

## Trends of Urbanization in Tigray Regional State, Ethiopia (1994–2020): Levels, Rates, and Spatial Disparities

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### Abstract

Ethiopia has experienced accelerated urbanization in recent decades, though significant spatial disparities persist both between and within regions. Using a combination of national census data (1994 and 2007), population projections from the Central Statistical Agency for 2020, and a household survey of 385 urban households, this study investigates the levels, rates, and spatial disparities of urbanization in Tigray Regional State between 1994 and 2020. Survey data provided complementary insights into infrastructure access, employment, spatial inequality, and urban management perceptions. According to the findings, Tigray's urban population grew moderately but consistently from 14.9% in 1994 to 21.7% in 2007 and was predicted to reach 27.7% by 2020. The Eastern Zone has consistently shown the highest levels and rates of urbanization, followed by the Western and Southern Zones, while the Central Zone has lagged behind. However, this urban expansion has been spatially uneven. The region's average yearly pace of urbanization was 0.49%, which concealed significant inter-zonal heterogeneity. Concentrated growth in regional and zonal capitals, especially Mekelle, reinforces spatial polarization, according to city-level data. Household survey results indicate that infrastructure and service improvements have lagged behind urban expansion. In peripheral communities and informal settlements, access to water, power, sanitation, and solid waste management is still inadequate to moderate. While urbanization has generated some employment, limited economic diversification constrains livelihood transformation. Further temporal analysis reveals that improvements in housing and services have not kept up with the expansion of urban territory, which is indicative of poor urban growth management. Overall, the analysis shows that Tigray's urbanization has been extensive but uneven, creating serious environmental and socioeconomic problems. The results highlight the necessity of employment-oriented urban policies, improved local planning capability, infrastructure-led and spatially balanced urban development, and environmentally sustainable growth strategies. The study offers a crucial foundation for comprehending urban changes in a post-conflict and data-constrained regional setting, notwithstanding data limitations.

**Keywords:** Urbanization, Temporal Evolution, Census Data, Urban Growth, Tigray Region

## **1. INTRODUCTION**

Urbanization is a rapidly accelerating global phenomenon, and no region is immune to this trend. Sustainable city management and efficient urban planning are essential to address challenges such as poverty, pollution, and climate change associated with rapid urban growth (Anestis & Stathakis, 2024). Population growth in recent decades has been closely linked to urban concentration and economic agglomeration, which have played significant roles in development processes over the past century. This pattern suggests that local (non-economic) forces are becoming increasingly influential. However, major metropolitan areas often diverge from these patterns and follow more individualized models of expansion (Salvati, 2025). Urbanization patterns also vary significantly across regions. In China, the degree of urbanization at the county level remains uneven. Between 2000 and 2010, spatial patterns in county-level urbanization remained relatively stable. Rapidly urbanizing counties were primarily located in central and western regions, whereas counties with high urbanization levels were concentrated along the eastern coast (Zhang et al., 2022).

Globally, clear regional differences in urbanization patterns are evident. For example, China's urbanization rate reached 56.1% by 2015, though with significant regional variation (Lin et al., 2018). Similarly, India's urban population increased from 11% in 1901 to 31% in 2011 due to industrialization and modernization; however, this growth has occurred at a slower pace than in many developing countries (Kadi & Nelavigi, 2015; Kumar & Rai, 2014). Bangalore exemplifies this dual transformation, with its population increasing from 384,601 in 1951 to over 9.6 million by 2011, while urbanization levels are commonly classified as low (<20%), moderate (20–40%), or high (>40%) (Puttalingaiah et al., 2019; Sarkar, 2017).

In Ethiopia, localities with 2,000 or more inhabitants are classified as urban centers. Despite having one of Africa's fastest urbanization rates estimated at 4.63% annually—the country's urban population remains below 25% (Benti et al., 2022; Mezgebo, 2021) Large and medium-sized cities function as regional growth hubs, while most urban settlements remain small and geographically dispersed. Key drivers of urbanization include road development, administrative and economic centers, religious institutions, and educational facilities. National policies have also promoted urban development through housing, employment, and infrastructure programs (Kassahun & Tiwari, 2012).

However, notable regional disparities characterize Ethiopia's urbanization patterns. The northern Ethiopian Tigray Regional State has experienced steady population growth and presents a compelling case for understanding

spatially uneven urban expansion due to its geographical, historical, and sociopolitical context. According to the Central Statistical Agency (CSA, 2007), Ethiopia's most recent census was conducted in 2007 most recent census was conducted in 2007, Central Statistical Agency projections for 2020 enable the examination of urbanization trends over time. While war and displacement after 2020 may have altered these patterns, understanding long-term trends remains essential for informed policy responses.

Despite a growing interest in urbanization dynamics, Tigray's zonal-level assessment of urbanization patterns that considers both the degree and temporal evolution of urbanization remains lacking. Previous studies have primarily focused on national aggregates, leaving a knowledge gap regarding sub-regional urbanization processes particularly in war-affected, infrastructure-poor, and environmentally vulnerable regions such as Tigray.

Therefore, this study aims to:

1. Assess the level and spatial variation of urbanization in Tigray between 1994 and 2020.
2. Evaluate the temporal evolution (rate) of urbanization using official census and projection data.
3. Identify the socio-economic and environmental implications of uneven urbanization among zones.

