Land Use and Land Cover Types in Eldoret Municipality, Uasin Gishu County, Kenya, in the Years 1973, 1985 and 1993

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Abstract

Land is an important natural resource but it is often misused by man through imposition of many activities on it without considering its sustenance and future utility. These activities also influence the changes in both land use and land cover types of a place. This paper aims at exploring the land use and Land cover types in Eldoret Municipality. 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 therefore used as the main source of data. 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. Data was also obtained from documented literature such as the government reports related to urban development and Municipal annual reports on Eldoret town. The Kenya government development plans and other reports on urban growth and urban environmental management were also used. From the results of the study, land use changes can be attributed to policies and development plans which have no emphasis on environmental concerns.

Key Words: Land Use, Land Cover Types, Environment, Eldoret Municipality, Natural Resources

INTRODUCTION

Land Use Pattern of Eldoret Town

The Land use patterns of Eldoret Municipality have been changing following the extensions of boundaries in 1959 (25km²), 1974 (59km²) and 1989 (147km²). However the major land use and land cover patterns include commercial activities (0.3%), industrial activities (3.7%), recreational (3.3%), educational institutions (5.9%), infrastructural (1.7%), aquatic (0.4%), residential (19.6%) and deferred land (64.4%) (Ombura, 1997).

Urban centres can provide a healthy and stimulating environment for their inhabitants without necessarily imposing unsuitable demands on natural resources and ecosystems. This will happen only if the land use and land cover types in these centres are designed in such a way that they contribute to the achievement of a number of goals. Such goals include attainment of healthy living and working environment for inhabitants, adequate water supply, provision for sanitation, efficient garbage disposal surface and underground drainage, paved roads and other forms of infrastructure. There should also be a sustainable relationship between demands of

consumers and the ecosystems on which they draw the resources. If all of these are achieved, environmental hazards will be minimized while live ability within urban centres will be promoted. This study assumes that the growth of Eldoret town has brought about a number of land use and land cover changes both within and around the town which in turn have resulted in a number of environmental costs.

With the elevation of Eldoret township to a municipality status, expansion of land use activities called for more land from the surrounding agricultural land, especially in an attempt to alleviate housing problem in 1985 (Eldoret Municipal Council, 1985). The loss of large hectares of fertile agricultural land results in the decline of the much needed food which is essential for a high quality urban life. Nyakaana (1996) notes that the bulk of foodstuffs consumed in Eldoret come from diverse sources as far as Coast Province, Uganda, Western and Nyanza Provinces.

In addition, expansion of built environment and other infrastructural facilities sometimes takes place over the lands which are ill - suited for such activities and which are fragile, thus negate the quality of life for the dwellers. Settlement on these fragile environments poses risks to dwellers such as flooding and loss of both life and property.

Hardoy and Satterthwaite (1992) point out that urban development directly transforms large areas of the earth surface. Such transformations may be such that hill sides may be cut or bulldozed into new shapes, valleys and swamps may be filled with rocks and waste materials, water and mineral may be extracted from beneath an urban centre, and soil and ground water regimes modified in many ways. Eldoret town is no exception; already, the need to expand the town rapidly has necessitated the cutting of hill sides to generate building materials in the town. Also, the rapid expansion of land use activities result in reduction of vast areas of wattle trees, which are cleared to pave way for residential and other infrastructural developments, as well as to provide the needed raw material for the industries. This particular activity has greatly accelerated in recent times, as the East African Tanning and Extract Company winds down its operations and sells off its forests.

Natural habitats are also endangered due to rapid increase in population which calls for more room to develop residential areas and other essential facilities. Environmental degradation is obvious when the same population increase happens so rapidly and without any associated expansion in the necessary services and facilities required for a healthy urban environment. Housing is, perhaps, the most acute and visible problem facing most urban centres in Kenya, the shortage of which results in escalating house rents and mushrooming of slums and squatters in urban centres. Other associated problems are inadequate water supply, lack of open spaces, poor sanitation and poor management of solid waste.

