Linking non-urbanized areas and eco-sustainable planning: Realities and Challenges from urban Ethiopia

Introduction

Complexities brought about by climate change and the twin processes of globalization and urbanization have in recent times led to a renewed interest in the way cities are planned, designed and lived in (de Groot et al., 2002; UNEP, 2007; Yang et al, 2011). More specifically, the social, economic and environmental consequences thereof have led to a reevaluation of the factors that contribute to sustainable urban environments (Li et al., 2003; James et al, 2009; Lyytimaki and Sipila, 2009; Petrosillo et al., 2010). Such a primary focus on the sustainability of urban ecosystems is not misplaced given that cities are (undoubtedly) centers of economic growth and population. It is this dominant feature that has seen cities becoming a focal point of both ecological disturbance (through resource consumption and land conversion) and the provision of public goods (Young, 2010). Ecosystem Services (ES) from urban forests and open spaces are said to be well positioned to address these two arenas yet their very existence is under threat from high rates of urbanization that that are threatening the integrity of Non Urbanized Areas (NUAs) in most urban environments among other factors.

There is overwhelming evidence to suggest NUAs can play an important role in fostering healthy, liveable and sustainable cities by providing urban ecosystem with a wide variety of ES. It is often argued that NUAs can help improve livelihoods, moderate harsh urban climates, conserve biodiversity minimize air pollution and contribute to better human health (FAO, 2002; Van Veenhuizen et al., 2004; Tyrvainen et al., 2005; Nowak et al, 2006; Jim and Chen, 2008).

This analysis defines NUAs as outdoor places with significant amounts of vegetation, mainly semi-natural areas that represent the last remnants of nature in urban areas (Jim and Chen, 2003). NUAs play a multifarious role in urban ecosystems. Such roles range from preservation of biodiversity (McHale et al., 2007), production of oxygen (Jo, 2002), reducing of air pollution (Yang et al., 2005) and noise (Fang and Ling, 2003), regulating microclimates, reducing the heat island effect (Shinand Lee, 2005), to the achievement of crucial health, well-being and social safety objectives (Groenewegen et al., 2006). Literature on urban forests, pollution, and sustainability promotes and advocates the positive contribution of NUAs in maintaining environmental quality. In general, these and a myriad of other related studies have led to a normative assertion by environmental planners and urban managers that an increase in NUAs in urban ecosystems is desirable and will provide a wide variety of ES among other functions.

Increasing rates of urbanization, lack of prioritization on preservation of NUAs by city officials, inclusion of NUAs in environmental policies, and a widespread neglect of the costs associated with NUAs however have called into question the assumption that the net effect of NUAs on environmental quality is always positive (Escobedo et al, 2011). In Ethiopia this however is a view that is based on anecdote rather than reliable empirical evidence. NUAs in Ethiopia have never been studied systematically in spite of their strategic role. This analysis seeks to bridge this knowledge gap by exploring realities and challenges of fostering eco-sustainable planning through NUAs in a sample of Ethiopian cities.

Obstacles to sustainable urban planning practices for NUAs

Most scholars concur that achieving sustainable urban development has become the most significant current and future environmental challenge (Cirardet, 2003; McDonald and Patterson, 2007; Agudelo-vera, 2011) that requires solutions that are not piecemeal (Pahl-Wostl, 2007). To this end creating and conserving NUAs has been viewed as the only first step towards winnowing the challenges thereof (Hostetler et al, 2011). There are however a myriad of obstacles that threaten the potential role that NUAs play in fostering eco-sustainable urban spaces.

Wald and Hostetler, (2010) note that most policies on NUAs do not address possible impacts of nearby built areas or the importance of design and management of nearby developments. Hostetler et al, (2011) have observed that green and built infrastructures are not integrated in most urban ecosystems.

It has now become obvious that NUAs are a key factor to sustainable urban development. Recent years have seen the concept of sustainable development increasingly being used to guide urban planning (Agudelo-vera, 2011). Lack of practical guidelines on how the concept should be translated into practice has however hampered its effective implementation (Berke and Conroy, 2000; Jepson, 2001).

