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Exploring the nexus of migration dynamics and urban expansion: key drivers of horizontal spatial growth in Woldia Township, Ethiopia

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Ethiopia remains one of the least urbanized countries globally, although many of its urban centers, including Woldia, the capital of the North Wollo Zone, are undergoing rapid growth. Woldia has recently faced significant urban challenges due to its expanding horizontal growth. One of the major issues associated with this growth is the increasing demand for land and space, driven by population pressure, largely attributed to migration. This migration has led to the annexation of agricultural land at the rural periphery, further contributing to the town's horizontal expansion. This study aims to explore the key drivers behind the horizontal growth of Woldia, particularly in its peripheral areas. Data were collected through a structured questionnaire administered to a randomly selected sample of 395 respondents, complemented by key informant interviews and secondary data sources. Both qualitative and quantitative analytical methods were employed. The findings indicate that poor social services and poverty in migrants' areas of origin are the primary push factors. Conversely, improved social infrastructure and job opportunities at the destination are the main pull factors. Consequently, the influx of migrants has resulted in significant pressure on peri-urban areas, where housing availability and accessibility remain limited. The study recommends that local government officials and urban planners enhance their understanding of migration dynamics to effectively manage the town's spatial expansion and address the challenges of accommodating a growing population.

KEYWORDS

drivers, Ethiopia, migration dynamics, nexus, urban expansion, Woldia

1 Introduction

The increasing number of people residing in urban areas results from the general increase in the human population and the continuous migration of individuals from rural to urban areas (Clement et al., 2021). The number of people living in urban areas has increased, which is one of the most significant shifts in human life during the last few centuries (Perry et al., 2022). In this regard, Aerni (2016) stated that migration will play a major role in shaping the demographics of urban areas in the 21st century. Internal migrations will inevitably shape and change the urban environments of developing countries.

With migratory flows occurring within countries and across borders worldwide, migration is truly a global problem. Migration can be categorized as internal and external,

depending on the nature of the political and geographic border crossings. External migration is the movement of people across international borders, whereas domestic migration is the movement of people within certain political boundaries (Hanlon and Vicino, 2014). Moreover, Fentaw (2020) noted that one of the fundamental and significant elements of population dynamics in urban areas is migration, which is defined by the migrant's conscious and reasonable decision. Some types of checks and limits are placed on prospective migrants by international migration. Internal migration, however, is much more feasible. In most developing nations worldwide, internal migration has significantly impacted government policies and initiatives. According to Chernyak and Chernyak (2019), there are 763 million internal migrants and 244 million external migrants worldwide. Internal migration, or the movement of people within one's own country, appears to be commonplace when one considers spatial movements of people.

More than half of the world's population already resides in urban areas. This trend is anticipated to continue in the 21st century, with emerging countries having the fastest rates of development (Alliance, 2015). In this regard, UN-Habitat forecasts that 66% of the world's population will be urbanized by 2050. Due to urbanization, 2.5 billion people will reside in urban areas worldwide by 2050. As a result, about 90% of the increase will be found in urban areas of developing nations (UN-Habitat, 2014).

Furthermore, Mohammed et al. (2020) noted that worldwide urbanization is accelerating, with developing nations now seeing the fastest rate of urban growth. In line with this, Kundu and Pandey (2020) asserted that an important turning point in human history occurred in 2007 when the world's urban population finally surpassed its rural population. Our planet is currently more urbanized than it has ever been, and forecasts suggest that this trend will increase over the next several decades. In light of this, Zhang (2016) reasoned out that these dynamics of urbanization in the globalization era of the 20th and 21st centuries resulted in migrant flows toward urban centers. The migration of individuals from rural to urban areas is pervasive and significantly changing our way of life. Currently and in the future, the developing world will see the fastest rates of urbanization.

The rate of urbanization is increasing with time in developing and poor countries. In this regard, Zhang (2016) found that the majority of the urban population growth will occur in Asia, Africa, and Latin America, which will account for 54%, 32.5%, and 6.8% of the overall urban population growth, respectively. In many countries, urbanization brought on by migration causes urban areas to expand horizontally into adjacent rural areas, where farming is the main source of income for the local population (Mengist, 2022). Moreover, Fetene et al. (2019) noted that due to urbanization, rural farmland on the periphery of existing built-up areas is being transformed in significantly to meet the increased demand for urban land. Tassie (2018) also claimed that peri-urban areas are among the most susceptible to the swift conversion of a significant portion of prime agricultural land to urban areas, which results in the loss of livelihood assets for farmers.

Around the world, a significant quantity of farmland is consumed by horizontal urban growth into the surrounding periphery (Mohammed et al., 2017). Moreover, Baye (2009), in his empirical studies, found that horizontal spatial growth of urban areas consumes

prime agricultural lands in their urban periphery, which has resulted in a significant decrease in the amount/quantity of agricultural/crop/lands. By 2030, an estimated 1.2 million km² of urban land will be converted worldwide, assuming all areas with a high probability of urban expansion transform (Seto et al., 2012). Regional differences in urban growth rates exist. Despite regional variations in the contributions of population growth, the annual growth rate of urban land expansion was 7.48% in China, 4.84% in India, and 4.32% in Africa (Seto et al., 2011).

As more people live in urban areas across Africa, there will be more space for further growth (Seto et al., 2012). Amrevurayire and Ojeh (2016) noted that between 2000 and 2030, the urban population in Africa is projected to double. As a result, formal housing shortage is ongoing migration to urban areas. More, urban people are now estimated to live in informal housing on the periphery. In line with this, Talema and Nigusie (2023) asserted that most Ethiopian urban centers, especially Addis Ababa, the capital, and the surrounding towns, have been growing horizontally towards peri-urban areas to accommodate the country's growing urban population and economic activity.

Urbanization is anticipated to will play a significant role in Ethiopia's development in the near future. Based on available data, Ethiopia's urbanization is mostly caused by natural population growth, rural-urban movement, and the reclassification of rural land (Negari and Kumar, 2019). In line with this, the World Bank Group (2015) noted that natural growth accounted for 40% of the urban population growth before 2018, with rural-urban migration coming in second at 33% and reclassifying rural villages to urban centers at 24%. However, given the country's rapid rate of urbanization, rural-to-urban migration is predicted to surpass natural growth. According to Tegenu (2010), despite a rise in urban-urban migration, the majority of Ethiopia's migrants, who have made up about half of the country's urban population for the past 20 years, came directly from rural areas.

Compared to countries in Sub-Saharan Africa (SSA), where the average level of urbanization is 37%, Ethiopia has one of the lowest (23.1%) levels of urbanization (Weldegebriel et al., 2021). However, its urbanization rate (4.8%) threatens the country's development because it lacks the necessary planning skills and political and economic institutions (Koroso et al., 2021).

According to Lamson-Hall et al. (2022), while a high natural rate of population growth contributes to horizontal urban expansion in Ethiopia; it is also a result of significant migrant patterns that are triggered by a variety of factors, including new job possibilities in urban centers, displacement from ethnic conflicts, and difficulties in the rural economy due to drought. Besides, urbanization has been fueled by a number of social, economic, and environmental factors (Kebbede, 2017).

As urban areas expand and develop, their inhabitants need more space or floor area. In line with this, Angel et al. (2021) stated that urban areas have acquired floor space to grow in three ways. (1) by extending horizontal growth (2) by filling up the empty spaces between buildings, and (3) by building upwards (vertical growth). Usually, these three methods have been combined. However, the main focus of this study is the first way, which is the horizontal growth of the town.

Currently, Woldia is faced with various urban challenges. One is the town's rapid horizontal expansion and unplanned growth into the peripheral areas. The town is not adequately governed by appropriate

planning (Baye et al., 2020). This physical growth happened because of the growing population which resulted in a natural increase, rural-to-urban migration supported by urban-to-urban migration primarily from adjacent small towns, rural districts and intra-migration from the center of the town to the periphery. Baye (2009) stated that urban spatial growth consumes prime agricultural lands in their urban periphery, which has resulted in a significant decrease in the amount/quantity/of agricultural/crop/lands. Furthermore, Mohammed et al. (2017) found that government policies that expropriate prime agricultural land from the periphery due to urban expansion are the reason behind Woldia town's horizontal growth. These consist of: (1) public sector projects like roads, universities, water and sanitation facilities, health stations, and schools; (2) industrial zones like manufacturing industries; (3) residential housing for urban residents and government and private employees; and (4) private investment like private hotels and mixed land use.

Different scholars such as Bekele (2005), Getahun (2005), Baye (2009), Miheretu (2011), Melesse and Nachimuthu (2017), Mohammed et al. (2017), Teshome and Belete (2017), Tassie (2018), Fetene et al. (2019), Kebede (2017), Baye et al. (2020), Fentaw (2020), Kassegn and Endris (2020), Weldegebriel et al. (2021), Mengist (2022), Baye et al. (2023), and Talema and Nigusie (2023) have done empirical works on urban and migration-related topics. While these studies have contributed valuable insights into the general causes and consequences of urbanization and migration, they have not specifically addressed the nexus between migration and horizontal spatial growth in Ethiopian towns. This gap is particularly evident in the case of Woldia, where such an analysis has not been previously undertaken. Therefore, the uniqueness of this study lies in its focus on the drivers of horizontal spatial growth in Woldia and its aim to fill the existing research gap by examining the specific relationship between migration patterns and spatial expansion in this urban context.

The primary objective of this paper is to investigate the key drivers behind the peri-urban horizontal spatial growth of Woldia. Specifically, the study aims to: (1) identify the main push and pull factors that contribute to the horizontal expansion of the town, (2) assess the population growth trends of Woldia from 1967 to 2020, and (3) examine the pattern and spatial growth rate of the town from 1965 to 2020. By addressing these objectives, the paper seeks to provide a comprehensive understanding of the dynamics influencing the town's spatial development and population changes over the past several decades.

