

Research Article

Urban green infrastructure planning in Ethiopia: The case of emerging towns of Oromia special zone surrounding Finfinne[☆]



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ABSTRACT

Urban green infrastructure planning should be based on certain principles for addressing a variety of challenges associated with sustainable development. Even though a set of principles such as multifunctionality and connectivity are increasingly recognized in the academic discourse, there is a difference how these are implemented regionally and locally. Yet urban green infrastructure planning research is often carried out in highly developed countries, while relatively little is known about the integration of the principles in the current green space planning practices of developing countries. Therefore, this study attempts to evaluate the integration of urban green infrastructure planning principles in the current green space planning practices in an urban center of Ethiopia with reference to the emerging towns of Oromia special zone surrounding Finfinne (Addis Ababa). This study employed a documents analysis, which was underpinned by interviews and observation. Regarding the evaluation of the planning documents, this study identified that the principles of multi-functionality, green-grey integration and social inclusiveness are present to some extent. At the same time, the result from interviews and observation revealed that the existing green spaces provide mono-functional services and their integration with grey structure is limited. Furthermore, the combination of document analysis and interview result shows that issues related to connectivity of green spaces, such as green corridors and green ways are not recognized in planning documents and practices. The study result indicate that lack of awareness, financial constraints, insufficient professional knowledge, absence of collaboration and poor public involvement are the most influential factors hindering the integration of green infrastructure planning principles into urban development. Therefore, current green space planning practices in developing countries in general and in Ethiopia in particular require advanced development in budget allocation, capacity building, awareness creation and stakeholder's involvement to be effectively considered as urban green infrastructure compliant.

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1. Introduction

Since 2007, urban centers have become the predominant human habitats. For the first time in human history, over half of the world's population is now living in urban centers (United Nations, 2014). Net population growth is now occurring almost entirely within urban areas and by 2050, urban environment will need to accommodate an additional 2.6 billion people, including 86% of the developed world and 64% of the developing world (Potter, 2013). Urbanization induces high pressure on natural resources and threats to compromise the quality of life within urban centers (Liu, 2008; Mazza & Rydin, 1997). Urban green infrastructure is identified as an alternative nature-based and cost-effective remedy to some of these negative consequences (Pakzad & Osmond, 2016).

Urban green infrastructure has been suggested to provide multiple benefits to urban residents' through creation of interconnected network of green spaces (Benedict & McMahon, 2002; Gill, Handley, Ennos, & Pauleit, 2007; Kato, 2011; Mell, 2008). Its elements can include a variety of green spaces such as parks, open spaces, playing fields, pocket spaces, small incidental green space and neighborhood gardens that are linked by tree-lined streets and waterways, around and between urban areas (Said & Mansor, 2011).

Well-planned and managed urban green infrastructure needs to be considered as an integrative part of the city, since it is indispensable for the functioning of the city in a sustainable manner (Sandstrom, 2002). In recent times, green infrastructure has been identified as a specific strategy to support resilience in cities (Ahern, 2007). The integration and strategic planning and delivery of networks of connected green space described as green infrastructure has become a major discourse in urban greening and is increasingly accepted as a policy and planning approach (Davies et al., 2015; Lennon, 2014). Thus, to successfully plan and implement a high-performing urban green infrastructure capable of delivering multiple benefits, adoption of a set of principles in planning become necessary (Pauleit et al., 2017). These principles relate to the content as well as the process of planning (Ahern, 2007; Benedict & McMahon, 2012; Kambites & Owen, 2006; Laforteza, Davies, Sanesi, & Konijnendijk, 2013; Mell, 2008; Pauleit, Liu, Ahern, & Kazmierczak, 2011).

In parts of Europe, North America and Asia, green infrastructure planning principles and approaches have been receiving more attention and green infrastructures is considered as essential urban infrastructure (Laforteza et al., 2013). For instance, in the United States the integration of green and grey infrastructures has become an important solution for storm water management. In Europe, cities such as Barcelona, Spain, are now noted for equally ambitious strategies that put emphasis on increasing connectivity of green spaces (Pauleit et al., 2017). Moreover, the Berlin Landscape Program emphasizes a well-connected green structure that should serve as a habitat network, moderate the urban climate and create corridors for human uses (Hansen et al., 2016). Review of current planning and good practice in European urban centers indicates that developed countries have established a fertile ground for application of urban green infrastructure planning principles and for further stretching to exploit the benefits of green infrastructure (Davies et al., 2015; Hansen et al., 2016).

In African city planning, the term urban green infrastructure is rarely (Roberts et al., 2011). According to Herslund et al. (2017) this is partly due to lack of appropriate green infrastructure approach that well integrates into the planning and governance system of the cities. Owing to this fact, benefits that can be obtained from green infrastructure resource are still mostly missed (Lindley et al., 2015).

Even though urban areas in developing countries are the most populous and rapidly expanding, research regarding urban green infrastructure planning and ecosystem is at an infant level (Haase et al., 2014; Pauleit et al., 2017). As a result, the concepts and principles of urban green infrastructure planning are poorly disseminated and understood in most of the sub-Saharan African countries (Shackleton et al., 2017).

In Ethiopia, one of the most rapidly urbanizing countries in sub-Saharan Africa (Lamson-Hall, Angel, DeGroot, Martin, & Tafesse, 2018) where urbanization is largely taking the place through unplanned urban growth which aggravates environmental problems (Ministry of Urban Development and Housing, 2015), the role of green infrastructure to address these challenges is still largely unknown. For example, planning document for the city of Addis Ababa propose development of a green infrastructure based on principles such as integration and multifunctionality; but, the proposal is rarely implemented (Herslund et al., 2017).

