لقد تم اعتماد مدينة القائم كمثال لوضع اسلوب احصائي يتم من خلاله تقدير التغيرات التي يمكن ان تطرأ على النظام الحضري عند استحداث صناعة معينة وفق مجموعة من الفرضيات. لقد تم من خلال استخدام نموذج افتراضي تقدير مقدار التغيرات التي يحتمل ان تطرأ على المنظومة الحضرية للمدينة حيث بين النموذج التغيرات الحاصلة في الاراضي السكنية و بعض اراضي الخدمات عند افتراض وجود عدد من الوظائف التي تدخل سوق العمل.

الكلمات المفتاحية:

النظام الحضري ، التوازن الحضري ، النمذجة الحضرية ، النمو الحضري

Modeling Urban System

The urban system is defined by (Pred, 1977) as a comprehensive set of cities that are interconnected through economic fluctuations, the dissemination and exchange of information, the flow of goods, capital and people. Cities that are part of such a system does not grow and does not freeze and does not deteriorate independently of each other; but they change in response to growth or decline in other cities. The study of urban systems do not bother to expand the spatial city or its internal structure; such a study modify the dependencies between cities, resulting from the expansion of economic activities on a large area and the intensification of transport networks and information. (Yuji, 2006) in his book The Japanese Urban System points out that it is not possible to gain a clear understanding of the functions and growth of cities without thinking of these systems as a combination of social and economic factors.

On this basis, it can be said that there are interrelations between economic activity and urban growth of cities, since the result of economic activity is the provision of capital that finances various aspects of urban development, without which there can be no material possibility to change the urban reality of any city or urban system.

Asiedu, 2001, presented a research at the International Conference on spatial information for Sustainable Development, summarizing the components of the urban system model in the following components:

- Society: the society was divided into three categories: low income, middle income and high income.

- The essence of the urban environment : it is all sectors that lead to:

A. Basic services ,

B. Complementary services.

- Urban development policy: it is a process of developing plans for the development of Socio-economic groups.

In addition to the above, there are relatively different visions about the basic components of the urban system and it is possible to discuss and extrapolate these components according to global definitions, these components can be represented in the following form, which represents the relationships between the basic components of the urban system and that affect and are influenced by each other.
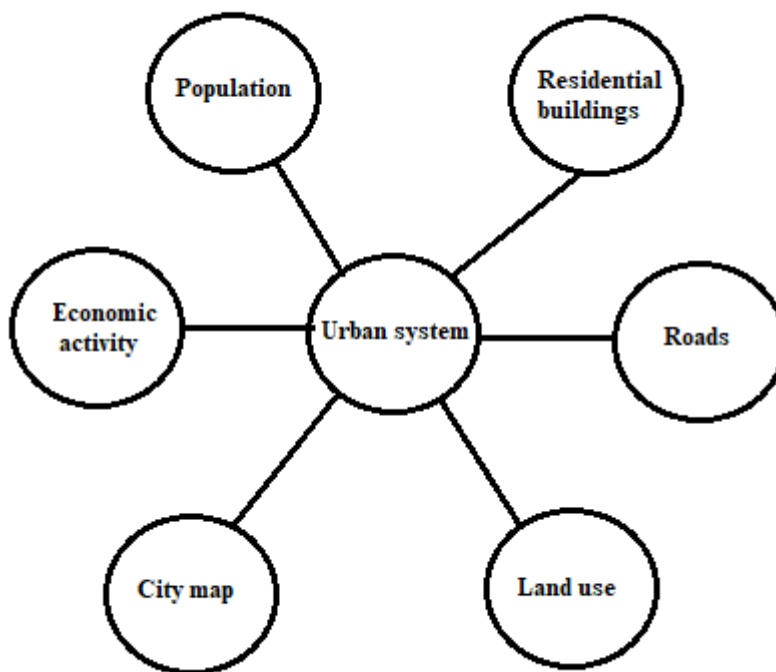

Figure No. 1: A sketch describes the main constituent elements of the urban system.

From a geographical point of view, it can be said that in the early Twenty-First Century, geographers continued to examine the relations between cities and towns and what might lie outside their perceived boundaries in order to redefine

the law of the urban system. The focus on relations between cities is now shifting from rank to network or from national hierarchy to transnational communication increasingly as a result of the emergence of multi-centers, widespread and functionally integrated cities.