1.1 An empirical review of related works

1.1.1 Migration-led horizontal spatial growth and drivers of migration

1.1.1.1 Overview of migration-led horizontal spatial growth

The physical expansion of urban areas can be explained through both economic, functional, and demographic perspectives. Economic functional definitions of urbanization emphasize the spatial concentration of productive activities, such as services and industries, rather than focusing solely on population dynamics. In contrast, demographic definitions of urbanization are primarily concerned with

factors such as population size and density. This study examines horizontal growth from a demographic perspective, focusing on population changes rather than economic functions, as discussed by Tegenu (2010).

The main cause of urbanization is migration. Internal migration and net migration to urban areas cause a nation's population's urbanization. International migration can also have an impact on urbanization if it primarily impacts either rural or urban populations, but it is rarely a major effect when urbanization and growth are occurring at a rapid pace. Rapid urbanization frequently coexists with rapid overall population growth, particularly in rapid urban population growth (Tacoli et al., 2015).

The origins of urban growth are viewed from quite different angles among scholars. For instance, Angel et al. (2016) asserted that the horizontal growth of human settlements always increases in tandem with population growth since newcomers need land for houses and services. Moreover, Jedwab and Vollrath (2015) stated that demand for land and space rises over time as population pressure in urban areas increases due to migration.

Furthermore, Lamson-Hall et al. (2022) stated that most residents may no longer be able to access land in the existing area when urban populations are increasing quickly. Therefore, land can be developed through the occupation of peri-urban areas to facilitate the expansion of enterprises that need more space, the densification of crowded areas, or the arrival of new residents, such as through rural-urban migration.

Additionally, Caldeira (2017) and Mabin et al. (2013) noted that the urban periphery also becomes home to a large number of new migrants. Due to a rise in urban population, the total built-up area of developing countries doubled between 2000 and 2015 (Pesaresi et al., 2016). As urban areas expand to the periphery of rural areas, the natural environment and landscape are changed because they use more resources and land. Furthermore, climate change, pollution, and biodiversity loss may follow from this (McGranahan and Satterthwaite, 2014). Singh (2014) also stated that the urban environment, economy, government, infrastructure, society, shelter, and urban landscape are all changing as a result of urban centers' rapid growth.

Spatial growth is a phenomenon that occurs as urban space expands and is a crucial indicator of how quickly urban areas in developing nations are expanding. As many urban areas expand swiftly onto their periphery, previous villages and farmlands are engulfed and turned into urban areas (Bhatta, 2010). Moreover, Mekuriaw and Gokcekus (2019) stated that urban areas in developing nations are expanding in a dynamic, diversified, chaotic, and increasingly expansive manner. This shifts land usage from rural to urban activities and impacts the physical forms of the environment and the peri-urban interface's social and economic characteristics. Similarly, Mengist (2022) found that as urban areas grow, urban areas expand into the rural peripheries, forcing the government to evict farmers already living there and earning a living from farming.

According to Tegenu (2010), the following characteristics define migration-led urbanization: (a) an increase in the number of towns (multiplication of the points of concentration); (b) the development of the rural market functions (handicraft, trade, and service); and (c) an uneven growth in the size and spatial distribution of towns ("distorted location incentives").

1.2 Migration-led urbanization in Africa and Ethiopia

The countries in the Global South are where the anticipated urbanization is concentrated. Although they are the least urbanized, sub-Saharan African nations are growing at the fastest rate, 4.1% annually. Rural-to-urban migration is the primary cause of urban growth in this region (Tumwesigye et al., 2021). In line with this, Lamson-Hall et al. (2019) pointed out the United Nations Population Division estimated that 55% of people in Sub-Saharan Africa will live in urban areas by 2050. Over the next three decades, Ethiopia will see the development of urban areas that will last for many generations.

The extent of rural–urban mobility will affect projections of future urban growth, and migrants' requirements differ from those of urban dwellers even though migration to urban areas is evident in sub-Saharan Africa (Lamson-Hall et al., 2022). Additionally, Tacoli et al. (2015) noted that one out of every three new residents of Sub-Saharan African urban areas was a migrant from the rural areas. The rural–urban movement contributed to the region's urban population growth. The study also found that more than two out of every five individuals added to Sub-Saharan African urban areas over the next three decades will be rural migrants.

The United Nation (2018) reports that urban areas in sub-Saharan Africa are expanding at a faster rate than urban areas worldwide and that over one-third of the additional people living in urban centers over the next 30 years will reside there. By 2050, sub-Saharan Africa's urbanization rate is expected to rise from 41.4% in 2020 to 58.1%. According to Lamson-Hall et al. (2022), Sub-Saharan Africa is at the epicenter of the world's urban growth, with urban areas accounting for over half of this growth, which comes from rural-to-urban migration, which accounts for 43%.

Due to urban centers' proximity to the periphery, rural populations will have access to pre-existing networks within urban regions, making the move easier (Awumbila, 2014). According to Rondinelli (1983), adjacent urban centers are areas of arrival and progressively important components of the urban system that “bridge the gap between the major urban centers and the rural hinterlands.” The growth of existing settlements due to natural rise and rural–urban migration is creating a new system of adjacent urban centers in several African nations.

Awumbila (2014) also pointed out that the rapid urbanization of Sub-Saharan Africa has resulted in migration, and the majority of the population from rural to urban areas has been characterized as possibly the most significant development since independence in the majority of African nations. African governments and outside observers have legitimately been concerned about the severe urban demographic strain for decades.

In most developing nations, including Ethiopia, the majority of urban population growth is accommodated by the fast horizontal urban expansion from the urban center to the periphery. Migration is the main driving force behind this phenomenon. Furthermore, Chandel and Mathewos (2023) identified that a number of reasons have contributed to the horizontal growth of urban areas in Ethiopia, including natural population growth, rural–urban migration, and government policies that support urbanization and economic development.

According to the Central Statistical Authority (CSA) of Ethiopia, Ethiopia's urban population has been significantly impacted by migration, which is a key driver of the country's urban growth. Rural–urban and urban–urban migration have both occurred in the country. Numerous studies showed that the proportion of migrants to Ethiopian urban centers sharply rose. More than 73% of urban migrants were from rural areas, and the percentage of movers from urban areas was above 40%, which shows an increasingly widespread level of rural–urban movement (CSA, 2008).

Table 1 shows the nexuses between the population (driven by migration) and the horizontal spatial growth rate of urban centers in East African countries that are used as case studies. Accordingly, these urban centers are urbanizing more quickly, partly because of a significantly higher rate of migration from rural to urban areas (Lamson-Hall et al., 2022). Recent data examines urban centers' role in integrating these new migrants and assesses the extent of this rural–urban migration.

Furthermore, based on satellite imagery analysis, the study found that these urban centers have an average annual population growth rate of 5.2% and an average annual urban area expansion rate of 6.1%. As the study indicates, these urban centers will, on average, double over the next 12 years if current trends continue. This suggests that urban centers are growing at an alarming rate in terms of both people and territory, which causes urban centers to engulf new areas at the periphery.

TABLE 1 Population and urban extent growth rate of sub-Saharan African urban centers (case studies of Eastern African urban centers).

City name	Country	Population (2019)	Urban extent (hectares) 2019	Population growth rate % (2000–2019)	Urban extent growth rate % (2000–2019)
Arua	Uganda	174,628	3,553	6.9	5.7
Jinja	Uganda	182,455	4,945	7.2	7.6
Mbale	Uganda	171,746	3,652	4.8	5.8
Gulu	Uganda	198,062	4,177	5.7	5.5
Dire Dawa	Ethiopia	182,455	4,946	7.1	7.6
Adama	Ethiopia	171,746	3,652	4.2	5.8
Jigjiga	Ethiopia	198,062	4,178	5.5	5.5
Gabiley	Somalia	30,734	490	2.2	5.4
Borama	Somalia	174,628	3,554	6.2	5.7

Source: Lamson-Hall et al. (2022), p. 15.

1.2.1 Key drivers of migration

Migration to urban areas, in particular, has more complicated causes. For many reasons, people relocate. Push and pull factors are the two main categories into which the reasons for migration are typically divided (Delango, 2019). According to Everett Lee's theory, migration is selective and is impacted by both push and pull variables (Urbański, 2022). Moreover, Bean and Brown (2014) stated that Lee categorized four variables of push and pull factors of migration that people decide to migrate. These are (1) the areas of origin, (2) the areas of destination, (3) personal factors, and (4) intervening obstacle-related variables. Thus, migration can be seen as a wise choice made by people to take advantage of chances that are insufficient in their own area. In this regard, Abeje (2021) also asserted that Ethiopia has a high rate of rural–urban migration due to a series of causes, including push factors in the rural areas and pull factors in urban areas. Rural push factors have been the main driving forces for the swift shift of people from rural to urban areas.

Thus, the study aims to identify the different push and pull factors, such as economic, social, environmental, and political drivers, that are likely to affect people's decisions to migrate and their implications on the horizontal growth of towns. All of these have the power to influence someone's goals and choice to relocate. They should not be viewed as isolated elements but rather as interconnected and complex, supporting or hindering one another. The key drivers of migration include:

1.2.1.1 Economic drivers

Economic opportunity disparities, especially those related to employment and wages, have long been seen to be the main causes of migration. Accordingly, Todaro and Smith (2009) claimed that migration between rural and urban areas is generally regarded as a rational action and that the choice to migrate is determined by considering the advantages and disadvantages. According to this model, migrants react to variations in expected rather than real earnings between rural and urban areas, and they continue to migrate until expected and actual incomes in each region are equal. So, the deciding element, in this case, is thought to be the person's logical cost–benefit analysis of an existing wage gap between their place of origin and destination, which serves as a stand-in for improved economic possibilities.