In addition, literature on green infrastructure planning in Ethiopia is quite scarce. Available literature is focused on issues such as adaptation to climate change (Lindley et al., 2015) and conditions and opportunities of green infrastructure in relation to water resilient cities (Herslund et al., 2017). Nevertheless, the results of previous studies did not fully address how the current green spaces planning practices considered the main principles of urban green infrastructure planning.

Therefore, this study is intended to contribute to bridging this gap by assessing the state of urban green infrastructure planning and its potentials and limitations in sub-Saharan Africa. In specific, the study explore how the principles of green infrastructure planning have been integrated into the current green space planning practices in Ethiopia by taking the emerging towns of Oromia special zone surrounding Finfinne as a case and to make recommendations which contribute to the transformation to green infrastructure planning.

2. Research methodology

2.1. Study area

Three emerging towns found in the Oromia special zone surrounding Finfinne have been chosen as case study sites. Oromia is one of the nine regional states of Ethiopia in which Addis Ababa, the Ethiopian capital (Finfinne in the regional language) is located. The special zone consists of eight major towns (Burayu, Dukam, Gelan, Holata, Lega Tafo, Sebeta, Sendafa, and Sululta) out of which,

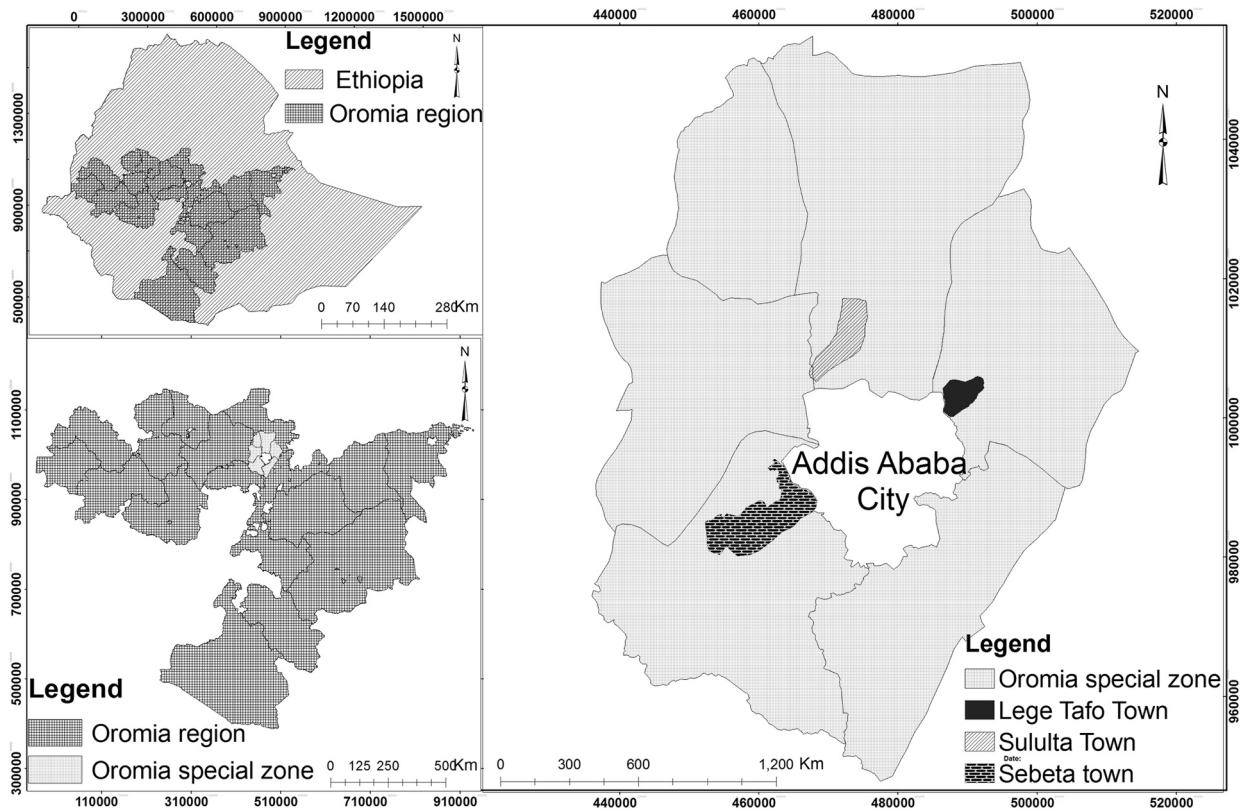


Fig. 1. Map of the study area.

three towns namely Sululta, Sebeta, and Lega Tafo were selected purposively as case study sites (Fig. 1). The rationale for selecting the towns was that they are the economic powerhouses in the special zone and Oromia region as a whole, they are highly expanding their grey infrastructure to support the economy, and they have a rapidly growing population as a result of which there is high pressure on green spaces. The altitude of the areas ranges from 1500 to 3443 m above sea level. The total area that is covered by the current structural plan of the towns is estimated at about 16,537 ha. The special zone is located between latitude 8°34'25" and 9°32'41"N and longitude 38°25'50" and 39°07'53"E. The temperature ranges from 10 °C to 26 °C and the annual rainfall ranges from 1043.87 mm to 1316.6 mm in the study area.

2.2. Materials and methods

To explore the integration of the main principles of urban green infrastructure planning in current green space planning practices of the towns, this study employed a planning documents review and analysis supplemented with interviews and personal observations. Both primary and secondary data sources were used to achieve the intended objective. Primary data was obtained from key informant interviews and personal observation while secondary data were obtained from reviews of different policies, strategy, regulation, standards and guidelines related to current green space planning practice.