The study utilized demographic data from the national censuses of 1994 and 2007, along with Central Statistical Agency population projections for 2020. Quantitative indicators including urbanization levels, urban rural population ratios, and rates of urban growth were computed to analyze spatial and temporal trends. Particularly in post-conflict contexts, this research contributes to discussions on regional urban dynamics in sub-Saharan Africa. The findings are relevant for government agencies, development partners, and regional planners seeking to address population redistribution, infrastructure pressure, and urban inequalities. Although the study relies on earlier data, it provides an essential foundation for understanding urban transitions in a region where recent census data remain unavailable

### **1.1 Conceptual Framework**

The conceptual framework for this study was developed based on previous studies and theoretical perspectives related to urbanization trends, population growth, and spatial development. It integrates key variables that influence urbanization dynamics in Ethiopia, particularly in the Tigray Regional State. The framework helps to explain how different factors interact to shape the levels, rates, and spatial disparities of urbanization over time. Urbanization Studies literature indicates that demographic growth, administrative changes, economic

development, and migration patterns play a crucial role in influencing urban expansion and distribution. Based on these perspectives, the framework identifies the relationships between population growth, urban population proportion, urban growth rates, and spatial distribution of towns.



**Figure 1.** Conceptual Framework of Trends of Urbanization in Ethiopia’s Tigray Regional State (1994–2020): Levels, Rates, and Spatial Disparities.

Figure 1 shows the interconnection among the variables examined in this study. It illustrates how demographic dynamics, urban population changes, and spatial distribution of urban centers interact to influence the overall trends of urbanization in Tigray Regional State between 1994 and 2020. The framework also highlights the relationship between urbanization levels, growth rates, and spatial disparities across different areas of the region.

## **2. RESEARCH METHODOLOGY**

### **2.1. Study Area**

The study was conducted in the Tigray Regional State, located in northern Ethiopia. It spans an area of 54,593 km<sup>2</sup> and lies between 12°19'47.678"N to 14°52'26.73"N latitude and 36°28'0.465"E to 39°32'44.831"E longitude. Tigray shares borders with Eritrea (north), Afar (east), Amhara (south), and Sudan (west). Administratively, it comprises seven zones, 52 districts (woredas), and 763 kebelles (Beyene et al., 2021).

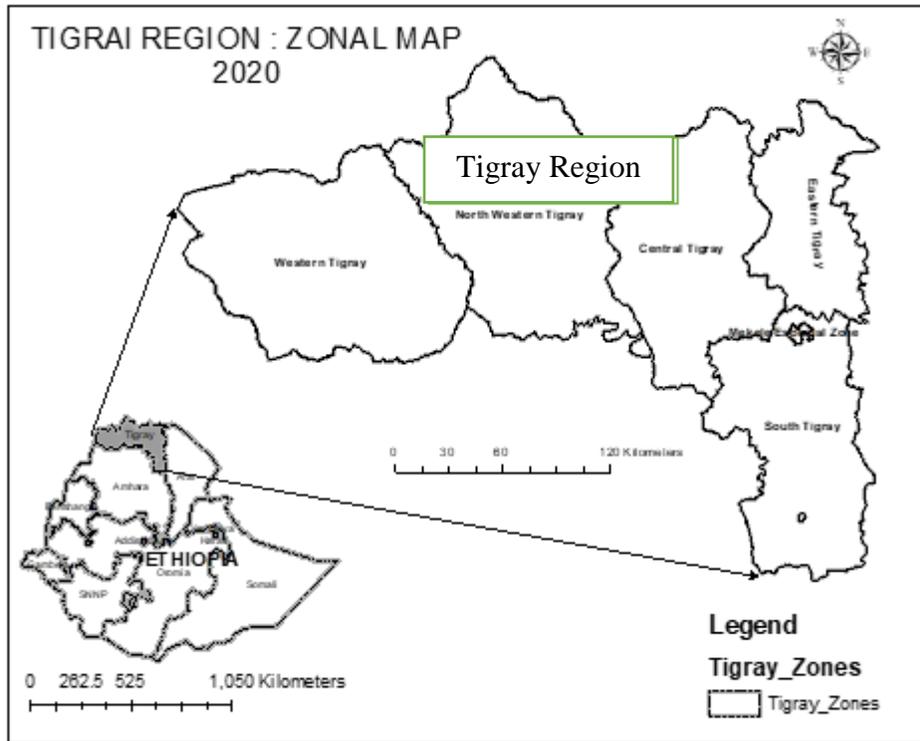
Topographically, the region is characterized by mountainous and rugged terrain, ranging from 600 to 2,700 meters above sea level (Balehegn et al., 2019). The elevation varies significantly, creating a range of agro ecological zones, including “Kolla” (semiarid lowlands – 39%), “Woina Dega” (midlands – 49%), and “Dega” (highlands – 12%). The average annual temperature is around 18°C, and annual rainfall ranges between 450–980 mm (Fitsum et al., 1999). The population was recorded at 3,136,267 in 1994 and 4,314,456 in 2007, with Central Statics Agency projections estimating 6,149,199 in recent years (Central Statics Agency, 1994; Central Statics Agency, 2007).

The region’s economy is dominated by subsistence agriculture, where mixed crop-livestock systems are common. Over 90% of the population engages in smallholder farming (Zerssa et al., 2021). Major crops include maize, barley, wheat, sorghum, teff, and legumes, while livestock production focuses on cattle, goats, sheep, poultry, and honeybees. The location of the study area map indicated on figure 2 below.

This study employed a mixed-methods approach to examine urbanization trends, spatial disparities, and urban growth dynamics in Tigray Regional State from 1994 to 2020. Quantitative data were obtained from primary household surveys and secondary demographic sources, including census reports and regional statistical data. These datasets were analyzed to identify patterns of urban growth, population distribution, and spatial inequalities.

To complement the quantitative findings, qualitative data were collected through key informant interviews and field observations. Participants included local administrators, urban planners, and long-term residents, who

provided contextual insights into drivers of urban expansion, infrastructure challenges, and socio-economic disparities.



The figure 2 indicates the location of the study area Tigray regional state in relation to Ethiopia.

