INTEGRATION OF RS AND GIS TO ASSESS HUMAN IMPACT ON ECOSYSTEM CHANGE IN NYANDO BASIN, KENYA.

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Abstract

The demand on available resources has significantly altered our environment. Studies concerning the anthropogenic impact on the environment (particularly land cover change) in Lake Victoria basin are in their infancy. GIS and remote sensing are important in analysis, interpretation and extrapolation. This study analyses the process of human induced landscape transformation on Nyando river basin (3517Km2) in the Lake Victoria basin. The watershed geomorphology comprises; hills, scarps, plateaus and a plain area with different types of erosional features; The spatial and temporal change patterns of land use were quantified by interpreting remote Sensing (RS) data and used a geographical information system (GIS). Landsat images (1973, and 2000) were used to classify the catchment into five land use classes: bare ground, water body, agricultural land, dense forest and sparse forest using supervised classification in ENVI. During the last 32 years, the vegetal cover was altered drastically with increasing population pressure (both human and animal), agricultural activities and wood extraction, results have shown that the area covered by dense forest has reduced while the area covered by sparse forests, agricultural land and likewise bare ground (which includes eroded areas) has increased. Erosional features; rills, badlands and gullies have also increased significantly. The future of the environments depends on the way we use them now.

Introduction

Remote sensing image analyses systems and Geographical Information system (GIS) show great functionality for the integration of a wide variety of spatial information supporting tasks such as natural resources management, regional planning and environmental monitoring.

Remote sensing technology and GIS offer the ability to facilitate ecosystem change investigations leading to a more complete understanding of human impact on the ecosystem. This research gives the approaches of deriving temporal ecosystem change.

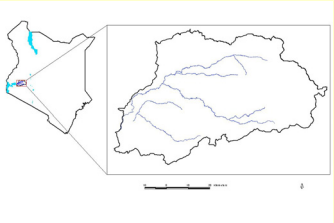


Fig. 1 Location of study area

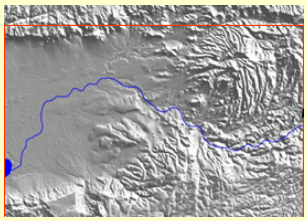


Fig. 2 Study area DEM

Study area

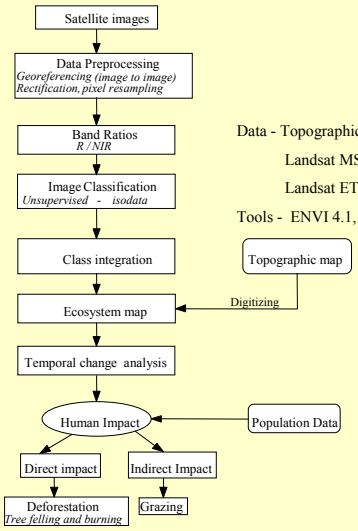
The study area is part of the Lake Victoria basin, the Nyando River basin occupies about 3517 km2 and lies between the latitudes 0025"S to 0010"N and longitude 340 50" to 350 50"E. Nyando river flows from east to west and is joined by many tributaries (Fig 1). The study area has been identified as a major source of sediment and nutrient flow into the lake.

The physiography of the catchment is varied; it ranges from pronounced scarps in the North, East and South and from associated footslopes and piedmont plains to the Kano plains; Fig 2, (Jaetzold and Schmidt, 1983; 1982; Kenya Soil Survey, 1982)

Vegetation cover varies according to elevation, due to its effect on climate. In general, the study area is dominated by a patchwork of forested and agricultural land, with some tracts of wetlands along the lake. Some portion of the basin area contains developed land and a dense network of roads and footpaths. Land use/ cover, population distribution, and farming methods have significant influences on the catchment.

The population of Nyando basin is currently about 746,000 inhabitants. The average population density is 214 persons per square kilometers with some areas of the basin exceeding 1,200 persons per square kilometer (Hansen, 2000)

Methodology



Data - Topographic map 1:250,000

Landsat MSS-01 Feb. 1973

Landsat ETM- 27th Jan 2000

Tools - ENVI 4.1, ARCVIEW 3.3

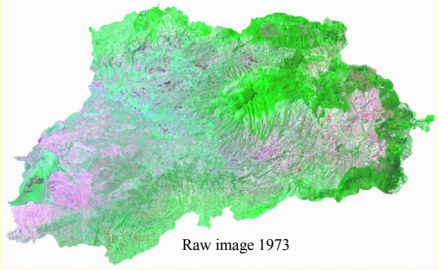
Results and discussion

Vegetated soil and bare/degraded soil can be differentiated by using the band ratios (Lillesand and Kiefer, 1994).The ratio between R/NIR gives high DN value for water, bare soils and low DN value for vegetation.

