Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 8, July 2021: 538-549

Estimating the Expansion of Urban Land Uses with the Hypothetical Impact of Economic Change Resulting from Assuming New Jobs in the City of Anna, Anbar Province, Iraq

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Abstract

Economy is the main driver of all the vital activities that civilized societies aspire to and the per capita income is a measure of the level of economic advancement of a particular country. Countries with a high per capita income are always those countries that have the potential to change their reality by adopting different methods of development while low income is a clear indication of poverty and lack of possibilities for development. In this research, a mathematical model was adopted that simulates the amount of expansion of urban land uses as a result of the availability of employment opportunities, the existence of which is reflected in the annual and cumulative per capita income.

Some indicators have been used that help to understand the nature of the expansion of urban land uses for the 2012-2020 time period.

Through the proposed model, it turns out that it is possible to make predictions about the future expansion of urban land uses when increasing employment opportunities by identifying changes in the annual per capita income rate and its direct and indirect impact on the expansion rates of land uses.

Keywords: economic growth, per capita annual income , per capita share of urban land, urbanization

Introduction

The cities of Anna and Rawa, which are within the geographical area of the Iraqi province of Anbar and are described as part of the western region, are considered the least populous among the cities of the province. The city of Anna, which has been changed to the new site built on the basis of modern designs, is characterized by the small area of the city that forms

the urban side of the city and therefore the city over time must depart from these designs in a natural response to the rates of population growth and the impact they have on.

The processes of population growth is one of the foundations of Urban Development determined by the population of economic power to constitute a demand for goods and services which in turn leads to the creation of the economic cycle in the city help to seriously change the reality of the city.

The urban side of the city of Anna does not have large industries, so most of the industries in it are either small or medium and the opportunities to upgrade the economic reality of the city will remain dependent on what the market movement, which consists mostly of small or medium industries or what is offered by fixed income employees and retirees. On this basis, opportunities for change in land uses will be subject to slow growth rates associated with population growth rates.

It is known that the establishment of any economic activity will lead to the availability of jobs, which leads in turn to get the new entry for this section arranged panchayat request extra on goods and services which in turn are incompatible to meet the new demand. The relationship between the previous components is represented by the following scheme proposed by the scientist Allan Pred, 1965, which was also mentioned by Sami M P, 1982, showing how the industry grew after creation and how to set new thresholds for the society that embraces this activity, as shown in Figure 1.

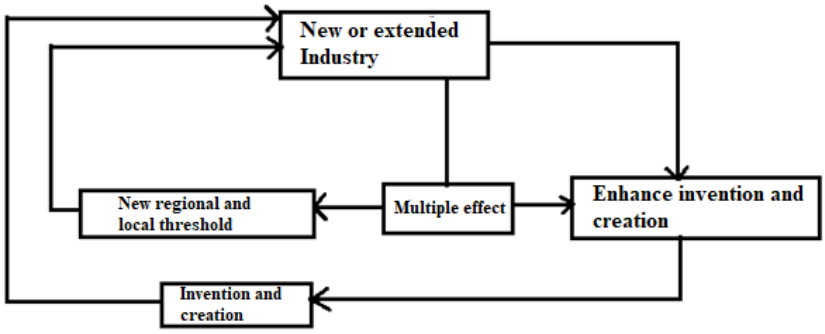


Fig.1. Chart showing the circular relationships of industry and its impact on the growth of society

According to the proposed model, when urban centers begin the process of establishing industries in them, the process of expansion of industries and society begins to grow steadily (Wilbur R. Thompson, 1966) . Surely there will be a difference in the rates of population growth and industrialization because the sowing of the seeds of industry will not only involve the expansion of that industry but will extend towards industrial integration that generates new opportunities, new incomes, new productive diversity and growth in the way of thinking of society and its future directions, as is evident through the relations stated in figure 1.

Urban land uses for 2012 and 2020

Table 1 represents the area of land used for urban purposes in the city of Anna for the years 2012-2020. These spaces have been represented using graphical circles through which the usage ratios for the total area used for each year can be clearly customised. I've been calculating the projections of the two years 2014 and 2017-on-year growth rate 2012/2020 was calculated as the remaining years to complete the series 2012-2020 the same way for the purpose of providing the necessary data for the calculation models to estimate the change in urban spaces.