Despite numerous benefits associated with urbanization, Chen, (2007) has observed that a rapidly urbanizing world faces intensified resource scarcity and environmental degradation. The ultimate effect is the loss of green spaces. The usual argument is that as the city grows, the increasing concentration of population and economic activities demands more land to be developed for public infrastructure (including roads, water facilities, and utilities), housing, industrial and commercial use (Girardet, 2003; Batty, 2008; Yang et al, 2011). Urbanization is therefore characterized by transformation of non urban land into urban land (Lopez et al, 2001). It is this physical alteration of the urban landscape that impedes the adoption of eco-sustainable planning approaches that seek to preserve NUAs. Associated negative consequences are not only localized. They range from species habitat loss, climatic changes, to the accumulation and spread of wastes in the Earth's atmosphere, hydrosphere and pedosphere (Bai, 2007; Chen, 2007).

Current global statistics on urbanization trends are not encouraging. It is estimated that more than half of the world's population (i.e. 3.5 billion) resides in urban areas (Agudelo-vera, 2011). This urban fraction is projected to increase to almost 60% by 2030 and 70% by 2050 (ESA-UN, 2007). In addition to challenges posed by urbanization, it is often argued that associated technological and infrastructural innovations have increased the rate of depletion of NUAs (Kennedy et al., 2007; Krausmann et al., 2008, 2009; Monstadt, 2009). The unprecedented loss of NUAs would mean the subsequent loss and thinning of ecosystem services which also leads to loss of resilience and options for future generations (Folke et al., 2004). Part of the objectives of eco-sustainable planning is to ensure that the capacity of an ecosystem to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity and feedbacks remain undisturbed (Berkes et al., 2003; Carpenter and Folke, 2006). This mandate also includes an ecosystem's capacity to recover from management mistakes made by multiplicity of stakeholders that characterize the city decision making process (Fischer et al., 2006). Lack of strong partnerships among ecologists, urban

designers, landscape architects, and urban residents has also been blamed for unsustainable practices in NUAs (Golding, 2007).

As development trajectories of towns and cities of the world vary (Kasanko et al, 2006), requirements for eco-sustainable planning are also different. Where populations are falling (as in some European cities), opportunities to redesign the built and external environments in order to improve liveability and sustainability exist (Mace et al, 2007). Such an opportunity is however nonexistent, where populations are growing and cities are expanding spatially (as in most African cities), or are confined by physical or political boundaries. In such urban ecosystems there is a general decrease in per capita space and often a need to address issues of the loss of urban green space (James et al, 2009).

The institutional environment for NUAs in Ethiopia

Ethiopia has become one among a few other developing countries in Africa that has recognized the pivotal role played by Green Infrastructure in preserving water quality through the enactment of various legal instruments. Notable policy / legal instruments include the Ethiopian Constitution of 1995, and the Ethiopian Urban Development Policy (EUDP) of 2005 (Tegegne, 2006; Solomon, 2007). Central to the implementation of such legal instruments has been The Ethiopian National Urban Planning Institute (NUPI) and the Environmental Protection Agency (EPA). Despite the existence of such an institutional framework, associated green Infrastructure management efforts have to date remained an under researched area.

Materials and Methods

Empirical evidence relates to a sample of independent cases study material drawn from three cities and / towns of Ethiopia, including the city of Addis Ababa, city of Nekemte and Chancho town. The study utilizes survey material gathered in the period 2008/9. The pooling together of data from such independent samples was achieved through a Comparatives Studies framework that utilized the concept of Meta analysis.

Multiple regression analysis was employed to discern existing relationships between urbanization trends and NUA supporting architectures such as open spaces and urban forests among others. Such supporting architectures were deemed to be appropriate as they form the hall mark of some of the commonly mentioned indices that seek to quantify the visual effects of urbanization trends (Young et al, 2009). The visibility of NUAs was assessed through a combination of Green View Index instruments such as field surveys and photography interpretation. Such data collection instruments are widely recommended in studies that seek to quantify existing amounts of Green Infrastructure (Ulrich and Addams, 1981; Schroeder, 1986; Smardon, 1988; Coombes, 1994;. McGaughey, 2007; Young et al, 2009).