2.2.1. Document review and analysis

A desktop review and analysis of documents related to national and urban plan and polices were undertaken in this study. The review process was focused on examination of documents that were relevant to this study while the analysis part was concerned with separation of parts in each document that are relevant to this study. Documents related to current green space planning practices were selected from the Ministry of Urban Development and Housing, and Oromia Urban Planning Institutes by consultation with experts from different sectors. The following criteria were used for selection: the planning documents should (1) represent strategies, which refer to the planning, implementation and management of green spaces on a national, regional, and city level, and (2) be put into force and still be in use. In addition, structural plans of the towns were collected from municipalities of the case study towns and reviewed. The list of documents analyzed is provided in Table 1 below.

These documents were carefully reviewed and analyzed by using principles adopted from the literature on green infrastructure planning (Ahern 2007; Benedict & McMahon, 2012; Davies et al., 2015; Hansen et al., 2016; Kambites & Owen, 2006; Liu, 2008; Pauleit et al., 2011, 2017) to extract information relevant to this study. The list of the principles is provided in Table 2 below.

Data from document review and analysis were analyzed by using content analysis (Krippendorff, 2013; Rall, Kabisch, & Hansen,

Table 1
Planning documents reviewed and analyzed in this research.

| S/N | Planning documents | Year of formulation |
|-----|---|---------------------|
| 1 | Ethiopian Environmental Policy | 1997 |
| 2 | Urban Plan Proclamation | 2005 |
| 3 | Ethiopian National Urban Green Infrastructure Standards | 2015 |
| 4 | Urban Greenery and Beautification Strategy | 2015 |
| 5 | Green Infrastructure Based Landscape Design | 2011 |
| 6 | Growth and Transformation plan II | 2016 |
| 7 | Participatory Urban Planning Manual | 2007 |
| 8 | Public Right of Way Management and Establishment Manual | 2016 |

Table 2
Main principles of urban green infrastructure planning (adopted from [Davies et al., 2015](#)).

| Principles | Planning of urban green infrastructure needs to: |
|--------------------------------|--|
| Multi-functionality | ✓ Consider the combination of whole set functions and benefits of urban green spaces including ecological, social and economic on the same spatial area |
| Connectivity | ✓ Consider structural and functional connections between different green spaces at different level and from different perspectives e.g. recreation, biodiversity, urban climate, storm water management, etc. |
| Green- Grey Integration | ✓ Consider integrating and coordinating urban green spaces with other urban infrastructures in terms of physical and functional relations (e.g. built-up structure, energy and communication, transport infrastructure and water system) |
| Social-inclusiveness | ✓ Involve wide range of social groups, with special emphasis to groups that are vulnerable and disadvantaged in decision-making ✓ Attempt to meet the needs and interests of all stakeholders |

2015) in which explicit references to various terms of green infrastructure planning principles were identified (e.g., using exact wording; [Hansen et al., 2015](#); [Roe, 2006](#)) also in addition to implicit references. Implicit references means identifying related concepts, e.g. “ecological, social and economic functions on the same spatial area” which were applied for example in 20 European cities ([Davies et al., 2015](#)), ‘landscape/ecological functions’ which were applied, for example, in Germany ([Bastian, Haase, & Grunewald, 2012](#); [Hansen et al., 2015](#); [Von Haaren & Albert, 2011](#)) and the Netherlands ([De Groot, 1992](#); [Hansen, et al., 2015](#)). To identify the explicit or/and implicit references the planning documents were carefully read and data (i.e presence/absence of terms, consideration of concepts and related issues) were filled in a document analysis worksheet ([Appendix C and D](#)). After coding of the concepts, the study has attempted to provide brief explanation of the concepts stated in the planning documents using citation from the original documents. However, the study has not attempted to present how often each urban green infrastructure planning principle was referred in the documents since the document have different lengths, writing styles, and foci of interest, making a fair assessment of such quantitative findings difficult.

2.2.2. Key informant interview

Fifteen professionals from different sectors were selected for interview using purposive sampling method. 5 from Ministry of Urban Development and Housing, 4 from Oromia Urban Planning Institute, 3 from the Department of Land Administration of Sebeta, Sululta and Lege Tafo town, and 3 from the Department of Greenery of Sebeta, Sululta and Lege Tafo town ([Appendix B](#)). Key informants were selected based on their knowledge and involvement in urban planning, green spaces planning and management, and/or issues of current green space practices. The main instrument used to interview the officials was semi-structured interviews, which contained open-ended questions whereby the respondents were given the chance to discuss all issues of concern. The main topic of the semi-structured interviews was on how far the concepts of multi-functionality, connectivity, green-grey integration and social inclusiveness were incorporated in current green space planning documents and practices. Moreover, the key informants were asked about barriers that hinder the adoption of green infrastructure both at planning and practice level. The key informants were also asked to propose solutions to overcome the constraints that hinder the adoption of green infrastructure planning ([Appendix A](#)). Interviews with the officials were conducted on December 2016 for approximately 25 minutes per individual respondents. In addition, non-structured interviews were undertaken with a total of 30 residents from Sebeta, Sululta and Lege Tafo towns to obtain data such as their participation and multi-functionality of the green spaces. The residents were selected purposively from the residential blocks adjacent to urban green spaces with threshold of 2 km. The selections were made based on age (elders preferred) and the number of years they lived in the area (10 years and above). These data were gathered with the assistance of town administration officials.

Data from the key informant interviews were analyzed using the theoretical proposition strategy recommended by [Yin \(2003\)](#), which requires interview data to be analyzed under key themes. Based on this strategy, the responses from key informant interviews were categorized under themes such as integration of the urban green infrastructure planning principles, and existing barriers and solutions for their effective application. For further analysis and discussion, the data obtained from key informant interviews were supplemented by personal observation.