The effects of all these fall especially on the urban poor, who pay with ill health and sub-human living conditions. The low income estates of Eldoret town such as Kimumu, Kamukunji, Langas and Huruma are no exception. According to the 1989 National population census, population densities of these areas were about 1,600 per square km (Republic of Kenya, 1994a). These were regarded as a danger to public

health as they lack adequate essential facilities like clean water supply, toilets, solid waste disposal and other infrastructure.

Thus monitoring of land use and land cover changes is quite relevant in Eldoret town in order to find ways of mitigating such environmental costs as well as offering alternative options for human settlement.

MATERIALS AND METHODS

Aerial Photographs and Topographical Maps

Three sets of black and white panchromatic aerial photographs at different scales were used to identify land use types. These were the 1973 (1:12,500), 1985(1:10,000) and 1993(1:35,000) photographs. Topographic maps (1:50,000) covering the entire area of Eldoret Municipality were used for geo-referencing of spatial data.

Documented Data

Certain data was obtained from various documented literature, which involved reviewing of target documents such as government reports that relate to urban development, the Kenya government development plans and other reports on urban growth and urban environmental management.

Data Collection and Interpretation

Land use and land cover data of Eldoret Municipality were interpreted for a 20-year time period from aerial photographs taken in 1973, 1985 and 1993. Each set of photographs was first assembled for pre-view so as to prepare a temporary classification system as well as assess the quality of the photographs. The first pre-survey made was to confirm the adequacy of photographs in providing the required data.

To suit the study, Anderson‘s (1976) classification system was modified to aid in interpretation and formulation of the legend. Modification of the Anderson (1976) system involved the merging up of the three levels of classification to one and the expansion of its categories into nineteen.

Using a mirror stereoscope, the photographs were interpreted one by one while applying photo image characteristics such as tone, texture, pattern and association to differentiate the features. The delineations of land use and land cover types from each run were recorded on a transparent sheet of paper which was superimposed on the photographs. These transparent sheets of paper for different runs were later assembled on the light table and compiled into a composite map of land use and land cover type and mapping units. The major land use and land cover types were then obtained for each year. However, due to the limitation of the varied scales of aerial photographs, the land use and land cover types could not be classified up-to level three of the Anderson (1976) classification system. The photographs taken at the medium scale of 1:35,000 could only allow interpretation of land use types in level one and very few in

level two. The photographs taken at a scale of 1:25,000 allowed interpretation of land use types in level one and two. And those taken at a scale of 1:12,500 allowed interpretation of levels one and two clearly but very few land use types from level three could be distinguished.

A second phase of field check was undertaken where the compiled drawings of land cover types were crosschecked for verification, completion and recording of the polygons which were not clear from the photographs. Fair drawings of the land use and land cover maps for the three set of years were completed.

Since the fair drawings of maps were not geo-referenced, three sets of topographic maps (1:50,000) covering the entire area of Eldoret Municipality were used to geo reference the spatial data obtained. Certain features/areas appearing on both the fair drawings and topographic maps were identified and their co-ordinates recorded to obtain the control points.

This analogue data was now ready for digitization. The features to be digitized were assigned the feature codes and digitized in Cartalinx Software. This was the most crucial exercise that led to a GIS Database generation from which analysis could be done. Digital data produced were edited using both interactive and batch modes. The resultant data was then coded before being exported to Idrisi programme for analysis.

GIS Analysis

Data analysis and presentation relied mainly on the three maps produced. Using Idrisi Software (version 2.01), the maps were compared and manipulated through overlays. This was meant to; quantify the changes, obtain their percentages and determine the nature, extent and intensity of changes.

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, shows 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.

RESULTS

Land Use and Land Cover Types in the Years 1973, 1985 and 1993

The characteristics for land use and land cover types in the years 1973, 1985 and 1993 are presented in the form of figures and tables. The acreage for these land use and land cover types during the three years is expressed in hectares and percentages. In 1973, the Municipal boundary was 2516.3 hectares while the land use and land cover types identified were seventeen as presented in figure 1 and table 1. The open urban grassland occupied the largest part of the study area during this year. This was 804.4 hectares which was equivalent to 31% of the total area in that year. This is the area which had not been used for construction and was not under any forest cover except for the grass cover. The same land could be used as pasture land by farmers within and around the Municipality.