Table No. 1

Uses of urban land in the province of Bana for the years 2012-2020.

Type of land use	2012		2014		2017		2020	
	Area	%	Area	%	Area	%	Area	%
Residential	381.84	47.48	592.39	47.26	1144.71	44.49	2212	38.85
Industry & Commercial	78	9.7	145.91	11.64	373.28	14.51	955	16.77
Governmental	5.84	0.73	17.18	1.37	86.76	3.37	438	7.69
Educational	133.92	16.65	234.73	18.73	544.7	21.17	1264	22.2
Religion	29.72	3.7	34.51	2.75	43.17	1.68	54	0.95
Green	13.72	1.71	32.16	2.57	115.38	4.48	414	7.27
Health	14.68	1.83	17.4	1.39	22.47	0.87	29	0.51
Roads	146.56	18.22	179.26	14.3	242.48	9.42	328	5.76
Total	804.28	100	1253.54	100	2572.95	100	5694	100

For the purpose of representing the change between 2012 and 2020, each year's data was represented using the chart circuit as shown in Figures 2 and 3.

We note through the two figures that the proportion of land allocated for housing in the total area of urban land has decreased as a result of the increase of areas allocated for other uses such as industry, government and green and the variation of spaces for other uses.

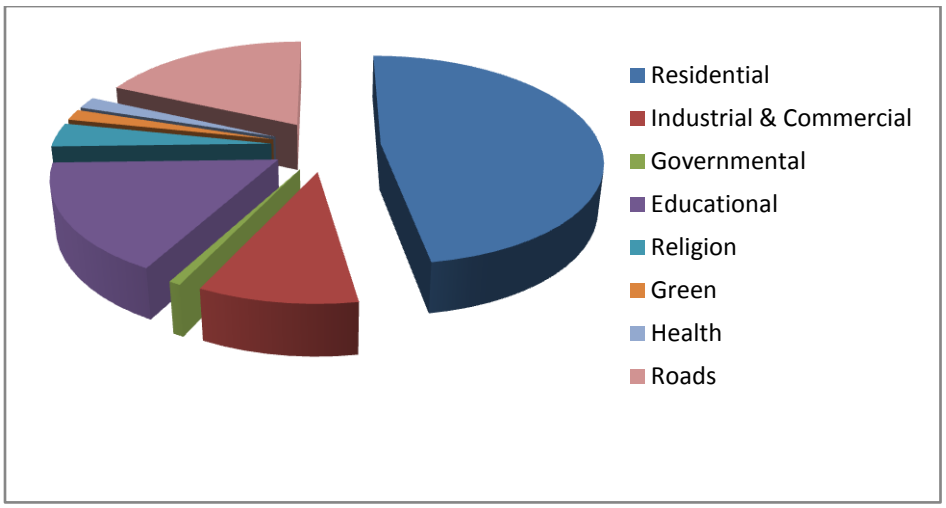


Figure No. (2): land use ratios according to 2012 data

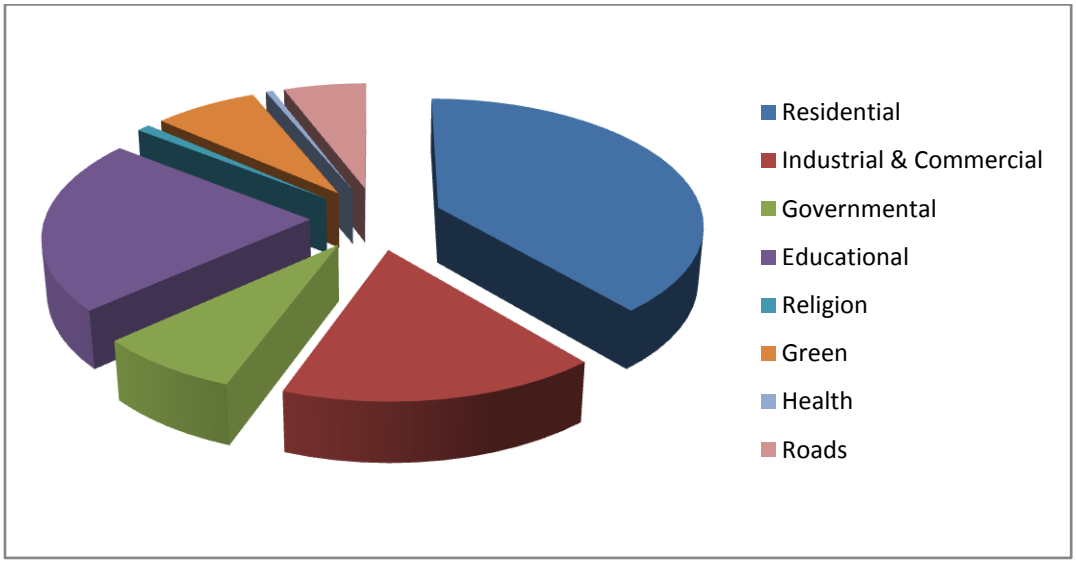


Figure No. (3): land use rates according to 2020 data

Methods of calculating land use indicators

For the purpose of calculating land use indicators, a number of scales used in a number of similar studies have been adopted Sana Arshad, et al.2017.

The urban Expansion scale UE is an important measure that reflects the amount of change in land use over time t. The following formula is used to calculate it:

$$UE = \frac{UA_{t+i} - UA_i}{t * UA_i} \times 100 \dots (1)$$

Where:

$$UE: UrbanExpansion$$
$$UA_{t+i}: UrbanAreaattimet + i$$
$$UA_i: UrbanAreaattimei$$
$$t: isthetime$$

This measure is equivalent to a growth meter that reaches the same result at the end of the time series and differs with the previous formula when the annual change, due to the calculation method adopted in the two formulas, and calculates the growth rate as in equation No. (2).

$$UE = \sqrt[t]{\frac{UA_{t+i}}{UA_i}} - 1 \dots (2)$$

The rate of population growth is calculated in the same way as the rate of expansion, using the size of the population instead of the area, as shown in equation No. (3).

$$PGR = \frac{UP_{t+i} - UP_i}{t * UP_i} \dots (3)$$