Certainly, the multiplicity of city centers can only be an indicator of the existence of one or more economic activities, and these activities can be related to each other, i.e. economically integrated or separate so that each performs a certain function. Regardless of the interrelationship between these centers, the increase in economic activity will inevitably be linked to a better standard of life, which directly contributes to the growth of the population and thus the growth of cities.

The process of urban growth entails significant changes in the sizes of cities, where their sizes are measured in different ways, including the number of population, the number of service functions provided by the city to its population and to its territory, and these two measures determine the rank-volumetric relations, and the hierarchical structure of the urban system. In some cases urbanization ordered according to a certain key that showed on the map to give a clear idea about the progress of urbanization on cities or even countries showed on the map.

An urban system or a city system consists of a group of agglomerations that are classified as urban centers within a specific geographical area such as a state, territory or province, and the existence of the system is based on the interaction of its elements with each other, where these cities are connected by mutual functional relations forming among themselves an integrated urban system. The study of the urban system is one of the important approaches in the study of the geography of cities, and according to this approach treat

cities as points, where attention is focused on their characteristics above the total space such as population size, labor, economic activities, and may be other characteristics. This system considered the followings:

1. Classification of cities based on one or more characteristics, cities may be classified on the basis of their population size into megacities called Metropolis, millionth cities, regional centers, large, medium and small cities, and cities may be classified on the basis of the economic events prevailing in them, such as: industrial cities, service cities, commercial cities, tourist cities.

2. Analysis of the spatial relationships between different cities within the urban system in order to identify the nature of the spatial distribution of cities, and thus identify the reasons that explain its spatial regularity according to the nature of the specific alignment.

Based on the above, the Urban Balance Index can be estimated according to the rank-size data related to Al-Anbar province that has been previously calculated. The following formula shows how such an index can be calculated:

$$Urban\ Balance\ Index = \frac{Sum\ of\ positive\ and\ negative\ differences}{Total\ Urban\ Population}$$

Differences are the gaps between the real and estimated values of the population of the cities studied by the rank-size rule. If the value of this indicator is less than the absolute one, it indicates that these cities are subject to a combined distribution in terms of population, but if the result is greater than the absolute one, it indicates a dispersion in the distribution of these cities.

It was found that the value of this indicator is equal to 0.96, which is less than the absolute one, and therefore urbanization in the

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province is uniformly distributed. In other words, cities vary in terms of their rates of urbanization so that there are cities where urbanization is less than half and this practically does not exist .

The development of a mathematical or statistical model for estimating urban growth is a complex process due to the overlap between indicators or variables that can be adopted to calculate estimated growth rates. Some of these variables are directly affected, such as the area of residential construction that is directly affected by population increases, while roads are indirectly affected by population increases, which follow the amount of expansion of residential buildings or the expansion and diversity of land uses that imposes an inevitable change in the road network. There are also a lot of factors that can be taken into account as an example of effect and affected like economic activity which leads to a rise in the provision of a kind of welfare that is reflected on the performance of society in general, where the needs are diverse and the demand for housing units and private vehicles increases, which resulted in urban sprawl on the master plan of the city and accordingly increases the expansion of land use and road network which in turn resulted in providing new jobs and income to the economics of the city .

On the above basis the process of estimating growth or amount of influence must involve some hypotheses that will restrict the fluctuation to some variables that thought to play the leading role in urban system growth.

Number of researchers (Suwit and Apiradee, 2010; Yu and Du, 2011) have been developing mathematical models to estimate the rate of urban growth and these models vary in terms of the way to reach the best estimate, including standard models, models based on the method of differential equations, models used artificial neural network, and many other models, but the work of all these models imposes restrictions on the procedure of implementing any of them.

In this context an attempt will be made to adopt a model that calculates the value of the change that can occur on urban growth

through one variable, industrial projects. It is important to mention that the urban growth hypothesis in the proposed model will include the components of the system that fall within the framework of the general concept of the system and that include:

1. Population

2. Economic activity

3. Land residential

4. Commercial land

5. Industrial land

6. Roads land

7. Service lands

The premise of the proposed system is that the establishment of an industrial project in a certain city with a certain number of labor forces will lead to the entry of a certain group of the population into the labor market and thus will lead to a new demand for goods and services, which over time will lead to changes in the components of the urban system.