The next largest land use type was agriculture row crops which covered 303.7 hectares, equivalent to 12.07% of the total area for that time. These were areas under such crops like maize, beans and potatoes grown for either subsistence or commercial purposes. They were located mostly at the outer edges of the Municipality. Residential Medium Density was the next largest during this year and this represented the area which was moderately settled in terms of densities. Residential Low Density referred to sparsely settled area while Residential High Density referred to areas with packed settlements.

The areas under the quarries and dumping sites did not appear in the year 1973. This implies that they either did not exist within the Municipality or they occupied a small area that could not be identified from aerial photographs.

Land use and land cover types of 1985 are presented in figure 2 and table 2. The Municipal boundary had expanded to 5951.7 hectares during this year and the land use and land cover types had increased to nineteen different types due to the presence of the quarry and dumping site occupying 1.2 hectares and 21.9 hectares respectively. The dominant land cover type in this year was still the urban open land with an area of 1754.7 hectares which was 29.48% of the total area that time. The second largest land use type was agriculture row crop followed by forest clear-cut, occupying 1411.7 hectares and 665.8 hectares respectively. At this time, quarries occupied the least area, 1.2 hectares which was only 0.02% of the total area. The 1993 land use and land cover types are presented in figure 3 and table 3. The Municipality had again expanded and now covered 14770 hectares.

The results show that agriculture-row crops was the largest land cover type with 2350.6 hectares, which implies that a lot of agricultural land had been included in the urban area. The next largest land cover types was the forest clear-cut which refers to that area where the trees had been felled by the time the photography of the areas was done. The least land cover type (8.2 ha) was recreational which occupied only 0.06 % of the total area.

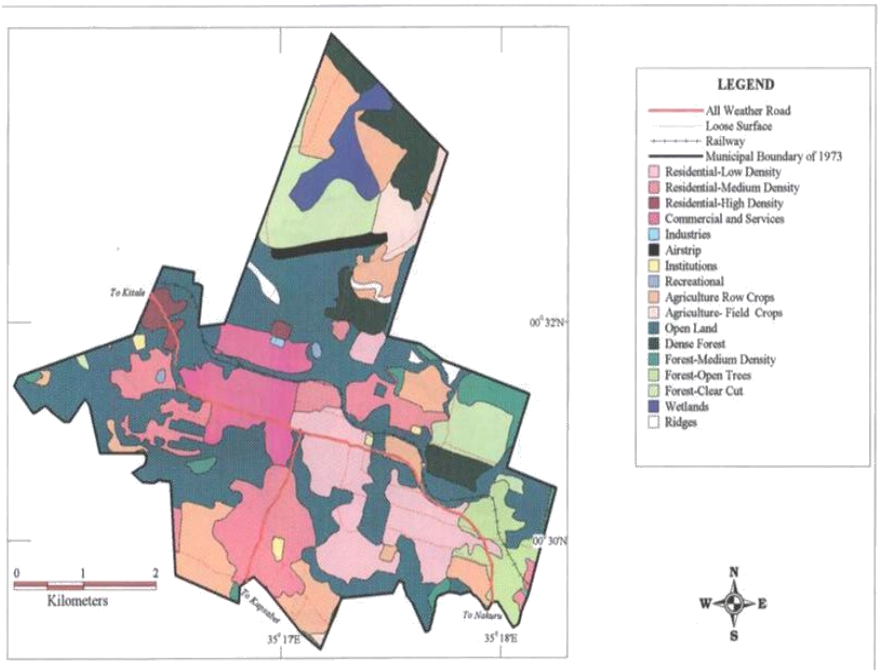

Figure 1. Land use/ Land cover types in Eldoret Municipality derived from aerial photographs taken at a scale of 1:12500

