SPATIAL ANALYSIS OF FACTORS AFFECTING VEGETATION CHANGE IN SOUTHERN SAMBURU, KENYA

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Abstract. Rangelands in Africa are under pressure from the increased human population that demand more land for food production and settlement. The once mobile communities have become more sedentary due to provision of centralized social and health amenities. These factors leads to concentrated use of land for grazing and settlement creating pressure on the vegetation and soil resources. This paper present a section of findings for study undertaken for Master thesis. Geographic information system was used to determine the distribution of various factors affecting vegetation change in Southern Samburu. This study dealt with analysis of the factors affecting the vegetation change in Southern Samburu. Data has been collected to determine the distribution of the land use and land cover of the study area. GIS Thematic maps showing distribution of schools, churches and clinic/health facilities as factors reducing the Samburu mobility have been developed and superimposed on the transport network and trading centres using ArcView 3.2 and ArcGIS.

1 BACKGROUND OF STUDY

Vegetation change in a broader sense is a major problem experienced in many rangelands of the world. Change in plant species structure and composition is phenomenon across the various rangelands. Population pressure, change in lifestyle change in land tenure and climatic change are some of the factors attributed with the vegetation change in the rangelands.

In Africa, rangeland ecosystems lies between the rainforest and desert on both side of equator from about 29^0S and 16^0N 9 (Stephen et al 1992). Rangelands are extensive socio-economic important ecosystem with a mixture of two-plant life form, trees and grasses (Belsky, 1990, Scholes and Walker, 1992). In Kenya, rangelands houses almost all the wildlife as 63% of the national parks and other protected area are located here. 60% of the Kenyan estimated 9.0 million heads of cattle, 70% of estimated goats and sheep and nearly 100% of the estimated 1.0 million camels are locate in Kenyan rangelands (Ayuko, 1978, Stephen et al 1992).

Plants are the foundation of rangelands worth. Livestock and wildlife is a product of a plant growth and their productivity is a commensurate with the welfare of plant. However, importance of the rangeland is under siege from vegetation change. Increased woody plants and decrease in grass cover has threatened the productivity of such ecosystems. In grazing system, there is decreased foliage for grazers such as cows and zebras while there is increase in foliage for browsers such a camels and giraffes. Such changes in the species composition affect the economies of the pastoral communities. Sheet Soil erosion, which later develops to rill and gully erosion, always accompanies such vegetation change due to lack of ground cover. In long run, removal of the topsoil and uprooting of the trees by flash floods and wind make the land to take long to heal from such perturbations and thus reduced chance of plant regeneration. The Samburu pastoral communities have been forced to keep camels to appendage their milk needs as the cows have reduced in population (IPAL). UNEP (2000) observed that the droughts after 1997 El Nino rainfall, 50% of the livestock in Samburu district died as well as wildlife like Zebras. Livestock and wildlife that survived the drought were affected by malnutrition and hence were week and have low productivity (UNEP 2000).

Natural factors such as fire frequency and climatic change bring about vegetation change. However, ecosystems are capable to recover from such perturbations since they tend to be temporal, irregular and physically separate. In contrast, population increase, sitting and realignment of the political and administrative boundaries, development of forest reserves and national parks, establishment commercial ranches and agricultural farm, and though the influence of the missions and several other modern institutions like schools, hospital and churches, there has been restriction of movement for the nomadic people and a reduction in the area the formally occupied. As such, the human orchestrated vegetation changes as result of land use tend to be

permanent, regular and concentrated in a given area. Southern Samburu is not inimitable from such perturbations.

The migration of people from high potential lands to arid and semi arid lands and the short-term benefits of leasing land have contributed to land degradation. The migrants occupy the more fertile area, which also produce good pasture. When combined with privatisation of lands, pastaroloist have lost access and left with more marginal pasture that are degraded by unsustainable land use.

