

# Causes and Trends of Urban Sprawl in Adigrat City, Tigray, Ethiopia



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## Abstract

The main objective of this research is to assess major causes and trends of the urban sprawl of Adigrat city. Both quantitative and qualitative approach of data analysis was used. The survey result indicates growth of population, increase the living and property cost in the main city, land demand and land speculation and the growth of transport are among the driving factor of urban sprawl. The study shows 1163.24 hectares of land was added to the city. This rapid growth of urban sprawl has adverse effect on the development of the city. Finally, the city administration should need integrated, effective and efficient workwith, timely preparation, supervision, evaluation and implementation of the structural plan of the city.

**Keywords:** Causes, Trends, Urban Sprawl.

## Introduction

There is no common understanding concerning the meaning and the concept of urban sprawl, due-to its dynamic nature and character across the world. According to Staley & Hisrich, (2001) urban sprawl is an urban development with low density, strip commercial development along major roads, scattered, un-integrated commercial and residential development. The scattered development creates long stretched of vacant land between developed areas.

Sprawl is a land use pattern in an urban area that has eight distinct dimensions: such as density, continuity, concentration, compactness, centrality, nuclearity, diversity, and proximity (Galster et al., 2001). Urban sprawl denotes the growth of urban areas without control, coordination, and plan of cities and towns along the periphery area (Majid, & Yahya, 2010). Urban sprawl has a low density physical shape when cities and towns expanded to their surrounding agricultural areas (EEA, 2006). Song & Knaap, (2004), Heimlich & Anderson, (2001), Torrens & Alberti (2000), and Tsai, (2005) referred in their study urban sprawl has different characteristics such as low density that consumes large plot of land, outward growth to the fringe of the urban area, leapfrog or dispersed development, most of cases the residences and commercial building are situated along street or roads and sprawl creates a division between urban and rural area but there is no clear identified border between urban centers and sprawl area.

Many researchers pointed out the cause of urban sprawl differ according to its character and nature. Bekele, (2005) indicates in her study, population growth, growth of household income, the provision of infrastructure such as roads, ineffective and inefficient land-use, excessive growth, social problems in core cities and poor land policies to be taken the main causes of sprawl.

Dhali, Dhali, Chakraborty & Sahana, (2018) studied urban sprawl in Parganas district is taking place a radial direction or linear forms along the highways. The driving forces of urban sprawl in Mangalore include growth of population increase, economic growth and the provision of infrastructure like construction of roads and service. Urban sprawl over a period of nearly thirty years in terms of the built-up area change and population growth, the change of built-up is (145.68 percent) and the change in population growth is (54.05 percent). Therefore the percentage change of built-up area is greater than the percentage change of the population (Sudhira, Ramachandra, & Jagadish, 2003).

The Bahardar city expanded annually 12 percent, 14 percent, 5 percent between 1957-1984, 1985-1994 and 1994- 2009 respectively. This indicates Bahardar expanded from 279 hectares in 1957 to 4830 hectares in 2009 (Haregeweyn, Fikadu, Tsunekawa, Tsubo, & Meshesha, 2012).

## Shrinkhla Ek Shodhparak Vaicharik Patrika

The trend of urban sprawl either it is fast or slow is determined by the demographic change and investment of infrastructure and growth of the economy. Addis Ababa city was stretched along its catchments with an average of 1 km in all directions, and 2 km along the major outlets (Kassa, 2014). Girma, (2013) in his study shows that, the population of Bantu town increased 6.5 percent annually between 1994 and 2007. Migration is among the main factor in population growth in Bantu town. Migration accounts for 77.6 percent and 53.26 Percent of the total population growth of the Bantu town between 1994 and 2007 respectively. The area of Bantu town increased from 83.1 hectares to 296 hectares in 1994 and 2007. In the case of Hawassa city the sprawl built-up area had increased continuously by 234.5 percent between 1987 and 2011. The development of built-up area consumed agricultural land in North-East, East, South-East, part of the city (Wondrade, Dick, & Tveite, 2014).