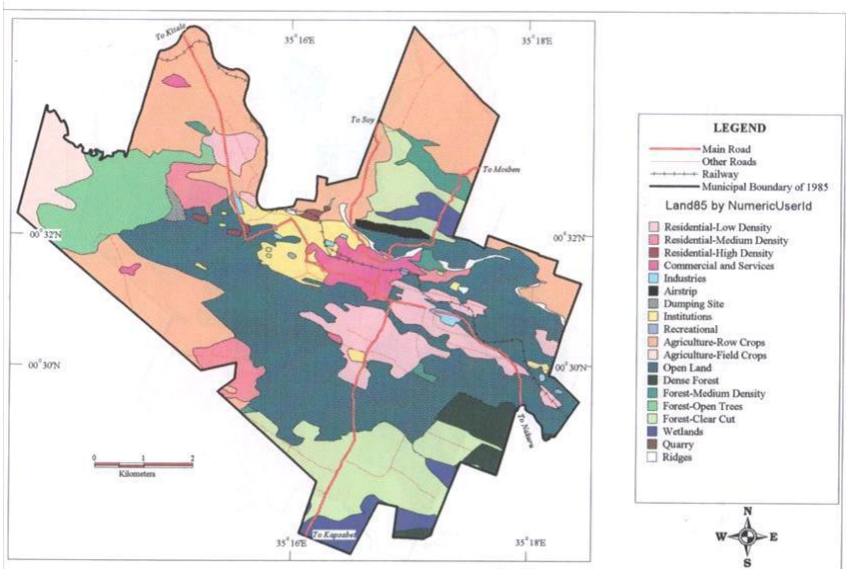

Figure 2: Land use/ Land cover types in Eldoret Municipality derived from aerial photographs taken in 1985 at a scale of 1: 25000

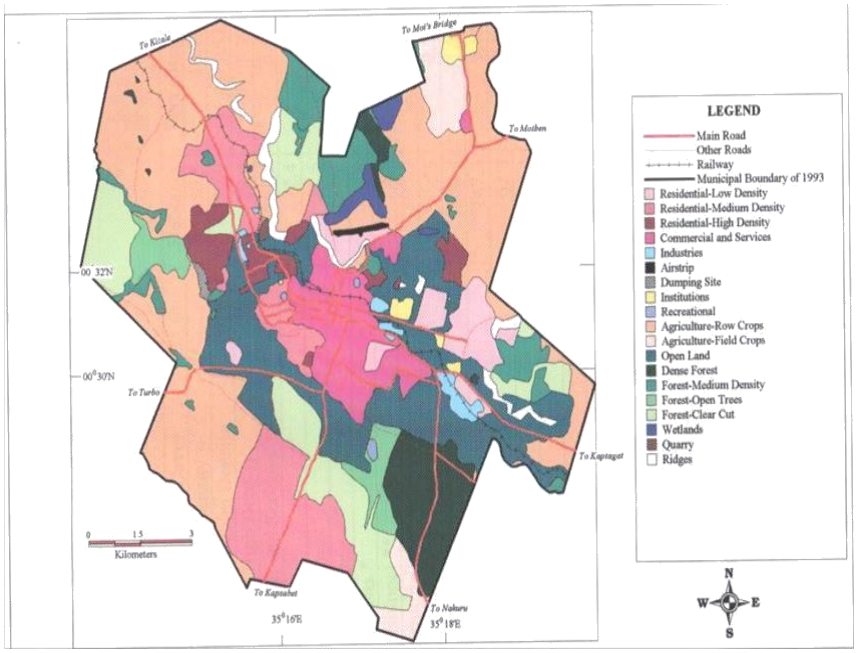

Figure 3: Land use/land cover types in Eldoret Municipality derived from aerial photographs taken in 1993 at a scale of 1:35000

Table 1. Areas of land use and land cover types in hectares and percentages in the year 1973 derived from aerial photographs taken in 1973

Land use and Land Cover	Hectares	Percentage
Residential Low Density	256.5	10.19
Residential Medium Density	289.9	11.52
Residential High Density	29.9	1.19
Commercial and Services	161.5	6.42
Industries	2.4	0.10
Airstrip	21.6	0.86
Dumping Site	-	.0
Institutions *	9.5	0.38
Recreational **	3.9	0.15
Agriculture row crop	303.7	12.07
Agriculture field crop	55	2.19
Open urban grass land	804.4	31.97
Dense forest	147.3	5.85
Forest Medium Density	62.8	2.50
Forest Open Trees	89.4	3.55
Forest clear-cut	186.3	7.40
Wetlands	72.5	2.88
Quarry	-	0
Ridges and Bare rock	19.7	0.78
Total	2,516.3	100

