

Effect of Urban Expansion on Agricultural Land in Hawzen Town, Tigray Region, Ethiopia

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Abstract

Urban expansion in Ethiopia is becoming a big challenge on land use land cover change. This study aims to investigate the effect of urban expansion on agricultural land in Hawzen Town. For this study, satellite imageries as Landsat 4-5 TM (2003 & 2009) and Landsat 8 (2015 & 2020) with intensive ground control points through GPS reading were used to analyze the spatio-temporal change of urban expansion and its effect on land use land cover changes over the last 17 years. Field works, questionnaires, interviews with local communities and office workers were conducted to address the objectives. Besides, the secondary data were collected to address the effect of urban expansion on crop production. 84 respondents of households were randomly selected from total households and 16 office experts from four kebelles (one representative from each kebelles of agricultural office experts, kebele manager, land administration experts and municipality experts) were selected purposively based on their professions. Forest, farmland, bareland and built up area were taken as major classes for the last 17 years in the study area. In specific, the area of built up were continually increased from 65.61ha (15.65 %) in 2003 to 151.92 ha (36.23 %) in 2020, while the forest (49.5ha to 36.99ha), farmland (155.97 ha to 102.42ha) and bareland (148.14 ha to 127.89 ha) were declined from 2003 to 2020. The losses of these areas were influenced due the expansion of built up areas. As a result, large area of forest, farmland and bareland were converted to built-up areas. The areas of these land use land covers were also converted from one to other or between them from 2003 to 2020. However, the production crops were decreased as the result of the large agricultural area becomes declining due to urban expansion. To conclude, agricultural lands are under threats, and challenge the sustainability of livelihoods. Therefore, the concerned body of the government should use effective strategy of vertical land use planning for sustainable development.

Keywords: *urban expansion, agricultural land, land use land cover change and crop production*

1. Introduction

Urban expansion is a worldwide phenomenon in the past of all urban centers. It was started with the earliest human civilization (Cernea, 1997). Urbanization describes the process by which rural areas become urbanized and has effects on economic development and industrialization (Friedman, 1996). According to Manish (2012), urban expansion is the vertical and horizontal expansion of urban areas over the neighboring agricultural land. It is also a man-made process that consumes many hectares of major agricultural lands in every year.

According to the United Nations (2012), from 1965 to 2010, the worldwide population was increased from 3.3 billion to 6.9 billion and the expected projected by 2050 will exceed 9.3 billion. In 1950 the urban dwellers in more

developed and less developed regions was 0.4 billion and 0.3 billion and by 2050, it is predicted that it will increase to 1.1 billion and 5.1 billion respectively (UN, 2012). Urbanization in developing country becomes more accelerated when compared with developed countries (Redman and Jones, 2004).

Urbanization is one of the most critical consequences of land use land cover change (Lambin *et al.*, 2003 and Abrantes *et al.*, 2016). The increasing in the number of urban dwellers and the need for housing among urban areas have a significant effect on agricultural land at the border of urban areas (Kavitha *et al.*, 2015 and Kaifang *et al.*, 2016). Human activities especially expansion of urban areas have a significant effect on the loss of agricultural land during the past decades around the world (Del *et al.*, 2001; Thapa *et al.*, 2009). Urban expansion has also brings loss of million hectares of farmland each year for the expansion of industrial areas, residential houses and the like (Njungbwen and Njugbwen, 2011). Moreover, urban expansion leads a rapid translation of large agricultural land to urban land uses land covers (mostly built-up areas) in the urban periphery (Lerise *et al.*, 2004).

Even if urban expansion has economic benefits, the rapid rates of urbanization and urban expansion have several negative consequences particularly in developing countries (Felke, 2003). Urbanization in African is characterized by rapid and uncontrolled urban progress and many people migrate to urban areas. This brought various socio economic and environmental problems like food insecurity, shortage of basic services, unemployment and social disintegrations (Atu *et al.*, 2013). Thus; urbanization in Africa has brought many negative effects both on the urban as well as on the urban farm communities throughout the continent. Moreover, urban expansion in Africa including Ethiopia causes not only loss of agricultural farmlands but also displacement of farm households and challenged for their livelihood sources in agrarian countries (Felke, 2003).

In Ethiopia, land is a source of income and means of production on which 85 percent of the population depends on it (World Bank, 2000). The major and very common environmental problem associated with urbanization of Ethiopia is the declining of agricultural land in most cities of the country (Felke, 2003). The local communities living adjacent to urban areas are under the great threat and in most cases, they are out of their agricultural land. This leads to decline in income from time to time due to lack of farm land (Feyra, 2005).

Hawzen Town is one of the most known Towns in the Tigray regional state of Ethiopia where urban expansion is more practicing especially since 2009 due to the opening of tender for lease and hence the agricultural area of the community becomes at high risks. Nowadays, urbanization and its effect on agricultural land have given considerable attention by planners, researchers, and policymakers (Elhadary *et al.*, 2013) due to it is negative effect on the agricultural productivity. There are limited local studies about the effect urban expansion on agricultural land in urban areas of Ethiopia like (Solomon, 2018; Dejene 2016; Firew, 2010 and Kindu 2018). There have been no large scales analyses of the country's urban expansion and its effect on and agricultural production. Furthermore, due to the diversified conditions of Tigray, effect of urban expansion on agricultural land and on its productivity hasn't been yet studied in Hawzen Town. From this point, some policy makers and land managers still do not give fully emphasis on the rapidly changing of agricultural lands over time. This indicates that the effect of urban

expansion on agricultural land needs further investigation in the region. Therefore, this gap requests an urgent to study about the effect of urban expansion on agricultural lands and on its crop production. To investigate the problem of the study, the following specific objectives were designed: (i) investigate the effect of urban expansion on the land use land cover change, (ii) examine the spatio-temporal change of urban expansion for the last 17 years and (iii) investigate the effect of urban expansion on crop production patterns.