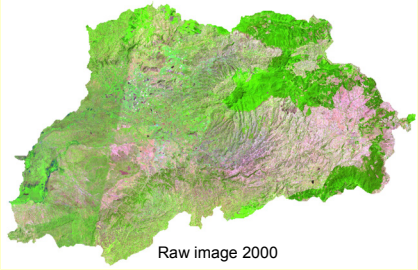
Temporal changes in Nyando landscape include change in (1) Patch number, (2) patch size.

The dense forests are concentrated on the hilltops and in narrow bands along the permanent rivers. Farms and settlement areas are found all over the landscape.

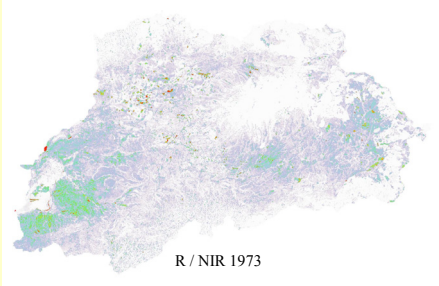
degraded soil was identified by classifying BRs between the red and near-infrared bands for both images. The results yielded an attractive picture of soil degradation dynamics since 1973. The extent of soil degradation increased. This trend is reasonable and can be associated with real human activities in Nyando basin; when forest was cut, soil degradation started and aggravated



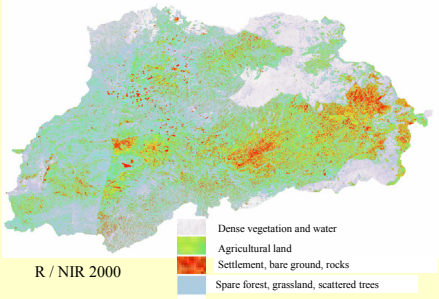
Raw image 1973



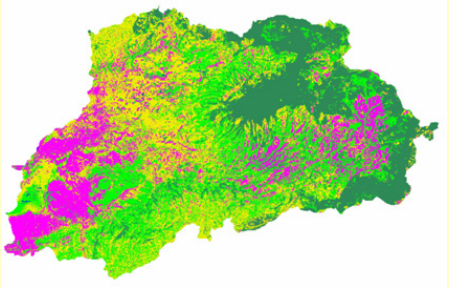
Raw image 2000



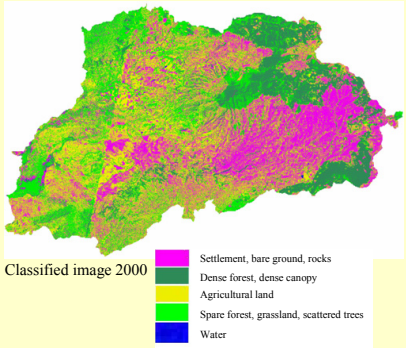
R / NIR 1973



R / NIR 2000



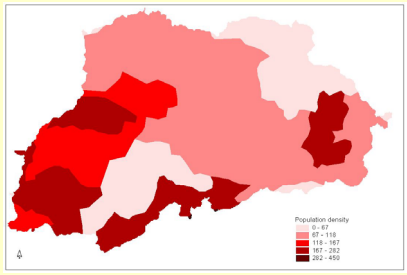
Classified image 1973



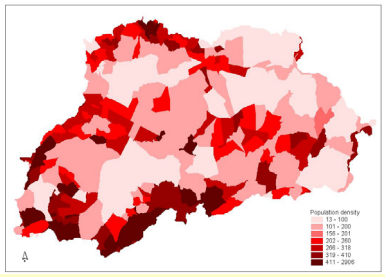
Classified image 2000

Land cover classes

Dense forest	Dense canopy
Agricultural Land	Cultivated area
Settlement, Bare ground	Roads, rocks, settlement, bare ground
Sparse forest	Scattered trees with grasslands
Water	Streams, rivers, ponds



Population density 1979



Population density 1999

Conclusion

Colour composite and unsupervised classified images of Red/near-infrared band ratio showed that the Nyando catchment, most degraded parts, and bare soil with very high reflectance and distinct colours are located on the transition zone between the hills and the plain. Classified images from 1973 and 2000 very clearly show the extent of soil degradation increasing, and dense forest decreasing, a trend that is closely related to land use dynamics in the catchment, especially forest cover and agricultural activities in the upland soils.

These results illustrate the possibility for use of satellite images for identification of ecosystem change. Moreover, types, causes and degrees of change could possibly be identified by testing more satellite images with different resolution and functions in combination with more ground truth data.

References

Jaetzold, R. and Schmidt, 1982. Farm Management Handbook of Kenya. Vol II:West Kenya, Ministry of Agriculture, Nairobi Kenya.

Lillesand, T.M. and Kiefer, R.W., 2000. Remote Sensing and Image interpretation. John Willey and Sons, New York.

Kenya Soil Survey, 1982

Hansen, T. 2000

Acknowledgements

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