Moreover, Henderson (2010) stated that rural communities are forced to migrate and travel longer distances to urbanization hubs as development becomes more concentrated. In addition, Ravenstein (1885) noted that rural-to-urban movement was the primary driver of urban growth and that economic factors were the main drivers of migration. In light of this, Clement et al. (2021) pointed out that seasonal economic gains and personal fulfillment are the main drivers for people who migrate to urban areas. Additionally, Van Dijk and Franssen (2008) stated that poor living circumstances and ongoing famine are the main causes of the fast rate of urbanization in Ethiopia, which forces people to migrate from rural areas to urban areas in search of better employment opportunities.

Moreover, the number of opportunities determines the magnitude of migration. In line with this, Stouffer (1940) claimed that the size of migration is determined by the total of the push and pull forces at the origin and destination area. Greater chances draw more people and make a location a destination. However, a

location with few opportunities turns into the starting point. Overall, it has been demonstrated that a major motivating factor for rural–urban migration is the absence of economic prospects in the region or place of origin and/or the availability of greater chances elsewhere.

1.2.1.2 Social drivers

Poor social services and inadequate infrastructures encourage people to migrate. In this regard, Kassegn and Endris (2020), in their review study of “Determinants of internal migration in Ethiopia,” identified that inadequate social services and poor infrastructure are the primary driving forces behind migration in rural Ethiopia. Moreover, Farrell (2018) noted that people in rural areas are driven to urban areas in search of a higher quality of life due to push factors, including poverty and a lack of basic amenities and other services. On the contrary, better education, health care, security, and other urban amenities attract people from rural areas to migrate to urban wards. People move to urban areas because they believe they are hubs for growth and education. According to Zhang (2016), urban areas are the driving forces behind social, cultural, and technological advancements and offer more learning and sharing opportunities.

Urban ward migration is determined by various social factors, including the presence of pre-existing social networks that can facilitate the migratory transition or the accessibility of transportation facilities (Haug, 2008; Van Hear et al., 2018). For example, social networking at the destination area (via family, friendship, and community relationships) can speed up the migration process by providing resources or helpful information and reducing the risks and expenses of relocation for prospective migrants. Accordingly, social networks can assist migrants in locating housing and employment in their new location (Cummings et al., 2015). Access to information before and during the migration process is essential to lowering risks, and it also offers the resources required for the route.

1.2.1.3 Environmental drivers

Environmental issues have drawn more attention in the context of migration in recent years. Soil degradation, drought or flooding, temperature or rainfall anomalies, and natural disasters have all been identified as causes of large-scale migration flows. Given this, Henderson et al. (2017) pointed out that populations moving from rural to urban areas in Sub-Saharan Africa are significantly impacted by climate change. In Ethiopia, individuals typically leave rural areas and migrate to urban areas to avoid unfavorable conditions. In light of this, Getahun (2005) identified that the main push factors in Ethiopia include a declining supply and quality of farmland, ongoing drought, conflict, and other similar issues. Besides, Jabal et al. (2022) pointed out that the decline of agricultural yields brought on by climate change poses a challenge to rural livelihoods, particularly in areas that are stressed by moisture. Since climate change is decreasing farm productivity and making food self-sufficiency more difficult, mass migration to urban areas is typical. This will accelerate urbanization, which is happening quickly in poor nations like Ethiopia facing food insecurity.

Furthermore, Marchiori et al. (2012) claimed that rainfall and temperature anomalies in Sub-Saharan Africa increased both rural-to-urban migration and international out-migration. On the other hand, a conducive climate and good urban environment attract migrants to urban areas. In line with this, Melesse and Nachimuthu

(2017) and Obijekwu et al. (2019) stated that better climatic conditions and a good urban environment may also attract people to relocate to different urban areas.

1.2.1.4 Political drivers

The development of urban infrastructure-related projects such as roads, dams, industrial parks, slum upgrading, or redevelopment of the center of urban areas by the government is considered one of the drives forcing people to migrate to other areas. Accordingly, Mohammed et al. (2017) claimed that local government buildings, manufacturing industries, roads, telecommunications, stadiums, health stations, recreational areas, and industrial parks were among the urban development projects in Ethiopia that caused migration. These have contributed to the horizontal expansion of urban areas across the nation and created a demand for peri-urban land on the outskirts. Furthermore, according to Dires et al. (2021), Ethiopia's horizontal urban growth is a result of the peri-urban families' farmland being taken away for infrastructural development, which drives people to migrate. In this regard, Bekele (2005) also stated that the main causes of horizontal spatial growth in Ethiopia include population increase, an increase in household income, subsidies for infrastructure projects like roads, inefficient land use, social issues in central urban areas, and poor land policies.

The government's reclassification of rural areas into urban areas for administrative purposes is another factor in the migration of people from rural areas to urban areas. In this regard, Ahmed and Ishrat (2020) asserted that the migration of people from rural to urban areas, coupled with the reclassification of rural areas as urban areas, has been very significant since it has changed the rapid expansion of urban centers, and it is still a crucial link in the chain of urban growth. Moreover, Montgomery et al. (2013) asserted that political or administrative processes are mostly responsible for the reclassification of nearby rural areas under urban administrative settings as sites of expansion to satisfy the demands of urban land for diverse activities.

From the literature review discussed so far, we can generally identify that the main drivers of migration, push factors at the place of origin (rural and/or urban areas) and pull factors at the place of destination (urban areas), have played a major role in increasing the urban population. This, in turn, leads to the horizontal growth of urban areas and the subsequent encroachment of the nearby valuable farmlands in Africa in general and Ethiopia and Woldia in particular. As a result, there was a demand for farmland in the periphery being encroached upon by urban usage to accommodate the growing population pressure from migration recently. Figure 1 depicts the main causes of migration and its implication for horizontal spatial growth.

2 Research methods and materials

2.1 Description of the study area and study site selection

Geographically, Woldia lies astronomically between 110° 48' N–110° 50' N latitudes and 390° 34' E–390° 36' E longitudes. The town is situated at an average elevation of 2000 meters above sea level and is

found in the North Wollo zone of the Amhara National Regional State, Ethiopia. It serves as the capital of the North Wollo Zone, Guba Lafto, and Woldia Woreda. The town's name, "central meeting place," reflects its historical role as a hub for goods redistribution to nearby areas (Baye et al., 2020). Woldia connects Addis Ababa, the national capital, along the primary north–south highway with Mekele in Tigray. It is approximately 521 km from Addis Ababa, 360 km from Bahir Dar (the regional capital), and 180 km from Lalibela, a significant tourist destination. The study area lies within the northwestern highlands and associated lowlands, specifically within the northern-central massifs subdivisions, with an average elevation of 2,000 meters above sea level.

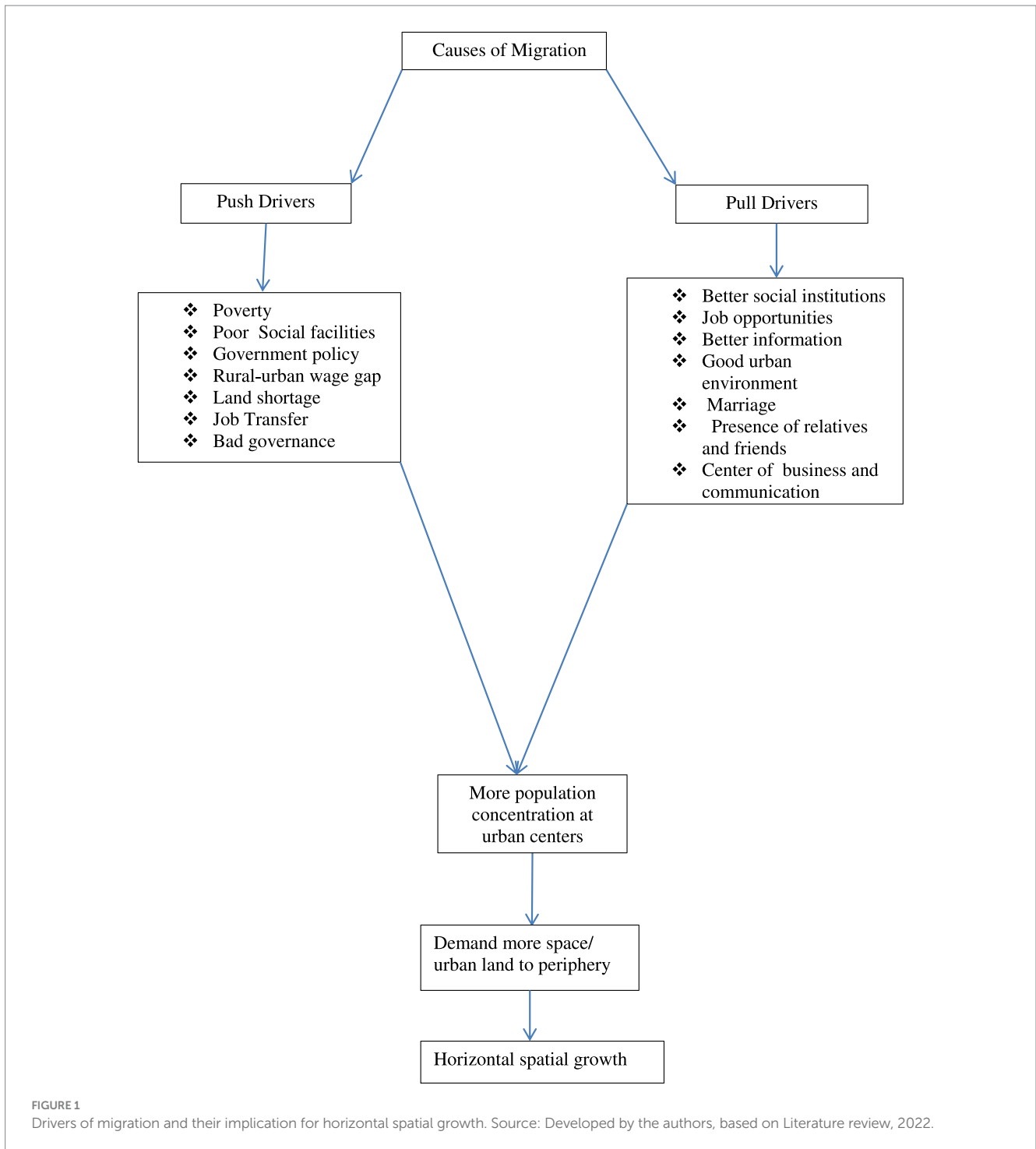
Woldia is a major transportation node where three significant highways converge: Addis Ababa–Dessie–Woldia, Bahir Dar–Gondar–Woldia, and Mekele–Woldia (see Figure 2). These highways not only connect Woldia to various parts of the country but also offer convenient access for commuters to the town center. Consequently, Woldia serves as a key junction connecting Mekele to the north, Djibouti to the east, Addis Ababa to the south, and Bahir Dar and Gondar to the west. It is also a main access route to Lalibela, a prominent religious and tourist site. The town is bordered by Mount Gubarja to the east and Mount Gebrael/Ariro to the north, with these topographic constraints channeling its rapid expansion primarily southward, northwestward, and westward. To the west of Woldia, the flat plains of Mechare provide suitable areas for further growth, extending to the Tikur Wuha and Melka Demo rivers (Baye, 2009).

