

An Assessment of the Environmental Impacts on Land Use and Land Cover Changes and Strategies of Reducing the Adverse Impacts: A Case of Eldoret Municipality, Uasin Gishu District, Kenya

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Abstract

Land use and land cover changes are quite common in nearly all urban centres, but little has been done to reduce their impacts especially in the developing countries. The green belt policy is intended to check and prevent these problems but according to Harvey (1989), this is not the case. Instead it contributes to spiraling increases in urban land values and adds to the problems of congestion by forcing development in existing urban centre. The study uses information gathered from the field to suggest alternative solutions to the problems brought by land use and land cover changes and urban expansion as a whole. This can ensure the achievement of sustainable urban development in Eldoret town. The study sought to identify environmental problems by analysing the changes and supplementing with other information collected from the field and suggests some of the ways of minimising these problems. Environmental problems related to land use and land cover changes were identified using various techniques. First, they were identified from doing a cross-classification analysis, which involved the running of a CROSS-TAB command from Database query of Analysis module in Idrisi for Windows. Some of the environmental impacts of land use and land cover changes from the study results include; Inadequate regulations, Inappropriate Regulations and Policies, Inadequate Infrastructure Capacity, Inadequate Environmental Information, Lack of Community Participation in Development Planning. It further suggests strategies that could be used to reduce the environmental impacts.

Keywords: Assessment, Environmental Impacts, Land Use, Land Cover Changes, Strategies, Eldoret Municipality

1. Introduction

Urbanization and land use changes determine the environmental quality of urban areas. In the third world countries, these effects are immense mainly due to ineffective land management practices. And they are experienced both within the city and in its periphery.

Hardoy and Satterthwaite (1992) identified pollution as the main problem of cities in developed countries. They noted four sources of these as the sewage, industrial effluent, urban run-off and agricultural run-off. Bernstein (1994) asserts that increased run-off due to urban development can have a negative impact on the downstream watershed hence the surrounding ecosystems. The polluted streams in turn pose danger to both aquatic life and human beings who draw water from the same streams for domestic purposes. Hardoy and Satterthwaite (1989) have also noted that there was industrial growth rate of five percent in the developing countries in 1980s and this envisage pollution which of late had been on the rise in these third world countries.

Wetlands are among the threatened ecosystems due to urban land use changes and this again can contribute to a chain of problems. According to Preece (1992), the filling of swamps for construction in Lagos and Manila have blocked the main river systems and thereby increased periodic flooding of both cities.

Other effects of fast land use changes and urban expansion are: overcrowding, congestion, poverty, unemployment and inadequate infrastructure and services. They all result from poor planning and squatter settlements on hazard-prone lands in the third world cities. According to Bernstein (1994), the condition results in both environmental degradation and increased vulnerability of areas to catastrophic events. Kreimer and Munasinghe (1991) remark that the extensive development on high risk sites, combined with deforestation and the dumping of solid waste in rivers result in increased incidents of flooding and landslides.

One other unavoidable impact of land conversion for urban development is the loss of prime agricultural land. In Egypt for instance, Hardoy and Satterthwaite (1989) noted that ten percent of the productive farm land has been converted to urban use during the last 30 years, which according to Dowall and Clark (1991) contributes to shortage of food especially in urban areas. Encroachment of urban areas does not only happen on farmland but even on other valuable lands. Amuzu and Lectmann (1991) in a study in Accra discovered that vast areas earmarked for recreational, open space and forest purposes have been converted to urban built-up.

Syagga (1992) in his study on Kenyan towns identified three main problems associated with land use planning that has resulted in severe impacts on the living conditions of the urban poor. The second problem is associated with inadequate infrastructural facilities and services like clean water, electricity and solid waste

disposal. Finally there is the problem of pollution especially of urban rivers, which results from domestic sewage and industrial effluent released to these watercourses.