Where:

$$PGR: PopulationGrowthRate$$
$$UP_{t+i}: UrbanPopulationattimet + i$$
$$UP_i: UrbanPopulationattimei$$
$$t: Time$$

The land Consumption Rate is one of the important indicators that can contribute to the assessment of urbanization phenomenon HaregeweynN.,et al., 2012. Equation number (4) indicates how this indicator is calculated.

$$LCR = \frac{UA}{P} \dots (4)$$

Where:

$$LCR: LandConsumptionRate$$
$$UA: UrbanArea$$
$$P: Population$$

Impact of the economic factor on urbanization

The topic of the relationship between economic factors and urban growth attracted the attention of a number of researchers, including Chen M, et al. (2014) and Zhao and Wang, 2015 and Li, X., et al. (2019). Several formulas have been developed to calculate the per capita share of urban land when a particular economic factor changes. Equation number (5) shows one of these formulas used to predict the amount of change per capita when the economic factor of per capita income changes.

$$pU_t = a + \frac{b}{1 + exp^{-c*(pCum\ GDP_t - d)}} \dots (5)$$

where

$$pU_t: logarithmofpercapitaUrbanareaattimet\ (insquaremeters)$$

$$pCummGDP_t: logarithofcumulativepercapitaGDPattimet$$
$$a, b, c, andd: parametersofthemodel.$$

This formula has been used by Li, X., et al. (2015) and Mertes et al., (2015) who discussed the idea of urbanization, which requires the exclusion of the annual per capita income rate, which causes a lot of fluctuations in the model, resulting in predictions that are inconsistent with the nature of Urban Development, and therefore the cumulative income rate that excludes these fluctuations from the calculation, which in fact reflects the accumulated investment of individuals in the urban environment.

Parameters a and b in the model represent the beginning and end of the urbanization phase and parameters c and d represent the shape of the X-growth curve according to Seto et al., 2012, Melaas et al., 2013, Yu et al., 2014.

Data and results

For the purpose of providing the minimum information needed for the study to employ the proposed model in estimating the impact of the cumulative income rate on the expansion of urban land use, Equation No. 1 of this study was used to calculate the annual rate of change and to find estimates of the annual rates of change during the period 2013-2019.

