Scientific Journal of Silesian University of Technology. Series Transport
Zeszyty Naukowe Politechniki Śląskiej. Seria Transport

Volume 101 **2018**

p-ISSN: 0209-3324

e-ISSN: 2450-1549

DOI: https://doi.org/10.20858/sjsutst.2018.101.1

Journal homepage: http://sjsutst.polsl.pl

Article citation information:
Abid, N.M., Al-Khazraji A.J.M. Urban growth and spatial development along transport corridors in Dujail Municipality. *Scientific Journal of Silesian University of Technology. Series Transport*. 2018, **101**, 05-14. ISSN: 0209-3324.
DOI: https://doi.org/10.20858/sjsutst.2018.101.1.

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URBAN GROWTH AND SPATIAL DEVELOPMENT ALONG TRANSPORT CORRIDORS IN DUJAIL MUNICIPALITY

Summary. Often, most cities grow as a result of the increase in population in addition to increased urbanization in developing cities, including in Iraq. Where urban growth is defined as a set of phenomena, which offers geographical, economic, social and administrative advantages in terms of attraction and influence, the areas associated with them tend to suffer from population concentration and accumulation in productive activities and services. This results in social impacts on an economic, geographical and administrative scale in the region itself and its surroundings [4]. Usually, growth sites in the city are places where development is feasible with the lowest possible costs on flat land and close to infrastructure services, especially transport corridors.

Keywords: urban corridor; city development; spatial effect

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1. INTRODUCTION

Research problem: The urban growth of cities in scattered centres (the distance between the centre is unequal and not equal in size) along the main transport corridors passing by or near them. This leads to cities forming along the length of these corridors without a threshold to prevent the subsequent negative effects. Research goal: To highlight the phenomenon of planned and unplanned growth along the main corridors and transport facilities that pass through or near cities and their negative effects on these cities. Research hypothesis: An artificial threshold must be established to prevent the growth of cities scattered along roads or near transport corridors, which affects the shape of the city, leaving a negative impact on providing infrastructure services and resulting in a lack of a clear centre for neighbourhood services [4]. One should remember about human factors, including safety-related issues [12-18].

2. FACTORS OF URBAN GROWTH

2.1. Population factors

A. Population growth: The world population growth rate was very slow until the early 20th century. This decline was due to the high mortality rate, reflecting a decline in natural increase. This decline was linked to many factors, including famines, epidemics, wars and their effects. Since the revolution in agriculture in England and some European countries prior to the first census in the seventh century, a number of factors has led to an increase in the population in these regions. Meanwhile, the world population in the first century CE was about 200-300 million people, but this had increased to 500 million by 1650. The number doubled to one billion in 1850 and then doubled again to two billion in 1930 [6].

We can say that population growth is due to the following:

1. Increase in the number of births compared with deaths
2. Internal migration from rural to urban areas
3. Foreign migration, i.e., from outside the state

With the emergence of the Industrial Revolution and the resulting prosperity, the means of production and transport were improved, with relative stability, and are considered to be have been important and fundamental factors leading to the growth in population in the West. There arose the theory of Maltose in the period 1802-1800, warning of the dangers and consequences of population growth and the conflict between it and available food resources. The rate of births in Western Europe subsequently began to descend from 1850, alongside progress in the field of health, resulting in the immunization of diseases and epidemics in particular. Meanwhile, war had a significant impact on the delay in population growth in the pre-industrial era, while the First and Second World Wars led to the mobilization of young people in the armed forces and a decrease in birth rates. The First World War recorded a loss of 7.3 million people and the Second World War recorded a loss of 7.2 million people [9]. The modern population boom resulted from a large natural increase with a decrease in the mortality rate and steady or low birth rates in some countries of the world. Statistics have shown that the decline in mortality is the main cause of rapid population growth in modern times, with the average life expectancy of individuals in most countries being due to the favourable conditions of health, thanks to scientific progress in the medical and

pharmaceutical fields. Arab countries have witnessed a rise in the rate of natural increase in recent decades, ranging from 2.4% in some countries to 4% in others. Yemen recorded the lowest rate of natural increase, amounting to 2.4%; and, if this increase continues at the same rate, then it will be doubled in a quarter a century [10].