The qualitative data were analyzed thematically and used to interpret, validate, and enrich the quantitative results. Specifically, qualitative findings helped explain observed spatial disparities, variations in service provision, and local perceptions of urban growth. Integrating both data strands allowed for a more comprehensive understanding of urbanization dynamics in the region.

## 2.2. Data Types, Sources and Collection Tools

### 2.2.1 Household Survey

The household survey was conducted in 2019, while data obtained from the Central Statistics Agency (CSA) cover the period from 1994 to 2020. These data were used to understand the opinions and experiences of the local population regarding urbanization trends. By providing micro-level information on urbanization levels, growth

patterns, and geographic disparities across specific urban areas, the survey complemented secondary data obtained from administrative sources and national censuses.

### **2.2.2. Primary Data sources**

A systematic home questionnaire was utilized to gather primary data. Both closed-ended and Likert-scale items made up the questionnaire, which was created in accordance with the study's goals. The study explored several dimensions of urban life, including the sociodemographic characteristics of households, the history of urban expansion and migration, and the conditions of housing and actual growth in the area. It also assessed the availability of urban services and infrastructure, as well as differences in service delivery across locations. In addition, the research examined employment opportunities and economic prospects within urban settings, tracked changes in the urban environment from 1994 to 2020, and gathered perspectives on future development and potential urban challenges

### **2.2.3. Secondary Data Sources**

This study primarily relies on secondary demographic data obtained from the Central Statistical Agency of Ethiopia (CSA). Specifically, the study uses population and housing census data from 1994 and 2007, which provide official demographic information on population size, distribution, and urban–rural composition in Ethiopia. In addition, population projections for 2020 were utilized based on the projection model developed by CSA in 2013. These projections estimate population changes using demographic parameters such as fertility, mortality, and migration trends. The use of both census data and population projections allows the study to examine the levels, rates, and spatial patterns of urbanization over time in the Tigray Regional State.

These sources continue to be the most thorough and spatially disaggregated for long-term analysis at the zonal and regional levels, despite the fact that census data is dated. Because of data restrictions and the emphasis on census-based urban population indicators, this study did not include remote sensing data. The lack of post-2020 data is acknowledged in the paper because recent data gathering has been hampered by political unrest and security issues. There are known limitations to the quality of the statistics, especially when it comes to projection-based figures. Three time periods (1994, 2007, and 2020) are used to observe broad patterns rather than absolute values in order to overcome these restrictions.

### **2.3. Sampling Technique and Sample Size**

A total of 385 households were selected using a multistage sample approach. The Tigray Regional State's major towns were deliberately selected in the first phase to represent different levels of urban hierarchy and spatial

distribution. Kebeles within each town were selected using stratified sampling based on location (within city, intermediate zones, and urban edge) in order to capture spatial variance. In the last round, households were selected using systematic random sampling using updated household lists.

Cochran's (1977) formula for large populations, which is frequently used in urban and demographic studies, was used to calculate the sample size of 385 homes at a 95% confidence level and a 5% margin of error.

$$no = \frac{Z^2 * p * q}{e^2}$$

$$no = \frac{(1.96)^2 * 0.5 * 0.5}{(0.05)^2} = \frac{3.8416 * 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16 = 385$$

## **2.4. Methods of Data Analysis**

### **2.4.1. Data Collection Procedure**

Face-to-face interviews with adult household members or household heads were conducted to gather data. The survey was carried out by trained enumerators who were fluent in the local languages and familiar with the local context. To ensure clarity, consistency, and relevance, the questionnaire was pre-tested on a small number of households outside the sample area, and necessary revisions were made based on the pre-test findings. Ethical considerations were strictly observed: all participants were informed about the purpose of the study, assured of the confidentiality of their responses, and provided voluntary consent prior to participation. Interviews were conducted in private settings to maintain participants' privacy and lasted approximately 30–45 minutes each. A total of 70 enumerators participated in the survey to ensure coverage and consistency in data collection.

### **2.4.2. Data Processing**

Prior to data entry, completed questionnaires were verified for accuracy and consistency. After being coded, the data was imported into Stata and SPSS for analysis. The characteristics of households and the degree of access to urban services were examined using descriptive statistics like frequencies, percentages, means, and standard deviations. Composite indices were constructed for select urbanization indicators, with Cronbach's alpha used to assess internal consistency of Likert-scale. Spatial disparities in urban conditions were examined by comparing responses across different towns and urban zones. The Tigray Regional State's urbanization patterns, growth rates, and spatial disparities were evaluated by triangulating the household survey results with secondary data.

## **2.5. Ethical Considerations**

Ethical approval for this study was obtained from the Quality control and ethics committee of college of social science and humanities, and all methods were performed in accordance with ethical standards as outlined in the

Declaration of Helsinki and its later amendments. Written informed consent was obtained from all participants

### 3. RESULTS AND DISCUSSION

#### 3.1. Result

##### 3.1.1. Degree or Level of Urbanization

The degree or level of urbanization is defined as the relative number of people who live in urban areas (Kumar and Rai,2014). The urbanization rate can be calculated by dividing the urban population by the total population and multiplying by 100.

The urbanization level was measured using eq.1

$$PU = \frac{U}{P} * 100 \dots\dots\dots\text{Eq. 1}$$

PU - is the percentage of Urban Population

U - is the Urban Population, and P-is total population

Urbanization levels were classified according to Sarkar (2017) into:

- Low (<20%)
- Moderate (20–40%)
- High (>40%)

##### 3.1.2. Ratio of Urban-Rural Population:

This index measures the balance between urban and rural populations and is calculated as::

$$UR = \frac{UP}{RP} \dots\dots\dots\text{Eq. 2}$$

Where:

UR = Urban-Rural Ratio

UP = Urban Population

RP = Rural Population

UR > 1 implies more urban than rural population,

UR < 1 implies the opposite

### 3.1.3 The speed(Tempo) of urbanization

The speed of urbanization refers to the rate at which a population is shifting from rural areas to urban areas or the rate at which urban areas are expanding. It is usually measured in terms of the increase in the urban population over time, typically expressed as a percentage growth rate per year (Kumar and Rai,2014).

