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# Sustainability and Greenery Assessment of Green Space Planning and Implementation in Debre Markos Town, Ethiopia, By Using Gis Software

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**Abstract:** The sustainability and climate of the city is significantly affected by the share of green space. This includes making use of unconventional types of green space planning, such as roof or façade greening, landscaping, and thus helping the city to adjust to climate change and other results. According to this and other reason, this research was conducted to assess green space planning and implementation in Debre Markos town. The study was shows two approaches; the government who had developed green space and the private association who had developed their own green spaces in the town.

The research tried to review related literatures of green space planning and implementation. This research was also followed a cross-sectional mixed method design which is a procedure for collecting, analyzing and mixing both quantitative and qualitative data at some stage of the research process. When used in combination; quantitative and qualitative methods complement each other and allow for more complete analysis. GIS and remote sensing application also applied for map generating and presentation in this study.

Moreover the paper concluded and recommends some basic issues to alleviate the challenges and make the town as competitive and sustainable as other cities in Ethiopia in green space planning and implementation. Professional training, awareness creation through different means and integration with stakeholders to increase participations are some of the recommendations. Moreover, the paper strongly suggest that, town officials who have a mandate and responsibilities should be equipped with the concept of urbanization, sustainable town and creating sustainable community.

**Key Words:** Existing green space, Government green space, Private Green space, Sustainable Planning & Implementation

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## I. INTRODUCTION

Sustainable urban planning in growing urban agglomeration encompasses the active development of urban green spaces (F. Barber (2005). The loss of urban green does not only threaten the urban climate and ecosystems, but it may also affect a city's image and the residential satisfaction in general. Green spaces usually function as corridors for fresh air supply and facilitate good air circulation in general (A. Amberger, 2006). It enhances the recreational quality for the public and the overall image of a place (G A Bradley, 1995). The amount of provision, distribution, and the ease of access to green spaces are key contributors to social and ecological function in urban environments (S.M.A. Haq, 2011). Public parks and private gardens play critical roles in supporting biodiversity and providing important ecosystem services in urban areas (Li F, Wang R S, Panlussen J *et al,2005*).It may influence the physical and mental well-being of those people, and in the case of public green spaces, it presents broader social benefits as the meeting places that give a shared focus to diverse communities and neighborhoods.

Planning and implementation activities like residential, commercial, and real estate developments have been given more priority at the expense of planning, implementation and development of green spaces (M.Lütz , O.Bastian , 2002).

The study concentrates on the planning followed to implement green spaces by different actors in the town (XL Zhou, Y C Wang, 2010). In addition to that, quality of the current available green spaces to households in Deber Markos town were assessed; access to public green spaces also analyzed in the study area.

### 1.1 Objectives

The main objective of the paper was to assess the status of existing green spaces planning and implementation by using GIS technology and different approaches of green spaces in Deber Markos town.

## II. STUDY AREA

Deber Markos town ranges in altitude from 2450-2509 meter above mean sea level (amsl). It has a hilly topography with varying slopes, but, 75.5% of the total land area is suitable for building construction (Deber Markos Administrative Town Communication Office, 2018)

Deber Markos town is located in the Amhara Region North West of Addis Ababa. It has relative Location of 300 km distance from Addis Ababa and 265 km distance from Bahir Dar. The geographical coordinates is situated $10^0$ 21' North and $37^0$ 43' East (Deber Markos Administrative Town Municipality, 2018). (Fig. 1)