3. Results and discussion

3.1. Multi-functionality aspects of current green space planning practices

The analysis of the planning documents revealed that four planning documents recognize multiple benefit and function of green spaces in different ways. This was confirmed by interviews held with the officials from Ministry of Urban Development and Housing and Oromia Urban Planning Institutes. As the officials stated, multiple benefits and functions provided by different green spaces have been taken into account during the preparation of different planning documents, which are related to green spaces. For instance:

- A. The Environmental Policy of Ethiopia, which was formulated in 1997, has an objective to plan and create green spaces within urban areas that provide recreational activities, habitats for plants and animals and ameliorate urban microclimates.
- B. The Urban Greenery and Beautification strategy, which was formulated in 2015, has an objective to develop green spaces, which reduce environmental degradation, pollution, urban floods, and which promote environmental sustainability in the urban area.
- C. The Ethiopian National Urban Green Infrastructure Standard, which was formulated in 2015, has an objective to create ecologically well functioning, aesthetically pleasing, and socially beneficial green spaces in cities and provide suitable, sufficient and ecologically viable green spaces for recreational, social, economic and environmental needs of the community.
- D. The Green Infrastructure Based Landscape Design Supporting Manual, which was developed in 2011, also proposes to develop street tree plantings for shading, mitigating the urban heat island effect, reducing runoff and sequestering carbon.

Thus, the planning documents appear to be supportive of multi-functionality and an understanding of the ability of green spaces to provide multiple functions and services was present in almost all documents. However, except in one document, the term multi-functionality was described only indirectly in all the planning documents. Moreover, information obtained from the document analysis indicated that the objectives of policies and strategies in promoting multi-functionality varied considerably between the different documents. For instance, some planning documents focused more on providing green spaces as habitats for plants and animals and for ameliorating urban microclimates while others focused more on creating green spaces that have aesthetic and social values.

Even when the planning documents support multiple functions and benefits provided by greens spaces, as information obtained from key informant interviews and field visits shows, only a few functions of urban green space (e.g. recreational functions) were taken into consideration in practice. As a result, many urban green infrastructure components are mono-functional, such as recreational, sports fields and playgrounds while their contributions to storm water infiltration or mitigation of the heat island effect are rarely taken into consideration.

Personal observation of playgrounds in the case study towns also shows that they have been serving only as playing grounds while other possible functions such as storm water regulation, social interaction, and microclimate regulation have been neglected. A community member had the following to say regarding this mono-functionality of a playground near his home:

“...the play ground found around my residential block is used only for playing football and it does not serve other functions such as recreational and social interaction since it lacks facilities and trees. The poor condition and lack of facilities discourages its use by people for other purpose.”(Key informant interview, 2016)

Studies emphasized that playgrounds can provide opportunities for recreational activities such as relaxing, walking, admiring nature and socializing with friends and loved ones (Laforteza, Carrus, Sanesi, & Davies, 2009). However, playgrounds in the study towns were not planned to provide multifunctional benefits and, consequently, as the respondents indicated the residents hardly use playgrounds found around their locality for other activities.

Generally, the study shows that while planning documents strive to address the issues of multi-functionality, in practices the multiple benefits of green spaces are neglected. The finding is similar to a study by Liu (2008) which found that attention given to multiple functions of green areas is present more in statutory planning than in practice. In contrast, a review of urban green space planning practices in 20 European cities by Davies et al. (2015) and Hansen et al. (2016) shows that several ecological and social functions or services of green space are mentioned in plans and taken into account in practice.

3.2. Green-grey integration in current green space planning practice

Regarding the integration of green space with other urban grey structure the analyzed strategies, standards and guidelines, which have been related to current green spaces planning practices contained little information. For instance:

- A. The Urban Greenery and Beautification Strategy has an objective to protect towns and cities from flooding by integrating green spaces with grey structure through the development of permeable surface and plantation.
- B. The Ethiopian National Urban Green Infrastructure Standard requires improving storm water management and enhancing storm water quality through the regulation of river flow and protection of riverbanks. Moreover, the standards state how urban and regional planning should incorporate green infrastructure early in the process of designing of infrastructures like new roads, transit facilities and other projects by assuring enough space (both above ground and underground) and enough resources for green.

- C. The Public Right of Way Management and Establishment Manual, which was developed in 2016 by the Ministry of Urban Development and Housing, has also an objective to encourage vegetation planting along the road sides and proper integration of both grey and green elements of the public right-of-way based on the current condition of green infrastructures in Ethiopia. These measures should reduce the urban heat island effect as well as noise and pollutants along roadways, and also improve air quality.

The information obtained from key informant interviews and personal observation from the field visit of the case study towns show that integration of green spaces and grey infrastructure has been practiced only in Sebeta town. In one of this town's neighborhoods called Furi, the town administration and the local community have developed vegetated road buffer, which is used to improve aesthetic quality and reduce noise and air pollution.

Even though such attempts of green-grey integration have been found, in general their application is at an early stage indicating that there is still a considerable gap of collaboration between the grey and green spaces sectors such as transport, urban planning, housing, energy and water. In particular, the study found that infrastructural integration was limited to certain functions (like storm water integration) in the document and particular networks (like road networks) in practice, whereas there is no emphasis on expanding green-gray synergies on other built-up structures such as green building, green energy and the like.