2. Materials and Methods

2.1 The study area

Hawzen Town is located in Eastern zone of Tigray regional state and 102 km far from the capital city of Mekelle to northern of the Region (Figure 1). Geographically the study area is located between latitudes of $13^{\circ}57'48''$ to $13^{\circ}59'13''$ N and longitudes of $39^{\circ}25'12''$ to $39^{\circ}26'34''$ E.

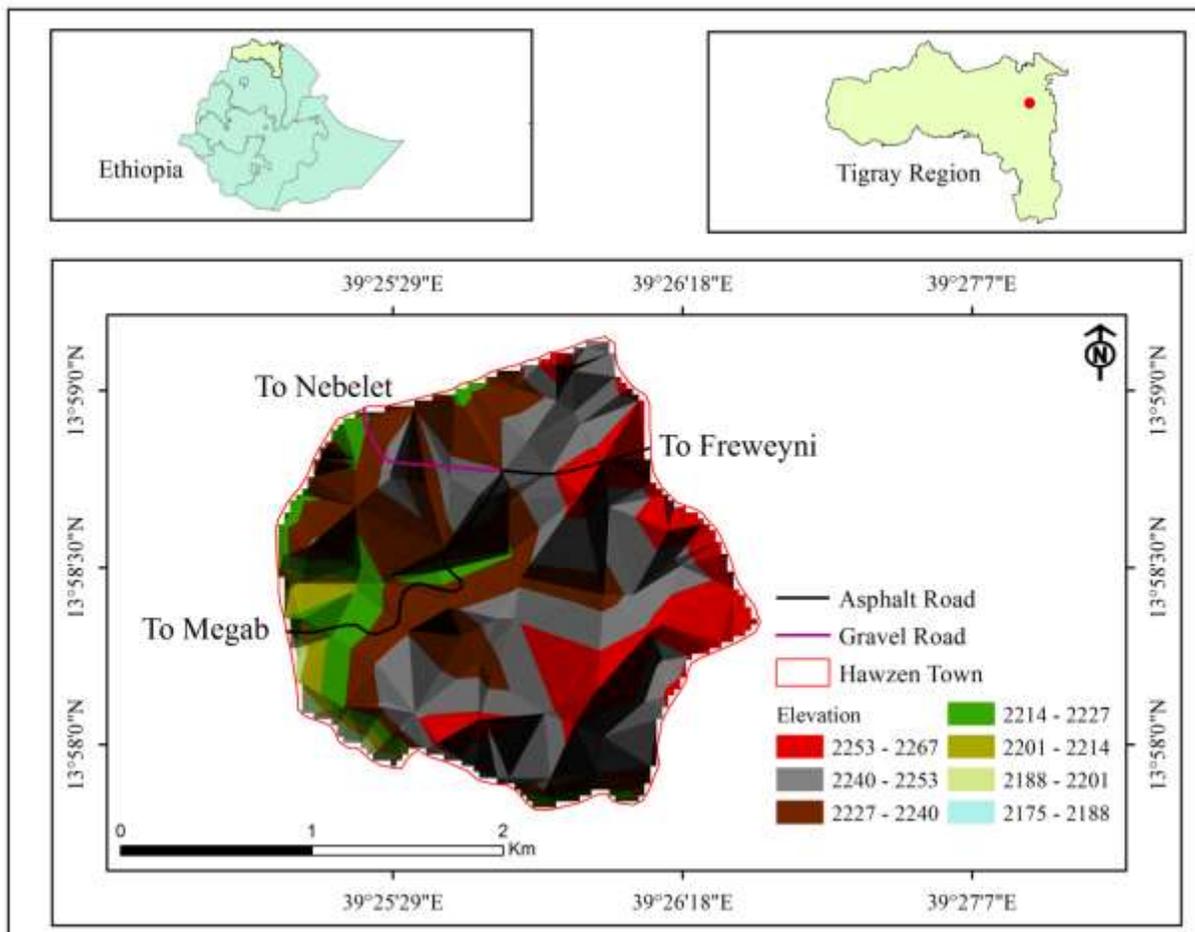


Figure 1. Map of the study area

The topographic landscape of the study is composed of almost plain area. Generally the altitude ranges from

2175m to 2267m above mean sea level. Relatively the highest elevation is located in eastern and southern while the lowest point located in the south western part. The climatic condition of the study area is characterized by Weyna Dega climate zone (Kahsay *et al.*, 2019). The daily temperature ranges between 15.5 °C to 19.5 °C. The average annual rainfall is 600 mm. Based on the 2007 population census of Ethiopia, the current projected total household sizes of the study area are 184, of which 67 are males and 117 are females.

2.2 Methods

2.2.1 Source of data and data collection procedures

In order to achieve the objectives of this study, all the required data was collected from both primary and secondary data sources. The primary data were collected from field works, structured questionnaires and interviews to complete required data. The secondary data were collected from satellite imageries, reports, documents, published and unpublished materials, books and journals systematically.

Satellite image acquisition and pre-processing: The major data input for this study is satellite images obtained from the earth explorer /<https://earthexplorer.usgs.gov/> website. In order to analyze the spatial-temporal effect of urban expansion on agricultural land of the study area, Land sat 4 TM 2003, Land sat 5 TM 2009 and Land sat 8 OLI (2015 and 2020) with 30x30m resolution with the path of 169 and row 50 were freely downloaded from United States geological survey (USGS) website (<http://www.earthexplorer.usgs.gov>). These data were used to produce the land use land cover change maps of the study area for the last 17 years. For simplicity, the satellites images were taken before and after the beginning of lease at different months and times because of the cloud cover availability and to look the changes at certain time interval (Table 1). In agreed with Lillesand *et al.* (2008), these satellite imageries were generally used to produce the past and recent land use land cover changes. Aster Global DEM 30mx30m was also extracted from United States geological survey (USGS) website to prepare elevation map of the study area.

