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Water and Pasture Availability on Livestock Routes Under a Changing Climate: A Case of Ilemela and Magu Districts in Tanzania

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Abstract

The beef cattle production system practiced in the Lake Victoria Basin is mainly extensive, which involves cattle grazing on natural pastures. This system is characterized by overgrazing, low livestock production and soil degradation. Under the effects of global climate change, these pastoral management challenges are expected to increase. As the impacts of climate change to beef cattle production over the Lake Victoria Basin is unknown, this study used participatory mapping method and focus group discussions to assess spatial changes in livestock routes in relation to water and pasture availability in Ilemela and Magu districts of Mwanza region, Tanzania. GIS technology was used for the formalization of spatial layers. It was revealed that there were many changes in livestock routes such that some have become roads, some have been lost, and others narrowed. These changes were due to increase of settlements and cultivated areas, and more specifically a general decline of water sources and grazing land. This implies that appropriate strategies such as a land use planning, stock routings modification, education on effective cattle farming and intervention by rainwater harvesting should be designed so as to adapt to climate change effects, and improve livestock production in Ilemela and Magu districts.

Keywords: *beef cattle production; Lake Victoria Basin; GIS; climate change*

1. Introduction

Livestock production contributes about 40 percent of the global value of agriculture output, and supports the livelihood of almost a billion people (FAO, 2009). As about 50 percent of the world's livestock is supported by ranges in drylands, the greatest extent of livestock production lies in semi-arid to arid rangeland which forms nearly 30% of the world's land surface (MEA, 2005a; Stafford, 1996; Sivakumar et al., 2005 cited in Tietjen and Jeltsch, 2007).

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In the Lake Victoria Basin (LVB), more than 60% of its area is covered by rangeland, which contributes 10-20% of the Gross Domestic Product (GDP) of the East African economies. Among the contributor of the rangeland to the GDP is the livestock sector, where over 36% of the cattle in Tanzania are concentrated in the LVB.

The beef cattle production system practiced in the basin is mainly extensive, which involves cattle grazing on natural pastures. This system is characterized by overgrazing, low livestock production and soil degradation (Mpofu et al., 1998). The expansion and intensification of crop production systems, deforestation and urbanization within the region increases challenges towards the system (Maitima et al., 2010). Under the effects of global climate change, these pastoral management challenges are expected to increase (Asner et al., 2004 cited in Jakoby, 2011). Reduced rainfall and increased drought will reduce primary productivity of rangelands and hence food insecurity (FAO, 2009).

As the impacts of climate change to beef cattle production over the LVB are unknown, this paper attempts to use participatory mapping method, focus group discussions and GIS technologies to generate spatial knowledge on the changes of livestock routes in relation to water availability and pasture under a changing climate in Ilemela and Magu ditricts, Mwanza Region, Tanzania. The information will be useful in designing viable land use strategies that will increase the yield of rangelands, while coevally ensuring long-term ecological as well as economic sustainability under a changing climate.

2. Methodology

2.1 Description of the Study Area

Ilemela and Magu districts are located between latitude 2° 10′ and 2° 50′ South, and longitude 33° and 34° East in Mwanza Region (Fig. 1). The districts have tropical temperatures ranging between 25° and 30°C. The rainfall pattern is bimodal: October to December and March to May; and ranges between 700mm and 1000mm. Temperatures and rainfall are strongly influenced by proximity to Lake Victoria and the Equator (URT, 2012).

Ilemela District is a highly populated area, with the consequent pressures on land and competition between human and livestock requirements (URT, 2012). According to the 2012 Tanzania national population and housing census, the human population in Ilemela District was 343,001, and the cattle population was 73,621 in the 2005/2006 fiscal year (URT, 2008).