Pastorololist further displaced because of the expansion of agriculture, urbanization and gazetting of land for conservation. The sedentarization of pastoralists has led to vegetation change. It should be recognized that, extensive grazing is most sustainable land use in arid and semi arid lands. In Wajir district, the creation of many administrative locations with many chiefs caused severe land degradation with each chief wanting to develop his location (UNEP 2000). This is archived in first place by providing water, which cause the sedentarazation of many pastoralists without an alternative livelihood. Sedentarization is not sustainable in fragile rangeland ecosystem.

It must be not that, the traditional knowledge of the local people had for thousand years made the fragile rangeland ecosystem sustainable. Coping strategies such as migration to available water and pasture that involved setting aside dry grazing pastures and splitting herds to minimize risks (Kelly 1993 in Mutiso 1995), loans and bride wealth (Ochieng in Mutiso 1995) and passing of traditional knowledge from one generation to the other maintained balance between land use and prevailing vegetation resource (UNEP 2000).

The beginning of the breakdown of the coping strategies and sustainable land use in both arid and semi arid lands started in colonial era when ethnic groups were restricted to particular pieces of land allocated to the (Native lands). Population growth made the situation uncontrollable and at independence, native lands changed into trust land (UNEP 2000). The land tenure reform (transforming trust land into individual land) has continued since 1955 to date. UNEP (2000) argues that, it was and still is thought that land must have an individual title to assure proper land use. However, it is debatable whether individual tenure is the best tenure system for pastoral area because pastoral coping strategies are based mainly on mobility and access to different areas in different seasons. Vegetation changes as result of land use change is further complicated by lack of a comprehensive land use policy that makes it impossible too take action against unsustainable use of land (Okoth-Ogendo 1999).

Studies on rangeland vegetation change have concentrated in single factor analysis such as overgrazing and fire (Kothmonn et al 1997), atmospheric CO_2 enrichment (Archer et al 2000) and exotic species introduction (Archer and Brown 1999). However, the problem of the vegetation change is complex and varies across time and space and thus need to be viewed in temporal, spatial and ecological and human dimension. Such is the dimension that was taken by this study.

This study dealt with analysis of the factors affecting the vegetation change in Southern Samburu. Data has been collected to determine the distribution of the land use and land cover of the study area. GIS Thematic maps showing distribution of schools, churches and clinic/health facilities as factors reducing the Samburu mobility have been developed and superimposed on the transport network and trading centres.

Plants species from near similar vegetation clusters has been collected and analysed to show their distribution along soil chemical gradient. All this data was interpreted in relation with the livestock productivity and rainfall distribution of the study area over temporal gradient.

However, this paper presents section on the application of geographic information systems.