Table 1. Types of satellites with their acquisition date

Satellite image	acquisition date	Path and row	Resolution
Landsat 4 TM	25/02/2003	169/50	30 m x 30 m
Landsat 5 TM	13/12/2009	169/50	30 m x 30 m
Landsat 8 OLI	25/01/2015	169/50	30 m x 30 m
Landsat 8 OLI	26/01/2020	169/50	30 m x 30 m

Field Works: After acquisition of the satellite images from remote sensing data, field works were taken as the second major data collection mechanisms. This was taken in two ways.

Preliminary field visit: For the first time preliminary field visit was carried out to get an overall overview of the study area, to identify the various land use land cover classes, to identify the effect of urban expansion on

agricultural land and to collect GPS readings for land use land cover classification. These data were used for preparation images classification for land use land cover maps with supervised classification.

Second field work: For the second time field works were taken to collect the various land use land cover classes identified through satellite images using GPS Garmin instrument. To collect the land use land cover classes in the study area, the study were used 30 sample ground control points for each land use land cover classes using the GPS Garmin instrument. These data were used for the preparation of final satellite image classifications and testing sample sites for image classification process to validate it. Besides, in-depth information about the effect of urban expansion on agricultural lands was also taken from the local households, agricultural office experts, kebele managers, land administration and municipality experts.

Questionnaires: Structured questionnaires composed of both closed and open ended questions were prepared and distributed to the local households, agricultural office experts, kebele managers, land administration and municipality experts. The closed ended questions were prepared to collect quantitative data; whereas the open ended questions were prepared to collect the qualitative data. Firstly the questionnaires were prepared in English and then translated in to Tigrigna so as to avoid language barriers for the local households, while for the rest they were prepared in English and then distributed to them because of they are experts and haven't language barriers.

Interviews: Interviews were taken in order to obtain in-depth information regarding the effect of urban expansion on agricultural lands. The study was fully participated in the interviews until to collect the required information. Besides, socioeconomic data were collected to strengthen the trend of urban expansion and its effect on crop production patterns from the concerned body.

2.2.2 Sample size and sampling procedure

Hawzen Town has four Kebeles including kebele 01, kebele 02, kebele 03 and kebele 04. To conduct the effect of urban expansion on land use land covers, ground control points were taken through field surveys. Even if it is difficult to collect all the ground control points of the whole area for each land use land cover, 30 ground control points were taken for each land use land cover to validate the land use land cover classification. Moreover, the agricultural system is exercising in all Kebeles. As a result of this, the study was selected 84 households randomly by applying lottery from the total number of households because they have similar knowledge on crop production patterns. 16 office experts from four kebeles (one representative from each kebeles of agricultural office experts, kebele manager, land administration and municipality experts) were selected using purposive sampling techniques based on their professions.

In order to obtain a manageable sample size, determining sample size is significant due to different factors like resources, time, the purpose of the study, characteristics of the population, etc. According Krejcie and Morgan (1970), scientific formula to determine the sample size is mandatory. Therefore, the study was used Yamane formula (1967:886) to get the sample sizes. The formula is given as:

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

Where;

n is the sample size,

N is total households, and

e is the level of precision. Confidential level (92%) and $e = 0.08$.

Therefore, based on the above-specified formula, the required sample sizes become:

$$n = \frac{N}{1+N(e)^2} = \frac{184}{1+184(0.08)^2} = \frac{184}{1+184(0.0064)} = \frac{184}{1+1.1776} = \frac{184}{2.1776} = 84$$

From the total number of households (184), 84 households and 16 office experts were selected and then finally total sample sizes for this study were 100 respondents.

2.2.3 Data analysis

Satellite Image analysis

Image pre-processing: Multi-temporal images were pre-processed both geometrically and radio metrically during image acquisition to correct errors rising from image sensors, cloud covers and earth's curvatures. The image pre-processing of remotely sensed data is essential for image classification and this requires several steps to process for better identification of the image features (Akhter, 2006). Image enhancement is one of the image pre-processing that takes to optimize the appearance of the satellite images in order to improve the visual quality and recognition of features in achieving specific goals of interpretation. This was done by displaying individual wavelength bands of the satellite images through the use of an appropriate color combination to obtain false color composites.

Image Classification: Image classification is the process of identifying groups of pixels that have similar spectral characteristics and determining the various features or land use land cover classes represented by these groups of images (Lillesand *et al.*, 2008). Based on the methods of use, classification of satellite images can be classified in to two broad subdivisions which are supervised and unsupervised classification procedures. In a supervised classification, the analyst classifies the imagery homogeneous representative samples of the different land cover types (classes) based on sample training areas. In contrast to supervised classification, unsupervised classification is the process of classifying the satellite image based on similar reflectance values in order to derive the required number of land cover classes (Tudor *et al.*, 1998).

For this study, supervised image classification was done using 30 selected sample training areas through GPS for each land use land cover classes using the application ERDAS imagine 2014 software with the maximum likelihood classification approach and the areas of land use land cover classes were quantified and mapped through Arc GIS 10.6 software.

According to FAO (2016) land use land cover classification, the land use land covers of the study area were classified into forest, farmland, bareland and built up area using ERDAS imagine 2014 and Arc GIS 10.6 soft wares (Table 2).

Table 2. Description of major land use land cover classes identified in the study area

LULC classes	Description
Forest	Areas permanent covered by trees forming closed or nearly closed canopies. It was made up of both natural and manmade.
Farmland	Areas used for growing crops through rain-fed and irrigated cultivation.
Bareland	Open spaces / exposed areas probably covered by sandy soils and bare rocks or cleared land.
Built up	Areas of man-made constructed features used for different purposes like residential, commercial, and industrial and other activities.