The total urbanized area of Dukem town increased from 648 hectares to 3586 hectares and more land is incorporated for housing, industrial, storage and infrastructure purpose 2508 hectares (70 percent) out of 3586 hectares covered by the houses, industrial and storage land use type (Dadi, Senbeta, Abebe, Taheri, 2016).

The city of Dire Dawa city is located in the eastern part of Ethiopia. The built-up area Dire Dawa city covered 517 hectares in 1985 this number grown to 2976 (15.8 percent) hectares in 2015. Expansion took place towards roads, business or service area and industrial park, which results the decline of Buren land, farmlands, and vegetation (Taffa, Mekonen, Mulugeta & Tesfaye, 2017). Like Dire Dawa, the built-up area of DebreBrihan expanded 65.53 Percent between 1986 to 2018 (Soni, Birke, Madan, & Tegegne, 2018). Adigrat city is not far from this reality, therefore, it is essential to understand the specific issue related to cause and trends of urban expansion or sprawl in the study area.

### Main Body Objective

The main objective of this study is to assess the cause and trends of the urban sprawl of Adigrat city. And the study area has a great contribution in reducing the adverse effects of urban sprawl on social, economy and the environment at country level in general and to the Administration and Municipal office of Adigrat city in particular.

### Review of Literature

Those most commonly stated that the definition of urban sprawl is an urban area that extended with low-density, leapfrogging, scattered of workplace and residential house that far apart from central-city, continuous strip development, car dependent and occurred as a result of poor planning (Bekele, 2005). Definition of urban sprawl consists such as urban area expansion, scattered settlement or widely separated building and consume large land per person (Jaeger et al., 2010).

The driving factors of urban sprawl differ based on the development level of countries or societal structure. In developed countries

like American nation individuals needed to have a large house with separate garden area along the suburb neared to the nature (Bruegmann, 2005). The driving factors, urban sprawl such as population increase, socio-economic factors, technological development and development policies (Karakayaci, 2016).

Urban sprawl has different character and nature. The driving factors of urban sprawl differ based on the development level of countries or societal structure. In developed countries like American nation individuals need to have a large house with separate garden area along the suburb near to the nature (Bruegmann, 2005).

Population growth, rise of household income, provision of infrastructure and social services, poor land management, in proportional growth, social problems in central cities and lack of effective land policies are considered the main cause of urban sprawl (Bekele, 2005). Sprawl in developed countries is usually a matter of preference. People move from the center of the city to rural areas for searching of safe environment and more space as their income is increased and their owned private car. To the reverse in the developing world sprawl is largely a result of necessity people, travels from rural area of the country to more heavily populated cities and towns for better living conditions (Menon, 2001).

Population growth, independence of decision (the competition between private and government expectation of future development land), economic growth, industrialization, land demand and speculation, physical geography, development and property tax, lack of affordable housing, increase living and property cost in the inner city, demand for more space, transportation and government development policies are among the cause of urban sprawl (Bhatta, 2010).

The rate urbanization in Arua district in Uganda increased fast as the population grows 3 percent per annum. The coverage of built-up area was 18.2 percent in 2001, these increases to 28.8 percent in 2010 and 40.9 percent in 2016. Urbanization will grow 57.4 percent in 2031 but agricultural land affected negatively and will be decreased 10 percent (Abudu, Echima, & Andogah, 2018).

Girma, (2013) pointed out in his study the population of Bantu town increased 6.5 percent annually between 1994 and 2007. Migration is among the main factor in population growth in Bantu town. Migration accounts for 77.6 percent and the total population of the Bantu town growth by 53.26 percent between 1994 and 2007 respectively. The area of Bantu town increased from 83.1 hectares in 1994 to 296 hectares in 2007. In the case of Hawassa city the sprawl built-up area had increased continuously by 234.5 percent between 1987 and 2011. The development of built-up area consumed agricultural land in North-East, East, South-East, part of the city (Wondrade, Dick, & Tveite, 2014).