2. THE STUDY AREA

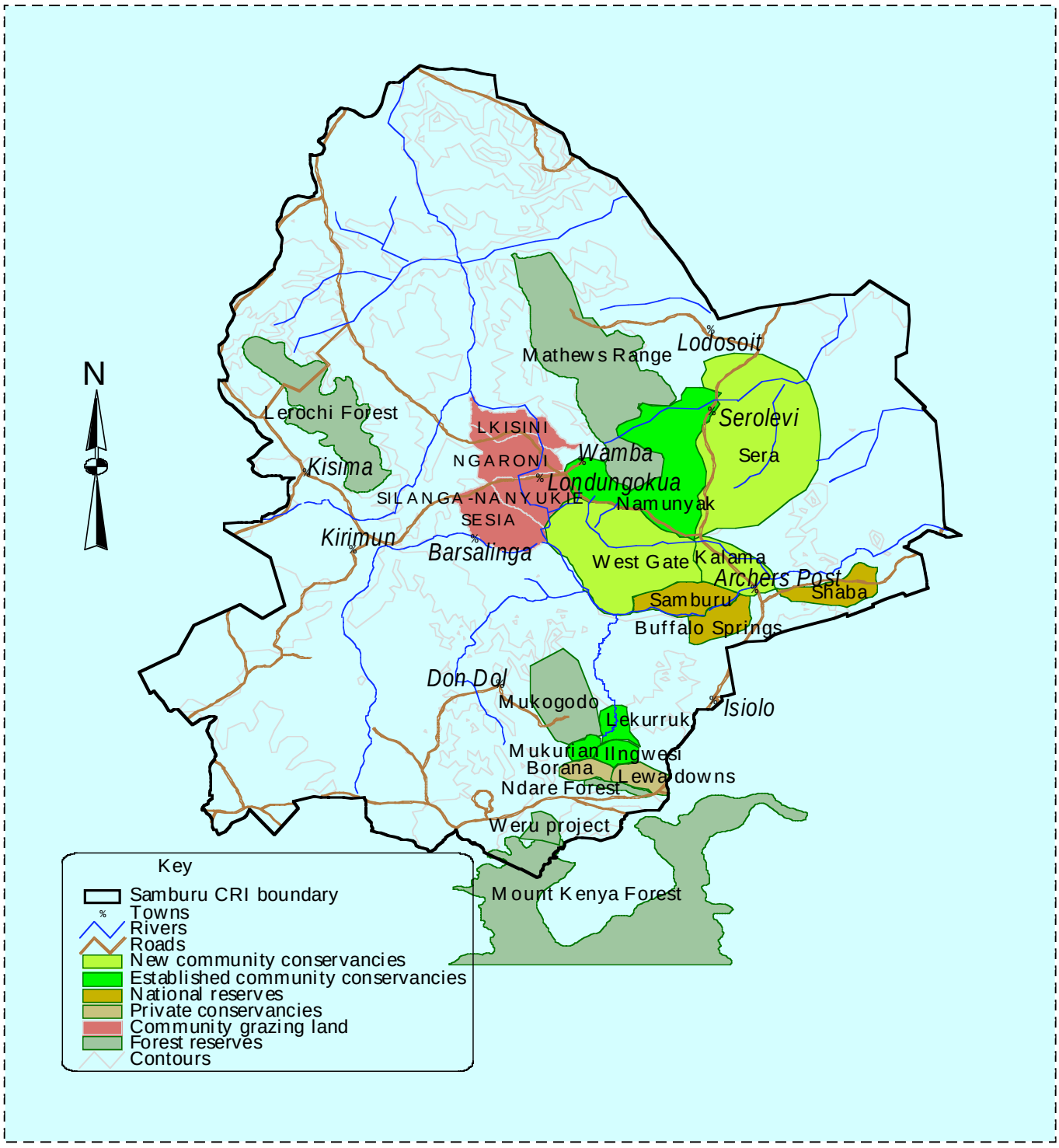
Southern Samburu is located in arid and semi part of the northern Kenya, north of Mt Kenya in the Rift valley province. It lies between latitude 0^0 30' N and $1^0$00' and longitudes $37^0$00' and 37^0 30'. Altitude range from 800m a.s.l around the Samburu reserve to 1230 m a.s.l at to Mathews range. Annual rainfall is bimodal and averages for most part from 200-450 mm but raises to 700mm in higher areas around Mathew range (Simpkin, 1995). Precambrian basement system made of gneiss and granites are found along the Mathews range. Volcanic ash and sedimentary rocks are spread on the plains of the area.

Samburu people who live slightly south of lake Turkana in rift valley province of Kenya inhabit the study area. They traditionally they herded cattle, goats and sheep in and around arid region with sparse vegetation. A nomadic lifestyle is essential for their survival since attempts to settle down in permanent

locations have reduced their self-sufficiency and ability to maintain their traditional values and practices. Samburu have the right to reside and graze their animals in areas historically occupied by Samburu as land is viewed as belonging to all Samburu rather than an individual.

Samburu herders rely almost completely on livestock and livestock products for their consumption needs either through home consumption or through market exchange. However, livestock productivity in this region is highly affected by high rainfall variability, which corresponds to high variability in forage production, as forage growth is almost exclusively dependent on rainfall. Fencing of private ranches on areas surrounding the study area where Samburu used to graze as reserve during the dry seasons further complicates.

Figure 1 showing the study area and the neighboring areas



3 METHODS

Data collection and analysis

Interviews and focused group discussions were used to collect land use data. The data collected focused on establishing lands used for grazing exclusively during the dry periods, during the wet areas, settlement areas and areas prone to insecurity (cattle rustling).