Traditional land use categories do not provide indication about land cover features and can therefore not be used to provide accurate information about the amount of NUAs such as green space associated with each land use type (Gill et al., 2008). Each land-use type patch can be composed by a mix of NUAs. For the objectives of this study, the characterization of land-use

types by Gross and net population densities was used. Such indices were deemed to be appropriate proxy measures of urbanization trends in the three cases study areas. The binary logistic regression model was used to decipher some of the factors that explain the adoption and non adoption of sustainable practices in the management of NUAs in the study areas. Details are given in the next section.

Empirical model specification

The logistic regression model was applied to identify the major determinants of the current management status of NUAs as perceived by urban households who in this analysis are deemed to be one of the key beneficiaries from ES rendered by NUAs. In order to foster sustainable urban spaces, several researchers concur that mental constructs must be considered when defining conservation objectives for NUAs in urban ecosystems (Minteer and Collins, 2005a; Colding et al., 2006; Bremner and Park, 2007). The importance of understanding people's attitudes towards management of NUAs has been underscored by many in recent times (refer to Hartig et al., 2003; Steward, 2006; Fischer and Young, 2007). It is this recent upsurge of studies attempting to explain the variation in how people use and perceive the attractiveness of green spaces (Krenichyn, 2006; Lopez-Mosquera and Sanchez, 2011) that has guided the choice of the dependent variable for model application.

This study assumed that the probability of a household defining the surrounding green space as poorly managed is determined by underlying obstacles to sustainable urban planning practices commonly mentioned in the literature of NUAs. In such a condition, when dealing with a dichotomous dependent variable - the main interest is to assess the probability that one or the other characteristics is present. The logistic regression model answers the question what determines the probability that the answer is yes, or no. The special features of the model guarantees that probabilities estimated from the logistic model will always lie within the logical bounds of 0 and1.

The adopted model assumed the following statistical formula;

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + u_i$$

Where Y = Probability / likelihood of a household of dismissing surrounding green space as poorly managed (Pr. poorly managed / = 1)

β_0 to β_7 = Are parameters to be estimated

x_1 = Poor urban planning policies

x_2 = Location of household (1 = Chancho town; 2 = Nekemte city; 3 = Addis Ababa city).

x_3 = Shortage of urban land

x_4 = Lack of environmental awareness

x_5 = Lack of stakeholder involvement

x_6　　　　=　　　　Poor co-ordination

The choice of the explanatory variables has been guided by current debates on NUAs as they obtain from existing literature. Existing literature on NUAs suggests that peoples attitude towards the management status of NUAs may be influenced by such variables as urban planning policies – including designing and management of the built environment (Bowler et al, 2010; Wald and Hostetler, 2010; Hostetler et al, 2011), the geographical location of people (August et al., 1998; Buijs et al., 2006), urbanization creating pressure on limited urban land resources (Girardet, 2003; Chen, 2007; Batty, 2008; Yang et al, 2011), limited environmental education and awareness (Teillac-Deschamps et al, 2009), stakeholder involvement and coordination and / or fragmentation of urban policies and stakeholder roles (Golding, 2007; Pahl-Wostl, 2007; Gondo et al, 2008; Hostetler et al, 2011). A deliberate bias towards more technical issues as they relate to urban planning as opposed to more psychological aspects (Sevenant and Antrop, 2009) that determine people's perceptions of NU landscapes has been made since the analysis is confined to the concept of eco-sustainable planning as reviewed in the previous sections.