3.3. Social inclusiveness of current urban green spaces planning practices

Studies show that social inclusiveness enhances effective management of green infrastructure and promotes community stewardship for green infrastructure components (Enger, 2005). This study was also aimed at assessing how the concept of social inclusiveness has been integrated into current green space planning practices. The results of the document analysis indicates that more than half of the planning documents, which relate to current green space planning practices, have considered the issue of social inclusiveness in different ways. For instance:

- A. The Ethiopia National Urban Green Infrastructure Standard states that urban green infrastructure shall be managed and administered in the interests of the local community and shall address its needs. The long-term collective interests of the local community shall be prioritized over the interests of any specific interest group or sector of society.
- B. The Growth and Transformation Plan (II) that was formulated in 2016 by the National Planning Commission of Federal Democratic Republic of Ethiopia has planned to increase the coverage of green infrastructure and recreational areas in urban centers of the country. Enhancing the awareness and participation of the community and stakeholders has been identified as important measures of green space planning in the document.
- C. The Urban Greenery and Beautification Strategy has an objective to involve the community and stakeholders in sustainable ways during the development of urban green spaces. Moreover, the strategy states that urban greenery planning can be successful only when there is active participation of the community and the stakeholders.
- D. The Participatory Urban Planning Manual that was formulated in 2007 by the Ministry of Urban Development and Housing has the objective of involving disadvantaged groups into decision-making during urban plan preparation, which includes planning of green spaces. Moreover, the manual has an objective to pay attention to the priorities, needs and constraints of the city's population, especially to low income groups during urban plan preparation, which includes green space planning.

In general, while the above reviewed planning documents emphasize social inclusion and community cohesion in urban areas by involving community members and other stakeholders in planning and management processes as well as fostering a sense of community, the idea of social inclusiveness is less emphasized in practice. The evidence collected through semi-structured interview shows that formal communication among different sectors (e.g. the Planning and Land Management and Administration offices) are limited at different levels of government. For instance, one of the key informants said:

"...sometimes we are not involved in decision-making on issues related to green space planning. As a result, we do not have access to major information on green spaces such as required standards and norms. This is because the formulation, preparation and approval of the plan is made at regional level by mayors and municipality managers excluding the direct responsible experts of the sector such as land administration and greenery department. Owing to this fact, we face problems in identifying green space standards that need to be implemented."(Key informant interview: 2016)

Likewise, the key informant interviews revealed that most of the local communities did not participate in green spaces planning (and establishment/ management) and that there is a widespread disengagement of the local community in the preservation of green spaces in their areas. Furthermore, the local communities were not informed about issues concerning green spaces planning and management by the town administration. For instance, some of the key informants said that:

"...I grew up in this village and I lived all my life here but I have never seen any resident of this village being involved in green space planning. The town administration does not see us as important stakeholders, they do everything on their own." (Key informant interview, 2016)

"...The town's administrations think we have nothing to offer so they do not involve us in green space planning and management activities." (Key informant interview, 2016)

These indicate that community participation in planning which is an essential element of social inclusiveness and an essential

process for identifying community need and interests and for matching plans with them was very weak. In addition, the planning process lacked adequate accountability to the community while the plans lacked statutory status and mandatory implementation requirement making the community for influencing urban development in general very slim.

As Fuwape and Onyekwelu (2011), Mensah (2014) and Zakka, Permana, Majid, Danladi, and Bako (2017) indicate poor community participation in green space management is a common problem in many African cities. In contrast, partly due to long urban history, in many European cities especially cities in the United Kingdom, residents and community groups are highly involved by local city authorities in the conservation of green infrastructure components (CABE, 2010a). Similarly, a study conducted by Davies et al. (2015) on 20 European cities shows that citizen participation in urban green infrastructure planning is widely implemented.

3.4. Connectivity aspect of current green spaces planning practices

The analysis of documents revealed that issues related to connectivity of different green spaces were not given due consideration in any planning documents, policies and strategies related to current green space planning. None of the documents considered how to link green spaces physically and/or functionally.

According to information obtained from the key informants, green spaces planned in the study area were not considered as parts of a large network and connectivity was not the objective in their planning process. As a result, there is a highly fragmented green space system in the study area as confirmed by key informants:

“...the idea of a network of open spaces was not incorporated in the green space planning documents. As a result, no green spaces found in the town are connected to each other. In my opinion lack of adequate knowledge at national and local levels resulting from the newness of the concept of making green space a larger network has significantly affected the plan implementation practices.” (Key informant interview: 2016)

In addition, evaluation of the structure plan of the case study site shows that green spaces were proposed in a fragmented way and creation of a large network of green spaces was not attempted (Fig. 2).

3.5. Barriers preventing the adoption of green infrastructure planning principles

In the quest for further development of urban landscapes, the concept of green infrastructure planning has become central in policy documents and as a planning tool (Lindholm, 2017). Nevertheless, there are a number of barriers associated with implementing the concept and its planning principles in the current green space planning practices of the study area. The barriers have been related to the following four potential factors.

First, lack of awareness and poor involvement. The poor involvement of the local community coupled with limited awareness of the benefits of green infrastructure has made the local community to view urban green space planning and protection as the sole responsibility of government. Regarding this, a key informant reported that:

“...I don’t think there’s awareness of the concept of green infrastructure planning at all in the local community, planners, policy and