Munyakho (1992) noted a common problem of rapid land use changes in Nairobi and Mombasa to be increased in slum dwelling. This increases the presence of street children who survive on scavenging, begging and hawking while their peers are in school. In Kisumu, Anyumba (1995) has identified the degradation in housing facilities, mountains of domestic solid waste, inadequate water supply, sewage disposal and difficulties in controlling industrial effluent as the most disturbing problems, which have emanated from the rapid growth of the town.

The rapid growth of population in Eldoret has led to a number of problems namely: shortage of housing and health facilities, inadequate recreation facilities, shortage of water, poor sewage disposal and the general degradation of environmental quality. This in turn has strained the Municipality's ability to provide for these services (Eldoret Municipal Council, 1985).

2. Material and Methods

This study attempts to explore some of the environmental problems that result from land use and land cover changes. Eldoret municipality is chosen for this study since Eldoret town provides an ideal situation of an inland urban area that has undergone drastic changes in the recent past. Availability of aerial photographs was also taken into account in choosing the study area. The aerial photographs were used as the main source of data for the study. The proximity of Eldoret Municipality to Moi University, where the facilities for data analysis are easily available, also played a role in the choice of the study area. Environmental problems related to land use and land cover changes were identified using various techniques. First, they were identified from doing a cross-classification analysis, which involved the running of a CROSS-TAB command from Database query of Analysis module in Idrisi for Windows.

The cross-classification, which can be described as a multiple overlays, showed all combinations of logical operation. The image attributes for 1973 were first expanded to match with those of 1993. After this, cross-classification analysis was run and this resulted in a new image as well as a table showing the location of all combinations of the categories in the original images. ASSIGN module was used to filter all the areas which were identified as problem areas. ASSIGN created a new image by linking geographical attributes of features defined in the first image file with attributes defined in an attribute values file. This resulted in a map showing the location of some of the problems in the study area. Secondly field survey coupled with observation technique was done to ascertain the location of environmental problems of land use/land cover changes. Photographs were taken for some of the visible problems.

3. Results

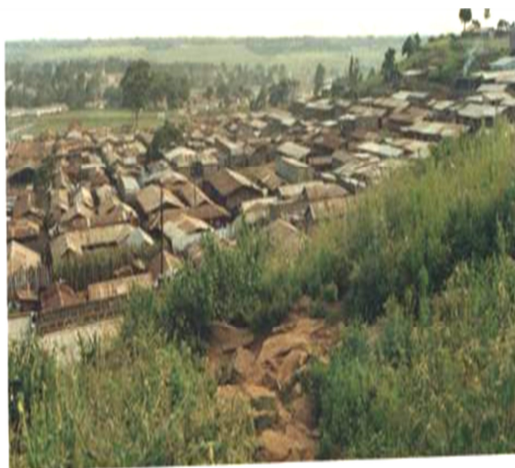


Plate 1: Overcrowding in Kamkunji estate



Plate 2: Encroachment on a wetland around Elgon View estate



Plate 3: A dangerous pool of water collected on an unrehabilitated quarry near Raiply wood processing plant



4: Settlement and cultivation on an unsuitable site

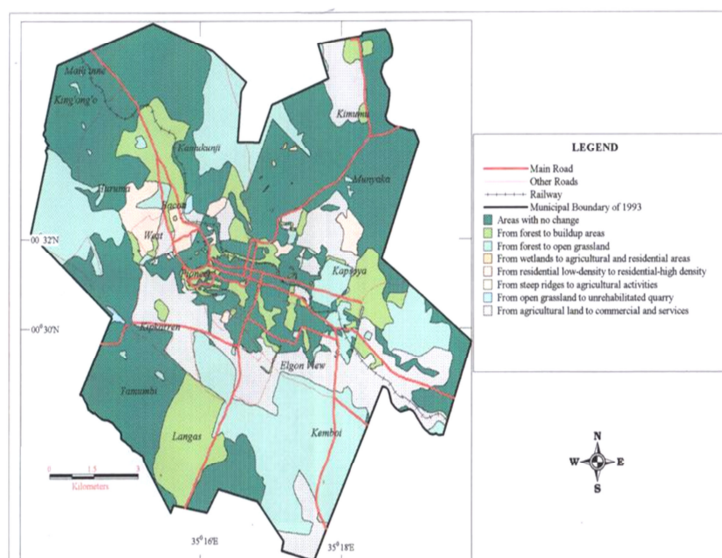


Figure 1: Land Use and Land cover change map from aerial photographs taken in 1973 and 1993