Results

Results reveal that urbanization trends in the three cities and / towns under investigation have resulted in loss of ecosystem services supporting architectures such as open spaces, wetlands, forests among others during the period 2002 to 2008. The analysis found a negative correlation (Beta coefficient = -0.473) between area covered by green space (Y). Urbanization as measured by gross population densities (X). Refer to figure 1.
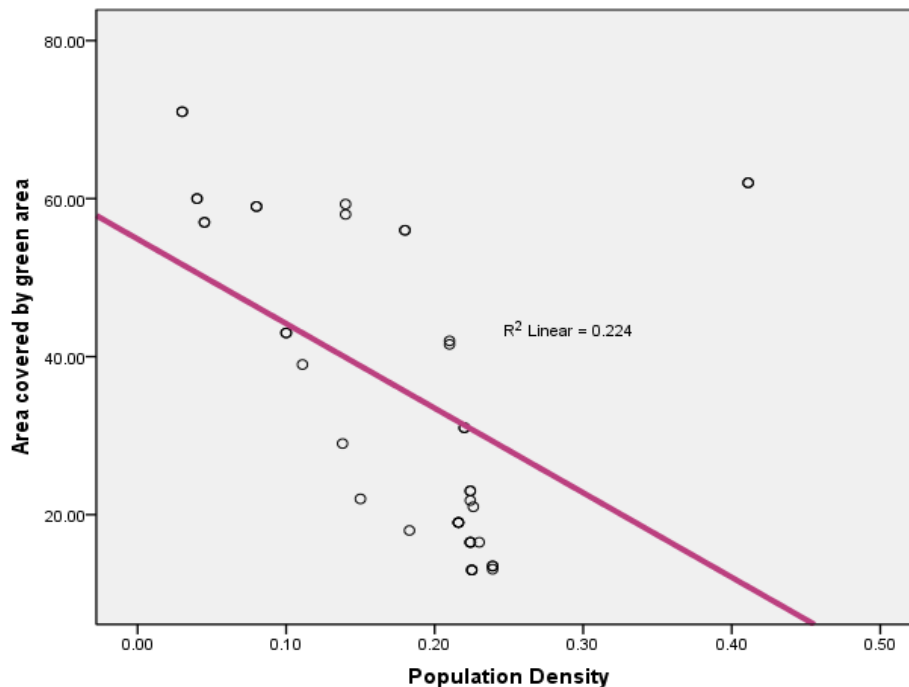
Figure 1. Relationship between Green Space and Population Density in cities and / or towns (2002 – 2008)

The potential risk to ecosystem services was found however to be surmountable in Addis Ababa where the interconnected network of open spaces and natural areas such as greenways, wetlands, parks, forest preserves and native plant vegetation was severely disturbed owing to wide spread destruction of the forest ecosystem. A significant negative association between population density and area covered by urban forest was discerned in Addis Ababa (R square = 0.737, df = 1, p value = 0.013, F = 14.002). Most of the NUAs of Addis Ababa have given way to increasing residential, industrial and commercial land uses. In much smaller towns as Nekemte and Chancho, the major land use changes have been residential as opposed to industry, other business and administrative land use activities (refer to figure 2). Such urban ecosystems lag behind in terms of industrialization; technological innovation and infrastructure development hence land use changes have largely been confined to residential uses.
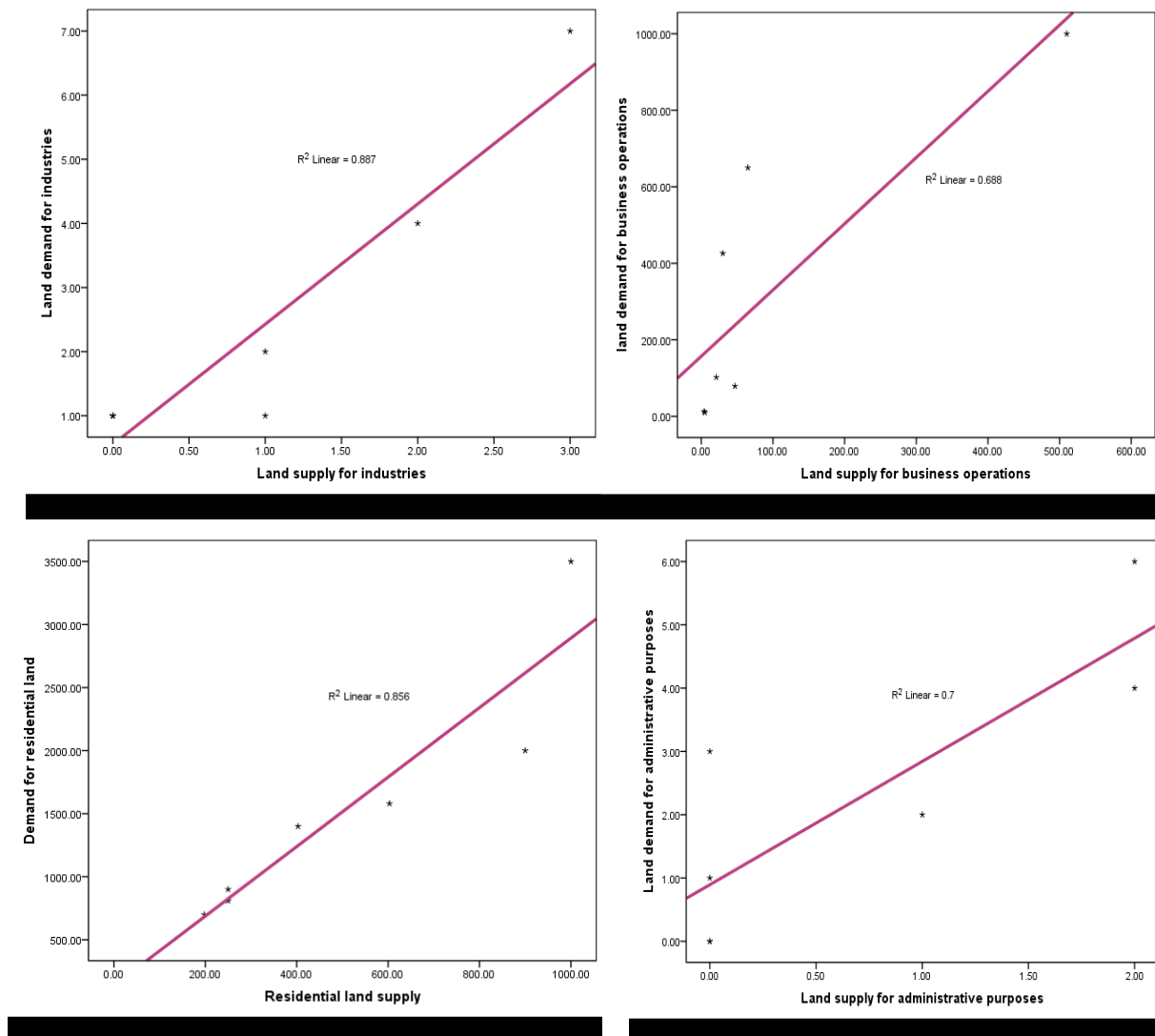
Figure 2. Demand and supply trends for land Nekemte town (2001 – 2007).

