

# AN ANALYSIS ON URBAN SPRAWL IN THE TABRIZ METROPOLITAN AND ITS FRINGE CITIES

<sup>1</sup>RASOUL GHORBANI, <sup>2</sup>MINA FAROKHISOMEH

<sup>1</sup>Professor in Department of Geography and Urban Planning, University of Tabriz, Tabriz, Iran.

<sup>2</sup>PhD Candidate of Geography and Urban Planning, University of Tabriz, Tabriz, Iran.

Email: <sup>1</sup>Rghorbani@Tabrizu.ac.ir, <sup>2</sup>min.farokhi@yahoo.com

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**Abstract-** This paper assesses causes and effects of urban sprawl development pattern in during 1984- 2011 in fringe cities of the Tabriz metropolitan Area. The sprawl is external growth without control and imbalance at around of urban area that caused of destruction green space, increase traffic, loss of agricultural land and changes it's to built-up area. In order to detect and evaluate to measure the model of urban sprawl, density and Holderness model was employed. We used quantities data of the study area from the period between 1984 and 2011, and Population Censuses Data. The result of this study shows that economic, social and environmental effects of sprawl caused that change in agriculture land to built-up area, density and transportation system from 1984 to 2011 in the around of Tabriz. Density and area analysis show that there has been an increase growth in area during the 27 years with the Percentage growth in population by 1.43% in Basmenj, 1.62% in Sardrud, 2.67% in Sofyan and 1.98% in Tabriz and with the reduction of density from 1984 to 2011. The Holderness Equation indicates in the fringe of the metropolitan city of Tabriz that on average high percent of the city physical growth was due to some factors other than population growth, and some percent was due to population growth.

**Keywords-** Metropolitan, Fringe, Urban sprawl, Density, Holderness method, IRAN- Tabriz.

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## I. INTRODUCTION

Urbanization is an inevitable process due to economic development and rapid population growth (Shalaby and Tateishi, 2007). Understanding the process of urbanization would help the city planners to understand and plan and eradicate the problems associated with increased urban area and population, and ultimately build a sustainable city (Ramachandra et al, 2014; P: 1). A sustainable development strategy can be designed by city developers and planners through measuring growth trend and sprawl urban development. The occurrence of urban development is so general, and its implications are so wide, that it is possible to view much of recent social and economic history in terms of the attempts to cope with its varying consequences (Bhatta et al., 2010; P: 96). The uncontrolled population growth and migration in urban areas have created the issues like of urban sprawl. However, population growth and urbanization urban sprawl are directly dependent on each other. In Iran level of urbanization increased to 72% in 2011 (Census of Iran, 2011). Urban sprawl as a concept suffers from difficulties in definition. There is still little consensus on the definition of sprawl or its alternatives: compact development, pedestrian-friendly design, transit-oriented development, and the catch-all term "smart growth." There is also little consensus about how sprawl impacts everything from open space preservation, air quality, traffic congestion, housing affordability, and quality of life (Hamidi et al., 2014: 2). Urban sprawl has become a characteristic of urban development worldwide. In the past, it has been used to describe the low-density suburban development around the periphery of cities. In recent years, it has become fashionable to take sprawl more as a verb of dynamic evolution and as

the synchronized process of spatial growth and the scattering of urban areas (Zeng et al., 2015). Urban sprawl is characterized based on various indicators such as growth, social, aesthetic, decentralization, accessibility, density, open space, dynamics, costs, benefits, etc. Further, Galster et al. (2001), has identified parameters such as density, continuity, concentration, clustering, centrality, nuclearity, proximity and mixed uses for quantifying sprawl (Ramachandra et al, 2012; P: 330). Urban sprawl is known as a multifarious concept dealing with the expansion of auto-oriented low-density development and has a considerable impact on the surrounding ecosystem (Yuan et al., 2005).

## II. DETAILS EXPERIMENTAL

### 2.1. Study Area

Tabriz, one of the oldest cities in Iran, is the capital of the eastern Azerbaijan province. It is the fifth largest metropolitan in the Iran by population with more than 1.7 million inhabitants. Basmenj, Sardrud, Sofyan and Tabriz are fringe cities located in eastern Azerbaijan. Tabriz is center of the province, Basmenj is in the East, while Sardrud is in the West and Sofyan is in the East (Fig. 1). Population of Basmenj was 7250 in 1990, and it is expected to 11190 in 2011. Population of Sofyan was 6220 in 1990, and it is expected to 9126 in 2011. The city of Sardrud, one of the ancient cities in eastern Azerbaijan has expanded very rapidly, especially after increase population in Tabriz. This city has a high influence on Tabriz. Population of Sardrud was 14885 in 1990, and it is expected to 26856 in 2011 (Municipality of Sardrud, 2011), also area is expected to 371.83 he in 2011.