Accuracy Assessment: Accuracy assessment can be defined as the degree (a percentage) of correspondence between observation and reality using the sample areas using GPS (Noam, 1999). It is useful for cross checking the validity of the classification approach between the classified map and the reference data summarized in an error matrix, called also a confusion matrix or a contingency table (Jensen, 1996 and Lillesand *et al.*, 2008).

The most way to represent classification accuracy is in the form of an error matrix. Using error matrix to represent accuracy is recommended and adopted as the standard reporting convention (Congalton, 1991). An error matrix is a table of values that compares the value assigned during the classification process to the actual value from the ground taken by GPS on a point-by-point basis. Then finally from the error matrix table, the overall accuracy assessment statistics for the land use land cover classifications were taken. For this purpose, the accuracy assessment was done for the classified images of 2003, 2009, 2015 and 2020 with the corresponding ground control points for each class. Based on this, the overall accuracy of the land use land cover classification was greater than 85% for each year, which is acceptable.

Change Detection: After classifying images in to different the land use land cover classes using supervised classification, the next step is detecting land use land cover changes. In order to quantify the temporal and spatial changes of urban expansion in the study area, the land use land cover were analyzed using land sat images of 2003, 2009, 2015 and 2020. The land use land cover changes were analyzed from the classified land sat imageries from the time intervals of 2003 to 2020. The land use land cover changes were examined how many one land use land cover class is changed to other land use land cover classes from initial year to the next year. This process were accomplished through matrix union analysis using ERDAS imagine 2014 and Arc GIS 10.6 soft wares.

Socio-economic data analysis: The socio economic data gathered through questionnaires, field works and interviews were analyzed using qualitative and quantitative methods of the effect of urban expansion on agricultural land and its effects on crop production pattern, which were collected from the concerned body.

3. Results

3.1 Temporal distribution of land use and land cover

In the year of 2003, the results of land use land cover shows that forest, farmland, bareland and built up had areas with 49.5 ha (11.80%), 155.97 ha (37.20%), 148.14 ha (35.33%) and 65.61 (15.65%), respectively (Table 3).

During 2009, forest (10.99%), farmland (33.34%), bareland (35.53%) and built up (20.13%) had varied areas (Table 3). In this year the highest and the lowest portion of the total area was seen in barelands and forests respectively. However, the built up area was increased in this year as a result of the beginning of lease (Table 3 & Figure 2). From the year of 2003 to 2009, the coverage of built up area was increased from 65.61ha to 84.42 ha (15.65% to 20.13%). In 2015, areas of built up was also increased greatly from 84.42 ha to 131.04 ha (20.13 % to 31.25 %), while the rest land use land covers; forest (45.18 ha), farmland (109.26 ha) and bareland (133.74 ha) were decreased from the previous year (Table 3 & Figure 2).

Lastly in the year of 2020 the land use land cover has varied areas with forest 36.99 ha, farmland 102.42 ha, bareland 127.89 ha and built up 151.92 ha (Table 3). Like in previous years, the areas of forest, farmland and bareland were decreased. Besides, the area of built up has also increased from the previous years as the result of the demand for housing becomes high.

Table 3. Summary statistics of land use land cover from 2003 to 2020

Class Name	Year							
	2003 (ha)	%	2009 (ha)	%	2015 (ha)	%	2020 (ha)	%
Forest	49.5	11.80	46.08	10.99	45.18	10.77	36.99	8.82
Farmland	155.97	37.20	139.77	33.34	109.26	26.06	102.42	24.43
Bareland	148.14	35.33	148.95	35.53	133.74	31.90	127.89	30.50
Built up	65.61	15.65	84.42	20.13	131.04	31.25	151.92	36.23
Total	419.22	100	419.22	100	419.22	100	419.22	100