Mathematically, the amount of change of any component over time can be represented by equation No. (1) and the growth rate can be calculated by the same equation after adjustment, as shown in equation No. (2):

$$P_n = P_0(1+r)^n P_n = P_0(1+r)^n \quad \dots (1)$$

$$r = \sqrt{\frac{P_n}{P_0}} - 1 \dots (2)$$

The city of Al-Qaim, whose location is noted as in Map No. (1), has been adopted as an example

، Which can occur on the map of land uses in the city, note the map No. (2) and what is reflected in its arrangement within the urban system of Anbar Governorate when creating a specific industry according to the following hypotheses:

1. Assume the development of a specific industry in the city of Al-Qaim that accommodates 1000 people (workers, engineers, administrators)

2. Assume that the population growth rate of this supposed number is the same as the period 1987-1997 in which employment opportunities were created and some kind of relative stability was enjoyed.

3. Assume that the population growth rate of the remaining urban population is equal to the population growth rate of 2020
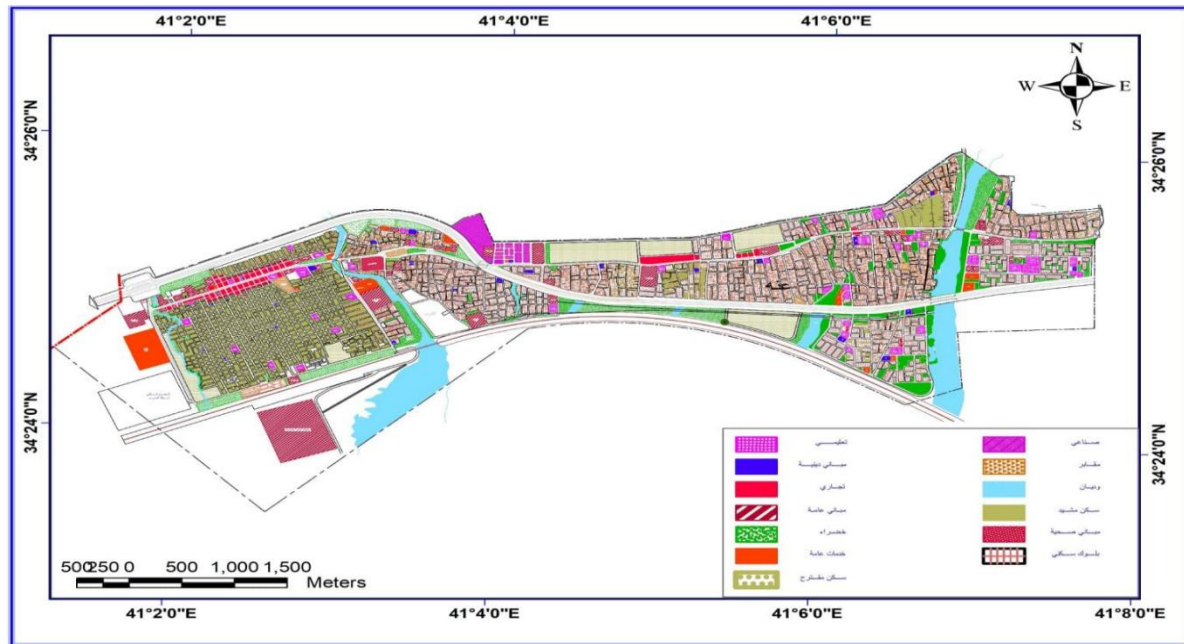
Mab (1)