The indicators referred to in the previous equations have been calculated, which will give a picture of the nature of the change in the rates of urban land use during the said period.

Figure No. (4) shows the change in the area of urban land during the years 2012-2020, in which the area is calculated in dunum. It is clear from this figure that the expansion of the allocation of residential land is the most among the other uses followed by educational. It is noted that the amount of change is nonlinear, which means that the rates of increase do not correspond to a certain percentage of population growth.

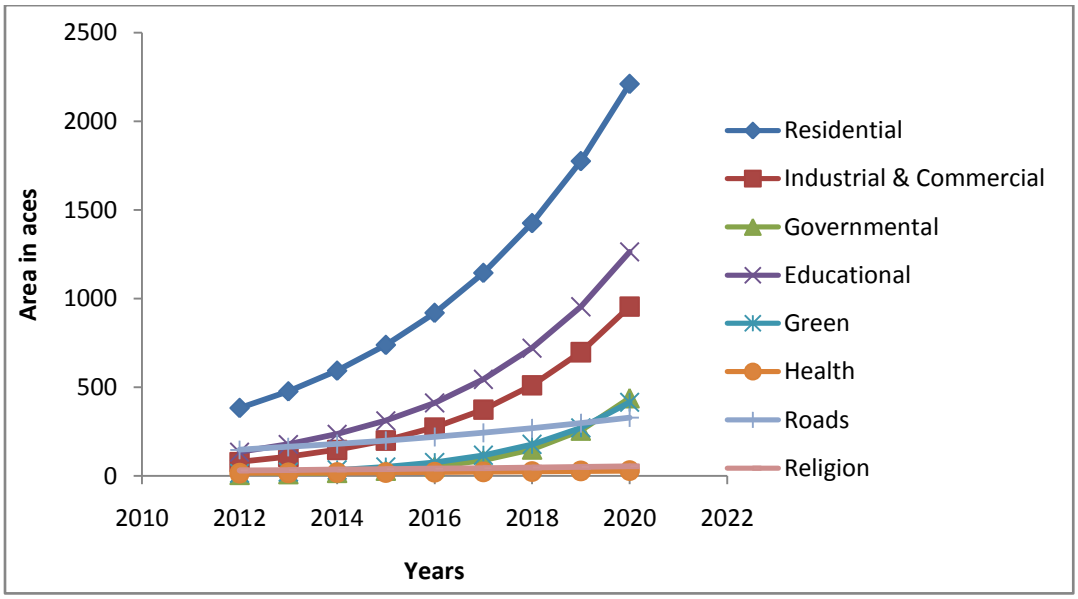


Figure No. (4): Change in urban land use areas during the period 2012-2020.

Table 2 shows that the density of Housing has decreased from 48.67 (persons/acres of residential land) in 2012 to 10 (persons/acres of residential land) in 2020, where this decrease represents an increase in the population at higher rates

than those allocated for housing, which can lead to the creation of a real housing problem over time.

Land use percentage refers to the increase of this percentage during the period described in the table for the same reason mentioned earlier.

Table No. 2

Indicators of urban land uses for the city of Bana 2012-2020.

	2012	2014	2017	2020
Urban Area UA	804.28	2026.71	3860.36	5694
Urban Population UP	18586	19311	20453	22110
Population Density	23.11	9.53	5.3	3.88
Land Consumption Rate LCR	0.0433	0.105	0.1887	0.2575
Residential Density	48.67	32.6	17.87	10

Figure 5 represents the density of the urban lands of the city of Anna calculated on the basis of (population/acres) and its relation to the annual per capita income rate after adding 1000 jobs and recalculating the per capita income rate based on the general rate of Iraq.

It is clear from this figure that the land for residential, industrial and commercial, educational and roads are the most affected by the rate of income and population growth and their densities are the least due to the increase of it areas compared to areas of other land uses, which leads directly to lower densities as presented on the figure 5.