* Only the area covered by institutional buildings

* *Both public and institutional recreational facilities

Table 2. Areas of land use/ land cover types in hectares and percentages in the year1985, derived from aerial photographs taken in 1985

Land use and Land Cover	Hectares	Percentages
Residential Low Density	409.4	6.88
Residential Medium Density	372.4	6.26
Residential High Density	57.1	0.96
Commercial and Services	167.4	2.81
Industries	25.8	0.43
Airstrip	21.6	0.36
Dumping Site	21.9	0.37
Institutions *	26.5	0.45
Recreational * *	4.7	0.08
Agriculture row crop	1411.7	23.71
Agriculture field crop	179.5	3.02
Open urban grass land	1754.7	29.48
Dense forest	152.2	2.56
Forest Medium Density	84.0	1.41
Forest Open Trees	380.6	6.39
Forest clear-cut	665.8	11.19
Wetlands	175.9	2.96
Quarry	1.2	0.02
Ridges and Bare rock	39.3	0.66
Total	5951.7	100

* Only the area covered by institutional buildings

* *Both public and institutional recreational facilities

Table 3. Areas of land use and land cover types hectares and percentages in the year 1993 derived from aerial photographs taken in 1993

Land use and Land Cover	Hectares	Percentage
Residential Low Density	439.4	2.97
Residential Medium Density	1135.6	7.69
Residential High Density	421.8	2.86
Commercial and Services	882.8	5.98
Industries	51.0	0.35
Airstrip	21.6	0.15
Dumping Site	21.9	0.15
Institutions *	129.6	0.88
Recreational * *	8.2	0.06
Agriculture row crop	5171.0	35.00
Agriculture field crop	433.3	2.93
Open urban grass land	2350.6	15.91
Dense forest	779.1	5.27
Forest Medium Density	782.0	5.29
Forest Open Trees	168.8	1.14
Forest clear-cut	1550.8	10.50
Wetlands	147.3	1.00
Quarry	25.3	0.17
Ridges and Bare rock	250.8	1.70
Total	14,770.9	100

* Only the area covered by institutional buildings.

* *Both public and institutional recreational facilities

DISCUSSION

Land Use and Land Cover Types for the Years 1973, 1985 and 1993

This section discusses the major land use and land cover types that existed in the study area during the three years mentioned. A comparison made between these years shows that all the land use and land cover types have undergone some changes, the main ones being the built environment, forest and agriculture. All these recorded some increase during the three years, and some have increased due to the expansion of the municipal boundaries. The increase in the built environment has a lot of implications which include encroachment on agricultural lands, deforestation, water pollution and encroachment on wetlands within the study area. The major explanation for this is the growth of population as well as the unplanned and planned social and economic structures. Bourne (1967) identified four main processes controlling urban land use change namely; the extension of the urban edge, or suburbanization, the renewal of the central area, the expansion of the infrastructure and the growth and decline of nucleation such as the removal of industrial areas from the inner city and the growth of institutional and recreational centres in the suburbs.

It is also noted here that the issue of land ownership has played a role in shaping the land use types of the study area. The areas which were formerly occupied by forest and agriculture are privately owned lands. And with the inclusion of these lands into the Municipal Council, the owners still have the control of their lands. These have been developed without basing them on the plans of the Municipal Council, as a result a number of undesirable land use patterns have come up.

CONCLUSION

The objective of the paper was to identify and map the land use and land cover types in the study area in the years 1973, 1985 and 1993. Remote sensing and GIS techniques have been used to accomplish this goal. This method involved interpretation of aerial photographs to identify land use and land cover types in the three years, creating a database using the data from aerial photographs and setting analysis criteria for generation of acreage of under each land use types.

RECOMMENDATION

In order to enhance land use development, there is a need to improve on both the land information system and Geographic information systems, so that investors can have ready information on land availability and suitability. At the same time infrastructural services will be easily extended to areas identified and planned for land use developments.

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