**Hypothesis**

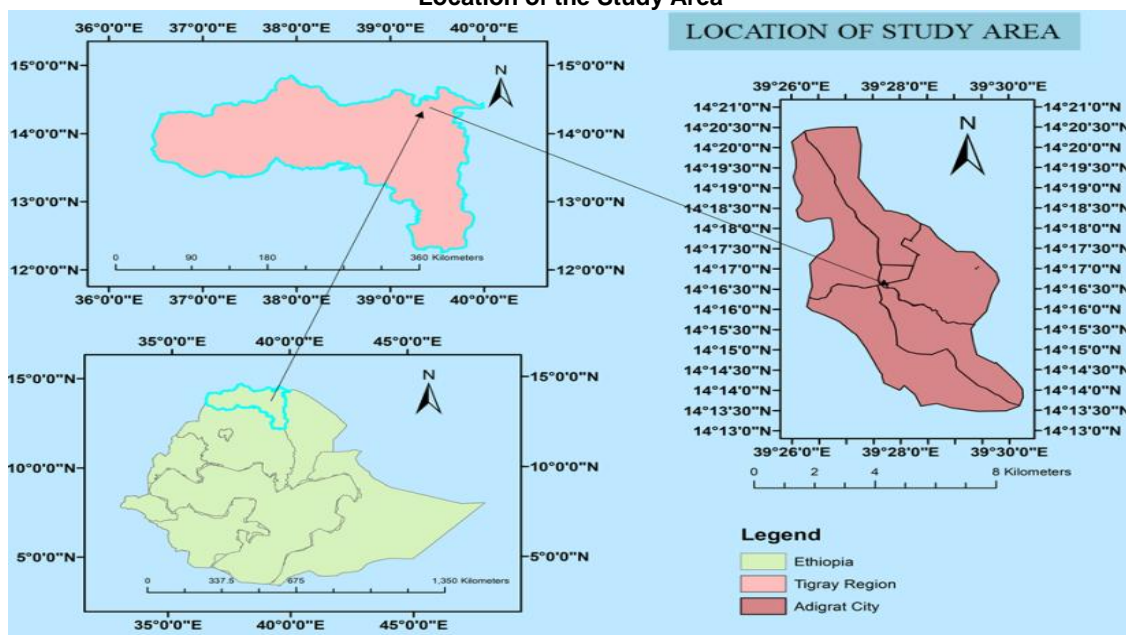
Population is one of the major factors for continuous growth of urban sprawl in the study area.

**Research Design****Background of Study Area**

Adigrat city is located in northern Ethiopia, in the Tigray National, Regional State, Eastern Tigray Zone at a Distance 894 Kms from Addis Ababa and 114 Kms from Mekelle, the regional capital.. Adigrat is located geographically 14° 20' North Latitude and 39° 29' East Longitude (MUDC, 2016). The total area of Adigrat city is 1877.24 hectares (Adigrat Municipal Office, 2018). The city is an administrative capital of

the Eastern Tigray Zone and also the capital of Gantafeshum wereda. The city of Adigrat located at the crossroads of Mekelle-Adigrat-Zalambessa and Mekelle-Adigrat Adwa-Axum highway.

Physiographical it is situated at the eastern foot of the Adigrat Ridge that forms a triple watershed dividing among the Tekeze to the South, Mereb- Gash to the North and the Danakil to the East (FUPI, 2006). The city has moderate temperature the with annual average between 15° C and 20° C that makes human settlement comfortable and its mean annual rainfall is about 659.4 mm (FUIP, 2006).

**Figure 1.****Location of the Study Area**

**Source:** GIS Lab, (2018)

The study employed mixed approach and 367 samples of households selected using simple random sampling out of 15522 households. Both primary and secondary sources of data were gathered in this study. Primary data were collected through a structured questionnaire (close-ended and open-ended questionnaires), Interview (unstructured) and observation.