The tempo or speed of urbanization was measured using eq. 3

$$TA = (PU_{t+n} - Pu_t) / n$$

Where:

TA = Tempo (annual speed) of urbanization

PU<sub>t</sub> = Percentage of urban population at year t

PU<sub>t+n</sub> = Percentage of urban population at year t+n

n = Number of years between t and t+n

- Higher TA indicates faster urban growth.

### 3.1. 4. Socio-Demographic Characteristics of Respondents

The socio-demographic characteristics shows the sex, age and length of residence of households.

Table 1. Socio-demographic characteristics of respondents (n = 385)

Variable	Category	Frequency	(%)
Sex of HH head	Male	248	64.4
	Female	137	35.6
Age of HH head	<30 years	72	18.7
	30–49 years	211	54.8
	≥50 years	102	26.5
Length of residence	<5 years	68	17.7
	5–10 years	94	24.4
	>10 years	223	57.9

Source: Field survey, 2019

Table 1 demonstrates that household perceptions of urban expansion and temporal change between 1994 and 2020. 64.4 % household respondents are male, whereas 35.6% are females and 54.8% household's age is ranged 30-49 years old. Majority households had been residents of the town for over a decade, indicating that they had sufficient awareness of long-term urban changes. The predominance of long-term residents enhances the reliability of household perceptions regarding urban expansion and temporal changes between 1994 and 2020.

### 3.1.5. Access to Urban Infrastructure and Services

Access to urban infrastructure was mainly assessed by comparing of water supply, electricity, road, solid waste management, and sanitation and drainage e as indicated in the following table.

Table 2. Access to urban services (mean scores)

Urban Service	Mean	Std. Dev.	Interpretation
Water supply	3.02	1.01	Moderate
Electricity	3.18	0.97	Moderate
Road & transport	2.91	1.05	Poor
Solid waste management	2.84	1.08	Poor
Sanitation & drainage	2.79	1.10	Poor
Overall service index	2.95	—	Poor

Source: Field survey, 2019

Table 2 shows that Tigray's urban centers have generally poor access to urban infrastructure and services. Even while the mean scores for water supply and electrical services are higher than those for other services, they are nonetheless below satisfactory levels and suffer from limited coverage and frequent outages. Sanitation and solid waste management stand out as particularly weak sectors, indicating insufficient institutional capability and service delivery. These results imply that the region's urban growth has happened without commensurate advancements in fundamental infrastructure, leading to service deficiencies that limit urban sustainability and livability.

### 3.1.6. Spatial Disparities in Urban Development

Spatial inequality was assessed by comparing perceptions of service distribution and housing conditions across neighborhoods.

Table 3. Perceived spatial disparities in urban areas

Statement	Mean	Std. Dev.	Dominant Response
Urban services are evenly distributed	2.88	1.02	Poor
Peripheral areas are disadvantaged	3.12	1.04	Moderate
Housing quality varies by neighborhood	3.21	0.98	Moderate
Informal settlements are increasing	3.06	1.01	Moderate

Source: Field survey, 2019

Spatial inequality was assessed by comparing perceptions of service distribution and living conditions across different communities. The results show significant spatial differences, especially between city centers and outlying locations, as seen in table 3. Respondents were somewhat in agreement that the rise in informal settlements and unequal housing quality is a reflection of the uneven spatial effects of urbanization.

**3.1.7. Urbanization, Employment, and Livelihoods**

Urbanization, employment, and livelihood evaluated the ways in which urbanization employment enhanced economic opportunities to sustain livelihood.

Table 4. Urbanization and employment perception

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Interpretation</b>
Employment opportunities improved	3.04	1.00	Moderate
Urban economy supports livelihoods	2.97	1.03	Poor

Source: Field survey, 2019

Table 4 shows that households were asked to evaluate how urbanization affected job prospects. the scale has been insufficient to substantially transform household livelihoods. This illustrates a trend of urban expansion without significant economic diversification.

**3.1.8. Temporal Changes in Urban Conditions (1994–2020)**

Urban land expansion and housing improvement as well as services were used to assess the temporal change in urban, as indicated in table5.

Table 5. Perceived temporal change in urban conditions

<b>Indicator</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Interpretation</b>
Improvement in services	3.15	0.96	Moderate
Improvement in housing	3.09	0.99	Moderate
Urban land expansion	3.27	1.01	Moderate–High

Source: Field survey, 2019

Table 5 shows that, between 1994 and 2020, there was a mismatch between physical growth and service supply, with urban area expansion advancing more quickly than housing and service enhancements.

### 3.1.9. Urban Management and Future Preparedness

Urban management refers to the planning, administration and coordination of urban services and infrastructure to ensure that cities function efficiently and sustainably It involves the management of land use, housing, water supply, energy, public health, and environmental protection.

Table 6. Urban management and future readiness

Indicator	Mean	Std. Dev.	Interpretation
Urban growth well managed	2.83	1.04	Poor
Town prepared for future growth	2.89	1.02	Poor
Sustainable planning applied	2.78	1.05	Poor
Overall satisfaction	2.83	0.97	Poor

Source: Field survey, 2019

Table 6 indicates that household satisfaction with urban management and future preparedness is generally low. The mean scores for all indicators range between 2.78 and 2.89, which fall within the poor satisfaction category. Specifically, respondents rated the management of urban growth (Mean = 2.83), preparedness of towns for future expansion (Mean = 2.89), and the application of sustainable planning practices (Mean = 2.78) as inadequate.