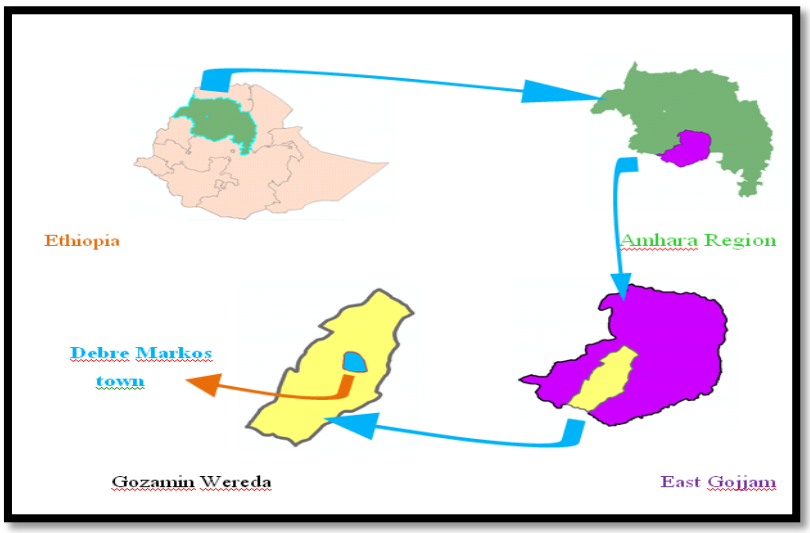


***Fig. 1:*** *Location map of Deber Markos town*

The weather condition of the town is Woina dega. The town enjoys a tropical climate with a mean annual temperature 16°c, while the maximum and minimum recorded temperature being 24°c and 4°c respectively. The average annual rainfall is 1324.4 mm (CSA, 2018).

**Table 1:** Data collection methods

| Sampling unit of Respondents | Data collection tools | | | Total | % |
|---|---|---|---|---|---|
| | Questionnaires | Focus group discussion | Interview | | |
| Households | 120 | -- | -- | 120 | 86 |
| Municipal officials | 3 | -- | 1 | 4 | 3 |
| Zone Urban Development officials | 3 | -- | 1 | 4 | 3 |
| Kebele officials | -- | 12 | -- | 12 | 8 |
| Total | 124 | 12 | 4 | 140 | 100 |
| Percentage | 88.57 | 8.57 | 2.86 | 100 | 100 |

According to Central statistics authority report in 2007, the population of the town is estimated to be 62,469 out of the total population; 32,568 are females and 29,901 are males. The major economic activities of the city people mainly on commerce, daily labor, petty traders, small-scale industries as well as domestic economic activates like, selling local beers like, "tella" and tea along with local alcoholic beverage (Town Municipality, 2018).

## III. MATERIALS AND METHODS

The paper used questionnaire, field observations, focused group discussion and interviews (ECSU, 2012). The quantitative and qualitative research approach was used, but mostly qualitative approach might great in use (Johan_W_Creswell, 2009). During the development of the qualitative approach was the best to evaluate the attitudes of different institution or investment professionals for the assessment challenge of Green Space planning and implementation. Where as in the quantitative approach was used to present out comes based on tables, charts, graphs and so on (C.R Kothari (2009).

The unit of observation in this study was covered both the institution and the residents accommodated in the town. The units of assessment were two institutions and three kebeles were taken in to contemplation for

the study area. From each kebele green space 12 households and 10 sampling frames were taken for the study. Total numbers of respondent from the three kebeles green space were120 households (Table 1). The paper was used a purposive sampling technique for households who are living near and around the existing green spaces. Therefore the total households surrounding the green spaces were the sampling units of the study (Fig. 2).

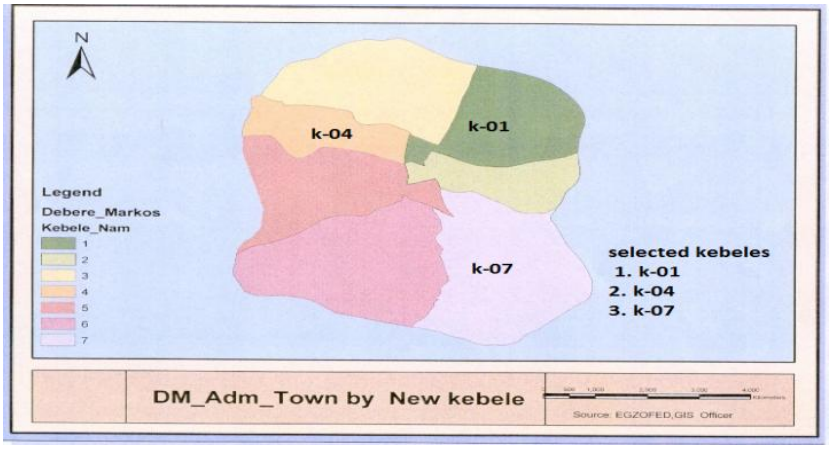


***Fig. 2:*** *Selected sample kebeles*

Both the primary and secondary data were used. The primary data were collected through questionnaires, interviews and focus group discussions. And the secondary data were collected from different documents like books, journals, previous researches, reports, websites and plans. The types of collection data were both qualitative and quantitative.