3.1 Environmental Impacts of Land Use and Land Cover Changes

Cross-classification analysis was done in order to identify the major problems of the rapid land use and land cover changes in the study area. The results show that the common problems that have arisen between 1973 and 1993 include: encroachment on agricultural land, deforestation, encroachment on wetlands, overcrowding, settlement and cultivation on unsuitable sites and water pollution. It was, however, noted that apart from the above problems there are a few positive impacts of the land use and land cover changes in the study area. These include: agricultural improvement in the rural hinterland as well as increase in remittances to the rural areas (Nyakaana 1996).

3.2 Encroachment on Agricultural Land

Due to the rapid expansion of the town, the surrounding agricultural land is being converted into other uses. Figure 1 indicates that vast areas that were used for production of both food crops and cash crops in 1973 had been converted into the built environment by 1993. In addition to this, the open-urban land that could promote the scenic beauty of the town was taken away to provide room for built-up expansion. The results indicate that in 1973 about 358 hectares of the study area was under agricultural lands while about 5604 hectares in 1993 were classified as agricultural land. Though this is an increase it is still a problem because the urban boundary has expanded between the two years so as to engulf more agricultural land. Figure 1 shows how the areas under agriculture and pasture in 1973 have been converted into residential and commercial utilities by 1993. This is

likely to increase the food prices in the study areas especially for vegetables and milk which are transported to town from the rural areas. There is therefore a need to enact by-laws that prevent urbanisation from impinging on rural areas especially agricultural land while safeguarding urban agriculture.

3.3 Deforestation and Encroachment on Wetlands

Rapid land use and land cover changes do interfere with biological communities which are both ecologically and economically important. The built environment as it expands, demands more space which is often obtained through deforestation and de-vegetation of the plant ecosystem, and thus destroys the natural habitat for both flora and fauna.

Figure 1 illustrates the land use and land cover changes between 1973 and 1993. This clearly indicates the areas which have undergone deforestation and encroachment of wetlands. Plate 2 indicates how wetlands are being threatened in some parts of the study area particularly the south-western part of Elgon View, where wetlands are drained to pave way for residential establishments.

Wetlands are important because they reduce flooding, recharge groundwater, control pollution, harbour wildlife and regulate temperatures of the surrounding environment.

3.4 Overcrowding

Overcrowding is another characteristic common in towns experiencing rapid land use changes. This rapid land use change together with urban expansion result in the mushrooming of unplanned housing facilities which are normally congested and lacking basic social amenities such as clean drinking water, sewage connection and sanitation and thus lead to epidemic diseases. Overcrowding, poor sanitation and uncollected garbage are the common conditions of the slums in the study area (see plates 1 above).

The study also show that some of the areas which were under residential high density in 1993 were occupied by other land use and land cover types in 1973, such as residential low and medium density, dense forest, forest clear-cut, open land and steep slopes. Figure 1 further indicates that those areas of residential high density are found in Kamukunji, Huruma and Langas Estates. Thus an implicit of environmental problems related to overcrowding in the study area.

3.5 Settlement and Cultivation on Unsuitable Sites

Figure 1 illustrates that some parts of steep hill sides in the study areas are being cultivated. These are landslide-prone areas which should not be settled or cultivated due to such risks. Kamukunji slum area for instance has expanded towards the hillside behind which there is a quarry which poses more risks to the occupants because of the poor soil strength (see Plate 1 and 4).

The study indicates that in 1985 quarries occupied 1.2 hectares of land which increased 25.3 hectares by 1993 (Plate 4). Quarries, which are large openings on the earth surface used for stone mining, are unsuitable sites for settlement. This is because they collect rain water to form pools of water which are breeding places for mosquitoes and also risky to young children who might drown in them (see Plate 3). These abandoned quarries also destroy the beautiful scenery if not rehabilitated as soon as mining is over. Active quarrying also uses dangerous blasting which may cause death of animals or even human beings around, hence there should be buffer zones and fencing around active quarries so as to minimize danger to nearby settlements.