Although Woldia lacks a major river, the Shelle stream flows from the north to the southwest, originating from Gebrael Mountain and passing near Woldia University. To the south, the flat Mechare plain and the gentle Guba Lafto escarpment provide potential for further expansion, which is limited only by Mount Guba (locally known as Guba Terara). This geographic layout initially led Woldia to expand in a linear pattern. The town has a compact, almost hollow shape when viewed from above, displaying a cohesive urban form.

Despite the limiting effect of the Guba Lafto escarpment on southern expansion, the construction of a 12-km highway from Jeneto Ber to Woldia through Guba Lafto has been a significant factor enabling growth in this direction. Other contributors to Woldia's expansion include the level terrain of Mechare, the establishment of Shehi Ala Mudi Stadium, Woldia University, Woldia College of Teacher Education, Woldia Polytechnic College, the Jeneto–Woldia Highway, and the Woldia–Gondar–Bahir Dar Highway (Baye, 2009). A designated industrial zone and an increase in business investments have further stimulated the town's economic growth. Financial institutions have also been increasingly supportive, providing investment opportunities and urban loan options to facilitate development. However, promoting sectors like tourism, hotel investment, transportation, commerce, and agriculture remains essential for sustained growth and regional development.

2.2 Study site selection

Woldia has recently been divided into three sub-cities: Taitu Bitul, Ras Ali, and Yeju. Taitu Bitul encompasses kebeles 01, 02, and 04 from the study areas; Yeju includes kebele 05, and Ras Ali covers kebeles 03,



06, and 08. These peri-urban areas have been intentionally selected for study, as Woldia’s spatial growth is especially prominent along the fringes of these kebeles.

The study area is located on the urban outskirts of Woldia town in the North Wollo zone of the Amhara Regional State. The primary reason for selecting these locations is their visibility as sites of rapid spatial growth at the town’s periphery. Specifically, the most suitable areas for current and future urban expansion are the level area west of Woldia extending toward the “*Tikur Wuha*” (Black Water) River, the southern and southwestern flat plain near Mechare, and the northern and northwestern zones around

Adengur and Michael. This growth direction is due to the limitations posed by steep terrain on the eastern margin at Kore and the northeastern slope of Mount Gabriel.

These sites were selected based on the following criteria: (1) locations where rapid spatial growth has encroached upon prime agricultural land on the rural periphery for diverse urban purposes, (2) areas with relatively few physical barriers to growth and adequate land supply, (3) areas experiencing an influx of migrant populations constructing both formal and informal housing, and (4) peri-urban zones that offer transitional environments for migrants, blending rural and urban

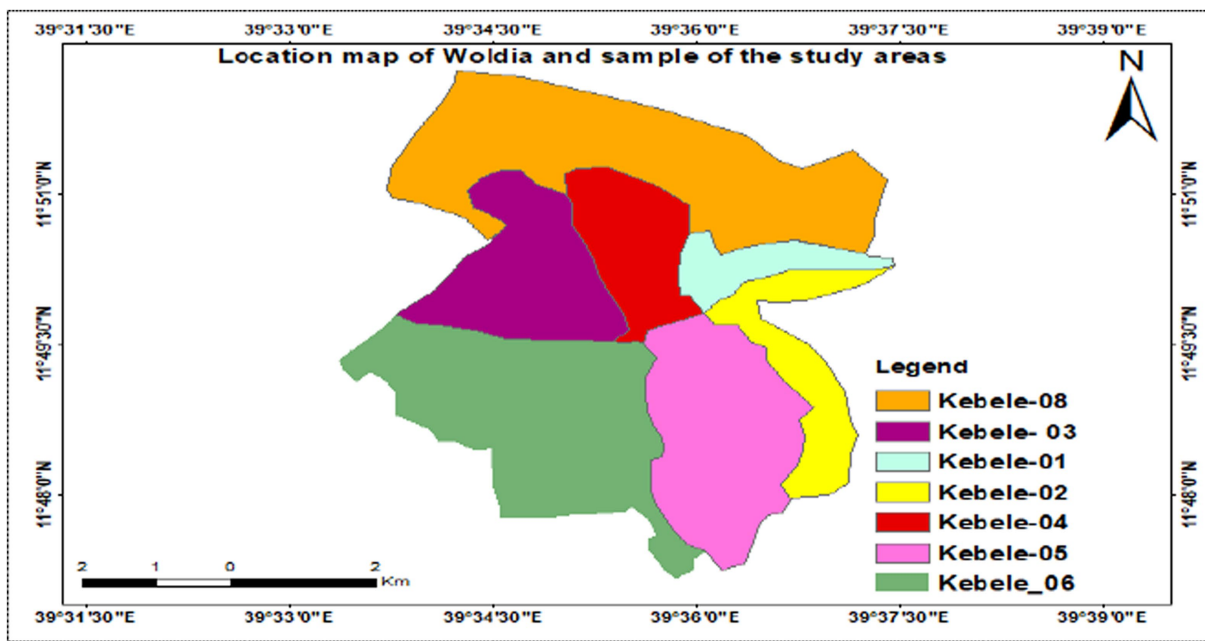


FIGURE 2 Location map of Woldia and sample of the study areas.

characteristics to facilitate their adaptation to urban life. Consequently, these areas play a crucial role in supporting the smoother integration of migrants into the urban structure. Figure 2 illustrates the location map of Woldia town and highlights the study kebeles.

2.3 Study population, sampling technique, and sample size

The study’s target population comprised various groups, including rural-to-urban migrants, intra-migrants (individuals relocating from the core of Woldia to its periphery), urban-to-urban migrants, as well as town mayors, officials from the North Wollo Zone Workers and Social Affairs Office, municipal managers and experts, kebele officials, and urban land administrators. According to Fasigo et al. (2024), the town recently had 10 kebeles, six classified as urban, while the remaining four were rural. Consequently, the sample for this study was drawn from six urban kebeles and one rural kebele close to the town, Adengure-Gabriel, where spatial growth is particularly evident.

According to data obtained from the Woldia Woreda Health Department, the entire urban population of the town in the year 2020 /21 was 89,707. Of these, 65,465 were residing in the town’s study areas. Of 65,465 populations, 37,887 of them were migrants. The sample size was determined by using the formula of Yamane (1973) cited in Fasigo et al. (2024) while taking the margin of error of 5% and the degree of confidence (95%) (Table 2).

$$n = \frac{N}{1 + N(e)^2}$$

where N = target population
 e = sample error estimated (0.05)
 n = total sample size

$$\text{Therefore, } n = \frac{37,887}{1 + 37,887(0.05)^2} = 395$$

From the total migrant population of 37,887, a sample of 395 migrant households was selected using a simple random sampling method based on kebele population lists. After establishing the sample size, lists of migrants were obtained from each kebele. The researcher (corresponding author) then selected a random starting number. For instance, in a kebele with a migrant population of 4,500 and a target sample size of 47, dividing the population by the sample size yielded approximately 96. A random number between 1 and 96 (in this case, 30) was chosen as the first sample point. The second sample was determined by adding 96 to the starting number (yielding 126), followed by the third sample at 222, the fourth at 318, and so on until the required sample size was reached. This process was replicated across all selected kebeles.

2.4 Data sources and methods of collection

2.4.1 Data sources

To produce reliable and comprehensive information, the study used both primary and secondary data. Primary data were collected from migrant respondents, mayors, zonal experts, municipality officials and experts, and kebele managers through questionnaires and key informant interviews. Secondary data were collected from census

TABLE 2 Sample distribution of the study sites.