The Data was presented and analyzed against the main variables which were presented in the specific objectives and research questions. The analysis used simple statistical tools like tables, percentages, and frequencies. Apart from the data analysis and interpretation the data presentation was presented through photographs, maps, figures charts, excel computer program and simple calculations for tabulation and charts. Arc GIS 10.2 is important software that was used for map generation and presentation in this study (P .DUy, N Nakagoshi, 2008).

The governing rules of the ethical considerations in this paper were (1) time would be respected and ruled by schedule (2) respecting social values (3) could not affect physical and social (4)confidentiality are very important.

## IV. RESULTS

The Socio-economic characteristics of respondents had a direct relationship with the development and management of green areas in a given city (Table 2).

**Table 2:** Age Structures of Respondents

| No. | Age Group | No. of Respondents | Percentage |
|---|---|---|---|
| 1 | $< 30$ | 30 | 21.4 |
| 2 | $30 - 45$ | 65 | 46.4 |
| 3 | $45 - 60$ | 39 | 27.9 |
| 4 | $> 60$ | 6 | 4.3 |
| | Total | 140 | 100.0 |

For children and youths who account 21.4% of the respondents, and adults account for 74.3 % of respondents it creates fertile ground for different socio-cultural cohesion and ceremony, and for aged people who account for 4.3 % it is used as restful place, negotiation of disagreement, quarrel and for leisure activities and also information exchange. Sex distribution of respondents affect the intention of using green spaces especially for those women who are not educated and had low awareness of green spaces, or had an intention of using green spaces for dumping solid waste and grazing(Fig.3).

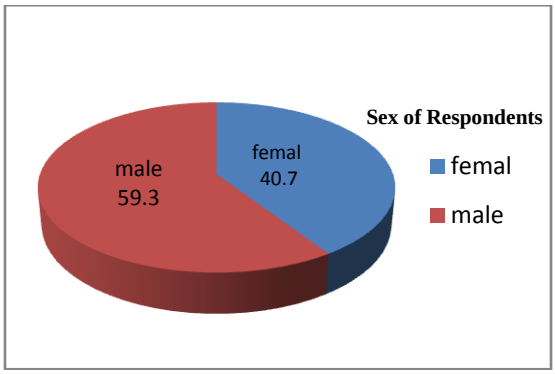


***Fig. 3:*** *Sex distribution of respondents*

Income of individuals and town as an entity affect directly the implementation and quality of green spaces (Table 3).

**Table 3:** Income Level of Respondents

| No. | Income interval in Birr | No. of respondent | Percentage |
|---|---|---|---|
| 1 | $< 1{,}000$ | 40 | 28.6 |
| 2 | $1000 - 2000$ | 64 | 45.7 |
| 3 | $> 2{,}000$ | 36 | 25.7 |
| | Total | 140 | 100 |

Education level and the attitude or awareness of green spaces planning and implementation had a direct relation. Therefore, education is one instrument necessary for the creation and implementation of green spaces in the towns (Table 4).

**Table 4:** Education Level of Respondents

| No. of respondent | Level of education | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | illiterate | Grd1-4 | Grd 5-8 | Grd 9-12 | Crt/ Dip | degree and above | |
| Respondent | 4 | 16 | 19 | 60 | 24 | 17 | 140 |
| Percentage | 2.9 | 11.4 | 13.6 | 42.9 | 17.1 | 12.1 | 100 |

**4.1 Existing governmental green space**

The town administration had tried to implement, protect and maintained existing green spaces (Fig.4). Although they had access to water, labor and sufficient and fertile land in the town there is not that much satisfactory in existing green space planning and implementation approach (Structural Plan of Debre Markos Town, Ethiopia 2018). (Table5).