B. Migration: This is a major component of population studies because it is considered as the second source of urban growth and the change in the size of populations and cities after natural increase. Migration is a social and geographical phenomenon characterized by human movement over time. It means moving or traveling from one place to another and living there for a long or short period. The transfer of persons from one geographical area to another is concerned with changing the place of permanent residence, as well as cross-border movements, except for tourist movements [7]. Migration comes in several types, such as international or internal migration, and encouraged or forced.

2.2. Political and military factors

The administrative arrangements that accompanied the development of patriarchal sovereignty towards tribal sovereignty, the coordination of relations between individuals in society, the monitoring of security matters, and the enactment of legal and social controls were key factors in the emergence of cities. Political power has played a distinct role in the formation and construction of cities. Governments often choose to locate their centres in cities [10].

2.3. Cultural factors

This includes the arts, ethical trends, historical conditions, doctrine, taboos, the sanctities of technology and urbanization. All of these affect the distribution of populations and services and play a major role in the emergence of cities, as well as how human culture informs the creation of cities and changes the morphology and physical form. Thanks to these cultural factors, cities have grown beyond their cultural structures to provide luxury.

2.4. Economic factors

Economic factors are a set of phenomena related to the physical life of societies. They include elements that produce goods and services, such as natural resources, land, capital, means of production, cultural values, technical knowledge, organization, labour, skills and personnel techniques, industry and its organization, urbanization and welfare levels. Goldsmith has divided economic growth into five stages

The first is the economy, which is based on roaming from one place to another: in the past, man was dependent on collecting fruit and fishing, followed by the stage of collecting fruit and hunting animals, with relative stability on the ground. This transition represents the development of society. The third stage was to rely on agriculture, grazing and animal husbandry. The fourth phase was characterized by the growth in agriculture and prosperity, along with a surplus sufficient to support the urban population. The fifth stage saw the emergence of more complex work, while we can add a sixth stage involving the emergence of a technology and information economy. This economic growth has led to a population increase and consequently the growth of cities. Montesquieu considered the city to be part of the economic system [5, 6].

3. URBAN GROWTH THEORIES

3.1. Ernest Burgess' theory of concentric circuits

Ernest Burgess made a remarkable contribution to the influence of early ecologists and contributed to the writing on city growth. Burgess was interested in the development of ecological theory. In order to evaluate this theory, he developed a model and a graphic description of the way the city is growing and its spatial organization using an ecological map of the city of Chicago. To this map, he fixed its growth in light of its physical extension and its differentiation in terms of place, stemming from the basic idea that land prices and accessibility are maximized in the heart of the commercial city and then decrease away from the central area. This confirms that land prices and accessibility are paramount in the city, while "the city in its growth takes five concentric rings or concentric or concentric domains", which are as follows:

1. The central business district
2. Transition zone or transformation
3. Workers' housing area
4. The best residential area
5. Daily or suburban travel [5]

3.2. Sector theory

This theory emerged at the end of the 1930s as a reaction to the many criticisms of the theory of concentric circles. This was at the hands of Homer Hoyt, who presented a conceptual framework, in which the ecological pattern was determined in light of the idea of sectors, after studying 142 cities in terms of rents and explaining the nature of dwellings and their advantages. This theory states that the city is divided into sectors not rings. He stated that social housing is based on rental values. The latter also highlights the fact that it is income that determines the housing of individuals. The internal structure of cities is the way out of its centre to the other parties and arranges residential areas into three main sectors. Alongside commercial activities in the city centre areas, these sectors are:

1. Low-rental sector including workers with limited incomes
2. Mid-rental sector including middle-income individuals
3. High-rental sector including rich people with high incomes

3.3. The theory of multiple nuclei

This resulted from criticism of the theory of concentric circles and sectors. Harris and Ullman advocated this theory and stated there is a number of centres in the city, rather than just one centre, and that each city is different from the other in terms of the types and number of centres. Harris and Ullman pointed to four factors affecting the distribution of activities, i.e., the establishment of their centres [5].