### 3.1.10. Population size Tigray regional state

Based on the available data, Tigray is one of the least urbanized regions in Ethiopia. According to the 3<sup>rd</sup> National Population and Housing Census conducted in 2007, only 14.9% of Tigray's population lived in urban areas, compared to the national average of 16.8%. as shown table 7.

Table 7: Population size of Tigray regional state (1994-2020)

Tigray region	1994			2007			2020		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Western	84560	649402	733962	179,618	913878	1,093,496	313,569	1063006	1,376,575
Central	91058	852792	943850	176,445	1,068,778	1,245,223	307279	1244514	1551793
Eastern	85508	499438	584946	146301	609332	755633	254155	709266	963421
Southern	110414	666157	776571	219188	785370	1,004,558	280,000	964154	1244154
Mekelle	96938	-	96938	215546	-	215546	376679	-	376679
<b>Total</b>	<b>468478</b>	<b>2667789</b>	<b>3136267</b>	<b>937,098</b>	<b>3377358</b>	<b>4,314,456</b>	<b>1,531,682</b>	<b>3980940</b>	<b>5,512,622</b>

Source: CSA,1994 & 2007 Census and Population Projection, 2013

Table 7 shows that the total population of Tigray was 3,136,267 in 1994, 4,314,456 in 2007, and 5,512,622 in 2020. The figure indicates that between 1994 and 2020, the urban population has grown dramatically.

Table 8: Urban-Rural growth Differentials (1994-2020 in %) of Tigray regions

Year	Rural	Urban	Urban-Rural growth Differentials rate in(%)
1994-2007	0.21	0.5	0.29
2007-2020	0.15	0.39	0.24
1994-2020	0.33	0.64	0.31

Source: Census and projection of Ethiopia different years

*Note: Growth rates are average annual percentage increases*

Table 8 above shows the disparity in growth between urban and rural areas. Between 1994 and 2020, the urban population increased by 50 percent to 64 percent annually, while the rural population increased by 21percent to 33 percent annually.

### 3.1.11. Level of Urbanization

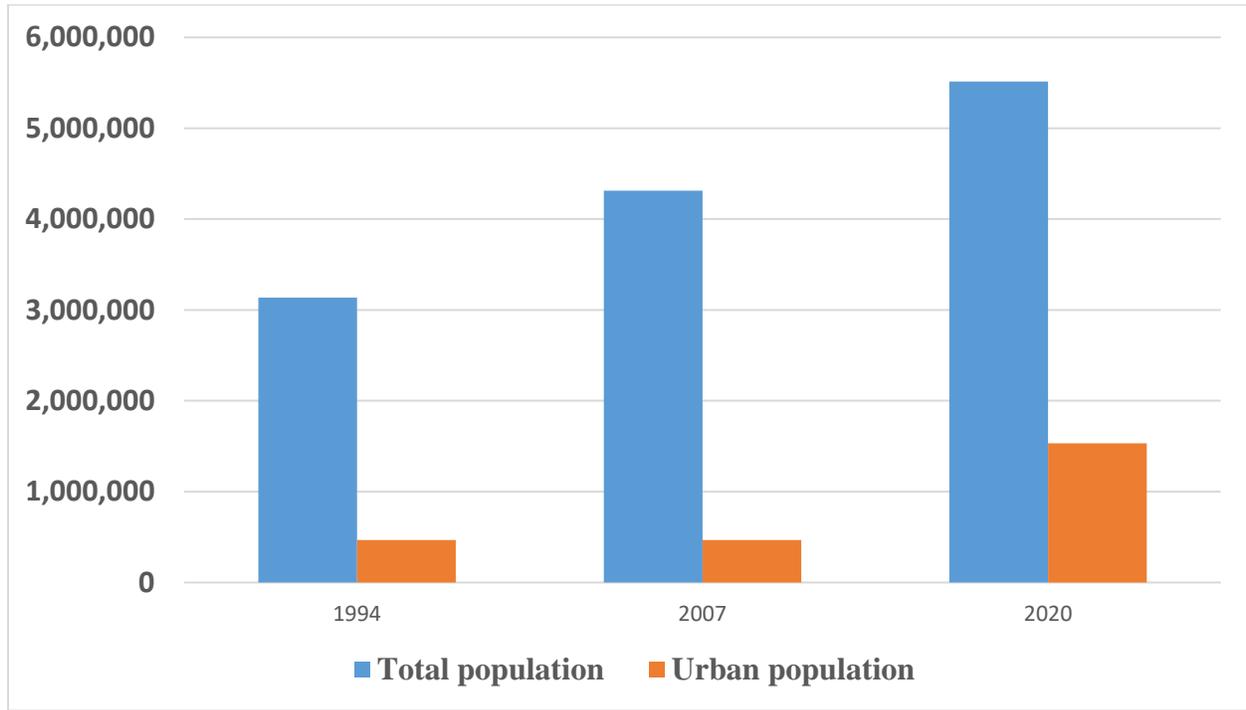
The percentage of population in urban places has been the most commonly used index for measuring the degree of urbanization.

Table 9: Level of Urbanization in Tigray Regional State (1994-2020)

Census year	Total population	Urban population	Growth	Growth in %	Proportion of urban population to total	Rate of Urbanization
1994	3,136,267	468478	-	-	14.9	-
2007	4,314,456	937,098	468620	100	21.7	6.8
2020	5,512,622	1,531,682	584584	62.4	27.78	6

Source: Study

Figure 3. Total and Urban Population in Tigray Regional State (1994,2007, 2020)



The percentage of population residing in urban areas is the most commonly used index for measuring urbanization degree..The population grew to 5,512,622 in 2020, a 62.4% growth rate over all previous years, as Table 9 and Figure 3 demonstrate. 2007 had the highest urbanization rate of any year, at 6.8%.