The secondary data sources were collected from different published and unpublished material of governmental and non-governmental organizations, internet sources and previous research works were employed in obtaining the essential information. Finally, the quantitative and qualitative approach of data analysis was used to describe the findings. The quantitative data are summarized in the form of percentage, graphs and tables.

**Findings****Cause of Urban Sprawl**

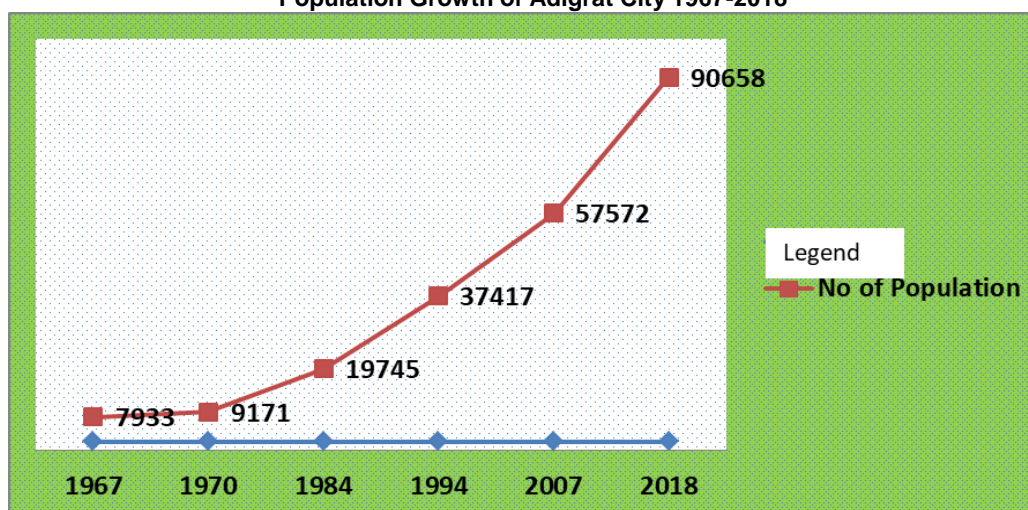
Urban sprawl has different character and nature. Different study indicates the cause of urban sprawl vary based on the development level of countries or societal structure. According to the European Environmental Agency the major driving

factors of urban sprawl are demographic factor, economic growth, housing preference, the inner city problem, the growth of transportation and weak and regulatory framework. According to the result of the study, the cause and trends of urban sprawl are summarized below.

Table 1.2 indicates the majority of the respondents agreed the main driving factors of urban sprawl in Adigrat city is the rapid growth of the population, increase the living and property cost in the main city land demand and land speculation and the growth of transport with a mean score of 4.1, 3.80, 3.78, 3.76 and 3.70 and increase in income of people and demand of more living space respectively. The population of the Adigrat city increased continuously the last four decades as the main cause of urban expansion. The population increased at annual growth rate of 20.44 percent in the last five decades. The result of the study shows population growth and rapid urban sprawl have a strong positive relation ( $r=0.946$ ,  $P=0.001$ ).