3.6 Water Pollution

Water pollution is a common problem in the study area since river Sosiani and its tributaries traverse the main built-up areas like residential, commercial and industrial areas. Pollution of the river is mainly attributed to liquids washed from industrial and domestic sources and uncollected garbage which are often washed down through the urban pavements to the river. All these lead to accumulation of various pathogens in the river, though this study didn't attempt to collect the data for such pathogens. However, increase in the built-up environment is a clear indicator of water pollution in the study area.

3.7 Agricultural improvement in Eldoret's Hinterland

The rapid expansion of land use types in an urban area also result in increased demand for food supply due to increase in urban population. This forms a ready market for the farmers who find it profitable to increase their output in order to have a salable surplus. Unwin (1989) suggests that with increase in urban land use type there is a requirement to increase the flow of food so as to sustain an increasing urban population.

Gould (1987) in his study on Kenyan towns found out that a high proportion of food for the majority of urban population is procured from local small scale farmers. In Eldoret Municipality, much of the food stuff come from Kakamega, Trans Nzoia, Kericho and even as far as Nyanza and Coastal Provinces (Nyakaana, 1996). Uasin Gishu district, which constitute the immediate hinterland, concentrates on cattle keeping and large scale growing of wheat and maize with little cultivation of other food crops. Eldoret therefore provides a ready market

for fresh agricultural produce from these areas.

3.8 Increase in flow of Remittances from Eldoret Municipality to its Immediate Hinterland

The practice of remitting funds to rural areas by urban workers is evident in a number of African towns. In Tanzania, Gulliver (1995) discovered that the worker in the urban area remitted not only cash but also clothing accounting for 20% of the annual cash of that worker. Carter (1970) conducted his survey in Liberia and found out that at least 53%, of the households he interviewed received their assistance from their relatives working in urban areas.

In Nairobi, a study by Johnson and Whitelaw (1974) revealed that 89% of the low and middle-income earners remitted substantial amounts of their income to their rural families. Remittances from workers in Eldoret was studied by Nyakaana (1996) who found out that about 88% of the formal workers in the town remitted a good amount of money to their relatives in rural areas. Ombura (1997) further noted that the majority of workers in Eldoret formal sector come from diverse districts, which include: Kakamega, Bungoma, Siaya, Kericho, Uasin Gishu, Nandi, Trans Nzoia and South Nyanza.

This therefore implies that, with increase in land use changes in Eldoret Municipality, more rooms are opened for more workers, who in turn increase the flow of remittances to various rural areas. These remittances are either in form of money or other materials that play an important role in the socio-economic development of rural hinterland.

4. Discussion

4.1 Environmental impacts of land use and land cover changes in the study area

The results from cross-classification analysis illustrate the major environmental problems related to urban expansion and land use changes in the study area. These include encroachment of agricultural land, deforestation, encroachment of wetland, water pollution and settlement on unsuitable sites. The major explanation for these problems is that there has been some poor management of the land and the general environment, leading to rapid expansion of the built environment at the expense of the other land cover types. The poor management practices are discussed in the following sections.

4.1.1 Inadequate regulations

This is the most important factor accounting for losses of ecologically important resources as well as settlement on unsuitable sites by low income population. Development plans and policies in the study area have been enacted just to form strategies for expansion of land use types without taking into account the environmental quality. These policies have encouraged rapid expansion of the built environment which in turn has raised the land prices as well as the house rents thus forcing the poor to squat illegally on the vacant lands which are often unsuitable sites.

In addition, there are no effective land use policies and standards in the study area that address development in the sensitive areas, or if they exist, then they have never been enforcing adequately in the existing land use policies. Encroachment on wetlands could not have taken place if adequate regulations safeguarding such ecosystems were being enforced. It is also true that enforcement of recommendations of physical development plan (PDP) of 1970 resulted in rapid infrastructural developments with little consideration of their environmental impacts. Large parts of the study area were excavated to provide building materials which up to now remain as dangerous openings on the land surface because of inadequate regulations for their rehabilitation.