4. THE ROLE OF TRANSPORT IN THE GROWTH AND EXPANSION OF THE CITY

The basic function of transport highlights the integration of human activity in the place where the exchange of products and activities, as well as the distribution of people, energy and goods, takes place. As transport is a key mechanism for the integration of the results of the ecological division of labour and activity, it can be one of the constraints that greatly affect the integration process and its results. In light of ancient and medieval history, we find much evidence of societies that flourished in becoming civilized, which enabled them to invent and develop appropriate transport mechanisms and connect with other societies that were isolated from human civilization because of their spatial isolation. The most effective means of transport were developed and isolated communities began to communicate through trade processes. By making links with activities and products of individuals who were located in various places, the first signs of urban growth and extension were witnessed, leading to an increase in the size of the urban population. In any case, the technological revolution was the starting point for urban growth in modern times.

5. STUDY AREA INFORMATION

The city of Dujail (the centre of the Dujail District) was a rural settlement in the Ottoman period. It was then developed and expanded by the national government. It became a district known as Smika, under Samarra's royal decree, in 1925 [2]. The name was then changed to Ibrahimia, after which the name was changed to Dujail, due to its closeness to the former Dujail River (this river no longer existed after the implementation of the Ishaqi irrigation project in the north-west of the city. In 1989, under the Presidential Decree No. 366, Dujail became a city, which included two districts, named Taji and Tarmiyah. These two areas were then separated and attached to the capital of Baghdad under Decree No. 222 in 1999, thus creating the district of Dujail without any administrative units. The area of the basic design of the developed city area is 6 km^2 and the total area of the city of Dujail is 18 km^2, with one third of the land having been developed and containing urban activities. The remaining two thirds comprise agricultural lands, most of which contain grape orchards, with a population of about 35,000 [3].

5.1. The city of Dujail

The city of Dujail is one of the cities in the province of Salah al-Din, where the area of the basic design of the city's developed area is 6 km^2, with a population of about 35,000. It became a stable urban city in 1925 when the Smika District became the area of Dujail.

5.2. Urban land uses in the city of Dujail

Planners who are interested in the study of cities refer to the term "land use", which concerns what functions (such as commercial, industrial, residential, transport or recreational) are located on its land. Land use can involve human or natural controls or both [6]. The city of Dujail is used for commercial uses, industrial uses, residential uses and service uses. It is known that the scale of the uses in the city varies according to the type of use, where residential use represents the largest percentage of the city's land use. According to the

functions of the city, the more the city has a major function, the greater the impact on this area of use. For example, cities with tourism functions, where tourism use is the leading role, or cities with industrial use, the effect of this usage is clear. It is noticeable that growth in Iraqi cities firstly involved residential use, followed by transport use, and then commercial and industrial use. In the study area, the area within the municipal boundaries covers about 2,400 acres, of which 48 acres are for commercial use, representing 2% of the total area. Industrial use covers 169 acres or 7% of the total, although only 1 acre is currently used and built factories are located within an industrial zone, which has been cancelled due to the growth of the city within residential areas in the southern part of the city, i.e., between two residential quarters 204 and 206 in the Al-Zahra neighbourhood. Recreational use covers 43 acres across 58 sites or 1.8% of total use, most in the form of four parks and two football stadiums, while public buildings and services cover an area of 123 acres across 45 sites or 5.1% of total use. Residential use, as defined above, covers a total area of 1,557 acres (64.9%). Table 1 and Figure 1 illustrate the above. In the study area, we find that residential use ranks first, transport use comes in second place, industrial use in third place and general service use in fourth place, while commercial use ranks fifth and recreational use ranks sixth and last.