**Table 5:** Total Areas Used for Green Spaces in Hectares

| No. | Area Covered by Green Spaces | Total Area |
|---|---|---|
| 1 | GS Around Weteren field | 16 |
| 2 | GS Around Negus Tekelehaymanot Square | 0.125 |
| 3 | GS Around Weseta field | 4 |
| 4 | GS Around Amhara Police Collage | 2 |
| 5 | Yeraba Forest and its Surrounding Green Space | 12 |
| Total | | 34.125 |

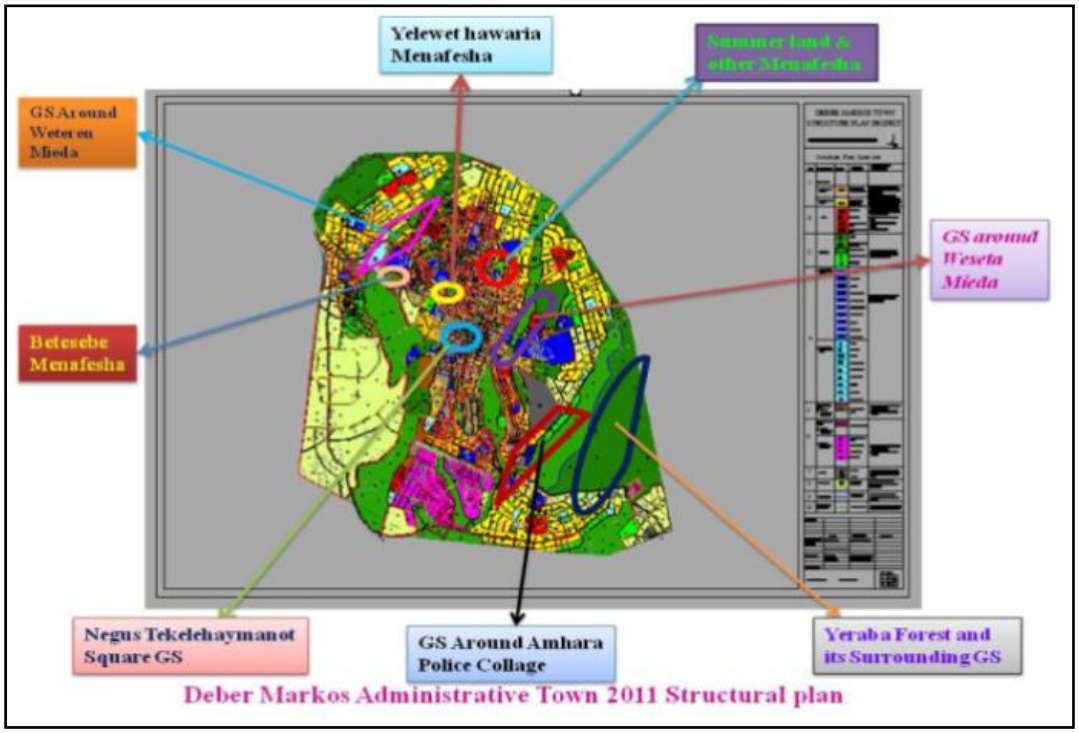


***Fig.4:*** *Debre Markos town structural plan*

Wutrin field and the surrounding green spaces are administered by Deber Markos town which is located in kebele 04 on the way to Bahir Dar. Negus Tekelehaymanot Square Green Space is administered by Deber Markos administrative town which is found at the center of the town (Fig.5, 6).


***Fig.5:*** *Debre markos town wutrin field existing green space*


***Fig.6:*** *Debre Markos town Negus Tekelehaymanot Square Existing Green Space*

Wieseta field green space had implemented a mini-forest and wet land in its surrounding using grasses and indigenous tree seedlings (Fig.7).