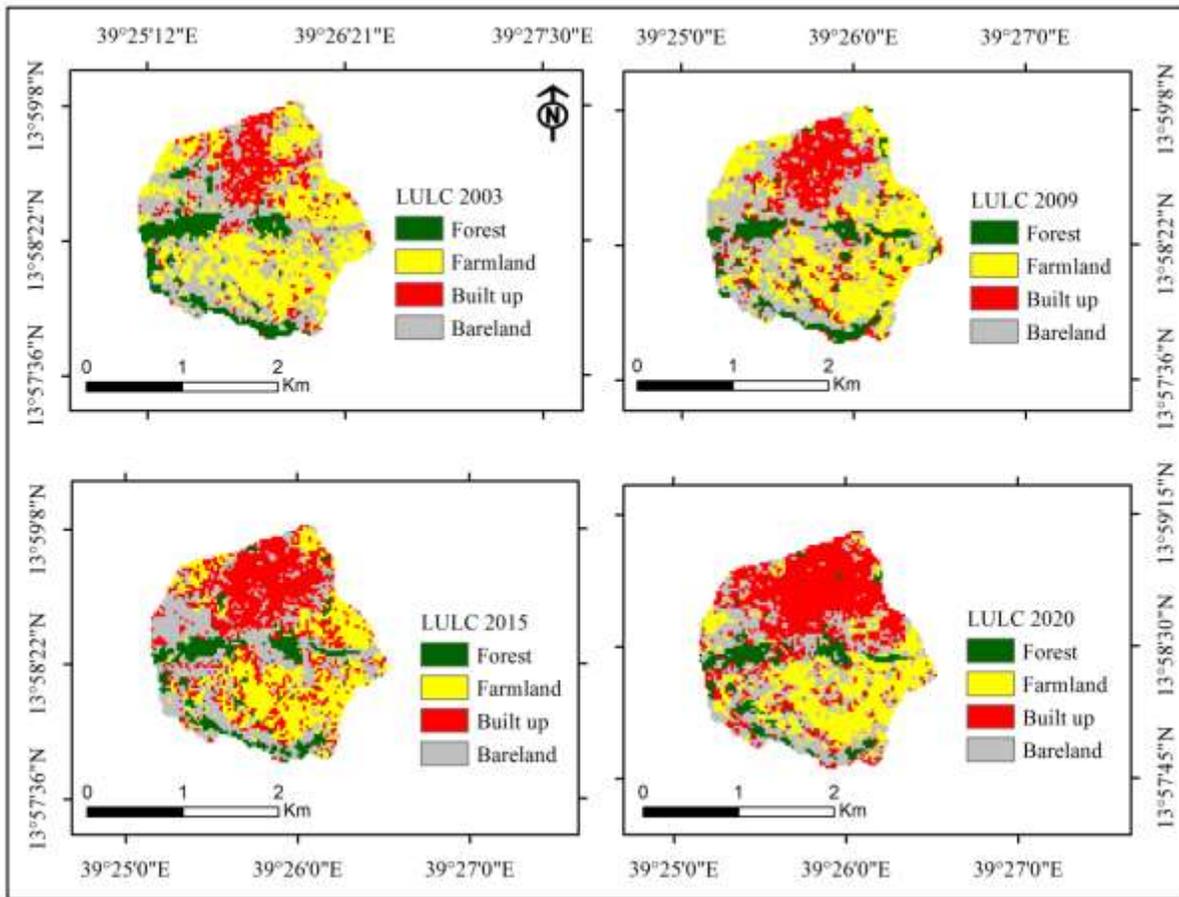


Figure 2. Land use land cover map of Hawzen Town in 2003, 2009, 2015 and 2020

3.2 Land use land cover change from 2003 to 2020

The detection of land use land cover change determines which class of land use land cover was changed to the other classes. The result of land use and land cover change from 2003 to 2009 indicates that there was a great class change in bareland (74.97 ha) to forest, farmland, and built up areas from its total area (Table 4 and Figure 3). Moreover, Table 4 and Figure 3 shows that the class changes of farmland (61.83 ha) and built up area (30.15 ha) were seen the second and third land use land cover changes observed from 2003 to 2009 respectively, while the lowest class change was seen in forest area (20.52 ha).

Like to the previous year (2003 to 2009), the result of land use and land cover change between 2009 and 2015 indicates that there was a massive reduction in bareland area. From the total area of bareland (148.95 ha), 70.74 ha were converted to forest, farmland, and built up areas. The remaining 65.61 ha of farmland and 28.53 ha of built up were changed to the other land use land cover classes. The lowest class change of forest (15.21 ha) was changed to other classes from 2009 to 2015 (Table 4). The change observed from 2015 to 2020, a large trend of class change was seen in bareland (70.92 ha) to other land classes (Table 4 and Figure 3). Table 4 also shows that there was a record of change in farmland (56.07 ha), built up (44.28 ha) and forest (16.29 ha) to other land classes from 2015 to 2020. Mostly the unchanged land use land cover change was seen in farmland (Table 4 and Figure 3).

Table 4. Area units of land use land cover change matrix between 2003 and 2020

2003 (ha)		Forest	Farmland	Bareland	Built up	Total
2009 (ha)	Class Name					
	Forest	28.98	4.5	11.88	0.72	46.08
	Farmland	1.26	94.14	35.01	9.36	139.77
	Bareland	12.87	42.84	73.17	20.07	148.95
	Built up	6.39	14.49	28.08	35.46	84.42
	Total	49.5	155.97	148.14	65.61	419.22
	Class change	20.52	61.83	74.97	30.15	187.47
2009 (ha)		Forest	Farmland	Bareland	Built up	Total
2015 (ha)	Forest	30.87	0.99	7.38	5.94	45.18
	Farmland	3.15	74.16	22.5	9.45	109.26
	Bareland	9.54	32.85	78.21	13.14	133.74
	Built up	2.52	31.77	40.86	55.89	131.04
	Total	46.08	139.77	148.95	84.42	419.22
		Class change	15.21	65.61	70.74	28.53
2015 (ha)		Forest	Farmland	Bareland	Built up	Total
2020 (ha)	Forest	28.89	1.71	5.49	0.9	36.99
	Farmland	0.54	53.19	29.79	18.9	102.42
	Bareland	9.36	31.23	62.82	24.48	127.89
	Built up	6.39	23.13	35.64	86.76	151.92
	Total	45.18	109.26	133.74	131.04	419.22
		Cass change	16.29	56.07	70.92	44.28