**Table 10: Level of Urbanization at zonal level**

<b>Zones</b>	<b>1994</b>	<b>2007</b>	<b>2020</b>
	<b>Eq. 1</b>	<b>Eq. 1</b>	<b>Eq. 1</b>
Western	11.5	16.42	22.8
Central	9.64	14.2	19.8
Eastern	14.6	19.4	26.4
Southern	14.2	21.8	22.5
<b>Total</b>	<b>14.9</b>	<b>21.7</b>	<b>27.78</b>

Source: Study

At the zonal level, urbanization rates are moderate in the Western, Southern, and Eastern zones, while the Central zone consistently exhibits the lowest levels. The Ethiopian government has worked hard over the past 20 years to encourage economic growth and urbanization throughout the nation, especially in Tigray. The regional capital of Tigray, Mekelle, has experienced substantial urbanization and growth in recent years, with the construction of new residential neighborhoods, business districts, and infrastructural projects.

The ongoing war in Tigray since 2020 has substantially impacted urbanization patterns, causing widespread displacement and infrastructure damage in major urban centers including Mekelle. Overall, even though Tigray has made considerable progress toward urbanization, the region's conflict and instability have had a major impact on the rate and direction of growth.

**3.1.12. Urban-Rural Ratio**

Urban-rural ratio (U/R) is used to measure the degree of urbanization. These are most commonly used for measuring the degree of urbanization. The ratio U/P has lower limit 0 and upper limit 1ie.  $0 < U/P < 1$  (Datta, 2007).

Table 11: Urban-Rural Ratio of Tigray Region

<b>Tigray region zones</b>	<b>1994</b>	<b>2007</b>	<b>2020</b>
Western	0.13	0.16	0.29
Central	0.1	0.17	0.25
Eastern	0.17	0.24	0.35
Southern	0.17	0.28	0.29
Mekelle			
<b>Total</b>	<b>0.175</b>	<b>0.277</b>	<b>0.384</b>

Source: Study

Urban-rural ratio (U/R) is used to measure the degree of urbanization. .The ratio U/P has lower limit 0 and upper limit 1ie.  $0 < U/P < 1$  (Datta, 2007). According to Table 11, the regional urban-rural ratio for Tigray was 0.175, 0.277, and 0.384 in 1994, 2007, and 2020, respectively. This indicates a significant increase in the proportion of the population residing in urban areas over the 26-year period.

- 1994: There were approximately 17 urban residents per 100 rural residents.
- 2020: This increased to approximately 38 urban residents per 100 rural residents.

This change represents a structural demographic shift in Tigray, reflecting accelerated urbanization and a gradual move away from a predominantly rural population. The trend highlights both population concentration in towns and cities and the growing demand for urban infrastructure, services, and planning interventions.

Table 12: Population size of Tigray regional state (1994-2020)

Tigray region	1994			2007			2020		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
	468478	2667789	3136267	937,098	3377358	4,314,456	1,531,682	3980940	5,512,622

Source: CSA,1994 & 2007 Census and Population Projection, 2013

The urban ratio of Tigray regional state is 14.9%, 21.7%, and 27.78 in 1994, 2007, and 2020, respectively, as shown in the table 12. This suggests that the number of people restricted in urban areas has occasionally increased.

### 3.1.13. Tempo or Speed of Urbanization

The tempo of urbanization refers to the speed of urbanization and is measured as change registered in the level or degree of urbanization over the years (Datta , 2007).

Table 13: Tempo or Speed of Urbanization In Tigray Region

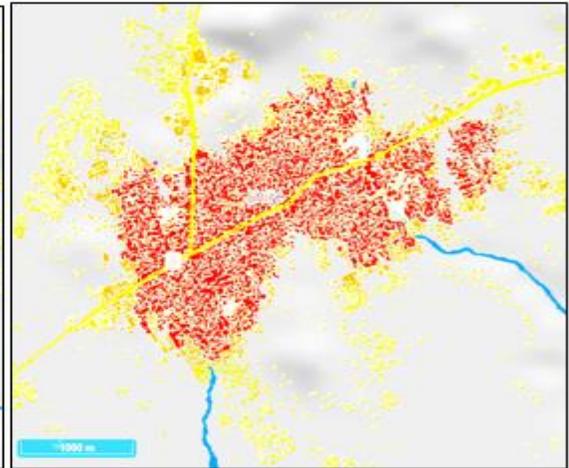
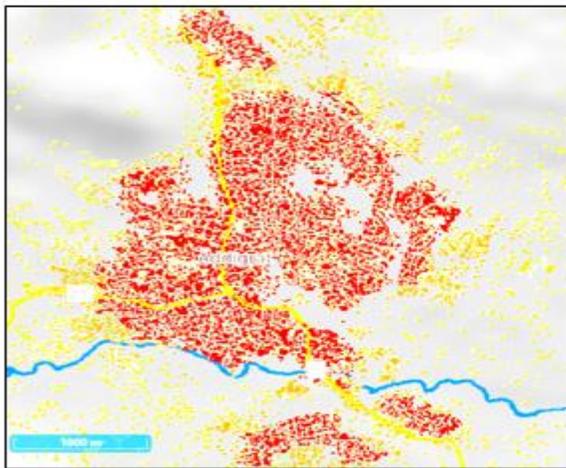
Name of Zones	1994-2007	2007-2020	1994-2020
Western	0.37	0.49	0.43
Central	0.35	0.43	0.39
Eastern	0.37	0.54	0.45
Southern	0.054	0.019	0.03
<b>All</b>	<b>0.29</b>	<b>0.37</b>	<b>0.33</b>