Location Qaim District abont for Iraq and Anbar Governorte
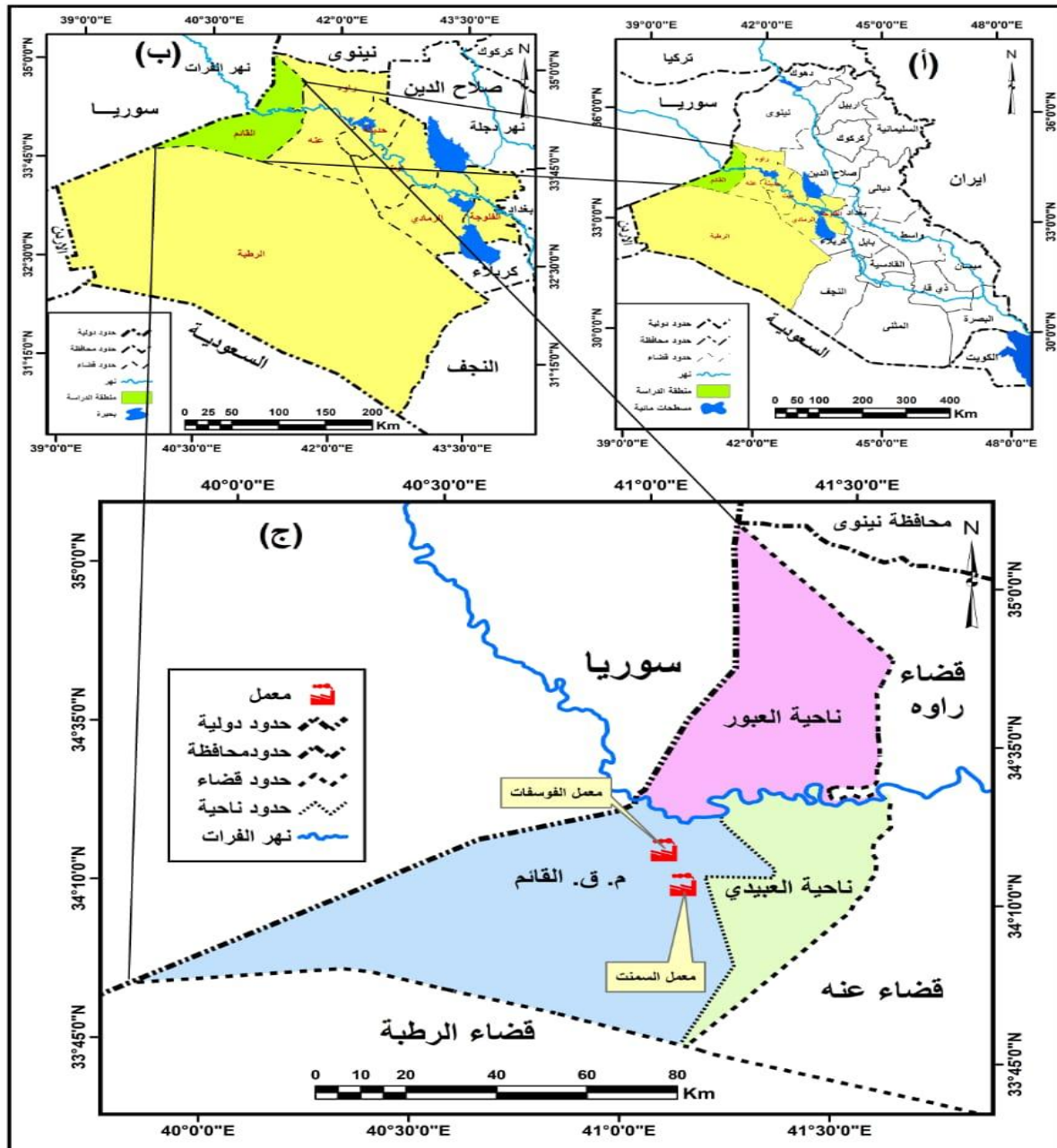
Source: Ministry of Water Resources- Directorate of Public Survey, Iraq administrive map for the year 2010 scale (1:1000000).

Mab (2)

Basic plans for the city of Al-Qaim

Source: Al Qaim Municipal Directorate Basic Design Map.