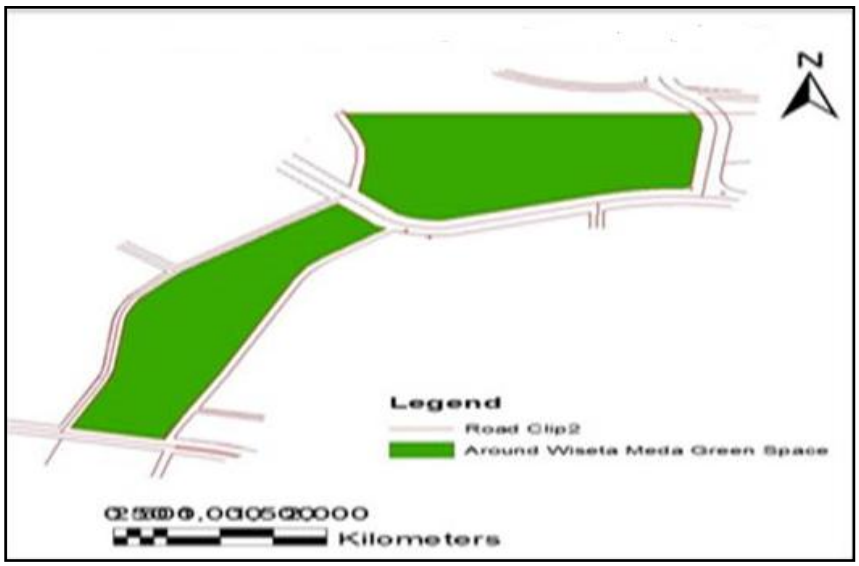


***Fig.7:*** *Debre Markos town Wieseta field existing green space*

Green Spaces around Amhara Police College, found in kebele 07 which is situated at the right bank of Weseta and Abaye River on the way to Addis Ababa, provides better opportunity for irrigation (Fig.8).

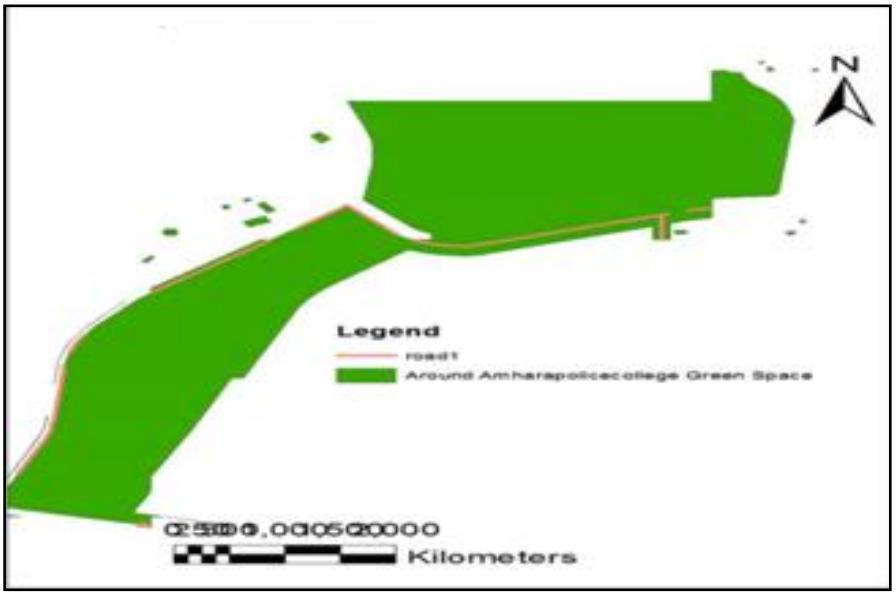


***Fig.8:*** *Debre Markos town around Amhara Police College existing green space.*

The total area of the centre was covered about 4 hectares while more than 55 percents were covered with plantations; the remaining had different structures like grasses and wet land which were covered by different grass spices. It had also some wet land around the river bank.

Yeraba forest and it surrounding green spaces was found in kebele 07 which was situated between Abaye and Chemoga river bank on the way to Addis Ababa (Fig.9).