Source: Study

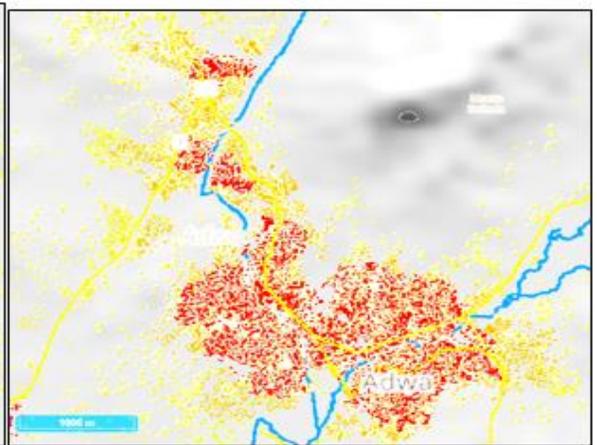
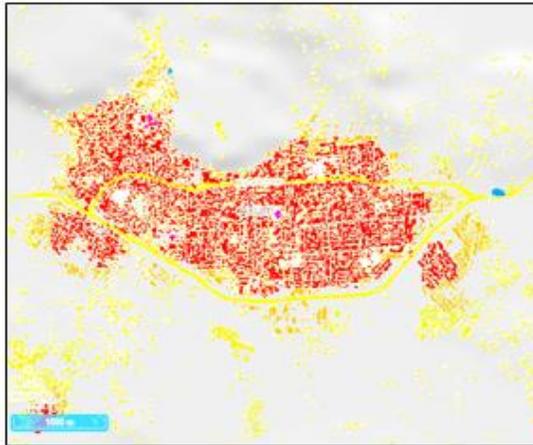
The tempo or speed of urbanization varies among the zones, as seen in table 13 above. From 1994 to 2020, the Western Zone, Central Zone, Eastern Zone, and Southern Zone experienced urbanization at rates of 0.43, 0.39, 0.45, and 0.037, respectively, while the regional level experienced urbanization at a rate of 0.33 per year during the same period. This suggests that the Eastern Tigray zone has the fastest rate of urbanization, followed by the western zone of Tigray, while the Southern zone of Tigray has the slowest rate. The Southern Zone records the lowest speed of urbanization largely because Mekelle has been administered as a separate administrative zone since the early 1990s.

### 3.1.14. Urbanization Trends in City & Town of Zonal Capital

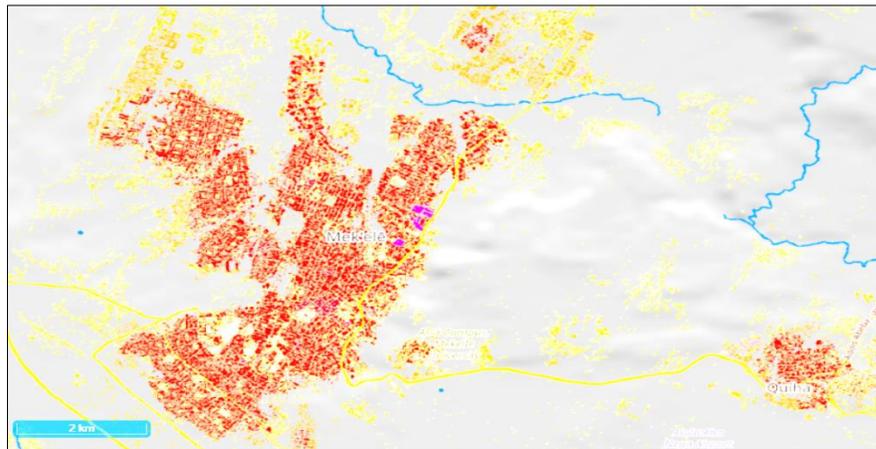
The following figures indicated the spatial expansion of Tigray regional states' zonal cities and towns (Mekelle, Adigrat, Shire, and Adwa)



**Figure 4. Urbanization trends of Adigrat City**    **Figure 5. Urbanization trends of Shire City**



**Figure 6. Urbanization trends of Aksum City**    **Figure 7. Urbanization trends of Adwa Town**



**Figure 8. Urbanization trends of Mekelle City**

The spatial expansion of Tigray regional states' zonal cities was shown in Figures 4, 5, 6, 7, and 8. Mekelle, the regional capital, has a significant geographical increase when compared to the others, according to figure 8 above

## **4. DISCUSSIONS**

### **4.1. Social**

A major social consequence of uneven urbanization is the concentration of populations in a limited number of urban centers. This pattern has intensified following the Tigray war, with large numbers of internally displaced persons (IDPs) congregating in towns such as Shire, Aksum, Adwa, Abiy-Adi, Adigrat, Mekelle, and Maychew. In the aftermath of the armed conflict in Tigray, large-scale internal displacement has increased pressure on urban infrastructure, social services, and local livelihoods in receiving towns and cities. Rapid urban concentration may strain urban labor markets, potentially increasing youth unemployment and related social vulnerabilities. In line with this, formal job creation is not keeping pace with migration to urban areas. Cities are struggling to provide adequate infrastructure and essential services. In addition, poor-quality and often overcrowded living conditions remain major housing challenges experienced by urban households( Engida,2019). The unbalanced urban growth increases travel time between homes and workplaces, leads to loss of agricultural land and subsequent food import dependence, fosters social segregation, potentially increases crime, displaces less affluent populations from core urban areas due to rising property prices, and creates burdens on infrastructure and basic services including health and education.