Table 1

Urban land use in the area of Dujail City

Land use	Area (acres)	%
Commercial	48	2
Industrial	169	7
Residential	1,557	64.9
Recreational	43	1,8
Public services	123	5.1
Transportation	460	19.2
Total	2,400	100

Source: Municipality of Dujail Planning Department

Based on the above table, the percentage shares of land use are plotted (see Figure 1).

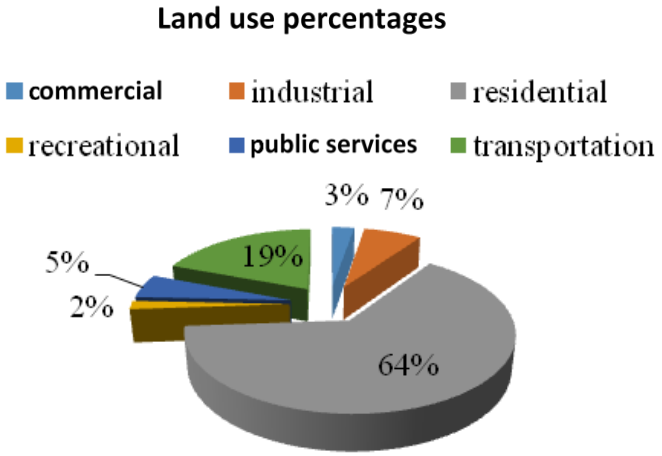

Fig. 1. Urban land use percentages for the urban area of Dujail City
Source: Based on the data in Table 1

5.3. The development stages for the city of Dujail during the age of the modern Iraqi state

The city of Dujail has undergone four stages of development and, since 1925, the first royal recognition has emerged as a city, as follows:

The first phase: The centre of the city was considered a centre of a district in 1925 known as the Smika District. This year was the starting point of the first phase until 1944. The city before this was known as the Smika area and consisting of five provinces (24, 25, 26, 27 and 28). The areas are coloured brown in Figure 2 and covered an area of 9.1 ha.

The second phase: This covered the period 1944-1969, during which the city expanded its surroundings into a large province. This was considered a district (22, indicated in yellow, in Figure 3), while the expansion area of 37.7 ha became part of the city's total area of 56.9 ha.

The third phase: This covered the period 1969-1983, when the city expanded to include parts of the province (nine Tall Maskins) as shown in pink in Figure 3. The area of expansion reached 80.4 ha, meaning that the city's total urban area became 137.2 ha. At the same time, the main street in the city of Dujail was composed of several nuclei: the first nucleus was 2 km south-east of the city and the other nuclei were a triangle near the train station.

The fourth phase: This runs from 1983 until the end of 2017, during which the city expanded in some of the agricultural districts (nine Tall Maskins, 16 Halis, 18 eastern orchards, 19 middle orchards, 20 northern orchards and 21 southern orchards), with an area of 382.5 ha, making the total urban area equal to 519.8 ha, with the total design area being 1,840.3 ha. This was the largest expansion of the city after the events of 1982, when it reached 1,703 ha. Meanwhile, the area used for the urban expansion of the city equated to 383 ha or 28.24% of the total design area, with the rest (71.76%) comprising agricultural land, 65% of which is arable and 35% unsuitable for agriculture. Given the exposure of the earth to direct sunlight, without cultivation and rising groundwater, this has caused significant amounts of salts from the ground to settle on the surface, rendering the land unsuitable for agriculture. By observing the stages of urban growth in the city, we find that, with the development of the means of transport, the city has grown along the main street with two large nuclei, allowing the city to grow in the final stage, as shown in Figure 2, with a longitudinal form consisting of five neighbourhoods and 15 residential quarters spread sequentially along the street. This runs from the main city of Dujail to the Baghdad-Mosul Regional Road before reaching Dujail Railway Station as shown on the map.