Using the hand held GPS (global positioning system), UTM coordinates of schools, clinics churches and water points as factors favoring land use change were collected. Community guide (a member of community chosen through community Barazas), was used to collect the various this data.

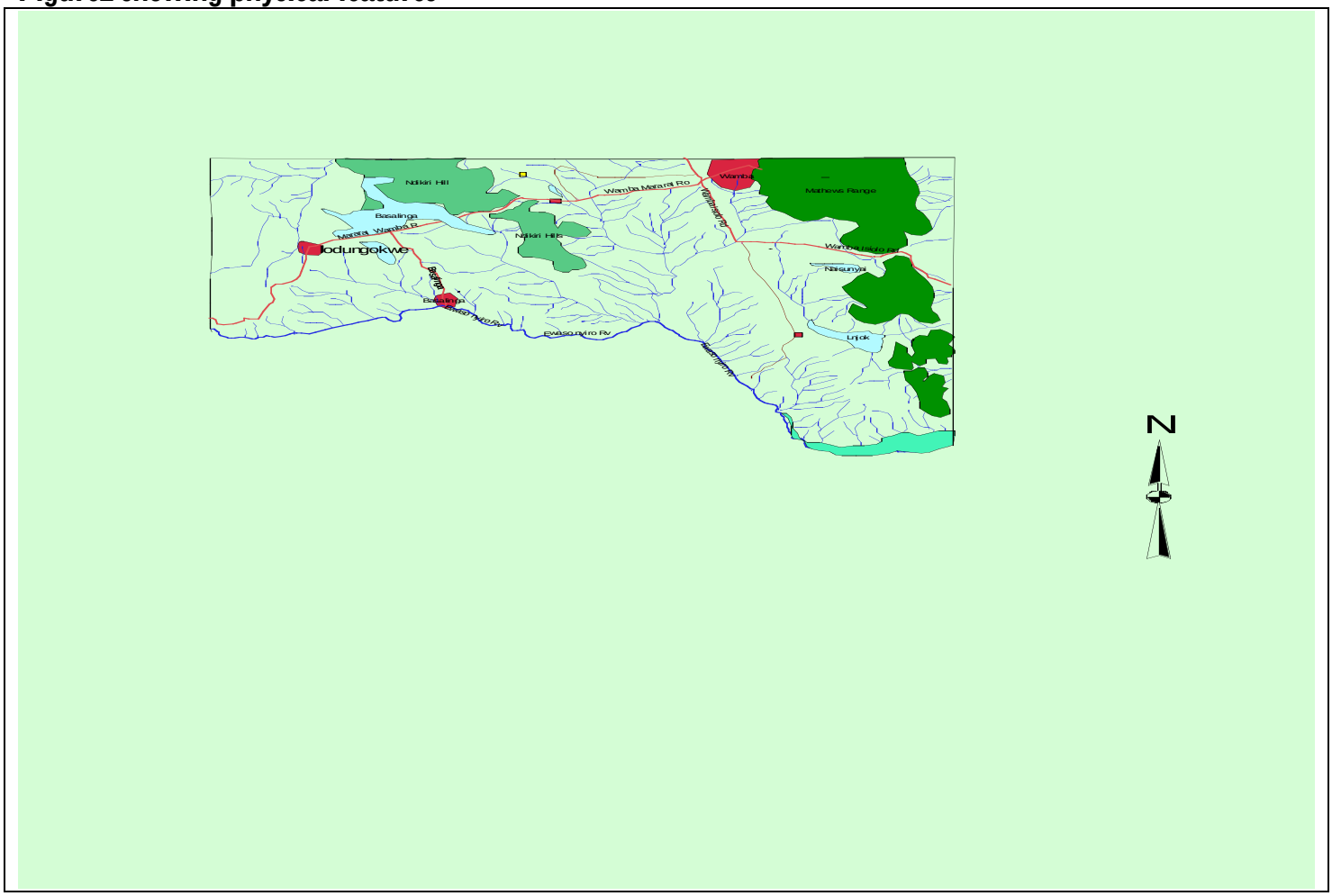
During the focused group discussions and interviews, participants were requested to delineate the various land uses boundaries by use of the natural features, such as lagas/rivers and ridges.