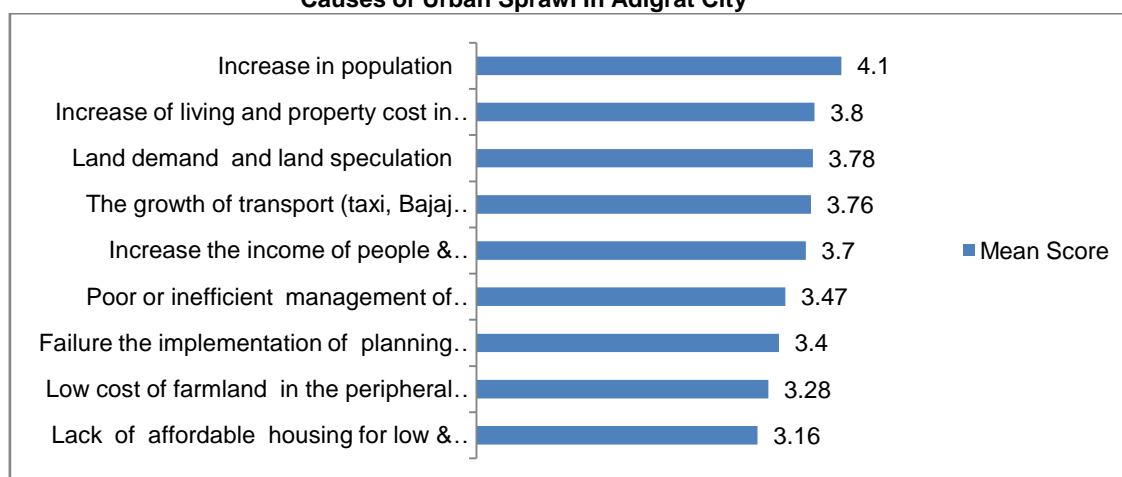
The growth of living and property cost in the inner of the city leads people to build houses along the periphery area which results of urban sprawl.

**Figure 2**  
**Population Growth of Adigrat City 1967-2018**



Source: CSO, EPHCC, (1968, 1977, 1991, 1995 and Plan & Finance Office (2018)

**Figure.3**  
**Causes of Urban Sprawl In Adigrat City**



Source: Field Survey, (2018)

#### **Growth and Trends of Urban Sprawl**

Adigrat city is expanding out into the surrounding rural area. This rapid expansion is not only demographically but also sprawling to the periphery area which consumed fertile agricultural land. In order to discover the trend of urban sprawl of Adigrat city from 2006 up to 2018 three measures, namely Rate of urban expansion (RUE) Land consumption rate (LCR) and Land Absorption Coefficient (LAC) have been used.

#### **Rate of Urban Expansion**

$$RUE = \frac{(UA)_{i+n} - (UA)_i}{n * (UA)_i} * 100$$

Where  $UA_{i+n}$  and  $UA_i$  are the urban area in hectare at time  $n$  and  $i$ , respectively, and  $n$  is the interval of the calculating period (in years) (Mohan, et al, 2011).

Based on table 3, Adigrat city gained 1163.24 hectares (162.91 percent) of land. The annual growth rate of Adigrat city was 13.57 percent per annum between 2006 and 2018.

**Table. 1**

**Expansion of Adigrat city between 2006 and 2018**

| Year | Area in (hectare) | Total change in (hectare) | Total Change in Percentage | Percent Per Annum Change |
|------|-------------------|---------------------------|----------------------------|--------------------------|
| 2006 | 714               | -                         | -                          | -                        |
| 2018 | 1877.24           | 1163.24                   | 162.91                     | 13.57                    |

Source: FUPI, (2006) and Municipal Office of Adigrat city, (2018)

According to table 4 indicates built-up areas gained 894.9 hectares (167.18 percent) additional land between 2006 and 2018. Built-up area growth was 13.9 percent per annum.

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Table. 2  
Built-up Area Expansion between 2006 and 2018

| Year | Built-up area in Hectare | Difference in Hectare | Total Change in Percent | Percent Per Annum Change |
|------|--------------------------|-----------------------|-------------------------|--------------------------|
| 2006 | 535.5                    | -                     | -                       | -                        |
| 2018 | 1430.2                   | 894.9                 | 167.17                  | 13.9                     |

Source: FUPI, (2006) and Municipal Office of Adigrat city, (2018)

## Land Consumption Rate (LCR)

$$LAC = \frac{A}{P}$$

Where A is an area of the city (ha) and P is the total population (Yeates, & Garner, 1976).