According to the above, the following symbols show how to calculate the overall rate of growth:

P_t: *Urban population size at time t*

E_t: *New employees at time t*

$$NP_t = P_t - E_t \ \dots (1)$$

$$E_t = E_0(1 + r_1)^t \ \dots (2)$$

$$NP_t = NP_0(1 + r_2)^t NP_t = NP_0(1 + r_2)^t \ldots (3)$$

$$E_0 = 1000, NP_0 = 91140, r_1 = 0.01773, r_2 = 0.012332$$

$$r = \frac{(r_1 \times E_t) + (r_2 \times NP_t)}{E_t + NP_t} \ldots (4)$$

Equation No. (4) represents the method of calculating the general rate of urban growth in the city, as the entry of employees into the labor market leads to increased chances of turnout for a number of social changes, including the formation of new families in a higher pattern than in the case of stability.

Accordingly, economic activity rates will rise as a result of the need to provide additional goods and services to a rapidly growing group. Although population growth rates impose certain rates of increases in land uses , increasing the level of well-being of any new population leads to increases in certain percentages in these uses subject to the general urban growth rate of the city according to the proposed hypothesis and can be represented by the following equations:

$$LUC_t = LUC_{t-1} + r \times LUC_{t-1}$$

$$LUC_t : Land\ Use\ Consumption\ at\ time\ t$$

Table No. (1) represents the urban land areas in the city of Al-Qaim and the rates of change by periods (first and second represented by the rate of change I, and second and third, represented by the rate of change II). The use of the previous equations resulted in the output that were placed in Table No. (2) where these results were represented by the radar diagram shown in Figure No. (2).

Table 1

Used land areas and rates of change in Al Qaim city by time periods

	Time period			Rate of change	
				First	Second
	1939-1968	1969-1979	1980-1990		
Residential land	41.44	158.12	171.44	2.815637	0.08424
Commercial land	0.053	0.116	0.74	1.188679	5.37931
Industrial land	0.0105	0.276	1.563	25.28571	4.663043
Service land	1.8	8.625	13.945	3.791667	0.616812
Roads land	6.94	27.15	74.26	2.912104	1.735175

Table 2

Changes of land consumption rates with respect to time

Year	Population Growth Rate	Residential Land	Commercial Land	Industrial Land	Service Land	Roads Land	Economic Activity
2021	0.01239089	9.48923E-05	0.006059549	0.005252707	0.00069481	0.001955	0.212602088
2022	0.01239152	0.00019096	0.012194181	0.010570499	0.00139823	0.003933	0.21523655
2023	0.01239246	0.000288219	0.018404828	0.015954185	0.002110366	0.005937	0.217903861
2024	0.01239375	0.000386683	0.024692431	0.02140458	0.002831325	0.007965	0.220604507
2025	0.01239539	0.000486366	0.031057943	0.02692251	0.003561218	0.010018	0.223338986
2026	0.01239742	0.000587285	0.037502331	0.032508814	0.004300156	0.012097	0.226107814
2027	0.01239987	0.000689455	0.044026571	0.038164337	0.005048249	0.014201	0.228911522
2028	0.01240278	0.00079289	0.050631652	0.043889938	0.005805612	0.016332	0.231750662
2029	0.01240621	0.000897607	0.057318578	0.049686485	0.00657236	0.018489	0.234625809
2030	0.0124102	0.001003622	0.064088361	0.055554856	0.007348608	0.020673	0.237537562
2031	0.01241484	0.00111095	0.070942028	0.061495943	0.008134475	0.022883	0.240486553

In Figure 2, which describes the change in logarithmic measurement, we note that the annual rates of change in the uses of residential land, services and roads lands are accelerating much less than the annual growth rate of the population, while the rates of commercial and industrial land uses increase higher than the annual increase in the population, which is explained by the growth of economic activities that create additional demands on products and services.