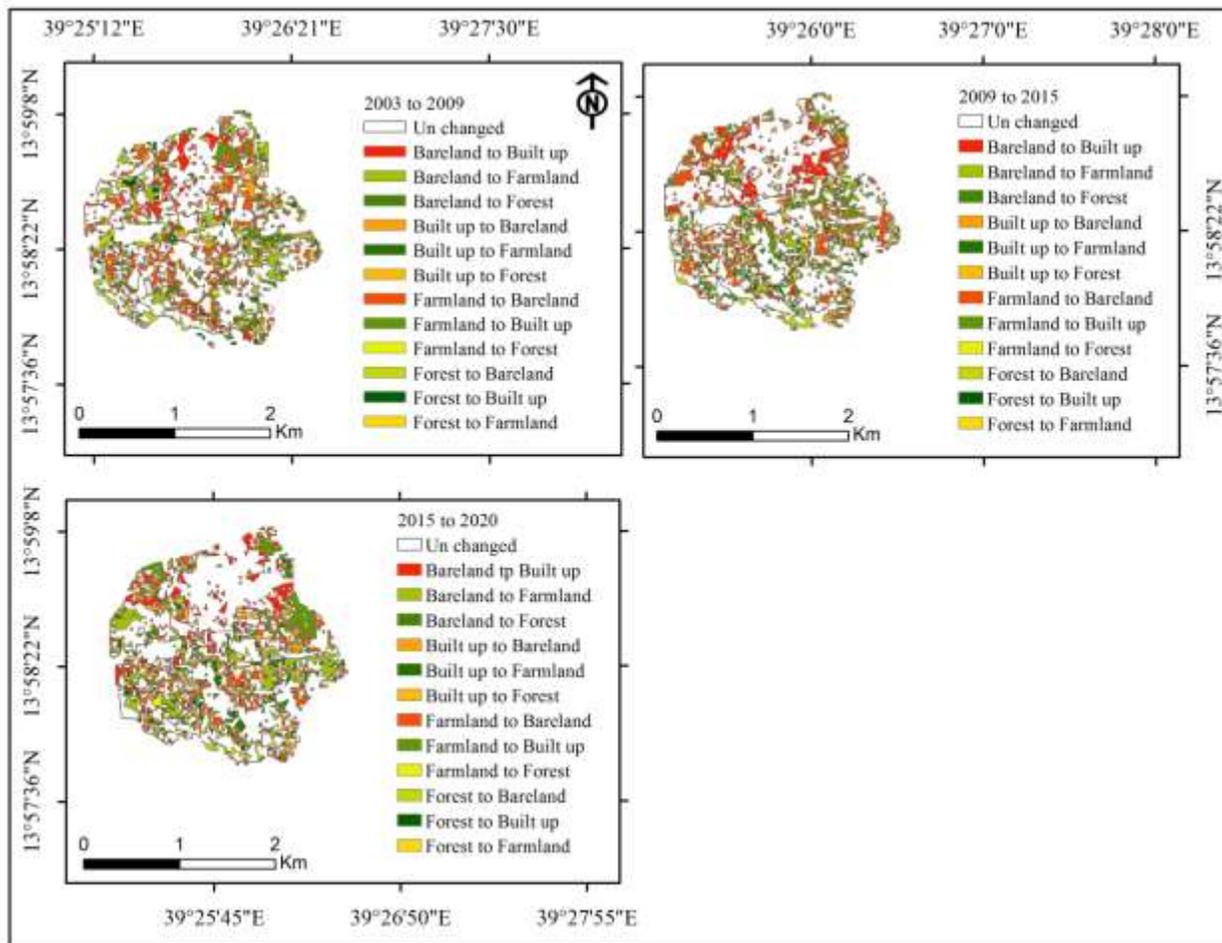


Figure 3. Land use land cover change map of Hawzen Town from 2003 to 2020

3.3 Effect of urban expansion on land use and land cover change

The expansion of built up area had negative effect on the land use land cover change in the study area. Moreover, the area of forest, farmland and bareland were converted to built-up area as a result of urban expansion (Table 5 and Figure 4). On the other hand the expansion of built up area in the Town has positive effect on solving of housing problems. Even if the expansion of urban areas solves housing problem, it has negative effect on declining the areas of other land use land cover classes. The area converted from forest, farmland and bareland to built-up area in each time interval becomes increasing. For instance from the year of 2003 to 2009, the area converted from forest, farmland and bareland to built-up area was 6.39 ha, 14.49 ha and 28.08 ha respectively (Table 5). For the last 17 years large area of bareland, farmland and forest were converted to built-up areas respectively (Table 5).

Table 5. Area converted to built-up from other land use land cover classes

Class name	Interval of Year		
	2003 to 2009	2009 to 2015	2015 to 2020
	Area converted in (ha)	Area converted in (ha)	Area converted in (ha)
Forest	6.39	2.52	6.39
Farmland	14.49	31.77	23.13
Bareland	28.08	40.86	35.64
Total	48.96	75.15	65.16