4.1.2 Inappropriate Regulations and Policies

Inappropriate regulations and policies in the study area have probably accounted for losses of ecologically important resources and occupation of low-income populations on unsuitable sites. The government policies which led to expansion of Municipal boundary both in 1974 and 1988 were actually necessary, but the way expansion itself has been done has contributed to a number of environmental problems.

With the boundary expansion from 25 square kilometers to 147 square kilometers, large areas under agricultural and forest covers brought under jurisdiction of the Municipality, are slowly by slowly being converted into built environment. These areas are also owned by individuals and co-operatives that have subdivided them according to their wishes and thus led to spontaneous growth of undesirable buildings. Ombura (1997) noted that hundreds of uncontrolled peripheral settlements in Eldoret exist in the corridors between the old and the new boundaries.

Furthermore, inappropriate zoning regulation of the Eldoret physical development plan (EPDP) of 1980 has encouraged expansion of the built-up environment at the expense of other land cover types. Deforestation has now taken place in order to pave way for both industrial and residential establishment. These zoning regulations have also resulted in high rental rates of residential houses such as in Kapsoya and Kahoya estates that are only affordable to high-class town dwellers. The low-income residents who cannot afford such formal housing are forced to live in squatter settlements found in estates like Kimumu, Langas and Kamukunji.

4.1.3 Inadequate Infrastructure Capacity

The lack of adequate infrastructure is another principal factor accounting for the environmental problems experienced in the study area. Most estates are not served with the necessary infrastructural and social facilities making inhabitants vulnerable to natural hazards. It is true that the urban population has increased so rapidly and cannot cope with the rate that Municipal Council is providing such facilities. It should also be noted that, with the boundary extension, the rural areas included need to be provided with the necessary infrastructural facilities, an issue which demands more than the capability of the Municipal Council.

The second contributing factor to the above problems is the type of land ownership that exist in the study area. The land within the old municipal boundary was wholly government land, but with the extension of the municipal boundaries, private agricultural land was brought into the jurisdiction of the council. These are large farms which are owned by individuals and co-operatives and have now been sub-divided to lead to spontaneous emergence of uncontrolled settlements. Such settlements lack the necessary sanitation, water and other social amenities.

Finally, the above problems can also be explained by the nature of land policies in the study area. The local government policies found here are mainly concerned with planning and zoning for development without considering the environmental impacts of these developments. Most of these developments are also implemented without basing them on the results of environmental impact assessment which is hardly done.

In addition to this, the government's growth centre policy which aimed at promoting the small urban centres has helped to perpetuate the high land prices in the study area. The growth of infrastructural, commercial and educational facilities in the study area encouraged the land owners to increase the land prices as well as house rents. The low income earners are left with no other choice but to live in slums. These slums are overcrowded and normally constructed in sites unsuitable for residential. Some of these include Kamukunji, Huruma, Langas and Kimumu estates.

4.1.4 Inadequate Environmental Information

Information relating to environmental quality, waste management practices and housing conditions is inadequate in the study area. The inadequate records and outdated methods of data collection make it difficult for the Municipal Council to establish effective regulations and policies of land use development. Due to this inefficiency, the plans and decisions made are always overtaken by the rapid growth of the town. Hence remote sensing data and the Geographic Information systems are vital for identifying problems in these growing urban areas.

4.1.5 Lack of Community Participation in Development Planning

Development planning in the study area is mainly done by the physical planning unit. They do not involve the local people in their planning processes and as such land use developments in the area are not in harmony with environmental concerns. This is because this kind of planning inhibits the community's participation in identifying their problems and resources and thus failure to find solutions which address their problems in an integrated way. There is therefore an urgent need to involve the local people in all the planning and management processes in urban areas in order to alleviate common urban problems.