Using A1 size scanner, the topographic maps were later scanned to extract the delineated features on the map. To achieve this, georeferencing of the scanned map was done using Arcmap GIS software. On screen digitizing using the same software was done to extract the various layers.

4 RESULTS

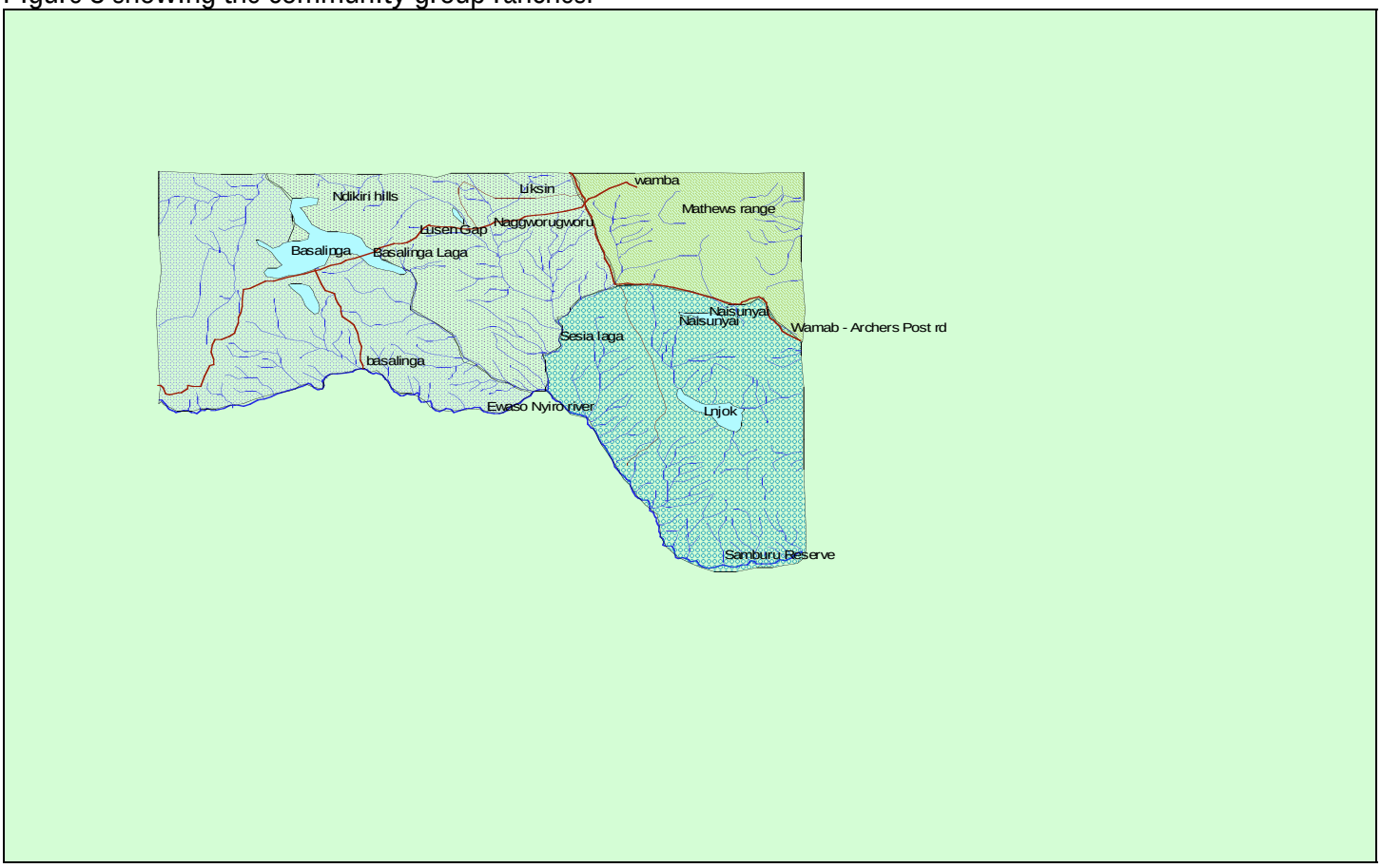
Various layers of physical features showing the river/swamps system, transport and hills and ridges were delineated as shown below