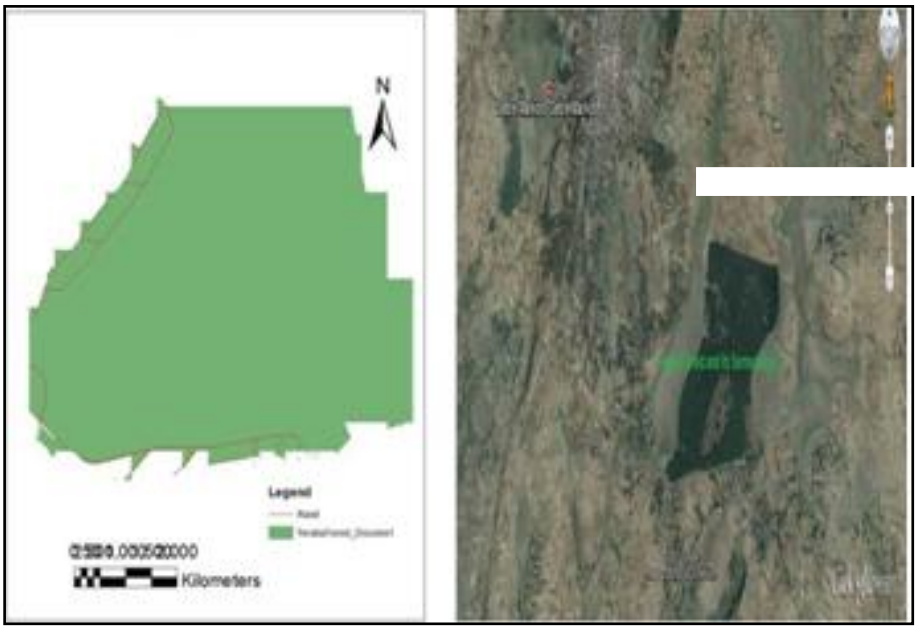


***Fig.9:*** *Debre Markos town Yeraba existing green space*

The types of tree species that are grown in the forest are eucalypts tree, Olivine, Juniper Tree, Acacia, and many other indigenous tree species.

All the existing green spaces that were found in Debre Markos town were connected each other. They were found on the main roads and sub arterial streets (Fig. 10).

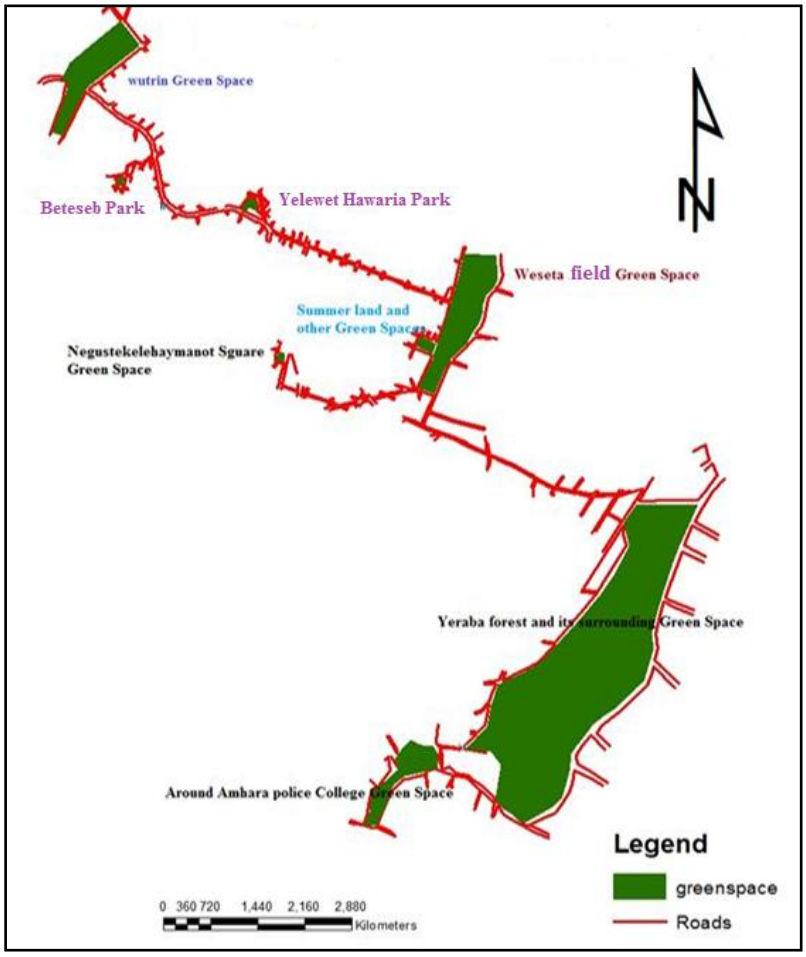


*Fig.**10:** Debre Markos town green space connectivity map*

**4.2 Existing Private and Associations Green Spaces**

There are different green spaces which are implemented by the micro and small enterprise associations for different purposes (ECSU, 2008) (Fig. 11, 12, 13). Some of the functions association implemented and developed green spaces are for recreational activity, income generating, for parking which are permitted by the municipality (Ministry of Urban Development, 2018). From those which are implemented and developed by the associations were Betesebe Park, Yelewete Hawaria Park, Summerland Park, Agere Park, Enkoye Park and others.