The general shortage of land resources owing to high rates of urbanization has seen the sprouting of informal land uses in NUAs of the three study sites. Statistics on the acquisition for land parcels for housing and other purposes by a sample households in the cities of Addis Ababa and Nekemte are not encouraging (Table 1). The bulk of city residence are acquiring land parcels through informal means owing to inefficient land administration procedures and the general shortage of urban land due to rising urbanization rates. Most of such informal settlements are occupying river ecosystems, wetlands and the few surviving urban forests that are found mostly in the urban fringe. In Addis Ababa for instance, it is mostly the river ecosystems, wetlands and highland areas that has fallen prey to informal activities. Such land parcels are usually associated with pockets of land that is lowly priced. Recent rezoning activities in the city has seen land values rising in the inner core of the city as opposed to the periphery (refer to figure 3) This new development alone has seen a steady shift of informality

Table 1. Acquisition of land parcels by a sample of households in Nekemte and Addis Ababa (based on household survey data)

Acquisition of land by sample households in Nekemte / 2008 (n=100)		
	No.	**(%)**
Purchase of land / house	37	23
Inheritance	9	6
Gift	11	7
Municipal allocation	55	34
Other (Renting of gvt. or private house)	49	30
Acquisition of land by sample households in Addis Ababa's Yeka subcity / 2008 (n=110)		
	Kebele 20,21	
	Kebele 19	*Abada & Tafa*	*Total*