Figure2 showing physical features



Three community group ranches were identified and main they were for both settlement and grazing. Namyak conservancy was mainly for conservation of the wildlife with controlled settlement. However, during the dry periods the area was used as grazing reserve.

Figure 3 showing the community group ranches.



Grazing and settlement areas

Grazing and settlement forms the major land uses. However, around the Namyak, there are conservation practices.

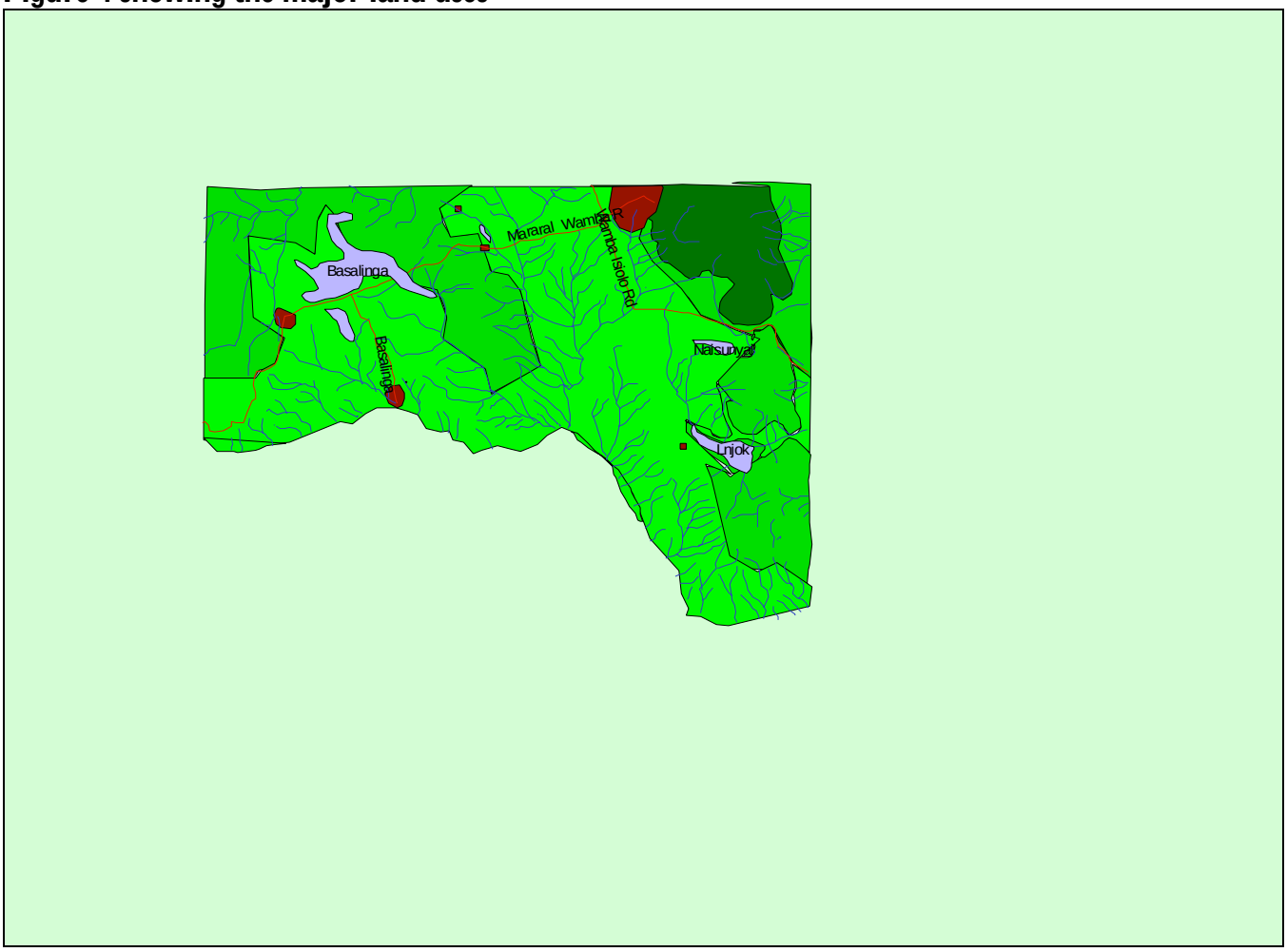
Grazing areas are delineated as from the topographic map as shown below by the seasons. Mathew's range and Ndikiri hills are preserved for grazing during the dry seasons. Asked whether vegetation have changed on these grazing areas, the respondent argued that trees have increased.