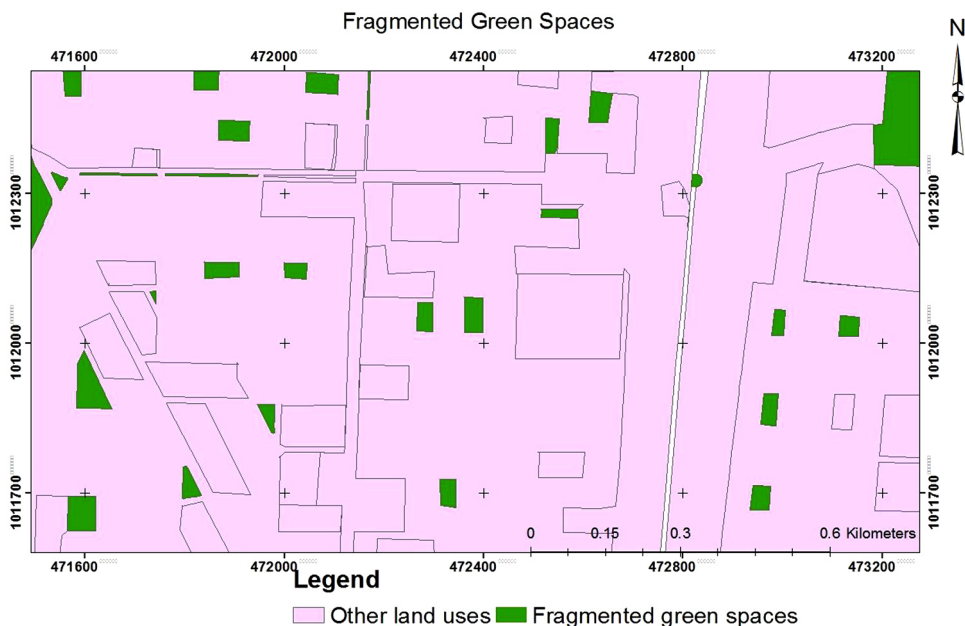


Fig. 2. Planned green spaces in the structural plan. Source: Structural plan of the study area.

decision makers. Moreover, the concept of green infrastructure is new to most of the policy and decision makers. As a result, low attention has been given by planners and decision makers to integrate properly the main principles of green infrastructure planning in the current green space planning practice.” (Key informant interview, 2016)

This quote shows how much the decision makers and planners lack awareness and understanding that hinders them to integrate green infrastructure planning principles into current planning practices. Moreover, the local authorities and decision-makers view green infrastructure as luxury, allot less budget and resources, and prioritize the land for other basic services. According to CABE (2010b), the information gap on the concept of green infrastructure is a worldwide challenge.

Second, lack of professional skills and experience. The environmental advantage and multi-functionality benefits of green infrastructure planning demands skilled professionals equipped with different disciplines such as landscape ecology, urban and regional planning, and landscape architecture (Pauleit et al., 2017). However, the findings of this research revealed that few skilled professionals occupy the departments of greenery and majority of the officers are from unrelated disciplines. Moreover, the employees are not highly motivated to work in the department as information from a key informant below indicates:

“...the employees who were recruited for the department of greenery are not professionals. The majority of them were recruited to this department when the government fired them from higher positions such as mayor and cabinet member positions. Moreover, some of the employees come to this department when their education level does not qualify them for better positions in other sectors. Professionals feel that they were given lower status if they are assigned in the department of greenery and, therefore, are unwilling to work in the department. This is a condition that creates problems in implementing the green infrastructure planning principles stated in the planning documents.”(Key informant interview: 2016)

The above comment shows that employees recruited in the department of greenery are not qualified and have no enough experiences to undertake works regarding green space planning and implementation. Moreover, the comment of the key informant shows how the sector is given less emphasis by the governmental body. Therefore, within the framework of lack of sufficient and qualified employees that undertake projects related to green space, it is very hard to integrate the green infrastructure planning principles into current urban green space planning practice in the study area.

Third, shortage of budget. Budget is a fundamental issue in putting any plan into action. If green infrastructure is to be taken forward then the question for providing adequate funding needs to be addressed (Mohamed, 2011). In the study area lack of finance has been one of the most substantive factors behind the problem of low implementation of green infrastructure planning. Based on information obtained from the key informant interviews, it was found that the towns do not have adequate funds allocated for the implementation of green spaces. For instance, a key informant said that:

“...the town administration has collected more than 108 million birr (4,696,652\$) per year and used almost all the revenue for construction of basic infrastructure and for other investments. However, the budget allocated for the department of greenery is very low and it is not enough to undertake projects related to green spaces. The financial hardship in our department is disrupting our activities and causing most of our tasks to remain on the drawing board.” (Key informant interview: 2016)

A close examination of the 2013–2016 financial report of the towns has also supports the comments given by the key informant. The report showed that very little priority had been given in allocating budget to the departments of greenery (Table 3).

Fourth, absence of collaboration among various governmental sectors. The planning and implementation of green infrastructure is not the sole responsibility of single sector, it has to be planned and implemented in an integrated way with different sectors such as transport, housing, water and energy both at regional and local levels (Benedict & McMahon, 2012). However, according to information obtained from the Ministry of Urban Development and Housing there is lack of coordination between different sectors during planning and implementation of green infrastructure components. Consequently, the majority of the grey infrastructure found in the study area has been planned and implemented independently by various departments of the local authority.

“...large multi-story buildings are constructed with inadequate green areas. This problem is due to absence of collaboration among different sectors that are responsible for the development of buildings and green spaces” (Key informant interview, 2016)

Table 3
Planned and allocated budget for the department of greenery.

| No. | Year | Town | Planned budget by the department of greenery in USD | Allocated budget by the town administration in USD |
|-----|---------|-----------|---|--|
| 1 | 2013/14 | Sululta | 422,360.5 | 34,922 |
| | | Lege Tafo | 593,748.2 | 47,457.7 |
| | | Sebeta | 774,814.7 | 106,521.7 |
| 2 | 2014/15 | Sululta | 510,427.1 | – |
| | | Lege Tafo | 601,909.7 | 56,728 |
| | | Sebeta | 751,757 | 98,834.6 |
| 3 | 2015/16 | Sululta | 533,686.4 | 48,697 |
| | | Lege Tafo | 690,143.3 | 83,360.9 |
| | | Sebeta | – | – |

“...even if there are some standards on how to integrate green space development during road construction, in practice the development of green spaces on most road sides does not reflect the overall concept of developing a continuous green infrastructure.”(Key informant interview, 2016)

These comments indicate the absence of collaboration between different sectors and that the need for integration of green spaces with other urban grey structures is not recognized by the responsible organizations hindering the successful integration of grey and green infrastructure into the current green spaces planning practices in the study area.

3.6. Implications for transforming green space planning to green infrastructure planning

Based on insights gained from literature, stakeholders' interviews and field observation the following recommendations are made to transform the current practice of green space planning to urban green infrastructure planning.