Name of Sites/Kebeles'	Total population	No. of migrants	Sample size distribution
Kebele (01)	9,502	4,300	$(4,300/37,887) \times 395 = 45$
Kebele (02)	9,501	2,500	$(2,500/37,887) \times 395 = 26$
Kebele (03)	11,042	9,200	$(9,200/37,887) \times 395 = 96$
Kebele (04)	11,042	5,200	$(5,200/37,887) \times 395 = 54$
Kebele (05)	8,301	4,687	$(4,687/37,887) \times 395 = 49$
Kebele (06)	9,940	7,500	$(7,500/37,887) \times 395 = 78$
Kebele (08)	6,137	4,500	$(4,500/37,887) \times 395 = 47$
Total	65,465	37,887	395

Source: Woldia Woredas' Health Department, 2021.

results, official documents and records of the city administration, the town municipality, published and unpublished data, different research papers, books, the internet, and articles relevant to the problem under investigation.

2.4.2 Data collecting procedures and tools

2.4.2.1 Data collecting procedures

Given that Amharic is the working language of the town and is widely understood by most migrant residents, the final questionnaire was first prepared in English and then translated into Amharic. Three lecturers from Woldia University—two from the Department of English Language and Literature and one from the Department of Geography and Environmental Studies—were consulted during the translation process.

A pre-test was conducted on selected study sites to evaluate the initial questionnaire draft for any ambiguities, misunderstandings, or other issues to facilitate the research process. An initial draft pilot was tested with 10 migrant respondents (six men and four women) from the Admas Bashager, Mechare, and Yejugenet sites before the main survey commenced. These pilot respondents were part of the population from which the sample would be drawn and selected to represent the broader attributes of the migrant population.

The survey covered 395 households through home-to-home visits conducted by seven enumerators (six males and one female). These enumerators included three teachers from Woldia Preparatory Schools, two from Woldia High School, and two grade 12 students, all selected according to specific criteria and trained for field data collection. Additionally, four supervisors (all male and lecturers from Woldia University) oversaw data collection at each site. Ultimately, 395 respondents completed the questionnaire, supplemented by 12 key informant interviews, totaling 407 participants across various categories, as summarized in Table 3.

2.5 Data collection tools

2.5.1 Questionnaire

The questionnaire served as the primary data collection tool in this study due to its self-administered nature, which enables simultaneous distribution to a large number of individuals. The survey included both closed and open-ended questions. Given the time constraints, the questionnaire allowed efficient data collection

TABLE 3 Type of instruments and number of sample participants for data collection.

	Instruments/Tools/	Number
	Interview	12
	Questionnaires 395	395
Total		407

Source: Field Survey, 2021.

from a large respondent pool. Additionally, it minimized interviewer bias and supported the use of a larger sample size, thereby enhancing the reliability and consistency of the findings. Before respondents received the questionnaire, the researcher explained the study's purpose and anticipated outcomes. Participants were encouraged to ask questions and clarify any uncertainties about the questionnaire before responding. This comprehensive overview of the study helped reduce the likelihood of inaccurate responses.

2.5.2 Interview

The study employed structured and semi-structured interviews to collect qualitative data from key informants through face-to-face interactions. Prior to each interview, an appropriate location was arranged, and the researcher introduced himself, carefully explaining the research's purpose and assuring participants of the confidentiality of their responses. The interview questions were then administered according to a planned schedule.

To meet the study's objectives, interviews were conducted with two mayors and two experts from the North Wollo Zone Workers and Social Affairs Office, focusing on the main drivers of migration. Additional interviews included one manager, two municipal experts, and two urban land administration officers to obtain information on land issues and spatial growth. Five kebele managers were also interviewed to gather insights on basic social services. Each interview lasted between 20 and 70 min, averaging 45 min. After each session, the researcher expressed sincere appreciation to all participants for their valuable contributions to the study's success.

2.6 Methods of data analysis

Data gathered through various methods served as both inputs for the analysis being studied and essential sources for

understanding the main drivers behind migration and how they affected the town's horizontal growth. The analytical techniques for examining migration drivers and their impact on urban expansion at the periphery were employed in both quantitative and qualitative analysis. Therefore, after the necessary data had been gathered and coded, the quantitative parts were analyzed using Excel and SPSS version 21, utilizing descriptive methods such as tables, frequencies, percentages, and graphical representations. The qualitative method was employed to describe the numerical values of the findings in statement form and included an analysis of respondents' attitudes, opinions, and suggestions.

2.7 Ethical concerns and considerations

2.7.1 Consent to participate

After obtaining the necessary approvals and developing the data collection tools, the researcher and data collectors communicated the research objectives to participants clearly and effectively, outlining the study's purpose and scope. They ensured that participants were aware of the procedures for collecting, anonymizing, and securely storing their information. They also provided transparency and accountability by outlining the procedures for gathering data and how the study's conclusions would be applied and disseminated. The participants requested an informed consent form, but they declined to sign it because of political sensitivities and worries about possible consequences. Rather, subjects gave their verbal agreement after being fully informed about the study's goal and their withdrawal rights.

2.7.2 Consent to publish

In addition to their reservations about participating in the study, participants also voiced worries about the consequences of signing or giving written consent since they feared possible consequences if their names were on the document. Therefore, all participants were informed of the research aims, and verbal approval for publication was obtained from them instead of written consent. No published material revealed their names or identities, ensuring their secrecy. Regarding their comments, the researcher promised to keep them private and provided transcripts upon request.

2.8 Woldia's population growth and its implications on spatial growth

Towns in Ethiopia are growing quite quickly these days. Their population is growing as a result of migration as well. Woldia town has one of the fastest population growth rates in the country due to migration. In 1984, there were 1,038 migrants in Woldia town; by 1994, there were 11,325 (Miheretu, 2011). The number of migrants living in the town has surged drastically in recent years. In this regard, Fasigo et al. (2024) noted that the total urban population of the town was 89,707. Of these, 49,887 (55.61%) of the population were migrants. This implies that migration is one of the basic components of the current population growth of the town. This is mostly due to the availability of better social amenities such as the establishment of Woldia University, Woldia College of Teacher Education, Woldia Polytechnic College, the Jeneto–Woldia highway, and the

Woldia–Gondar–Bahir Dar highway. Besides, the town is the center of the industrial zone, and business investments and financial institutions have increasingly attracted and stimulated migrants to the town.

With a total population of 150 from its founding between 1778 and 1785, Woldia has shown consistent growth (Baye et al., 2020). After 243 years since its founding in the last quarter of the 18th century, the town has expanded to be a home of 89,707 people in the year 2020/21.

Central Statistical Authority (CSA) of Ethiopia estimated that the yearly growth rate of the urban population in Woldia was 4.11%, compared to 2.23% for the rural areas. According to the CSA (2007), the town's overall population was 46,126 in the year 2007, and in the year 2020/21, the town's population accounted for 89,707, as the information obtained from Woldia Woreda Health Department. This indicates a high level of population pressure observed between the years 2007 and 2020/21.

The town's population grew at an annual rate of 7.04% between 2007 and 2020/21, indicating that as the population increases, more space will be needed to accommodate the rising number of residents. The surrounding highland and lowland Woredas (administrative units in Ethiopia higher than kebele) of the North Wollo zone, along with the adjacent rural and urban Kebeles (the smallest administrative unit in Ethiopia), contribute significantly to the influx of migrants into the town.

Figure 3 illustrates the migration patterns to Woldia town (concentration zone) from various places of origin, specifically the different woredas. Based on the economic and environmental circumstances that the migrants encountered, the flow can be categorized into three groups according to data from the North Wollo Zone Works and Social Affairs Office. These categories include very high migration-flow Woredas (such as Meket and Wadla), high migration-flow Woredas (including Dawunt, Gubalافت, and Lasta), and Woredas with less migration flow (such as Bugna, Gidan, Habru, and Kobo).

In most cases, as distance increases, the number of migrants declines. This migration pattern is true according to Ravenstein (1885), who suggested that migrants tend to settle in major industrial and commercial hubs and prefer shorter distances due to accessibility and familiarity. The number of migrants decreases with increasing distance.

However, the migration flow map in Figure 3 depicts that a high flow of migrants is located far from Woldia town. This is mainly because agricultural land in those woredas is scarce and seriously affected by drought. In addition, the number of socio-economic opportunities at destination areas attracts more migrants than distance. In line with this, Stouffer (1940) stated that the number of opportunities at the places of origin and destination is strongly related to the size of migration. The place with more opportunities attracts more people and becomes the destination.

On the other hand, a place of limited opportunities becomes the point of origin. Thus, the greater the difference in the opportunities available at these two places, the greater the migration. On the other hand, Figure 3 illustrates that Bugna, Gidan, Habru, and Kobo Woredas, which are located closer to Woldia, have less flow of migrants. This is because those woredas are relatively better in their agricultural land and environmental and economic conditions than the other woredas.