4.2 Strategies for Reducing Problems of Land Use and Cover Changes

Land use and land cover changes have indeed caused a number of problems in the study area. These problems are varied and are mainly felt by the urban majority. A proper and urgent solution is therefore required to minimise the problems. This involves a balance between environmental concerns and land use development in an urban area. These strategies include:

4.2.1 Protection of Sensitive Land Resources

Under this approach, environmentally threatening activities in sensitive areas like wetlands and forests should be minimised as part of a broader environmental management framework. This can be done by banning all the settlements that seem to extend towards these sensitive areas. Further, buffer zones should be established to delineate and protect these areas from further settlement.

In addition to this approach, the land authorities need to guide development to environmentally appropriate sites while banning development on land having ecologically significant values. The land authorities should provide primary infrastructure to sites where development is desirable or where services permit increase of allowable densities in existing urban areas. The land use types which are developed in areas that are likely to cause irreversible damage to priority resources should be banned.

4.2.2 Management of Hazard-Prone Lands

The problems which are rampant in the slums of the study area are accelerated by the council's neglect of road and drainage maintenance. To alleviate this problem, the local authority should invest in infrastructural improvements as well as the general improvement in the management of urban services. Certain hazard-prone areas should also be developed with compatible land uses. The hill sites should be designated as forest lands so as to limit encroachment of settlements on these sites. While the quarries which have been created in the study

area should be improvised for fish farming as a means of rehabilitation, alternatively, any new developments should only be enforced once Environmental impact assessment has been undertaken.

4.2.3 Conservation of Open Urban Land

Open urban land in the study area is being converted to built-up environment at unprecedented rates. These areas should be delineated and protected so as to meet the minimum needs of the urban recreation, drainage or aquifer recharge. However, where shortages of urban land are elevating housing costs and pushing the poor out of the legal land market, this protection of open space should be avoided. Nonetheless, where there is a need to use the open areas for drainage, aquifer recharge or recreation as important environmental concern, the local authority should preserve at least the minimum land required for the purpose.

4.2.4 Discouraging Excessive Urban Expansion

The excessive urban expansion in the study area led to encroachment and conversion of both agricultural and forest lands for other purposes. Where expansion is seen to be approaching these resources, it should be discouraged. To facilitate this, land tenure should be clarified while other regulatory reforms that improve the functioning of the formal urban land markets are implemented. These two activities will go a long way towards making larger areas of urban land available for housing and thus reduce development pressures on urban peripheries.

4.2.5 Adopting a Bottom-Up Approach in Urban Environmental Planning and Management

In planning and managing of urban land so as to achieve environmental objectives, there is a need to involve the local people's participation. This can be done through the incorporation of local community, who include local leaders, pressure groups like churches and government officials.

This participation in decision making and management of urban areas is crucial because of the following reasons;

- (i) It provides a means of generating financial resources either through fund raising or welfare associations, which is useful in developing urban areas.
- (ii) It promotes the implementation of plans made because the ideas have come from the people themselves.
- (iii) It educates the local people on their rights and obligation in the planning processes as well as bringing awareness on the environmental problems that exist due to unplanned land uses.

5. Conclusion

It is clear that rapid land use and land cover changes can cause environmental problems which include loss of biodiversity, loss of agricultural land, settlement on hazard-prone areas as well as poor living conditions such as poor sanitation, overcrowding and inadequate drinking water.

The study therefore recognizes the need to control land use and land cover changes and the related problems in urban areas particularly for the purpose of promoting a quality environment both for the present and future generation.

6. Recommendations

The study proposes land management strategies that will place emphasis on environmental control while promoting urban development.

There is a need for an integrated land management strategy which involves: protection of sensitive land resources through establishment of buffer zones, provision of alternative safe sites for redevelopment of low-cost housing already existing in hazard-prone areas.

Management of hazard-prone lands should consider the following:

- (a) Discouraging excessive urban expansion on important ecological areas such as forests, wetlands and agricultural lands.
- (b) Adopting bottom-up approach in environmental planning which involves the local people in planning for their neighborhood

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