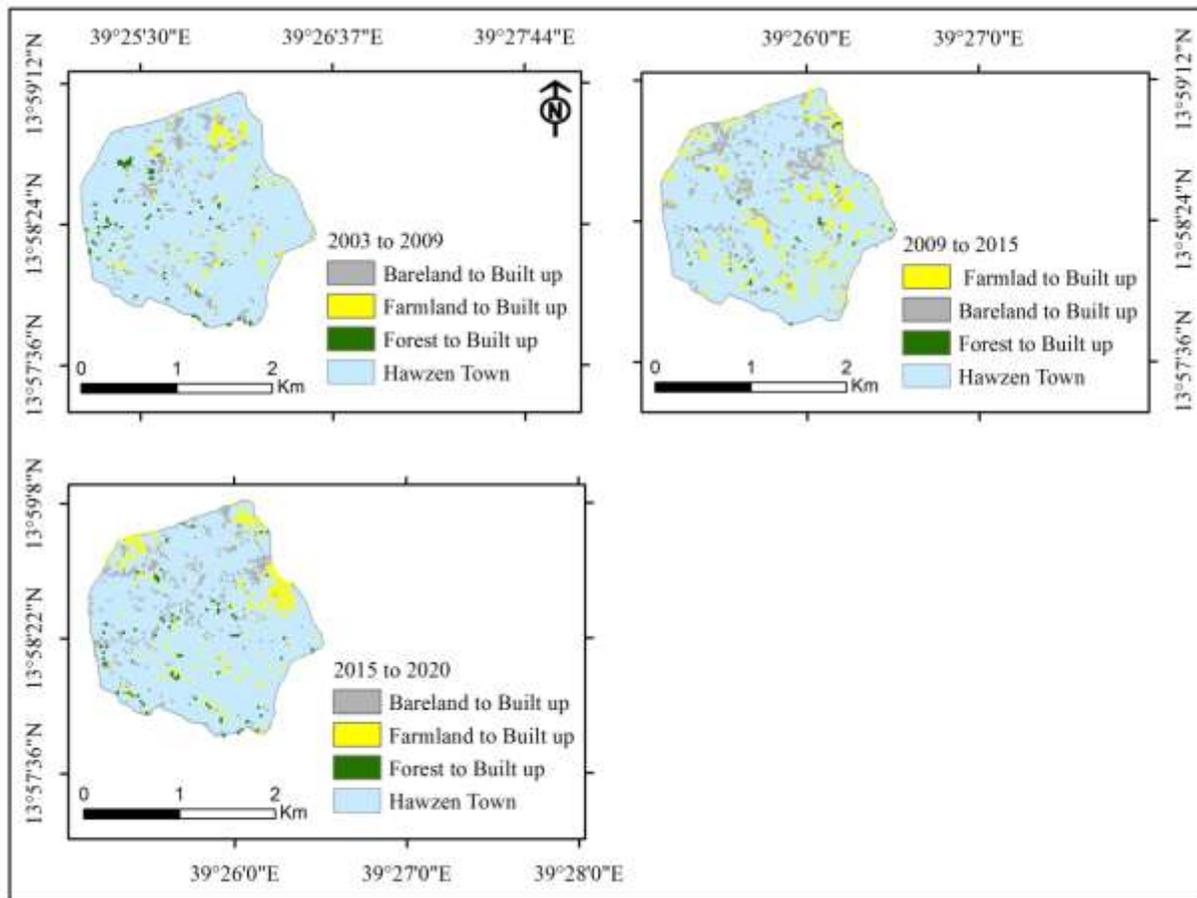


Figure 4. Map of Area converted to built-up from other land use land cover classes

3.4 Spatio-temporal change of urban expansion

The built up area of the study was much less in the first year as compared to the other years. In 2003 the total area coverage of built up was 65.61 ha (15.65%). However, it was increased to 84.42 ha (20.13%) in the year of 2009 (Table 3 and 6). The area of built up was increased by 18.81 ha from the year of 2003 to 2009, 46.62 ha from 2009 to 2015 and 20.88 ha from 2015 and 2020 (Table 7). Generally from the base year (2003) to the last year (2020), the area of built up was increased totally by 86.31 ha for the last 17 years (Table 7). This expansion of built up area from the year of 2003 to the year of 2020 was gained totally 86.31 ha from varied areas of forest, farmland and

bareland. Besides, every land use cover was gained and taken a portion area from the remaining other classes (Table 7).

Table 6. Spatio-temporal change of built up area from 2003 to 2020

Class name	Year							
	2003		2009		2015		2020	
	Area	%	Area	%	Area	%	Area	%
Built up	(ha)		(ha)		(ha)		(ha)	
Total	65.61	15.65	84.42	20.13	131.04	31.25	151.92	36.23

Table 7. Average rate of land use land cover change per year

Class name	Study interval								
	2003 to 2009			2009 to 2015			2015 to 2020		
	Area of change (ha)	Time interval	Rate of change (ha/y)	Area of change (ha)	Time interval	Rate of change (ha/y)	Area of change (ha)	Time interval	Rate of change (ha/y)
Forest	-3.42	6 years	-0.57	-0.9	6 years	-0.15	-8.19	5 years	-1.638
Farmland	-16.2	6 years	-2.7	-30.51	6 years	-5.085	-6.84	5 years	-1.368
Bareland	0.81	6 years	0.135	-15.21	6 years	-2.535	-5.85	5 years	-1.17
Built up	18.81	6 years	3.135	46.62	6 years	7.77	20.88	5 years	4.176

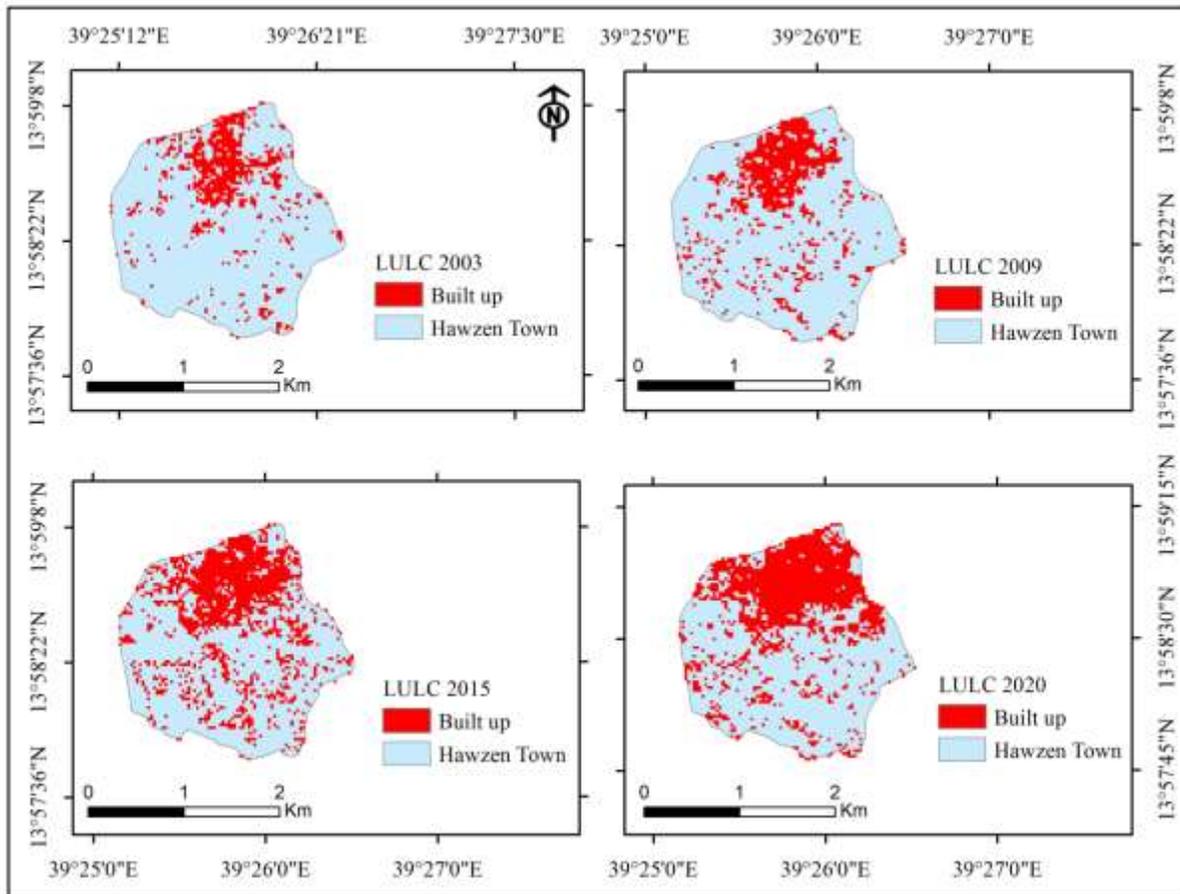


Figure 5. Map of spatio- temporal changes of built up area

3.5 Effect of urban expansion on crop production

In this section, the attitude of the communities towards the effect of urban expansion on crop production, majority of the respondents (93%) responded that it has negative effect on the size of farmland. However, 7% of the households who are living in the peri-urban areas replied that the size of farmland is still remains unchanged (Table 8).