Lokere (small areas fenced to preserve vegetation for young animals), delineated from land use. Based on this, vegetation inside the Lokere seemed healthy compared to vegetation outside where areas were marked by low to strong gully erosion.

Settlement areas are demarcated as the grazing zones where people do not settle on areas demarcated for grazing during the dry seasons. However, Samburu people do not settle also on areas considered as flood plains.

Their housing units are generally made from the plants where, acacia or other trees are used to make the poles for the house and the *sanserveria spp* make the roofing. The homesteads, manyatta, are made of the *acacia spp* braches. This makes the density of this species to be reduced around the homestead.

Figure 4 showing the major land uses



Security threats

Asked to delineate areas according to threat in past 20 years; two concrete areas were demarcated as shown below. Ngotuk Ongiloni community ranch was delineating as more insecure compared to the other areas. Community members sited that the area was vacated in 1997-2002 due to cattle rustling by the neighboring Somali community. A school whose roof was stolen during the rustling and had not been replaced during the time of study evidenced this.

Schools, clinics and churches

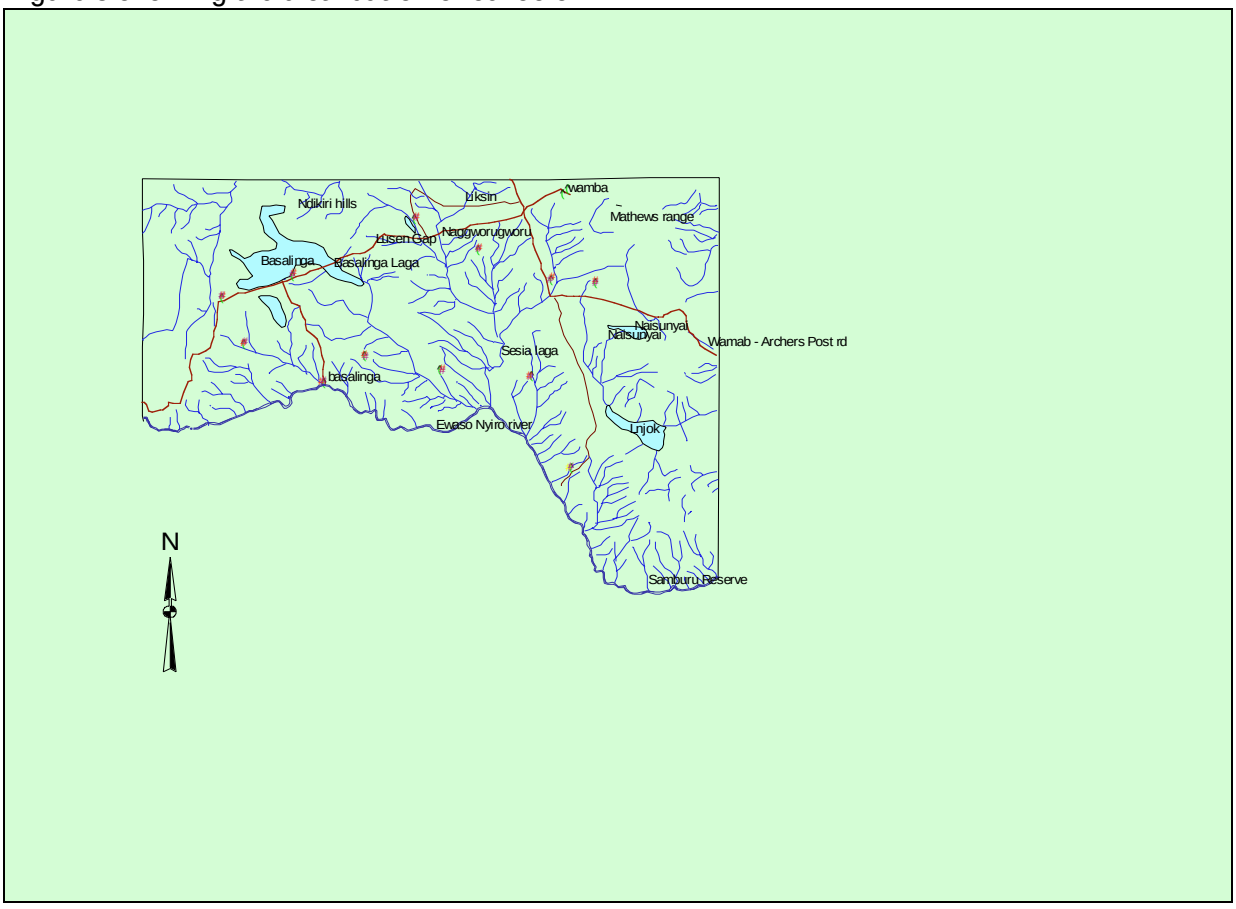
Schools, clinics and churches seemed to be tied together. The structures used as the church were the one that offered as the sites for the clinics. The Wamba mission Hospital once per month in different sites offered clinics. The regular clinics and their distribution show some level of the availability of medical care, which may reduce mortality rate, hence, the increase in population.

The schools varied on the level with most being at nursery level, few at class 1-3 and very few at up to class 8 as shown on table below.

Table 1 showing the distribution of schools

Study area	Levels			
	Nursery	1-3 class	1-8 class	Secondary
Ngaloni	4	1	1	0
Ngotuk Ongiloni	4	0	1	0
Basalinga	4	2	1	0

Figure 5 showing the distribution of schools