Rural Kebele Administration	1(2)	1(2)	2(2)
Buying from Peasants	19 (35)	10 (18)	29 (26)
Buying from speculators	21 (38)	29 (52)	50 (45)
Inherited from parents	11 (20)	16 (28)	27 (24)
Occupation by force	2 (4)	-	2 (2)
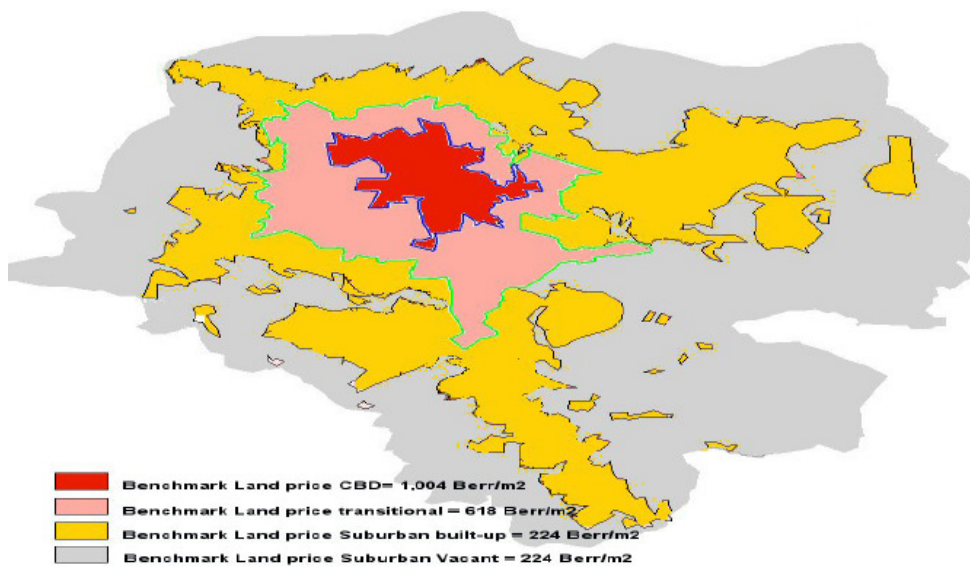
Figure 3. Land prices in Addis Ababa, 2008

trends towards the periphery. This situation has had obvious implications to NUAs bordering the city.

The management status of NUAs has been compounded by the disparity that exist between per capita solid waste generated and per capita solid waste collected and disposed off through formal means. Current urbanization trends have resulted in the general increase in per capita solid waste generated. Unfortunately the three municipal authorities have lacked adequate capacity to deal with the waste disposal challenge. In 2006 / 2007 alone, Addis Ababa city authorities were able to collect 75% of the solid waste generated with the rest deemed to have been disposed off illegally. Similar statistics for the town of Chancho were 50.03% (refer to table 2). Related statistics reveal that in 2004 the daily waste generation in Addis Ababa catchments was estimated to be at 0.252 kg per capita per day and 65% (1482 m2 per day) of municipal waste was collected (Tadesse et al. 2004).These statistics however do not adequately capture waste material generated by informal activities such as squatter settlements. This is because

the formal definition of city residents does not consider informal dwellers as part of the city or town.

Table 2. Solid waste generated and amount collected in Addis Ababa and Chancho town (2006/2007).

Name of city / town	Estimated solid waste generated (m³)	Quantity collected and disposed off formally (m³)	% collected
Addis Ababa city[1]	787305	593125	75
Chancho town[2]	3920	2352	50.03

Most of the municipal waste generated finds its way in riverine system of the city. Increasing concentrations of heavy metals (pH, Mn, Cr, Ni), coliform and pathogen pollution in both surface and groundwater water sources has been discerned by other studies in Addis Ababa alone (Alemayehu et al. 2003; Mazhindu et al, 2011).

The relationship between the likelihood of households describing their surrounding green spaces as poor (i.e probability of green space poor =1) and a number of possible explanatory variables was discerned through the binary logistic regression model. Summary results for the model are depicted in Table 3.

Table 3. Test parameters for factors influencing hosehold perceptions on the quality of green spaces in Addis Ababa, Chancho and Nekemte (n = 618)

	B	S.E.	Wald	df	Sig.	Exp(B)
Poor planning	-.249	.271	.842	1	.359	.780
Location	-3.232	.549	34.620	1	.000	.039
Shortage of land	1.779	.228	61.148	1	.000	5.924
Lack of awareness	.768	.425	3.263	1	.071	2.156
Lack of community involvement	1.854	.390	22.621	1	.000	6.388
Poor coordination	.784	.414	3.590	1	.058	2.189
Constant	.047	.638	.005	1	.942	1.048

The positive Beta estimates on such variables as shortage of land, lack of community awareness, lack of community involvement, and poor coordination signify the influence that

these factors exert on the likelihood of the household describing their surrounding green space as poorly managed. The negative Beta coefficient on poor planning shows that as one moves away from a well planned neighbourhood to a poorly planned one, the likelihood of the household dismissing the green spaces around as poorly managed increases. The negative Beta estimate on location reveals that as one move from the much smaller towns of Chancho and Nekemte, to the much bigger city of Addis Ababa, green space management becomes much problematic in relative terms.