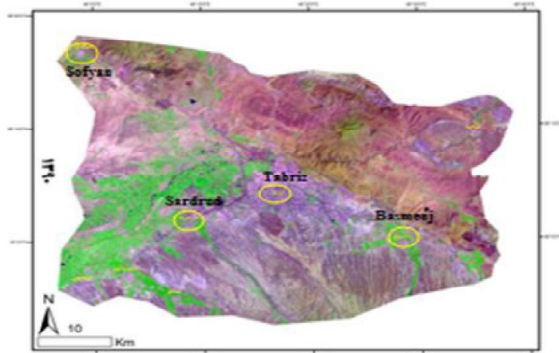


Fig. 1: study area, Metropolitan of Tabriz and Its fringe cities.

**2.2. Materials and Procedures**

This study is a method of investigation both descriptive and analytical. Satellite imageries of 1984 to 2011 were used to classify the land use patterns. The data collected from the satellite imageries TM, ETM+ for the years 1984, 1990, 2000 and 2011. Population data was collected from the Directorate of census Operations Iran. **Table 1** list the data used in the current analysis and shows the population growth and area rate in the Basmenj, Sardrud, Sofyan and Tabriz in during 1984- 2011. Table 1 reveals that the population density has reduced from 1984 to 2011. Fig. 2 shows growth of population and built-up area of fringe cities in last 27 years.

Understanding the dynamic phenomenon, for example, urban sprawl, requires area change analyses, urban sprawl pattern was analyzed using quantitative models of urban planning such as Holderness and density. By using population density data and area data at the fringe of the metropolitan city level, we calculated the sprawl index for each city (**Table. 2**).

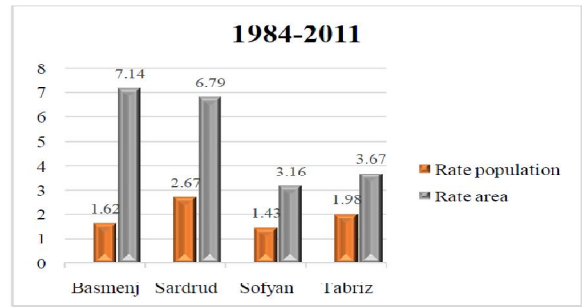


Fig. 2. Growth rate of population and built-up area in Tabriz metropolitan

Area has increased in the Basmenj from 32.31 he in year 1990 to 208.15 he in year 2011. In the Sardrud area has increased 63.09 he in 1984 to 371.83 he in 2011. In the Sofyan area was 69 he in 1984 and has increased to 160.3 he in 2011. In Tabriz city area was 5787.63 he in 1984 and has enlarged to 15326.71 he in 2011.

**III. RESULTS AND DISCUSSION**

Density in various forms has often been used to characterize urban sprawl. Several researchers created measures of sprawl that relied almost solely on density (Anthony, 2004; Fulton et al, 2001; Lang, 2003; Lopez & Hynes, 2003; Pendall, 1999; Bhatta et al, 2010). We chose population density to quantify urban sprawl because of its common usage and the availability of population data at the regions level.

Here population density (PD) for each city is calculated as the ratio of census-reported total population of the Basmenj, Sardrud, Sofyan and Tabriz to its land area, as follows:

$$(1) PD_i = \frac{Pop_i}{Area_i}, Pop = \sum_{i=1}^4 Pop_i$$

Where i (i= 1, 2,..., 4) is the number of city's;  $Pop_i$  is the population for cities; and  $Area_i$  is the area of cities i. We estimated the population data at the cities level in 1984, 1990, 2000 and 2011, and Table. 1 presented the percentage change of population density at the metropolis Tabriz and fringe cities.

**Table 1: Urban growth statistics in Tabriz metropolitan city**

Year	Density				Growth Rate	
	1984	1991	2006	2011	population	Area
Basmenj	224	87	69	54	1.43	3.16
Sardrud	209	120	85	72	1.62	7.14
Sofyan	90	68	60	57	2.67	6.79
Tabriz	152	164	116	98	1.98	3.67

Reference: The data were produced from Landsat images and the authors

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**Table 2: Calculating Holderness method between 1984 to 2011 in Tabriz metropolitan city**  
Reference: The authors

Years	1984		2011		Holderness Method 1984-2011					
	Population	Area	Population	Area	Ln(PF/Ps)	Ln(PcgF/PcgS)	Ln(UaF/UaS)	Pi=Ln (PF/Ps) Ln (UaF/UaS)	GPCi= Ln (PcgF/ PcgS) /Ln	Pi+GPCi=1
Basmenj	7250	32.31	11190	208.15	0.4340	1.4289	1.8628	0.23	0.77	0.23+0.77=1
Sardrud	13189	63.09	26856	371.83	0.7111	1.0628	1.7738	0.40	0.60	0.40+0.60=1
Sofyan	6220	69	9126	160.03	0.3834	0.4579	0.8412	0.46	0.54	0.46+0.54=1
Tabriz	881626	5787.6	1494998	15326.7	0.5281	0.4458	0.9738	0.54	0.46	0.54+0.46=1