The development of industrial projects, in addition to contributing to raising the level of economic activity, leads to the advancement of all sectors associated with the urban system, which effectively contributes to the expansion of this system.
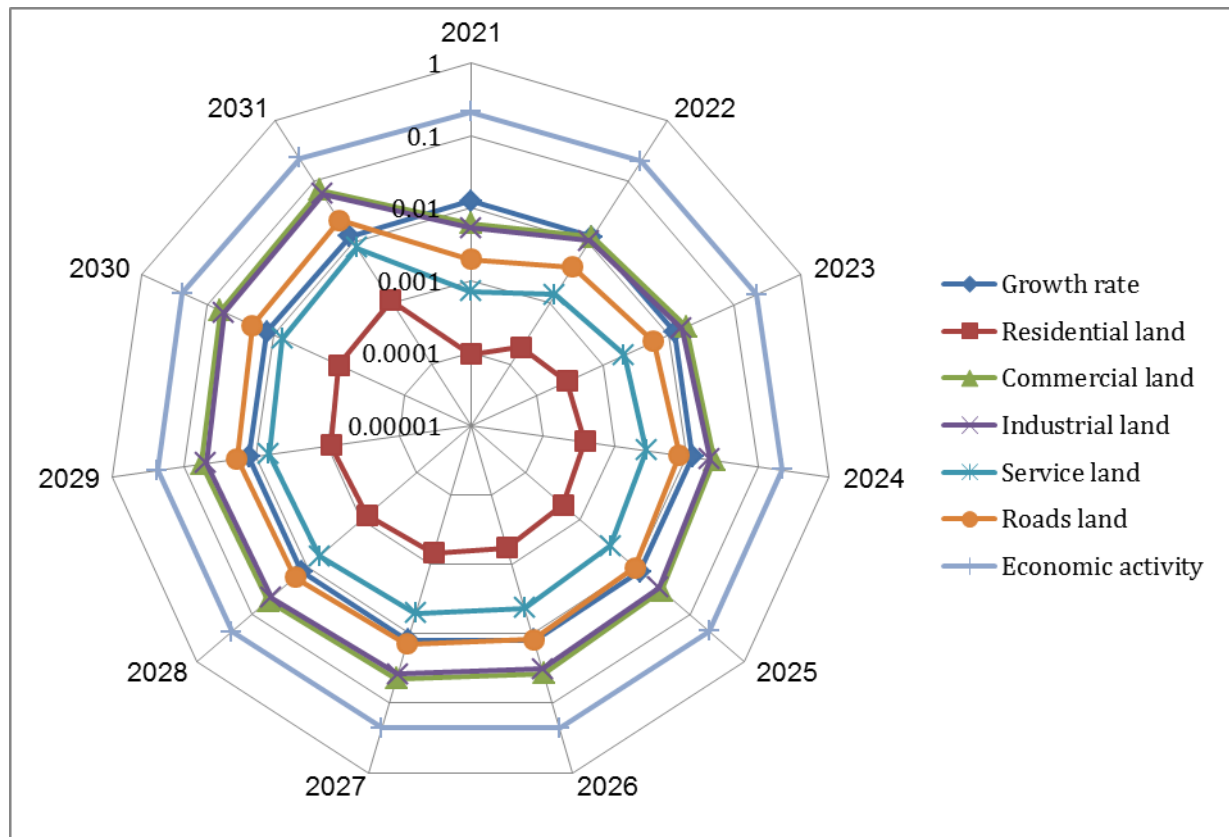
Fig.2. Sketch showing change in rates of land use and economic activity according to time

The increase in demand for goods and services in the event of economic activities can be explained on the basis that the rates of population growth will rise for the new category to more than double the rates of population growth in natural situations (Mohsan Dadras, et al., 2014) then begin to gradually decline down to a state of stability. This result can be used in the case of any new industry to find the proportions of new changes in line with the volume of new employment.

Conclusion

Certainly, economic activity motivates all sectors associated with that activity to contribute in one way or another to employ this activity to serve their interests. Think of the worker or employee is first and last in economic activity, its presence leads to the provision of the needed work force for activity on the one hand and, on the other hand be the beneficiary of market movement that creates its activity as a result of new income that can get it. Any model that simulates urban development or urban growth must be driven by the economic factor that employs capital to create certain industries or services, which raises the standard and quality of life, which leads to the creation of new demand for goods and services.

The model adopted in this study to calculate the impact of the proposed number of jobs represented possible changes at the level of urban land where the annual rates of change in the uses of residential land, services and roads were found to accelerate much less than the annual growth rate of the population while the rates of commercial and industrial land uses were found to increase .

It is possible to subdue the increased demand for goods and services when creating a new industry or expand already exist industry to the fact that rate of population growth will rise for the new class to reach more than twice the rate of growth for the other part of the population and process will continue for a while till approaching similar growth rate.

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