Solving budget shortages: to overcome the limitation of finances the town administration should allocate sufficient annual budget that can enable the greenery department to perform its activities effectively. In addition, the greenery department should be granted the authority and mandate to generate its own income from various activities such as licensing and franchising, sponsorship, entry fees and fines.

Professional capacity building: availability of sufficient number of skilled professionals is a prerequisite for advanced green infrastructure planning. This can be achieved in three ways. First, government should stop the practice of using the department as a dumping ground for demoted officials. Secondly, it should facilitate green infrastructure planning and implementation oriented long and short term on job training for unskilled employees and improve the image of the department. Thirdly, it shall sign memorandum of agreements with higher institutions to design curriculum and to launch trainings that are related to green infrastructure planning and implementation, environmental planning, urban horticulture, urban planning and landscape design.

Awareness creation: awareness needs to be raised among local communities, stakeholders, policy and decision makers on the importance and concepts of green infrastructure planning and its vital role in establishing sustainability within urban environments. In addition, planners need to be made aware of the concept and the need to think creatively in implementing the green infrastructure planning principles. The awareness creation can be done through workshop, seminars and by using the mass media.

Stakeholder involvement and community participation: the principles of social inclusiveness require that green spaces should meet the needs and interest of all stakeholders. This requires that the stakeholders are involved in the process of making the green spaces. The study indicates that this practice has been inadequately addressed in the study area. Although there were involvements in providing data sources for structure plan preparation, there was no meaningful participation of stakeholders in green spaces planning and development. Therefore, there is a need for a planning process which is more open to the community and which is accountable to it to ensure that relevant inputs of the community that can influence the plans.

Non-statutory status of the plans: the principles of green spaces and green infrastructure planning is focused on the process of planning such as stakeholder participation and the quality of the green infrastructure output such as multifunctionality, connectivity, integration and meeting the needs and interest of stakeholders. However, the study indicates that plan implementation related issues such as budget shortage, explained above and status of the plan can also be major challenges. In the Ethiopian context, plans do not necessarily have statutory status and, as a result, their implementation is based not on legal requirement but on administration decisions, which can be arbitrary influenced by level of government as well as the market.

Therefore, addressing not only the challenges of the process of planning and the qualities of the green infrastructure output but also plan implementation challenges is essential for transforming green space planning to green infrastructure planning.

3.7. Discussion of the methodology

The study context is quite different from the European and American urban context. In the case of Ethiopia, there is no adequate awareness regarding the benefits of green infrastructure. On the community side, the priority is given for housing and basic services. On the planners and decision makers side the priority is on the above needs of the community and efficient use of land and resources. As a result, the data collection process is necessarily preceded by conversation on the parts of the research to raise the awareness. As a result, a qualitative research methodology is more suitable for the study.

Moreover, documents may not be available in full sets. For example in the Ethiopian situation, plans are rarely statutory. As a result, changes in plans may not be explained by court order or council decision documents. They must be explained by administrative decisions many of which need interviews in order to trace. The result on the ground also can still vary from the plans and the administrative decision themselves because people can influence it informally, especially in situation in which they are excluded from the planning process. In this situation, the research cannot rely on documents review and interview of administrator alone. It must be supported by observation as well.

Therefore, it should be feasible to apply the methodology used in this study in other parts of Sub-Saharan African cities or other cities with similar characteristics as of emerging towns found in Oromia special zone surrounding Finfinne.

4. Conclusion

The general objective of the study was to evaluate the extent to which green infrastructure planning principles identified as; multifunctionality, integration of green and grey infrastructure, social inclusiveness and connectivity were integrated into the green

space planning practices of three towns in Ethiopia and to indicate major action needed to increase the integration. The study indicates that there have been efforts to integrate the principles at policy document levels although the term multi-functionality, connectivity, green and grey integration and social inclusion are lacking in the investigated planning documents.

Multiple functions and benefits of urban green spaces were recognized in reviewed planning documents in different ways. Nonetheless, in practice developed green spaces have mostly single functions. Green and grey infrastructure integration and social inclusiveness were recognized in a very limited degree in planning documents and in practice. Moreover, there is also a lack of communication and social inclusiveness in implementing different green infrastructure components while connectivity approaches, were absent in any planning documents for connecting green space physically and/or functionally and as a result green spaces in the study area were developed in a fragmented way.

The study also identifies lack of awareness, financial constraints, insufficient professional knowledge, absence of collaboration, poor involvement of the local community and stakeholders and non-statutory status of plans as the major challenges for green infrastructure development and recommends addressing these issues in order to realize the development.

Findings of the study will add new information to the urban green infrastructure literature in order to understand how the main principles of urban green infrastructure have been incorporated in current green space planning practices in Ethiopia. Due to scant literature, the findings from this research have wider applicability to urban areas in sub-Saharan Africa. Moreover, the findings will inform policy makers in their decision making process on how to consider green infrastructure planning principles to protect green spaces in the physical landscape of Ethiopia in general and the study area in particular.

Finally, future research should focus on developing tools, which help to transfer the main principles of urban green infrastructure into practice such as, information, decision-supporting and technical tools. Thus, such studies will significantly advance our understanding on the integration of green infrastructure planning principles into current green spaces planning in Ethiopia in particular and more widely in sub-Saharan Africa.