It was observed that most of the nursery schools are constructed by use of tree branches.

The high number of nursery school is an indication that the community may be realizing the importance of education and hence sending children to school. This is an indicator of the change in lifestyle to more sedentary life.

Watering points

The distribution of water points in this study area, as observed, depend on the seasons. During the rainy seasons there generally more as compared to during the dry seasons.

The sampled plots for this study was based mainly on the accessibly. The points were either in a raga, dam/pan or water pump. In the raga, they herdsmen burrow on water stored under the sand.

The notable effect of water points on the vegetation is the creation of cattle trails and overuse of the surrounding areas as they take water. It was observed that, these trails encourage rill erosion, which later developed to gully erosion leading to massive down movement of soil. The sheet erosion also occurred around the water points as the water loosen the surfaces as they rest before and after taking water.

Plates 3 showing the soil erosion attributed to cattle trails near watering points

5 DISCUSSION AND CONCLUSION

The increased number of schools, well-distributed health services and churches in the entire community group ranches can ascertain increased sedentrazation in the southern Samburu. Concerted use of land around the watering points has resulted in serious sol erosion increasing rate of runoff. Uprooting of vegetation was common due to gully erosion. Scare form the insecurity have led to land being abandoned for years giving vegetation time to regenerate.

From the above discussion, it is evidenced the spatial distribution of the various factors that have been associated with sedentrazation process and their impact on the vegetation. Measures have to be put into place to equate these processes in bid to avert the effect of such factors on vegetation especially the soil erosion.

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