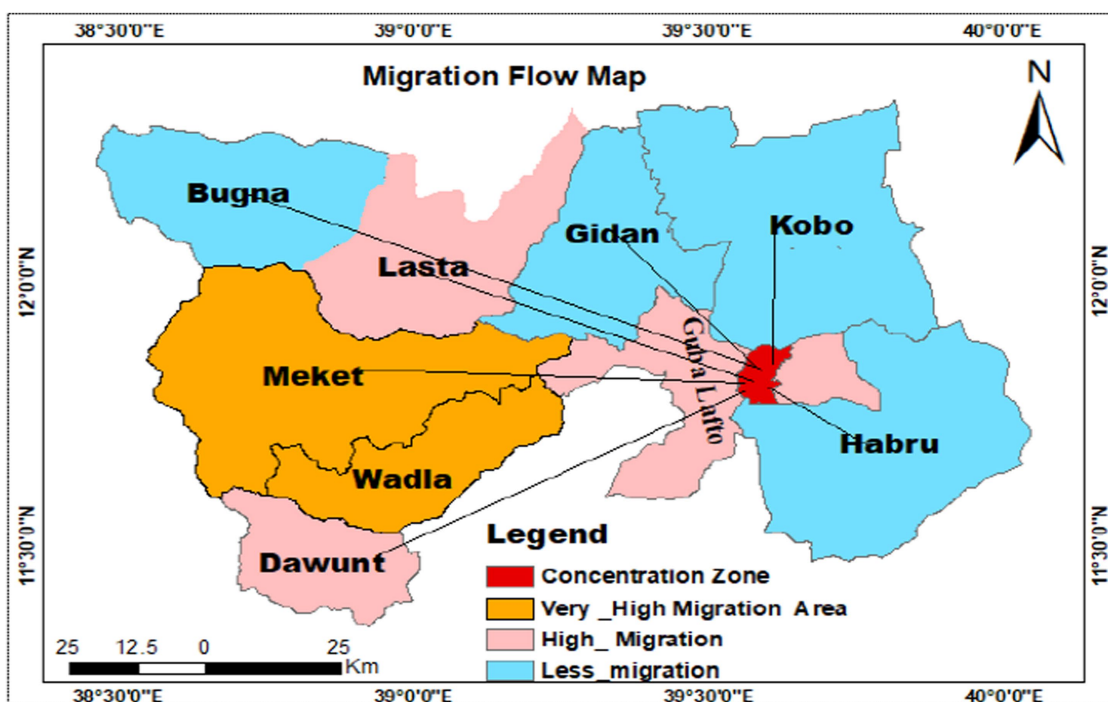


FIGURE 3 Migration flow Map of the surrounding Woredas of Woldia. Source: Developed by Author, 2022.

The population of the town increased with time, going from 8,505 in 1967 to 46,126 in 2007, at an average growth rate of 4.21%, as seen in Table 4. That means the town’s population has expanded more than five times throughout the last 40 years (1967–2007). Additionally, from the year 1970 through the year 2020/21, the town’s yearly growth rate was greater than 3.5%. The years 1992, 2002, 2019, and 2020/21 show the town’s maximum growth rates of 7.2, 7.1, 6.8, and 7.04%, respectively.

Regarding the main drivers of migration, a key informant’s interview of the mayors confirmed that the town has drawn a significant number of migrants from other small-sized towns and rural surrounding areas because of its administrative, economic, and geographic advantages over other urban centers in the zone. As of the 2019 population projection, Woldia was home to over 29.67% of all urban residents in North Wollo, while the zone’s total urban population was estimated to be 282,494. This demonstrates that the town’s population is growing rapidly, necessitating more land to support various socio-economic developments. As a result, there is currently rapid horizontal development in the town brought by strong population pressure, primarily due to migration. The town has grown by engulfing the nearby peripheral areas of Adengure, Ariro, Mechare, Michael, and Teklehaymanot.

TABLE 4 Population size and absolute increase of Woldia town from 1967 to 2020.

Year	Total population size	Absolute increase	Annual average growth rates (%)
1967	8,505	–	–
1970	9,409	904	3.5
1984	15,325	5,916	4.5
1989	18,759	3,434	4.5
1992	22,786	4,027	7.2
1994	24,533	1,747	3.8
1999	31,203	6,670	5.4
2000	32,692	1,489	4.8
2002	37,365	4,673	7.1
2004	40,804	3,439	4.6
2007	46,126	5,322	4.3
2019	83,806	37,680	6.8
2020/21	89,707	5,901	7.04

Source: Computed from CSA annual abstracts (1984–2007) and Woldia Woreda Health Department (2022).

3 Results and discussion

3.1 Push factors as the main drivers of migration

Table 5 depicts the main push drivers of migration. Accordingly, 26.55% of sample respondents responded that poor social facilities

forced people to migrate to Woldia town. From these percentage shares, poor social facilities as primary, secondary, and tertiary push factors account for 8.19, 11.17, and 7.20%, respectively. As a result, poor social facilities such as education and health care are factors that encourage people to migrate to the town. This result is consistent with Kassegn and Endris (2020), who highlighted that poor social infrastructure in rural areas can cause people to migrate to urban areas, with more economic

opportunities and greater access to social services. This is currently true in Woldia town as migrants from adjacent rural and urban kebeles move to Woldia to access better social services they were deprived of back home. The migration flow was prompted by the opening of Woldia University, Woldia Comprehensive Hospital, and many health stations in the town.

In this context, various scholars have recognized several social issues as drivers of migration. In this regard, [Urbański \(2022\)](#) stated that the lack of well-established healthcare systems influences people’s aspirations to seek better healthcare elsewhere. Lack of educational opportunity and intolerance of religion are also two additional social causes driving migration.

Social reasons such as a lack of career possibilities, educational chances, and affordable housing frequently drive migrants from locations with low social infrastructure to move to developed areas. According to [Carbajal and Calvo, 2021](#), the social causes driving migration are based on people’s desire for a higher standard of living. The urge for better education for oneself and one’s family is one social issue that drives migration.

From the total sample of migrants, 23.82% of the respondents replied that poverty is the primary push factor that induced migrants to move to Woldia town. Poverty is frequently regarded as a “push” element that can make someone susceptible to the human population migrating toward better socio-economic areas. This result is consistent with [Dessalegn et al. \(2023\)](#), who highlighted that migration is sometimes viewed as a way to diversify household income when opportunities are scarce or living conditions are poor. Some family members leave the home to move to places with better possibilities, while other family members remain in the home and gain from sources like remittances. Some Ethiopian households in areas prone to drought have also experienced this.

According to the information obtained from the North Wollo Zone Workers and Social Affairs Office and the migration flow map depicted in [Figure 3](#), rural woredas experienced inward migration to the town. This happened because the adjacent rural Woredas are mostly affected by drought and have low agricultural productivity. As a result, rural people in these areas were in a food insecurity situation.

Hence, they prefer to move to the town for employment opportunities and a better life. The spatial distribution of migrants at their place of origin manifests a rural–urban variation and a Woreda variation. They came from different administrative Woredas of the town.

Government policies can play a significant role in creating push factors that drive people to migrate toward urban areas. As stated in [Table 5](#), 16.87% of the respondents responded that government policy can be considered as the driver of the push factor. According to [Angel et al. \(2005\)](#), two policy arguments exist about whether urban growth should be limited, allowed, or welcomed. At one extreme, there have been those who fought to limit urban growth by all means. On the other hand, some welcomed it and actively prepared urban areas to absorb the oncoming waves of new migrants.

Based on those policies discussed so far, the local government of Woldia has applied the welcome policies to redevelop the central part of the town. As a result, people who previously lived at the center were shifted to the periphery areas of the town as intra-migrants, which contributes to the spatial growth of the town horizontally by demanding space.

Lack of land can force people to migrate since it can result in poor living conditions and food shortages. In this regard, different studies conducted in the northern, southern, and northwest parts of Ethiopia revealed that the shortage of land is a cause of the push factor that induced rural people to migrate to urban areas. In line with this, [Zelege et al. \(2008\)](#) and [Asfaw et al. \(2010\)](#) stated that farmland scarcity, landlessness, and a lack of appropriate means of sustenance are among the main causes of rural outmigration, according to studies carried out in various regions of Northern Ethiopia. This circumstance has recently been presented in the rural Woldia woredas that are close by. As we noted in the migration flow diagram in [Figure 3](#) and the survey results shown in [Table 5](#), 10.67% of respondents indicated that shortage of land was thought to be one of the driving forces behind a migrant’s decision to move to the town. This is a result of land scarcity affecting the majority of the town’s surrounding woredas.

Another study that was carried out in southern Ethiopian districts highlighted the fact that young people in rural areas are being driven away from agriculture by a lack of access to agricultural land ([Bezu](#)

TABLE 5 Response on push factors as drivers of migration.

Push factors	Categories of push factors						Total	%
	Primary		Secondary		Tertiary			
	Frequency	%	Frequency	%	Frequency	%		
Poverty	51	12.66	23	5.71	22	5.46	96	23.82
Land shortage	13	3.23	19	4.71	11	2.73	43	10.67
Poor facilities	33	8.19	45	11.17	29	7.20	107	26.55
Natural disasters	0	0	2	0.50	0	0	2	1.24
Man-made disasters	0	0	0	0	0	0	0	0
Job transfer	27	6.70	6	1.49	2	0.50	35	8.68
Government policy	41	10.17	15	3.7	12	2.98	68	16.87
Bad culture	2	0.50	5	1.24	2	0.50	9	2.23
Rural–urban wage gap	5	1.24	18	4.47	14	3.47	37	9.18
Bad governance	0	0	1	0.25	5	1.24	6	1.49
Total	172	42.68	134	33.25	97	24.07	403**	100%

**The multiple responses of the respondents that exceed the sample size. Source: Field Survey, 2021.

and Holden, 2014). According to research conducted in many rural districts of northwest Ethiopia, landlessness or lack of sufficient land are the main causes of rural out-migration (Tegegne and Penker, 2016).

The rural–urban wage difference is another factor that drives people to move to urban areas. As depicted in Table 5, the survey result indicated that 9.18% of the respondents responded that rural–urban wage differences at the place of origin and destination drove people to migrate to the town. Therefore, income differential at places of origin and destination has been an important push-pull factor regarding wage considerations in terms of higher or expected wages for migrants in the town.