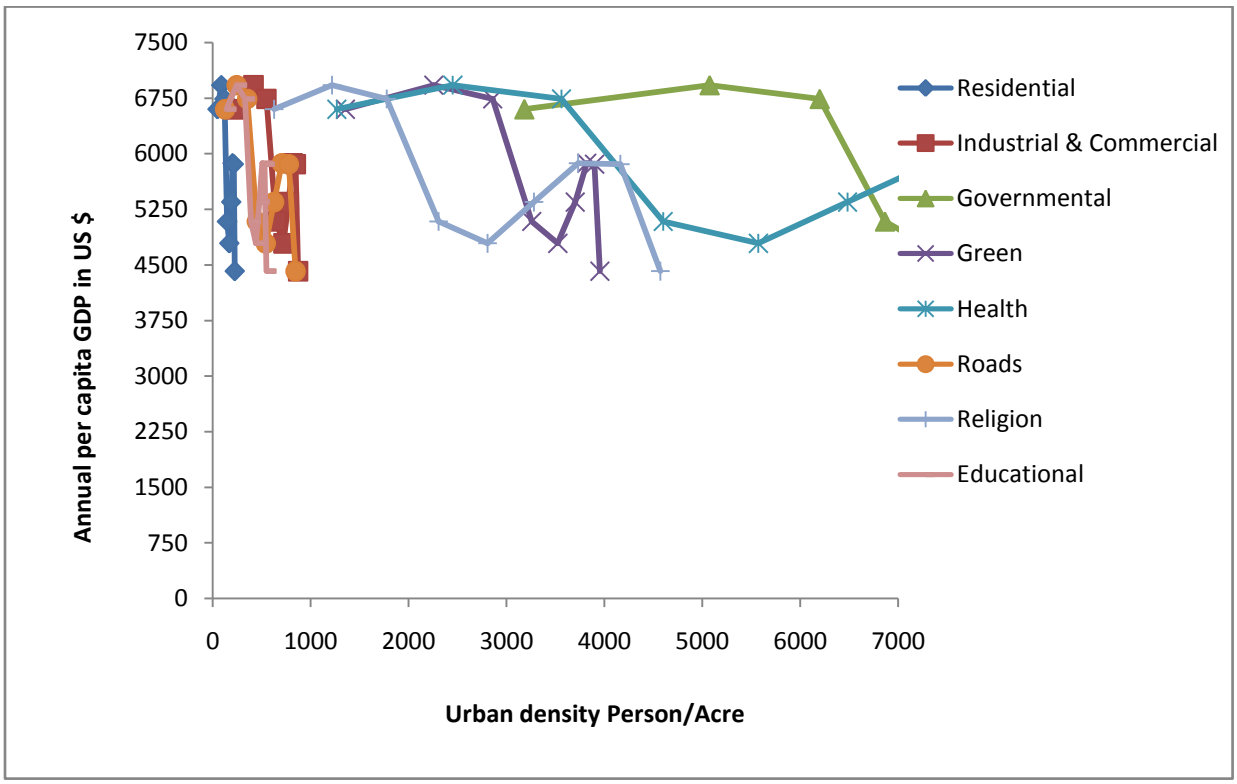


Figure No. (5): density of urban land types (inhabitants/acres) for the city of Anna

The necessary data have been prepared to use the model shown in equation No. (5) for the purpose of calculating how much the expansion of urban land uses has been affected by the accumulation of per capita income. The statistical package SPSS ver. 25 was used to obtain the results of the nonlinear regression model that was employed and initial values were created for the model parameters ranging from zero to 2.5 and the results were as shown in Table No. (4)