Like in many other African countries, the current divide that exists between urban planning and environmental management agencies has not helped either (Gondo et al, 2008). Despite their concern for sustainable urban development practices, activities of NUPI and EPA have remained separated. This has resulted in a fragmented approach to the management of NUAs. Despite a host of challenges discussed above, authorities in much smaller cities such as Nekemte where urbanization trends have in relative terms not depleted much of the NUAs, have come up with ambitious urban development plans that seek to restore the integrity of NUAs (refer to figure 4).
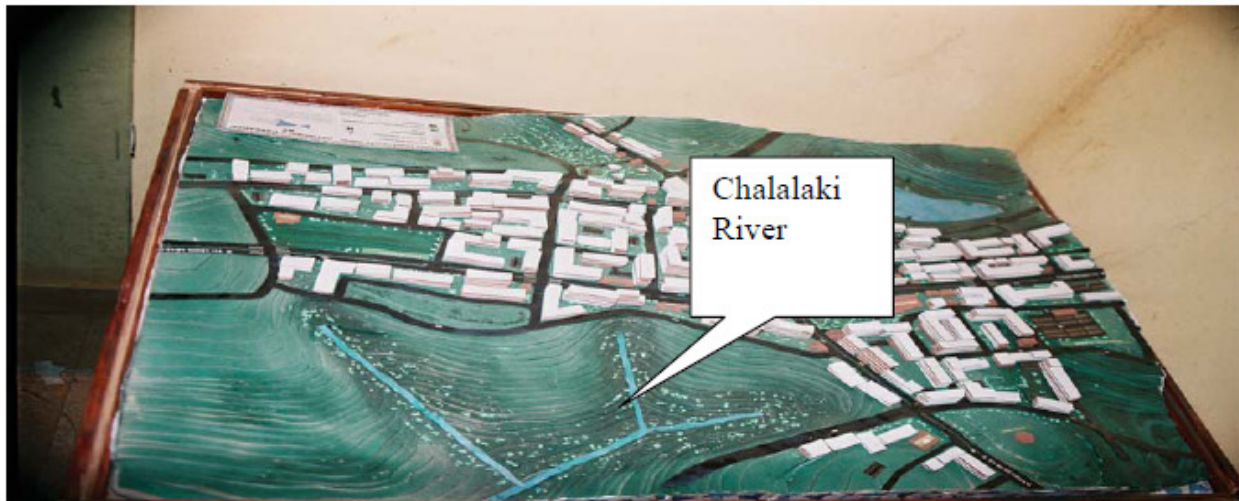
Figure 4. Development plan of Nekemte city showing green areas according to the new master plan.

Source: Nekemte municipality, 2008.

Such a move is a noble one given the insurmountable pressure that urbanization trends are putting on ailing NUAs in most Ethiopian cities and / or towns. The ultimate integration of the green and the built environment that such a city vision seeks to achieve in the city of Nekemte has been thwarted by lack of qualified urban planners, technological and financial resources that are crucial in the quantification and prediction of possible impacts of current and future built areas on adjacent NUAs. Such constraints are also evident in the administrative capacity of municipal authorities in Chancho town and the city of Addis Ababa.

Discussion

Despite their strategic role in fostering sustainable urban development (Agudelo-vera, 2011), NUAs in Ethiopia have never been systematically researched. While many scholars recognize that urban ecosystems have certain characteristics that impact on the ability of urban planners to adopt and develop sustainable urban planning practices (Berke and Conroy, 2000; Jepson, 2001; Lopez et al, 2001; Girardet, 2003; Chen, 2007; Batty, 2008; Wald and Hostetler, 2010; Hostetler et al, 2011; Yang et al, 2011), such factors have not been pursued in Ethiopia - at least within the context of NUAs. This analysis has deciphered some of the factors that influence the adoption or non adoption of such practices in the management of NUAs in the Addis Ababa, Nekemte and Chanhco town.