Fig. 2. Design of the urban area of Dujail 2017
Source: Dujail Municipality Department of Urban Planning/

As a result, the growth is lava-like, meaning it is scattered over uneven distances and across unequal sizes. However, as we mentioned above, it has taken a clear pathway along the main corridors (Dujail Main Street, Baghdad-Mosul Regional Road) and Al Qal facilities (Dujail Railway Station). In spite of the benefits that result from the growth near the transport

corridors in the field of spatial development (see Figure 3), in terms of easy access and job opportunities, it is not without the following disadvantages:

- The difficulty and cost of providing infrastructure services such as water and sewage networks, electricity grids and paving of main streets.
- The absence of a clear centre for neighbourhoods, while the scale of service provision in the neighbourhood is limited because of the extension of residential quarters.

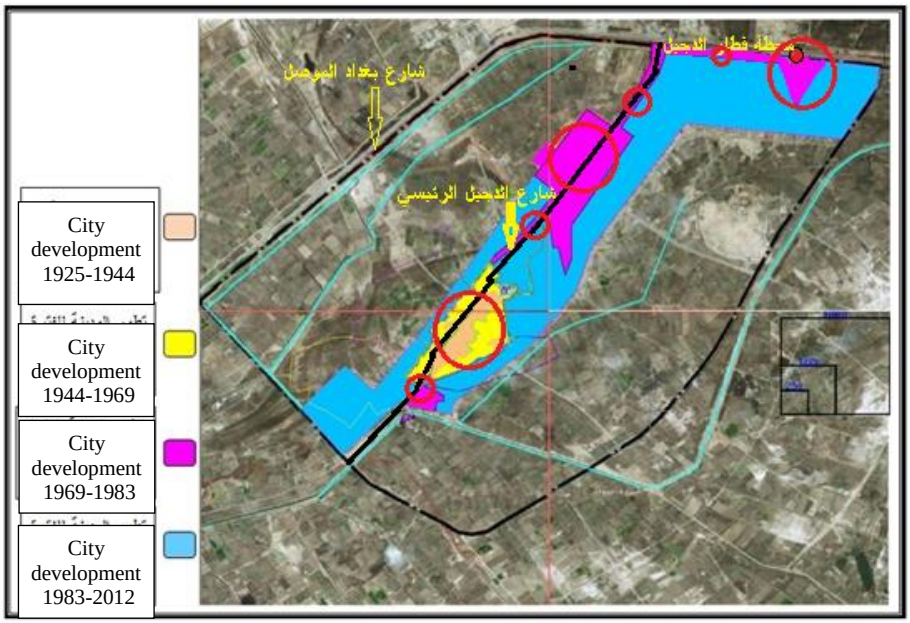

Fig. 3. The development stages of the city of Dujail since 1925
Source: From the work of the researcher, based on data from the stages of the development of the city of Dujail

When looking at the final shape of the urban area, and compared with the theories of growth, it does not match any of them except in the first and second stages, where there was no significant effect of transport in the formation of cities due to the principle of theories of concentric circles being accepted. However, the third and fourth stages, which saw spread and growth, made the centre become uncertain and longitudinal, i.e., taking the form of a transport corridor (Dujail Main Street and Baghdad-Mosul Regional Street) with the largest lava-like urban growth, as we mentioned, in the south-east of the city and near the train station. This would appear to link the theory of multiple nuclei with the nature of the spread and concentration. Thus, we see a clear role for transport corridors and facilities in the formation of cities and the nature of their growth when reviewing the stages of the development of the city of Dujail. As the economic aspect has been one of the most important reasons for the formation of cities in modern times, transport has one of the most important drivers of economic development, allowing the population to move in order to enhance quality of life and prosperity.

6. CONCLUSIONS

1. There is an effective role for urban corridors and facilities in the nature of cities and their stages of development, especially after significant advances in the means of transport.

2. Despite the positive role of the transport sector in the field of spatial development, the negative effects could surpass the positive effects, and this is what we have seen in the stages of growth and formation of the city of Dujail, where the city structure is bounded by the main street in the city, as well as Baghdad-Mosul Regional Street, which has led to the following:
   - The lack of a clear centre for neighbourhoods to assign the services of the neighbourhood because of the extension of residential quarters, which makes the coverage area of the impact of public services for the neighbourhood are few and do not cover all the neighbourhood.
   - The difficulty and cost of providing infrastructure services such as water and sewage networks, electricity grids and paving of main streets.
3. The nature of the city of Dujail may help to explain the formation of some cities based on transport corridors and facilities, which could inform a new theory of urban growth and detailed studies supporting this trend.