Based on table 5, the land development rate is far exceeding that of the rate of population growth. According to table 5, the land consumption rate is 0.0127 hectares / person and 0.0207 hectares / person in 2006 and 2018.

Table 3  
Land Consumption Rate of Adigrat City

| Year | Area (Hectare) | Population | LCR (hectare/person) |
|------|----------------|------------|----------------------|
| 2006 | 714            | 56021      | 0.0127               |
| 2018 | 1877.24        | 90658      | 0.0207               |

Source: FUPI, 2006, Municipal Office, (2018), EPHCC & Plan Finance Office (1995, 2008 & 2018)

## Land Absorption Coefficient (LAC)

$$LCR = \frac{A_2 - A_1}{P_2 - P_1}$$

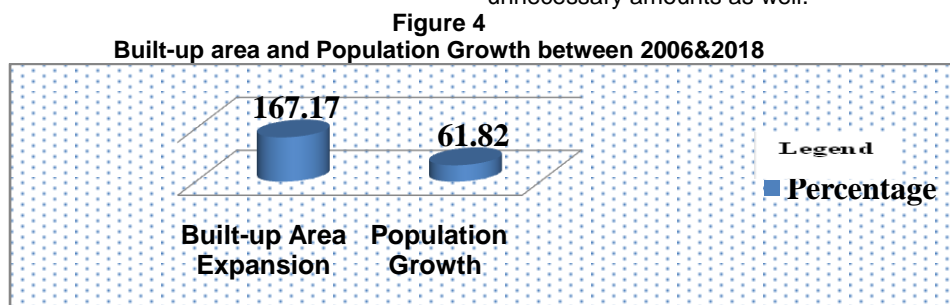
Based on the Table 6 result, the LAC is 0.0335 hectares per person or 335m<sup>2</sup> per person between 2006 and 2018. The result of the study shows the pattern of urban sprawl is high in the study area.

Table.4  
Land Absorption Coefficient of Adigrat City 1986-2018

| Year      | Area (Hectares) | Population Increase | LAC (Hectares, person) |
|-----------|-----------------|---------------------|------------------------|
| 2006-2018 | 1163.24         | 34,637              | 0.0335                 |

Source: FUPI, 2006, Municipal Office, (2018), EPHCC & Plan Finance Office (1995, 2008 & 2018)

Figure 4 depicts that built-up area and population increased 167.17 percent and 61.82 percent between 2006 and 2018. This indicates the growth of built-up area is nearly three times greater than the growth of population. This implies that the land consumed at excessive rates and probably in unnecessary amounts as well.



Source: FUPI, (2006) and Municipal Office, (2018)

## Conclusion

Adigrat city is one of the second largest populous city in the Tigray regional state. The city expanded horizontally at the expense of agricultural and forest lands. The current total population and total area of the city is 90658 and 18.7724km<sup>2</sup> respectively. The survey results indicate the major cause of urban sprawl in the study area includes rapid population growth, increase the living and property cost in the core of the city, land demand and land speculation and the growth of transport with a mean score of 4.1, 3.8, 3.78 and 3.76 respectively. The city added 1163.24 hectares of new lands to its jurisdiction from the adjacent Gantafeshum Wereda between 2006 and 2018. Built-up areas increased by 894.9 hectares (167.17 percent) of land with 13.9 percent per annum growth between 2006 and 2018.

The population of Adigrat city increased by 5.15 percent per annum between 2006 and 2018; while the land developed rate is 13.57 percent per annum, or nearly three times the rate of population growth. The result of LAC is 0.0335 hectares /person between 2006 and 2018. This denotes that the pattern

of urban sprawl is high in the Adigrat city in the last two decades.

## Suggestion

This high growth of urban sprawl has socio-economic and environmental impacts on the city. Therefore, the city administration should encourage vertical development, and need strong, integrated, effective and efficient work with its neighbor rural area, particularly with Gantafeshum Wereda, and done timely preparation, supervision, evaluation and implementation of the structural plan of the city bring out sustainable development.

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