The analysis reveals that urban planning trends in Addis Ababa, Nekemte and Chancho town have led to the unprecedented loss of NUAs such as green open spaces. The potential risk to ES was found to be surmountable in the much bigger city of Addis Ababa, where urbanization trends are threatening to deplete NUAs. Such a finding suggests that larger cities characterized by a relatively higher rate of urbanization are more likely to suffer from the subsequent loss and thinning of ecosystem services which also leads to loss of resilience and options for future generations (Folke et al., 2004, 2006) than much smaller urban ecosystems such as those found in Nekemte city and Chancho town.

Low urbanization rates in Nekemte and Chancho town have given city authorities an invaluable opportunity to redesign the built and external environments in order to improve liveability and sustainability (Mace et al, 2007). Such an opportunity is however nonexistent, in Addis Ababa where populations are growing faster with the end result being densification of land use activities as evidenced by high rates of informal activities (Ingwani et al, 2010; Gondo, 2011; Mazhindu et al, 2011). The need to address issues of the loss of urban green space is therefore urgent in Addis Ababa where the general decrease in per capita space is high (James et al, 2009). This is partly because urbanization induced loss of NUAs has potentially compromised the capacity of the ecosystem to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity and feedbacks (Berkes et al., 2003; Carpenter and Folke, 2006). Weak development control measures have also seen the much rooming of illegal land use activities in NUAs. The most severely affected land use pockets are those occupying land units that are lowly priced. These factors alone have severely constrained the ability of the urban policy makers to recover from the management mistakes made by previous urban planning policies (Fischer et al., 2006) that characterize the history of the city.

Other challenges affecting the effective management of NUAs include fragmentation of institutions that oversee the management of NUAs. At a more national level, activities of NUPI and EPA have remained parallel – with no coordination despite their one common goal of sustainable management of NUAs. As a result of the existing divide, sound urban management practices have been difficult to implement. Such a development does not come as a surprise given that a host of other scholars have observed that isolated technical solutions are insufficient to deal with the complex environmental challenges faced urban planners (Pahl-Wostl, 2007; Hostetler et al, 2011). Golding, (2007) has also observed the existence of weak partnerships among ecologists, urban designers, landscape architects, and urban residents with obvious implications on the environmental integrity of urban ecosystems. A study by Gondo et

al, (2008) on urban management practices in Ugand's town of Kamwenge revealed that the separation of urban planning and environmental management institutions was severely constraining the management of fragile ecosystems such as wetlands, forests and highland areas among others. Both community awareness and involvement in green issues was found to be low in all the sampled cases study areas. None of the three case study areas had benefited from any credible environmental education and awareness campain that is so instrumental in sound management practices for NUA (Teillac-Deschamps et al, 2009). Absence of an active constituent was identified as one of the major causes of indiscriminate disposal of solid waste by urban residents in most Ethiopian cities and / towns by Gondo et al, (2011). This practice alone has had major eco-hydrological implications for the ES of most affected water bodies in Ethiopia.

Only efforts that seek to integrate NUAs with the built environment will go a long way in restoring the integrity of NUAs. There should be a concerted effort targeted at matching new land uses with the capabilities of proposed land parcels. This can only be achieved through the adoption of a more objective land suitability strategy. More knowledge about the functioning of urban ecosystems needs to be developed (Felson and Pickett, 2005). This would go a long way in raising environmental awareness among urban residents and other important stakeholders in the city planning process.

Conclusion

Despite their strategic role in fostering sustainable urban development the management of NUAs in Ethiopia has remained an under researched area. This analysis has deciphered some of the factor that influence the none adoption of sustainable urban planning practices that seek to conserve NUAs. It has been revealed that the ecosystem service function of NUAs in Ethiopia is constrained by two major factors. On one hand is increasing the increasing rate of urbanization that is putting a strain on limited land resources. On the other hand are weak urban planning policies that have allowed the conversion of some NUAs into illegal land uses such as informal housing, informal business activities and the illegal dumping of both solid and liquid waste. The result has been a high level of fragmented NUAs that are notably not connected into any discernable network of continuous ecosystems. The analysis has argued that absence of a credible land use suitability strategy and lack of a sound land use planning system has compromised the management situation of NUAs. Only sound planning policies for NUAs that seek to restore the grid of natural ecosystems that has been broken would work for Ethiopia.

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