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Appendix A. Semi-structured interview lead questions¹

1. How do you think about the awareness of employees of federal, regional and town level administration on the concept of green infrastructure planning principles?
2. Which urban green infrastructure planning principles are integrated in current green space planning documents and practices?
Multi-functionality——— Green-grey integration———
Social inclusiveness——— Connectivity———
3. How are the concepts of multi-functionality, connectivity, green-grey integration and social inclusiveness incorporated in current green space planning documents and practices?
4. What are the main gaps and limitations of current green space planning practices in integrating green infrastructure planning principles?
5. To what extent are the principles of green infrastructure implemented on the ground? And what mechanisms are in place to ensure implantation of plans?
6. How does your institution work for integrating green infrastructure planning principles into planning documents and practices?
7. Do you think there is community participation in planning and development of green infrastructure?
8. How do relevant institutions communicate during urban green infrastructure planning and development process?
9. What are the funding mechanisms for developing urban green space? How do you think about if adequacy to undertake green space projects?
10. How do you think the collaboration of different government sector in planning and implement of green infrastructure planning principles?
11. Do you think professionals’ in your institution are adequately qualified to integrate green infrastructure planning principles in planning?
12. What do you think are the main barriers to adoption of green infrastructure planning principles both at planning and practices level?
13. What do you think are possible measures to overcome the barriers?

¹ Note: Additional follow-up questions were asked, as appropriate.

Appendix B. List of interviewed key informants with their affiliation and positions

| S/N | Number of key informants | Institutional level | Institution | Position | Education Qualification |
|-----|--------------------------|---------------------|---|--|--|
| 1 | 5 | Federal level | Ministry of Urban Development and Housing | Environmental Impact assessment officer Urban Planner Urban Forester officer Landscape Design officer Architectural officer | M.Sc. in Environmental Science Bsc in Urban planning Bsc in Forestry Bsc in Architecture |
| 2 | 4 | Regional level | Oromia Urban Planning Institute | Team Leader of Surveyor Spatial planner Team leader of Urban plan preparation Surveyor | Bsc in Architecture Bsc in Surveying Bsc in Urban Planning Bsc in Urban Planning Bsc in Surveying |
| 3 | 6 | Town level | Sebeta town Land Management and Administration Department Sululta town Land Management and Administration Department LegeTafo town Land Management and Administration Department Sebeta town Greenery and Beautification Department Sululta town Greenery and Beautification Department LegeTafo town Greenery and Beautification Department | Process owner of Land Administration Process Owner of Land Administration Head of the Department of Land Administration Urban Environmental Protection expert Team leader of Greenery and Beautification Department Team leader of Greenery and Beautification Department | Bsc in Urban Planning MA in Urban Management Bsc in Urban Engineering Bsc in Natural Resource Management Bsc in Agricultural Economics MA in Urban Management |

Appendix C. Green infrastructure planning principles addressed in the planning document both in explicit and implicit term

| S/N | Green Infrastructure Principles | Planning Documents | | | | | | | | | | | | | | | |
|-----|---------------------------------|--------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | EEP | | UPP | | ENUGIS | | UGBS | | GIBLD | | GTP(II) | | PUPM | | PRWMEM | |
| | | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term | Explicit Term | Implicit Term |
| 1 | Multi-functionality | - | MF1 | - | - | X | MF2 | - | MF3 | - | MF4 | - | - | - | - | - | - |
| 2 | Connectivity | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | Green- Grey Integration | - | - | - | - | - | GGI1 | - | GGI2 | - | - | - | - | - | - | - | GGI3 |
| 4 | Social-inclusiveness | - | - | - | - | - | S1 | - | S2 | - | - | S3 | - | S4 | - | - | - |

X = The term has directly considered **EEP** = Ethiopian Environmental Policy **UPP** = Urban Planning Proclamation **ENUGIS** = Ethiopian National Urban Green Infrastructure Standards **UGBS** = Urban Greenery and Beautification Strategy **GIBLD** = Green Infrastructure Based Landscape Design **GTP (II)** = Growth and Transformation Plan **PUPM** = Participatory Urban Planning Manual **PRWMEM** = Public Right of Way Management and Establishment Manual

Explicit Term = various terms of green infrastructure planning principles.

E.g. using exact wording of Multi-functionality, connectivity, green-grey integration and Social inclusive

Implicit Term = Identifying related concepts or combination of the concepts with other concepts

E.g. Consideration of ecological, social and economic functions on the same spatial area, consideration of integrating urban green spaces with other urban infrastructures and the like.

Appendix D. Implicit term coding description with regard of green infrastructure planning principles related concept

| S/N | Code | Description |
|-----|------|---|
| 1 | MF1 | Plan and create green spaces within urban areas that provide recreational activities, habitats for plants and animals and ameliorate urban microclimates |
| 2 | MF2 | Develop green spaces, which reduce environmental degradation, pollution, urban floods, and which promote environmental sustainability in the urban area |
| 3 | MF3 | Create ecologically well functioning, aesthetically pleasing, and socially beneficial green spaces in cities and provide suitable, sufficient and ecologically viable green spaces for recreational, social, economic and environmental needs of the community. |
| 4 | MF4 | Develop street tree plantings, which are used for shading, mitigate the urban heat island effect, reduce runoff and sequester carbon |
| 5 | GGI1 | Protect the town and cities from flooding by integrating green spaces with grey structure through the development of permeable surfaces and plantations. |
| 6 | GGI2 | Improve storm water management and enhance storm water quality through the regulation of river flow and protection of riverbanks. |
| 7 | GGI3 | Encourage plantings along the roadsides and proper integration of both grey and green elements of the public right-of-way based on the current condition of green infrastructures in the Ethiopia. |
| 8 | S1 | Urban green infrastructure shall be managed and administered in the interests of the local community and shall address its needs. The long-term collective interests of the local community shall be prioritized over the interests of any specific interest group or sector of society |
| 9 | S2 | Enhancing the awareness and participation of the community and stakeholders in green space planning and development |
| 10 | S3 | Involve the community and stakeholders in sustainable ways during the development of urban green spaces. |
| 11 | S4 | Disadvantaged groups should be involved into decision-making during urban plan preparation. Needs and constraints of the city's population should be prioritized, especially those of low income groups during urban plan preparation, which includes green spaces. |

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