Table No. 4

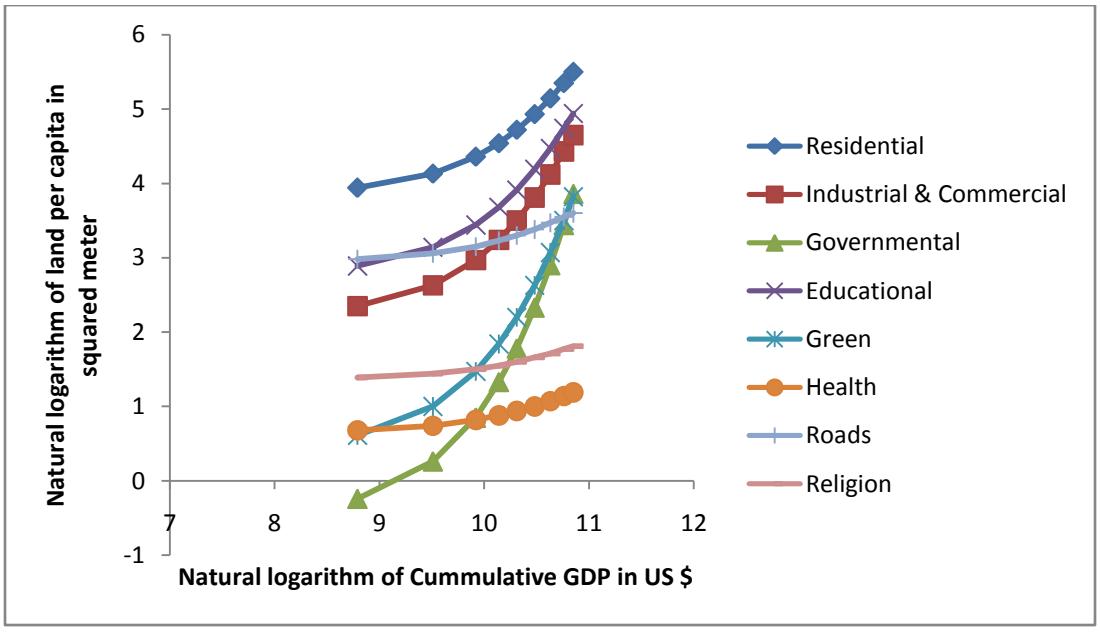
Results of using the Urban Land expansion estimation model based on accumulated income

Type of land use	Parameters of the model				Coefficient of determination
	a	b	c	d	
Residential	9.199	-5.358	-1.541	11.368	99.90%
Industrial & Commercial	9.812	-7.604	-1.561	11.328	99.90%
Governmental	14.783	-15.286	-1.516	11.456	99.90%
Educational	9.457	-6.693	-1.563	11.318	99.90%

Green	**12.163**	**-11.758**	**-1.519**	**11.439**	**99.90%**
Health	**2.136**	**-1.486**	**-1.586**	**11.212**	**99.90%**
Roads	**4.454**	**-1.508**	**-1.706**	**11.002**	**99.90%**
Religion	**2.409**	**-1.042**	**-1.69**	**11.04**	**99.90%**

Estimates of the values of the per capita logarithms of each type of urban land per square meter were calculated and the resulting data were drawn with the accumulated income and the results indicated conformity, which means that the model is efficient in estimating the data that fall within the given data of the series 2012-2020.

Figure No. (6) represents the estimated values of the per capita share of each type of urban land and its relation to the accumulated income and notes through the figure that the per capita share of residential land is the highest while of the land allocated to the health sector is the lowest.



Form No. 6: Estimates of logarithm of the per capita of the urban lands of the city of Anna.

Conclusion

Urbanization process is affected by many variables that varied in nature, such that some of these variables are measurable and others are not. Therefore, it is very difficult to quantify the extent to which of these variables, the urbanization

process is affected by. For instance, a certain set of variables that include the impact of the civilizational factors of certain countries and cities may essentially affect people to move from rural areas to urban areas looking for entertainment facilities that they may lack in rural areas. Such movement does not happened because of establishment new industries or other economic activities, rather, it just happened as a life style. This kind of movement is very hard to be interpreted on quantitative bases. The mobility of population in such a way will certainly emerge unexpected demand on transport, housing, security, markets and others. On the other hand, increasing the standard of living by increasing the per capita income may not necessarily lead to support the process of urbanization with better means of living. Urbanization progress is actually a process that utilize the potentialities of cities and developed them in order to provide the city with more energy of life and future progress by investing every possibility in a better way.

The model assumed in this study establishes a relationship between the expansion of urban land uses with economic growth represented by an increase in the cumulative per capita income. Through the study and the data used, it is clear that the forecasting process should not be for far years to come as this leads to a significant increase in the rate of cumulative income resulting in large estimates of the rate of expansion of any type of urban land use per capita. The closer the estimate is to the year of the last accumulation, the closer the estimate is to reality and vice versa. The reason for this is that the model is based on the relationship between two variables that increase over time and do not involve any fluctuations. Therefore, a decline in per capita income or a decline in land counts intended for particular use by the competent authorities will make the model a mathematical equation that does not involve a great deal of accuracy, although all the models calculated in this study were of high accuracy.

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