In this study, primary push factors refer to the main driving forces that push people to migrate from their home area to their destination. Secondary push factors refer to the second contributing factors that force people to migrate from their home area to their destination. Tertiary push factors refer to less contributing factors that push people to migrate from their home area to their destination.

3.2 Pull factors as the main drivers of migration

Table 6 depicts that 28.45% (the majority) of the respondents replied that better social facilities in the town were considered primary pull factors. This finding is consistent with Kassegn and Endris (2020), who found that better social amenities like healthcare, education, and public services, as well as the resulting shift in views and values, can be thought of as pull factors that induce individuals to move to a specific geographic area. Moreover, findings from key informants’ interviews with the mayors of the town and North Wollo Zone Workers and Social Affairs Offices also confirmed that one of the primary catalysts for the inward migration of people to the town was the availability of improved social services, which have also contributed to the continuous growth of urban population. Due to their tremendous demands for essential infrastructure services, people migrate, and the town’s rapid horizontal growth has been facilitated by the migration of residents from the nearby rural and urban areas.

The primary “pulling” factors behind the migration of significant populations from rural to urban areas are the relative improvement of various services and better living conditions in urban areas compared to rural areas. As a result of the flow of migration to urban areas, the urban population boomed, increasing the demand for various social amenities in destination areas, such as housing and other infrastructure. As a result, the demand for urban land by the growing population to the periphery also leads to the spatial growth of the town. This is currently the case in Woldia town, as migrants from nearby small-sized rural towns and urban woredas come there hoping to have easier access to social services. The opening of Woldia University, Woldia Teacher Education College, Woldia Comprehensive Hospital, and numerous health stations in the town all contributed to the migrant’s move to the town.

Employment opportunities are a common pull factor that can attract migrants to move to destination areas. Table 6 depicts that 19.30% of the surveyed sample migrants responded that employment opportunities at destination areas drive people to migrate to the town. In line with this, Zoelle (2011) stated that economic variables that attract migrants include indicators like the promise of better jobs, better housing, more income and food, and greater living standards. In addition to bringing back skills and helping to diversify and raise household income, migration helps to meet the labor needs of receiving areas.

Table 6 reveals that 11.15 and 6.49% of sample respondents responded that the town’s improved access to information, business district, and communication hub attracted migrants to settle there. Woldia’s nodal status for commerce, transportation, and communication, as well as the concentration of different industries at the Michael site, attracted the majority of migrants. In line with this, Fu and Gabriel (2012) noted that migrants’ main reasons for relocating to urban areas are the economic advantages of agglomeration economies, such as cost savings and employment opportunities. Furthermore, Tiffen (1995) stated that the benefits of migration include the influx of capital and information and investments in provisions and transportation, which can help make agriculture more profitable. The main motive of human migration has frequently been

TABLE 6 Response on pull factors as drivers of migration.

Pull factors	Categories of pull factors						Total	%
	Primary		Secondary		Tertiary			
	Frequency	%	Frequency	%	Frequency	%		
Good urban environment	29	4.83	14	2.33	21	3.49	64	10.65
Job opportunities	57	9.84	33	5.49	26	4.33	116	19.30
Marriage	7	1.16	7	1.16	30	4.99	44	7.32
Better information	8	1.33	34	5.66	25	4.16	67	11.15
Willingness to change to new places	2	0.33	13	2.16	9	1.50	24	3.99
Presence of relatives & friends	15	2.50	12	1.10	13	2.16	40	6.66
Better social institutions	80	13.31	64	10.65	27	4.49	171	28.45
Good governance	2	0.33	3	0.50	9	1.50	14	2.33
Peace	2	0.33	6	1.00	14	2.33	22	3.66
Center of business and communication	11	1.83	17	2.83	11	1.83	39	6.49
Total	213	35.44	203	33.78	185	30.78	601**	100

**The multiple responses of the respondents that exceed the sample size. Source: Field Survey, 2021.

economic gain. A significant asset that might be transferred to rural areas (home areas or villages) in the form of capital, technology, learning awareness, knowledge, trade, commodities, services, and so on, is the economic benefit attained by migrants from urban areas.

Moving to a destination area with a better climate, stunning scenery, a decreased danger of natural disasters, and a lower risk of flooding may be considered an environmental pull factor. The presence of cultural and recreational resources and neighborly conduct can all be considered aspects of a better environment. The ability to foresee population migrations and make plans depends on understanding pull factors, including a favorable environment. A close look at Table 6 depicted that 10.65% of the sample respondents responded that the good urban environment of the town attracted migrants to settle there. A conducive climate is one of the basic elements of the urban environment that drives people to migrate.

Social pull factors also drive people to migrate. Table 6 shows that 7.32 and 6.66% of the respondents said that marriage and the presence of relatives and friends, respectively, were initiated to migrate. Social attachment, such as having friends, relatives, and family in destination areas, can stimulate migration. In light of this, Wondimagegnhu and Zeleke (2017) asserted that migrants have a piece of earlier information and networks about the destination area before migration. Access to information and systems builds the likelihood of rural out-migration. Migrants often depend on networks once they reach their destination, especially for food, shelter, and advice about customs and language (de Brauw and Carletto, 2012). Strong linkages to the destination community can encourage migration by giving access to job information. Hence, social factors at the place of destination had their own contributing factors for migration.

In this study, primary pull factors refer to the main motivating factors that attract people to migrate from their area of origin to their destination. Secondary pull factors refer to the second motivating factors that attract people to migrate from their area of origin to their destination. Tertiary pull factors refer to fewer contributing factors that attract people to migrate from their home area to their destination.

All in all, the survey results discussed so far are more or less consistent with the empirical study done in Wolaita Sodo town of Ethiopia by Delango (2019), who found that the interaction of push and pull factors at the points of origin and destination encourages migration, at Diredewa Dawa City by Teshome and Belete (2017), who found that the main drivers influencing migration are economic, political, demographic, environmental, and social drivers and Torun et al. (2002) in Guatemala, who also found that the interaction of “Push and Pull” factors at the points of origin and destination encourages migration.

4 The pattern and rate of spatial growth of Woldia 1965–2020

It is crucial to briefly discuss the physical expansion (pattern) and trend (growing rate) of the town after clearly identifying the main drivers of migration and examining demographic trends and their implications for the spatial growth of the town. Since its establishment, Woldia has not undergone extraordinary development and transformation. Since the 1980s, when the town experienced a development phase, the town’s spatial expansion has essentially stalled. Since that time, the urban area of the town of Woldia has not grown spatially and has only slightly expanded due to the dispersal of low-density single-family homes.

Table 7 reveals the urban land area of Woldia in hectares, the amount of rural land that has been taken, the percentage and rate of increase, and the average yearly rate of expansion of the town between 1965 and 2020. The spatial growth rate of the town between the years 1965 and 2007 was 23.58% annually, as depicted in Table 7. The town encroached on 556 hectares (ha) of land in the year 2007, and this is one of the implications of the horizontal spatial growth of the town to the rural periphery by losing the prime rural farmland to urban to provide different urban services for its growing population which is resulted by natural increase and migration.

It is clear that urban ward migration, which is triggered by the interplay of push-pull factors, is inevitable; the influx of people has placed massive demands on urban land. The findings of the interview administered to the municipal manager and urban land administration office of the town indicated that although the high demand for urban land by the growing population of the town, which resulted in migration, the administration was unable to cope with the demand. Thus, the supply lagged behind its corresponding needs. As a result, these massive flows of people are urged by the administration to provide urban space for the construction of housing stock to the periphery, which leads to the spatial growth of the town formally and informally.

In addition to the problems caused by the rapid urban population growth, the road resurfacing (from Piazza to Gonder Ber and from Gonder Ber to Itege Taitu Bitul Primary Full Cycle School via Mugad and Adago) and the town’s growing significance as an administrative hub have also led to the town’s expansion and encroachment into the rural hinterland beyond the existing urban boundaries (Baye, 2009). Table 7 clearly shows the physical growth of the town from the year 1965 to 2020.

As we can see from Table 7, the town’s total area was 51 hectares in 1965 and 142 hectares in 1986, during the previous 21 years. Between 1965 and 1986, infill growth predominated. With 178 and 188%, respectively, the percentage change rate for the years 1986 and 2018 was exceptionally high. A total of 211 hectares of agricultural hinterland were encroached upon by urban uses at a rate of 16.23 hectares per year between 1994 and 2007. Between 1992 and 2007, the sites of Adengure, Ariro Mecharie, Michael, and Teklehaymanot, among others, were included within the town’s built-up area. This suggests that the town is growing horizontally at an alarming rate within a very short period.

Within 55 years, this outward growth and the subsequent invasion of rural land (both built-up and open spaces that would soon be built

TABLE 7 Urban area of Woldia in hectares from the Year 1965 to 2020.

Year	Urban area in hectares	Absolute increase	Rate of change in percent
1965	51	–	–
1986	142	91	178
1992	343	201	141
1994	355	12	3.5
2007	566	211	59.4
2009	694	138	25
2018	2001	1,307	188
2019	2,103	102	5.1
2020	2,213	110	5.2

Source: Aerial photo (1965 and 1986), CSA (1994), and the municipality of the town (2022).

up) absorbed 2,162 hectares of the surrounding territories, including agricultural fields. This means that between 1965 and 2020, the urban growth rate was 77.1% per year. Wherever there has been spatial growth, there are negative effects on the periphery in a variety of ways, particularly concerning farmer eviction from their farms (loss of farmland), deforestation and ecosystem loss, water and air pollution, environmental or land degradation, waste generation, conflicts, and higher costs for infrastructure and services.