Reference: The authors

**-Holderness method**

Existing studies often used a condition of population distribution too measure sprawl empirically. One of the principal methods for determining urban sprawl is the use of Holderness method in the middle-size city. Using this method, it could be specified what is the extent of urban growth in the result of population growth and what extent in the result of urban unorganized growth.

$$\begin{aligned}
 (2) \quad & \text{Ln} \left( \frac{\text{population at the end of period}}{\text{population at the beginning of period}} \right) \\
 & + \text{Ln} \left( \frac{\text{land gross per capita at the end of period}}{\text{land gross per capita at the beginning of period}} \right) \\
 & = \text{Ln} \left( \frac{\text{urban area at the end of period}}{\text{urban area at the beginning of period}} \right)
 \end{aligned}$$

Results shown on table 5 indicates the urban sprawl during the years 1984-2000, about 0.23 percent of the urban sprawl in the Basmenj was caused due to population growth and 0.77 percent was caused due to horizontal urban growth. Moreover, shows the urban sprawl in the Sardrud during 1984-2011, about 0.40 percent of the urban sprawl was instigated due to population growth and 0.60 percent was caused due to horizontal urban growth. The urban sprawl through the years 1984-2000, about 0.46 percent of the urban sprawl in the Sofyan was caused due to population growth and 0.54 percent was caused due to horizontal urban growth. The urban sprawl during the years 1984-2000, about 0.54 percent of the urban sprawl in the Tabriz was caused due to population growth and 0.46 percent was caused due to horizontal urban growth. Table 3 designates the urban sprawl through the years 1984-2011, in fringe cities of the metropolitan Tabriz.

Several factors are responsible for present patterns of sprawl. Among these factors, one is the accessibility through various transportation nodes, industrial location, topography, activities like services or urban

facilities, commercial and near settlements and other activities have also been contributing to the spatial spread of cities.

Urban sprawl, threatens our environment, our rural, our urban spaces, in numerous ways. Destruction of orchards, green spaces, gardens and agricultural lands, air pollution, increases traffic and drive up the cost of urban management, the sale of land to finance the city, are the most common problems in urban areas. All these have led to the decrease of life quality in urban societies and increase urban sprawl.

**CONCLUSIONS**

The findings of this study shows that economic, social and environmental effects of sprawl caused that change in agriculture land to built-up area, density and transportation system in Tabriz metropolitan and three middle-size city in 1984-2011. Urban dynamics of rapidly urbanizing landscape – Basmenj, Sardrud, Sofyan and Tabriz has been analyzed to understand historical perspective of urban sprawl and impacts of the changes. Urban density is computed for the period 1984–2011 and is depicted in (Table. 1), Density and area analysis show that there has been a growth in areas during the 27 years with the increase of population and with the reduction of density from 1984 to 2011. The approach for estimating city sprawl is Holderness Equation. The mentioned method indicates that between 1984- 2011 the urban sprawl during the years 1984-2011, about 0.23 percent of the urban sprawl in the Basmenj was caused due to population growth and 0.77 percent was caused due to horizontal urban growth. The urban sprawl in the Sardrud during 1984-2011, about 0.40 percent of the urban sprawl was instigated due to population growth and 0.60 percent was caused due to horizontal urban growth. The urban sprawl through the years 1984-2011, about 0.46 percent of the urban sprawl in the Sofyan was caused due to population growth and 0.54 percent was caused due to horizontal

urban growth. The urban sprawl during the years 1984-2011, about 0.54 percent of the urban sprawl in the Tabriz was caused due to population growth and 0.46 percent was caused due to horizontal urban growth.

In This study has attempted to understand the urban sprawl of Tabriz and its fringe cities, quantified by defining important metrics (Holderness method, Density). The result indicated urban sprawl is taking place continuously at a faster rate in outer and around Tabriz, bringing more area under built-up classification as discovered by distributed growth. Distance between Tabriz with Sofyan is low and Tabriz effect on urban sprawl in Sofyan. In the suburban the Tabriz near to the Sardrud there are many industrial business or industrial unit and highway then it's had the increment impact for the urban sprawl. Basmenj in spite of decrees in the rate of population have expand in the physical growth because built-up near the Tabriz have been found to be effective in determination of urban sprawl and its spatial distribution. Further, it has been found that the changes area in the Tabriz and urban region over the period of nearly 27 years like socio-economic conditions, governmental investments for transportation and regional transportation network, industrialization, distances from Tabriz are factors useful for the urban sprawl and development sprawl.

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