All these green spaces were implemented around the river banks of Weteren and Weseta except Yelewete Hawaria Park which was located in front of Gozamen finance and economic office; that owned by youth association and found in Kebele 01 and 04.

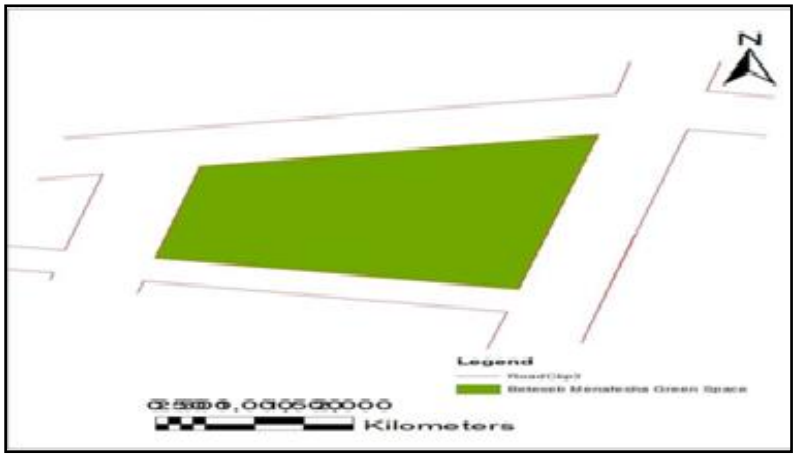


***Fig.11:** Debre Markos town Beteseb park existing green space*

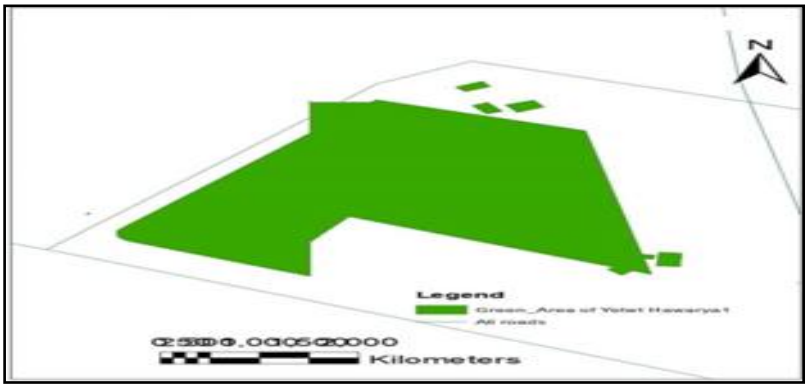


***Fig.12****: Debre Markos town Yelewt Hawaria Park implemented green space*


***Fig.13:*** *Debre Markos town summer Land Park implemented green space*

There were a lot of people who were implemented and developed different types of tree species in their compound (*Annual Statistical Bulletin of the Region*", 2018), (Fig.14). Individuals in the town had a practice of planting and developing tree species in their compound due to (1) availability of seedlings from municipal seedling garden center (2) availability of the area for tree planting (3) availability of seedling from the market center and (4) for income generating.


***Fig.14****: Debre Markos town private compound implemented green space*

Although the implementation and development of green spaces is the responsibility of the municipal authority (Ethiopia Proclamation No. 574/ 2008 ), some of the green spaces proposed on the structural plan were implemented and developed around the main square of the town and the different corridors of the town (Fig. 15, 16).

***Fig.15:*** *Debre Markos town square implemented green space*

***Fig. 16:*** *Debre Markos town along and within road side implemented green space*

In addition to the main square, the municipality had implemented and maintained road side green spaces. These road side trees stretch from the main square to the northern, southern, eastern and western direction of the town.

## V. CONCLUSION

The town administration had open spaces intended to implement green spaces in the structural plan of the town. These green spaces had been implemented either by the municipal authority itself, or by transferring to the community based organizations. The green spaces implemented by the government institutions were developed by the positive will of the head of the institutions that were willing to organize and initiate the staff members and also allocated budget for contract workers for caring about the plants and trees.

The individuals/associations that had permission for implementing their own private green spaces along the river banks of Weseta and Weteren as shown in the objectives of environmental protection and rehabilitation had planted different commercial tree species. In addition to trees for recreational and parking purposes; green spaces implemented by individuals in their compound had multipurpose though they were at first planted for protection from sunlight or shade and to sell the fruits.

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