This is because urban areas expand spatially to the periphery to accommodate more people as the population of any particular country grows, either through migration or the pace of natural increase. Instead of vertical growth, which optimizes the availability of land, horizontal growth is mostly achieved by absorbing the rural hinterland, primarily agricultural property near the town, and turning grazing land into urban uses. The town's vertical growth has been extremely limited because it is so expensive and beyond the reach of the majority of town residents to build high villas and stairs.

As one of Ethiopia's fastest-growing urban areas, Woldia town first developed linearly following the main roads (see the town's shape in Figure 4 until 1992). Even though the town's spatial growth is not uniformly large in all directions, at present, the town is growing primarily in the directions of the hillside of north, south, west, and southwest. However, the northern and northeastern parts of the geographical growth of the towns are limited by the physical obstacles of Mount Gabriel and Gubarja/Kore, respectively.

The town's growth in the northwest and south-west, which is primarily residential in nature, has resulted in the loss of prime agricultural lands in Adengure, Ariro, Mechare, Michael, and Teklehaymanot, some of the areas included by the town between 1992 and 2020. The westward expansion of the town along the Woldia-Gondar-Bahir Dar highway is mainly left for industrial purposes. Currently, the town has experienced not only remarkable spatial growth but also population pressure over the course of its history. The expansion of the adjacent built-up area follows the highways and into

the surrounding rural areas connected by three radial roads with other towns in the country.

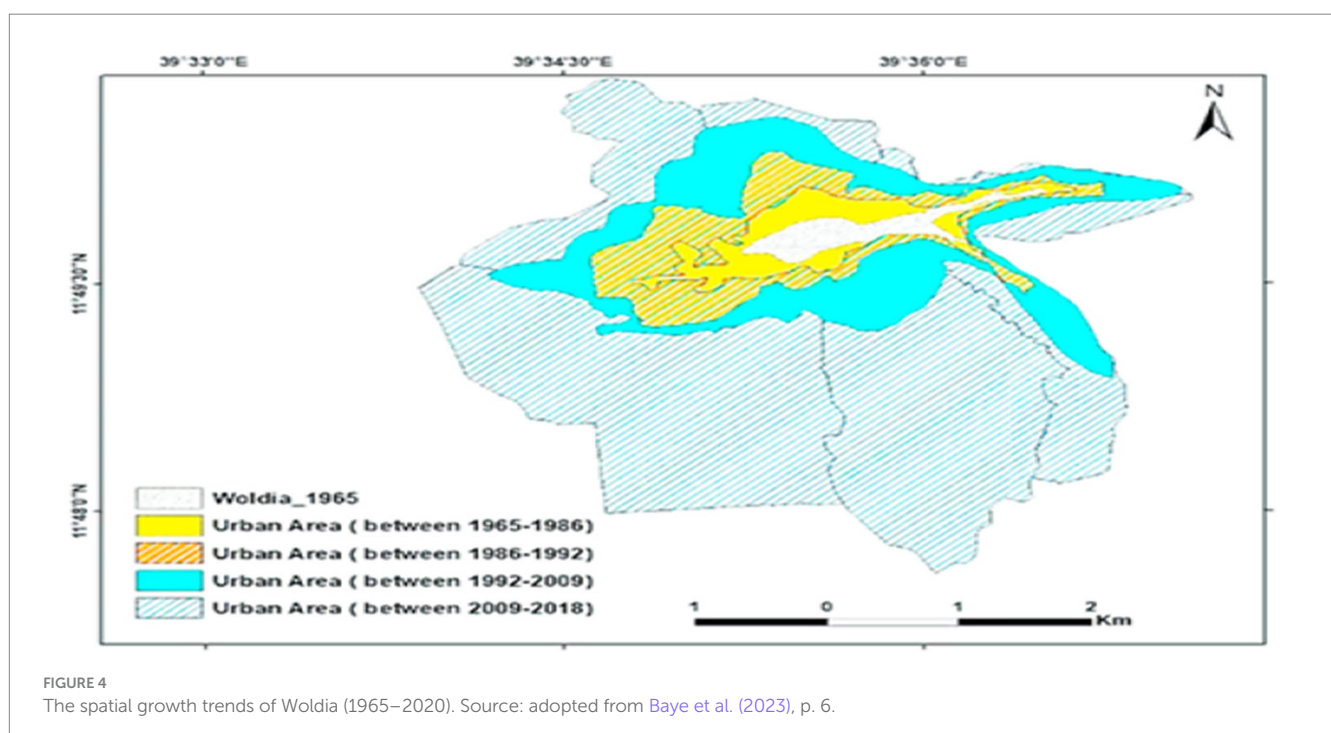
As we can see in Figure 4, Woldia's current and future urban growth will follow three main routes: the first is oriented toward the northwest and leads to Adengure, passing through parts of the Ariro region; the second is oriented toward the west and follows the ups and downs of the Woldia-Woreta road; and the third is oriented toward the south, southeast, and southwest.

Infrastructure services are also enhancing the town's spatial growth due to the population's increasing size and demand for various services, including residential, commercial, industrial, recreational, and institutional ones. This suggests that as the town's population grows and the demand for functional complexity rises, more and more space will be required to meet both the needs of residents and the town's excess population. As a result of encroaching on the rural agricultural areas, the urban area of the town is increased to the neighboring hinterlands. The town's urban growth is mostly a recent phenomenon that has been widely seen starting from the final part of the 20th century, as shown by the geographic growth map of the town.

5 Conclusion and recommendations

Urbanization is a defining phenomenon of the 21st century, characterized by a steadily increasing global urban population. At the heart of this transformation lies rural-to-urban migration, which is a powerful driver of demographic shifts and spatial expansion. This phenomenon is most pronounced in developing nations, where migration reshapes the urban landscape, redefines socio-economic dynamics, and influences growth patterns. The town of Woldia, Ethiopia, provides a compelling case study of how migration drives these changes.

This study delves into the complex relationship between migration and urban expansion in Woldia, highlighting how rural-urban migration, natural population growth, and land reclassification collectively accelerate urbanization. The findings reveal that these



factors have spurred significant horizontal expansion, with urban development encroaching on nearby rural lands. This encroachment has created a ripple effect, intensifying competition for resources, straining existing infrastructure, and posing challenges for sustainable development.

The study identifies a range of factors driving this migration. Push factors—such as poverty, inadequate rural facilities, and land shortages—motivate individuals to leave rural areas. Conversely, pull factors—such as improved employment prospects, access to superior social amenities, and the attraction of enhanced urban environments—draw individuals toward urban centers. Notably, access to better social facilities (28.45%) and job opportunities (19.30%) emerge as the most significant pull factors. These dynamics underline the need for targeted interventions to manage growth effectively and promote balanced development.

To address these challenges, the study underscores the critical importance of integrated strategies that bridge urban and rural disparities. Policymakers and urban planners must focus on fostering rural development through improved infrastructure and services while implementing sustainable urban management practices. Investments in peri-urban areas are essential to accommodate growth while preserving valuable rural lands. These measures are crucial not only for mitigating the immediate pressures of urbanization but also for ensuring long-term socio-economic and environmental sustainability.

The insights gleaned from this study have broader implications for African and global contexts, offering valuable lessons for regions grappling with similar challenges. Effective migration management requires a nuanced understanding of the interplay between migration drivers and urban growth dynamics. Strategic planning informed by robust data and cross-sector collaboration can help to balance development and sustainably manage urban expansion.

In conclusion, rural-to-urban migration plays a pivotal role in driving urban population growth and spatial expansion, with profound implications for resource management, infrastructure, and socio-economic stability. The encroachment of rural lands by urban areas, as seen in Woldia, reflects the urgent need for coordinated strategies to address the pressures of rapid urbanization. Future research should build on these findings, exploring gaps in knowledge and refining policy recommendations to guide sustainable urban development. As urban centers across the globe continue to grow, a proactive, evidence-based approach will be critical to ensuring that urbanization contributes positively to economic growth, social equity, and environmental resilience.

5.1 Recommendations

Recently, the impact of migration on the spatial growth of urban centers has rapidly increased due to various factors, and this has become a significant issue for scholars, policymakers, governments, and non-governmental organizations in Ethiopia in general and the study area in particular. Hence, considering the study's findings, the following suggestions are made.

Therefore, the study suggests that (1) town administrators and urban policymakers should have better knowledge of how to manage migrants at the place of destination to adequately respond to the spatial growth of the town with its growing population. (2) Policymakers should implement sound rural development strategies (providing rural job opportunities and basic social amenities) and efficient urban management to close the development gap between urban and rural communities. (3) The existing

spatial growth of the town has an impact on the loss of agricultural land at the periphery. To this end, municipal planners and urban policymakers should employ vertical expansion of urbanization, which minimizes the loss of prime agricultural rural land at the periphery. (4) Instead of encroaching on the rural periphery to expand the various socio-economic developments, the local and regional government should implement an infill policy on open floor spaces located at the center of the town. (5) Migration and horizontal spatial growth are inevitable phenomena in Woldia town. As a result, the population and physical areas of the town will grow. Therefore, to successfully support migrants, local, regional, and national governments, planners, and policymakers need to be clear-eyed about the dynamics of the growth that is taking place. In addition, proper urban expansion planning should be used to create productive, orderly, and inclusive towns in the context of rapid urban population growth by creating space for new urban residents at the right scale in areas where migrants are likely to settle.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Prior to commencing data collection, the researcher has secured full ethical clearance from the Postgraduate Directorate Office of EiABC (Ethiopian Institute of Architecture, Building Construction, and City Development) under reference number EiABC/GPD/156./2019. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MF: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Writing – original draft, Writing – review & editing. BA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Visualization, Software, Writing – review & editing. MW: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing – review & editing, Software.

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