### **4.2. Environment**

The study area's environment is impacted by the uneven urban growth. Degradation of the natural environment, including a decline in biodiversity and a decrease in the quantity, type, and coverage of forests in the study area, was brought about by the expansion of built-up territory. The research area's biodiversity is lost, flood threats are increased, and water access and availability are decreased due to the loss of forests and grasslands. Johnson (2001) provides similar notes that the environment is negatively impacted by unbalanced urban growth in a number of ways, including the loss of sensitive systems, a decrease in regional open spaces, increased air pollution, increased energy consumption, a decrease in farmland and species diversity, an increase in runoff or flooding, and an excessive removal of native vegetation.

In emerging nations like Ethiopia, unbalanced urban growth has a greater impact on agrarian society along rural-urban borders. The population of the study region is growing quickly, just as in other towns and cities, and this is contributing more to the spread of urban sprawl into the adjacent productive agricultural land. In recent decades, agricultural land has changed due to the fast expansion of urban built-up areas. Kassa (2014) and Nigusie (2011) report similar findings in this area.

The farming community's way of life has been significantly impacted by Sebeta town's recent urban expansion, including reduced agricultural acreage and asset loss. Additionally, imbalanced urban growth causes farmers to relocate from their home villages to neighboring rural areas, where they are either completely or partially replaced by new settlers or non-indigenous people. According to Dadi et al. (2016), unchecked urban growth causes rural land conversion, endangering the agricultural sector because more land has been exploited than was originally intended for infrastructure development, industrial growth, and residential expansion.

### **4.3. Economic Implication**

Low-density sprawl brought on by urban expansion on the outskirts of cities frequently boosts land values, decreases access to services and amenities, necessitates expensive infrastructure upgrades, and increases household commuting expenses. Municipal administrations in charge of extending roads, water supplies, electricity, and other urban services are under a lot of financial strain as a result of this tendency. Angel (2023) asserts that low-density development raises the costs of infrastructure and transportation, increases pollution, and lengthens travel times. Overall connection is weakened by the limited arterial road networks that further limit economic integration between urban centers and the adjacent rural areas. Therefore, the provision of infrastructure, such as roads, parking lots, water systems, and electricity supplies, is subject to rising budgetary demands as a result of uneven urban growth. Reducing the need for long-distance travel, encouraging community involvement in infrastructure supply, controlling land development and environmental preservation, and redeveloping inner-city regions are some of the suggested strategies to lessen urban sprawl (Habibi & Asadi, 2011).

However, the results of the survey show that the impact of urban expansion on job and livelihood prospects has been minimal. Improved employment prospects were regarded as moderate by respondents (Mean = 3.04), and the urban economy's ability to support household livelihoods was rated as moderate as well (Mean = 2.97). This implies that employment creation has not kept up with population expansion and rural-urban mobility, despite the fact that urban growth has produced some economic opportunities. Many households are consequently still reliant

on informal economic activity and low-income survival techniques. According to the findings, there is a fundamental gap between inclusive economic development and actual urban growth. Enhancing vocational skills training, encouraging labor-intensive investment, and assisting small business development could increase metropolitan areas' ability to provide long-term jobs.

## **5. CONCLUSIONS**

Tigray Regional State saw significant urbanization between 1994 and 2020, with the overall population growing from 3.1 million to 5.5 million. The rate of urbanization increased rapidly, reaching 27.8% in 2020, as was expected. Zones: Tigray's urbanization rate is lowest in the Central zone and moderate in the Western, Southern, and Eastern zones. Access to essential amenities including water, electricity, sanitation, and solid waste management is still poor to moderate despite fast urban expansion, and geographical gaps continue to exist, disproportionately harming periphery communities and informal settlements.

Although there has been a slight improvement in employment options, urbanization has not produced enough economic diversification to greatly improve livelihoods. A mismatch between physical development and service provision is shown by temporal analysis, which shows that urban land growth has outpaced advances in housing and services. Planning processes have only partially addressed the problems of fast urbanization and inequality, despite citizens' reasonable satisfaction with urban administration and readiness for future growth. City-level patterns reveal uneven development throughout zones, with concentrated growth in regional capitals, especially Mekelle. Overall, the results show that although Tigray has seen substantial urban growth, sustainable and inclusive urban development is hampered by a lack of proportionate infrastructure development, enduring spatial inequality, and a lack of economic opportunities. This emphasizes the necessity of integrated planning, infrastructure investment, and focused interventions in underprivileged areas.

## **6. RECOMMENDATIONS**

The study emphasizes the necessity of a balanced, infrastructure-led, and inclusive urban development approach based on empirical data on infrastructure access, geographical disparities, employment dynamics, and urban governance. It is advised to pursue these integrated policy directions: To ensure more equitable spatial development and lessen the strain of migration on major cities, invest in rural service centers and secondary towns. Frameworks for managing urban growth should direct growth while guaranteeing fair access to services and infrastructure.

Housing development and urban land expansion should be contingent upon the preceding or concurrent supply of basic infrastructure, such as roads, waste management, electricity, water, and sanitary facilities. Boundaries for urban growth should be in line with plans for financing and implementing infrastructure. Furthermore, to increase dependability, efficiency, and quality, give priority to repairing outdated water and electrical infrastructure, extend service coverage to under served and outlying areas, and implement service performance criteria. In addition to this, to lessen overcrowding and informality, focus on peripheral communities and informal settlements through fair infrastructure investment, settlement regularization, in-situ upgrading, and incentive-based affordable housing programs.

By assisting micro and small businesses, bolstering the unorganized sector, and connecting infrastructure expenditures to job creation, you may include local economic development into urban planning. To improve youth employability, align education and vocational training programs with the demands of the urban labor market. Boost intersectoral collaboration, data-driven planning, enhanced technical competence, and efficient implementation of land-use legislation to empower municipalities and kebele-level organizations. Additionally, to support adaptable and sustainable urban governance, enforce environmental laws, such as those pertaining to urban green belts and floodplain protection, encourage compact and climate-resilient urban forms, and set up ongoing monitoring systems.

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