7. RECOMMENDATIONS

1. Establish barriers that prevent the emergence of growth, such as those witnessed in Dujail, as these can avoid the disadvantages that result from such growth due to the strip shape of the city, although the third and fourth stages of the development of the city were planned stages and not as random as the first and second stages.
2. Prepare a study on costs and benefits should be undertaken in order to determine the nature of the formation of cities located along main transport corridors.
3. Consider the factors of the impact of transport in the development of expansion strategies, so that we can evaluate the negative and positive consequences of urban growth, when based on corridors and transport facilities. This will reinforce the positive factors and reduce the negative effects of the formation of cities as we have seen in the city of Dujail.
4. Strive to establish administrative or legal barriers that limit the longitudinal growth of cities by issuing laws, instructions or regulations, especially where such growth is supported by and in the interests of society, and in turn the negative effects of such expansion, which usually appear after long periods of time.

References

1. Abdel M. 1981. *Society of the City*. Libya: Dar al-Nahda al-Arabiya.
2. Al-Dujail District Court. Archives - Unpublished Data.
3. Municipality of Dujail Department of Planning and Follow-up.
4. Hakim M. 1978. *Urbanization in the Arab World, Arab Organization for Culture and Science, League of Arab States*. Cairo: Egyptian General Libraries.
5. Hamid K., S. Belkacem, K. Ismail. *Theoretical Problems and Reality*. Constantine: Montessori University Press.
6. Hussein R. 1998. *The City*. Alexandria: The Modern University Office.
7. Hussein R. 2002. *The City*. Alexandria: The Modern University Office.
8. Hussein A. 1973. *The Rise and Development of Iraqi Cities*. Ataba Printing Press.
9. Fathi A. 2000. *Studies in Demography*. Beirut: Dar al-Nahda al-Arabiya.

10. Tamadr H., R. Hussein. *Security Problems Associated with the Growth of Al-Muhannad and Al-Hijjah*. Riyadh: The Arab Center for Security Studies and Training.
11. Taha A. 2005. *Master of Urban Land Use Introduction to the Faculty of Education*. Ibn Rushd.
12. Czech P. 2017. "Physically disabled pedestrians – road users in terms of road accidents". In Macioszek E., Sierpiński G. (eds.), Contemporary Challenges of Transport Systems and Traffic Engineering. *Lecture Notes in Network Systems* Vol. 2: 157-165. Springer.
13. Bivina G.R., Purnima Parida, Mukti Advani, Manoranjan Parida. 2018. "Pedestrian level of service model for evaluating and improving sidewalks from various land uses". *European Transport \ Trasporti Europei.* Issue 67. Paper n 2.
14. Brumercik F., M. Lukac, Z. Krzysiak, L. Krzywonos. 2017. "Model of integrated transportation system". *Komunikacie* 2: 23-26.
15. Czech P. 2017. "Underage pedestrian road users in terms of road accidents". In Sierpiński G. (ed.), Intelligent Transport Systems and Travel Behaviour. *Advances in Intelligent Systems and Computing* Vol. 505: 75-85. Springer.
16. Jacyna M. 1998. "Some aspects of multicriteria evaluation of traffic flow distribution in a multimodal transport corridor". *Archives of Transport* 10(1-2): 37-52.
17. Jacyna M., M. Wasiak, K. Lewczuk, M. Kłodawski. 2014. "Simulation model of transport system of Poland as a tool for developing sustainable transport". *Archives of Transport* 31(3): 23-35.
18. Sokolovskij E., O. Prentkovskis. 2013. „Investigating traffic accidents: the interaction between a motor vehicle and a pedestrian". *Transport* 28(3): 302-312.

Received 26.08.2018; accepted in revised form 13.11.2018