Table 8. The observed effects of urban expansion on the local communities (Aexp = agricultural experts, Kmag= kebele managers, Laexp = land administration expert, Munexp = municipality experts and Hh=household heads)

Effects of urban expansion		Responses					
		Increase		No change		Decrease	
		Frequency	%	Frequency	%	Frequency	%
The size of farmland	Aexp	0	0	1	25	3	75
	Kmag	0	0	0	0	4	100
	Laexp	0	0	0	0	4	100
	Munexp	0	0	0	0	4	100
	Hh	0	0	6	7	78	93
	Total	0	0	7	7	93	93
Crop production	Aexp	1	25	0	0	3	75
	Kmag	0	0	0	0	4	100
	Laexp	0	0	0	0	4	100
	Munexp	0	0	0	0	4	100
	Hh	2	2	8	10	74	88
	Total	3	3	8	9	89	88
housing condition	Aexp	3	75	1	25	0	0
	Kmag	4	100	0	0	0	0
	Laexp	4	100	0	0	0	0
	Munexp	4	100	0	0	0	0
	Hh	80	95	4	5	0	0
	Total	95	95	5	5	0	0

The establishment of urban expansion along the farmland affects the production of crops. Regarding this, 88% of the respondents replied that the production of crops is declining as a result of the urban expansion. In contrast, 9% responded that the production of crops remains unchanged. The remaining 3% of the respondents disagreed that even if the size of farmland becomes decreases, the production of crops becomes increasing in some area due the use of fertilizers (Table 8).

In urban areas, built ups are the major sources of income for the people through house rent. Based on the field evidences, majority of the respondents (95%) believed that the housing conditions have increased in the urban areas. However, 5% of the respondents replied that even if there is urban expansion, the housing condition is still remains unbalanced with the total population (Table 8).

4. Discussion

Urban growth is inevitable change for the last two decades and mostly takes place in less developed countries (Masser, 2003). In the same way, the study shows that there was significant land use land cover change for the last 17 years as a result of urban expansion. The areas of forest, farmland and bareland have decreased, while the built up area has increased for the last 17 years (Table 3). In agreement with Ahlam (2017) and Shishay (2010), urban expansion has an effect on agricultural land. The expansion of built up area affects the land use land cover of the

study area, which declines the other land use land cover classes for the last 17 years. This result agreed with the recent study in Jigjiga Town by Isse *et al.* (2018), who reported that the status urban expansion is more possible to obtain a large area of farmland for built up development and then acquire high potential for urban expansion.

On the other hand the land use land cover changes of the study area have undergone significant conversions between the land cover classes over the last 17 years. The major land use land cover changes were seen in bareland and farmland which converted to forest and built up area between 2003 and 2020 (Table 4). In agreement to Solomon (2018) and Isse *et al.* (2018), large areas of agricultural lands have been converted to built-up areas due to fast urban expansion. The rapid spatio-temporal trends of urban expansion over the past 17 years had increased from 65.61ha (15.65%) in 2003 to 151.92 ha (36.23%) in 2020 (Table 3 and 6). The increasing of built up area in the Town is expanding to all directions, but the rate of urban expansion to all directions have not the same due to differences in its physical location, administrative conditions and master plan (Figure 2 and 4).

On the other hand the expansion urban area has significant effect on the socioeconomic condition of the local communities in the study area. Such intensive urban expansion on agricultural land has serious threats to the farmland and the rural communities' losses their large of agricultural lands due to the expansion of built-up areas. In line with the study of Firew and Shishay (2010), the effect of urban expansion on the agricultural land is serious because land is the most important source of income for the rural communities. As urban expansion consumes more agricultural land cover the size of farmland become smaller and smaller. Hence the small size of farmland cannot produce enough crop production to feed themselves and their families as well as to deliver for the market.

5. Conclusion

The urban areas of Ethiopian are expanding at an alarming rate and bringing about in losing of many very productive agricultural lands. As a result, the objective of the study was to analyze the effect of urban expansion on agricultural land in Hawzen Town, Tigray regional state of Ethiopia. Study of urban expansion and its effect on land use land cover has more benefit for the concerned body in order to plan and implement policies. The study shows that there is significant land use and land cover change in the study area. As a result of urban expansion, the built up area is continual increasing, while the forest and farmland and becomes declining for the last 17 years. On the other hand the area of bareland from the year of 2009 to 2015 was increased, while from the year 2003 to 2009 and 2015 to 2020 was declined. Furthermore, the land use land cover changes had been significant conversions between the land use land classes for the last 17 years. The major class changes between 2003 and 2020 were seen in bareland and farmland, and they were converted to forest and built up areas. Regarding to the socio economic condition of the local communities, the expansion of urban area has significant effect on the declining of crop production because of the source of income of the rural communities is agricultural based. Large horizontal urban expansion on agricultural land has serious effect on the area of farmland and hence they cannot produce enough crops for different purposes. Therefore, the government of Tigray regional state and the Woreda should be in use of effective

strategy of land use planning like vertical expansion instead of rapid horizontal expansion for sustainable development.

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