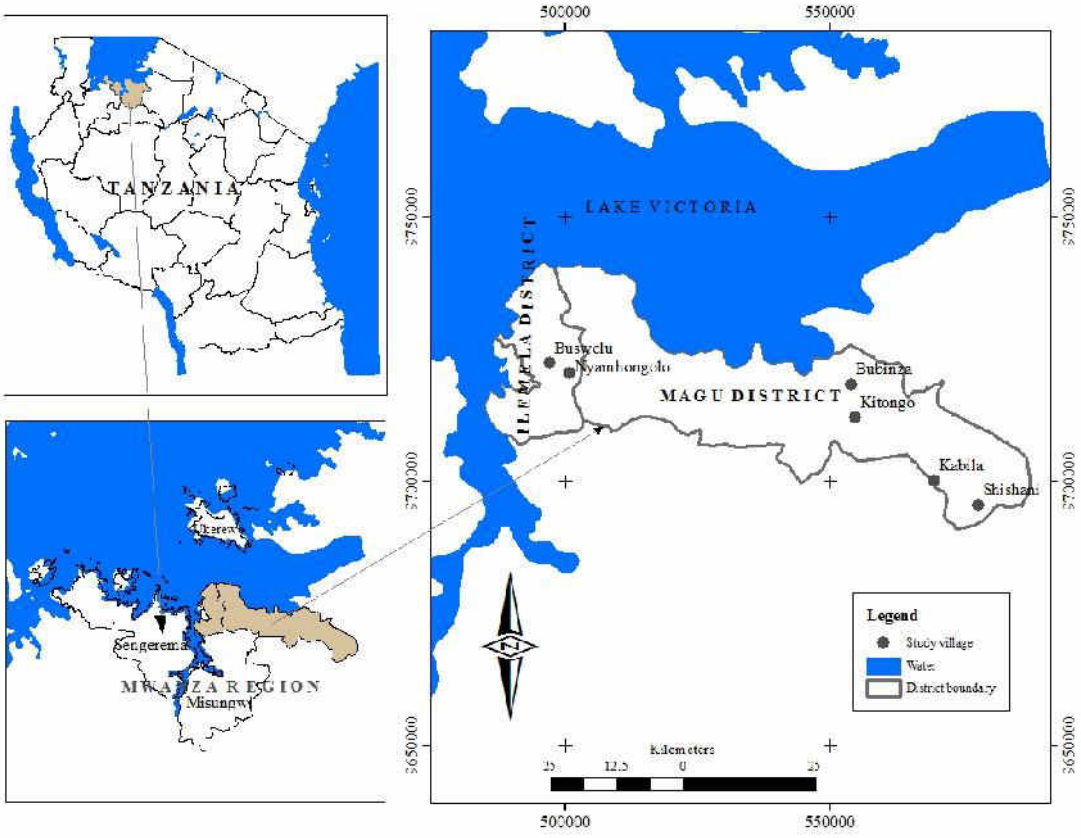


Figure 1: ***Ilemela and Magu Districts***

In Magu District, the 2012 national population and housing census put the human population at 299,759, while the cattle population was 320,163 in the year 2005/2006 (ibid.).

Livestock keeping is the third leading economic activity of the majority of people in Mwanza region, with 1,976,971 estimated cattle (URT, 2012); which is about 9% of the total cattle in Tanzania. The most leading economic activity is agriculture; and the main crops grown in Ilemela and Magu districts are cotton, paddy, maize, sorghum, sweet potatoes, cassava, pulses; and horticultural crops such as tomatoes, onions and fruits.

3. Methods

The assessment was done over a study period of 30 years (1980-2010) to reveal the impacts of climate change induced by water and pasture scarcity to stock routes. Participatory mapping (Evans et al., 2006) with communities was done to identify location of past and present water points, as well as cattle routes.

Coevally, focus group discussions (BCU, 2006) were purposively conducted in six villages with communal grazing areas in Ilemela and Magu Districts: Buswelu and Nyamhongolo villages in Ilemela District; and Bubinza, Kitongo, Kabila and Shishani villages in Magu District. Focus group discussions were used to identify factors behind changes in water and pasture availability, as well as changes in livestock migratory routes in the community.

3.1 Ground Field Data Collection

Village leaders and local communities were involved in the development of village use maps. Topographic map sheets (1:50,000) were used; and participants were guided in mapping rangeland boundaries, past and present water points, past and present cattle routes, and resources from community land. GPS was also used to collect the coordinates and validate the sketched maps.

3.2 Formalization of Sketch Maps

ArcGIS software (10) was used to develop maps showing the changes in stock routes following changes in the availability of water and pasture in the community between 1980 and 2010. The collected data was integrated into the GIS for formalization of spatial layers and integration with other related data, such as Tanzania villages and road layers.

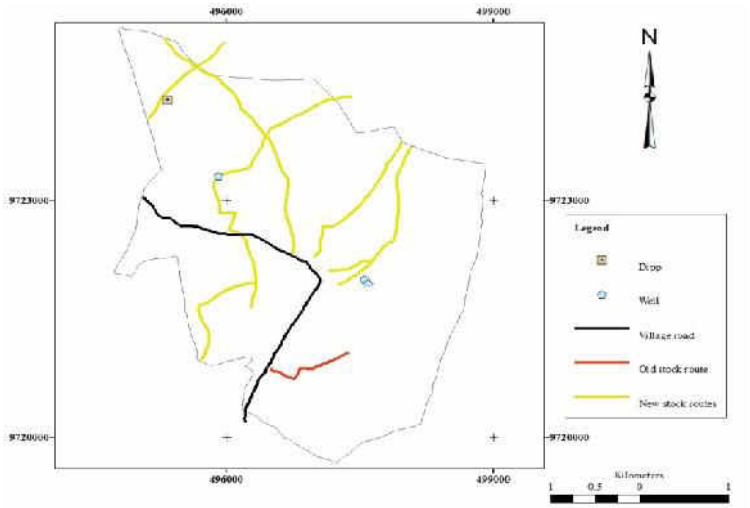
4. Results

4.1 Changes in Livestock Routes in Ilemela District

Comparative response during focused group discussions in Buswelu and Nyamhongolo villages in Ilemela District for the past 30 years revealed that:

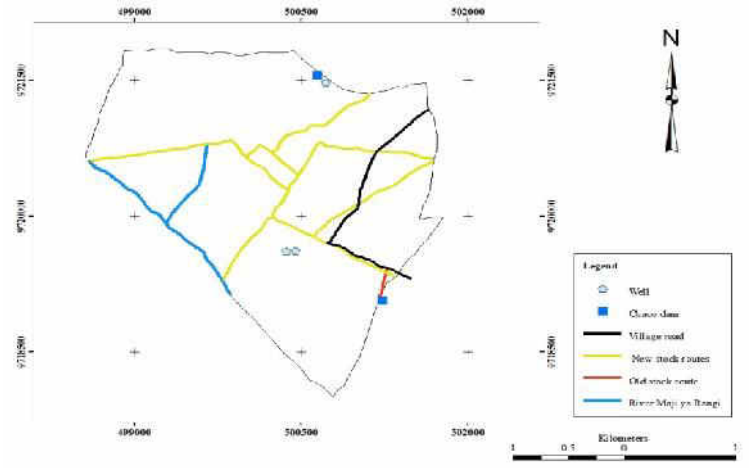
(i) There is much change in land cover due to the increase of settlements, institutions, farmlands, woodlots and industries caused by the population increase and urbanization. This has led to the decline of both pasture and water sources.

(ii) There are changes in livestock routes in response to changes in grazing land and water sources (Figs. 2 and 3).



Note: Stock routes were used by livestock to water sources and pasture land, but now have become roads and other blocked by houses due to urbanization. Moreover, urbanization has resulted to the decline of pasture land.

Figure 2: ***Map of Buswelu Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as a road used as a stock route***



Note: Stock routes were used by livestock to water sources and pasture land, but now have become roads and other blocked by houses due to urbanization. Moreover, urbanization has resulted to the decline of pasture land and water sources.

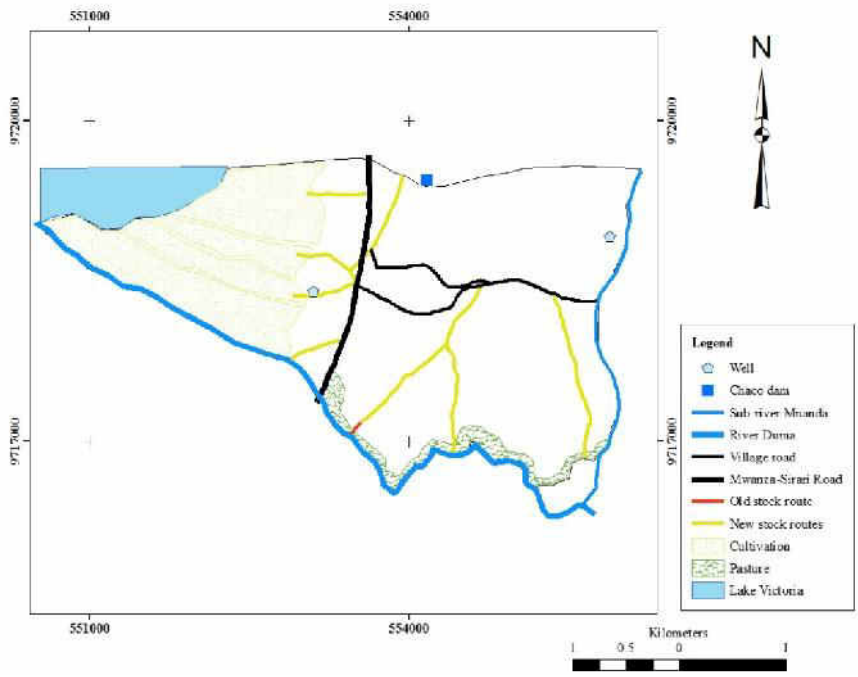
Figure 3: ***Map of Nyamhongolo Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as a road used as a stock route***

4.2 Changes in Livestock Routes in Magu District

Comparative response during focused group discussions in Bubinza, Kitongo, Kabila and Shishani villages in Magu District for the past 30 years revealed that:

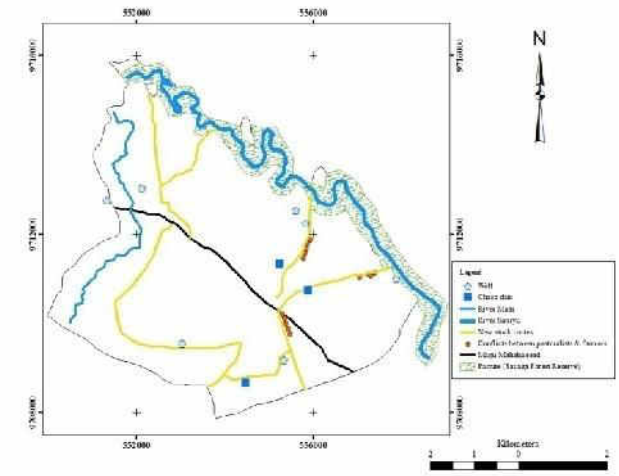
(i) There is much change in land cover due to the loss of forests and wetlands vegetation; and also due the increase of settlements, institutions, farmlands and woodlots as a result of population increase. This has led to the decline of both pasture and water sources.

(ii) There are changes in livestock routes in response to changes in grazing land and water sources. This has contributed to land use conflicts (Figs. 4, 5, 6 and 7).



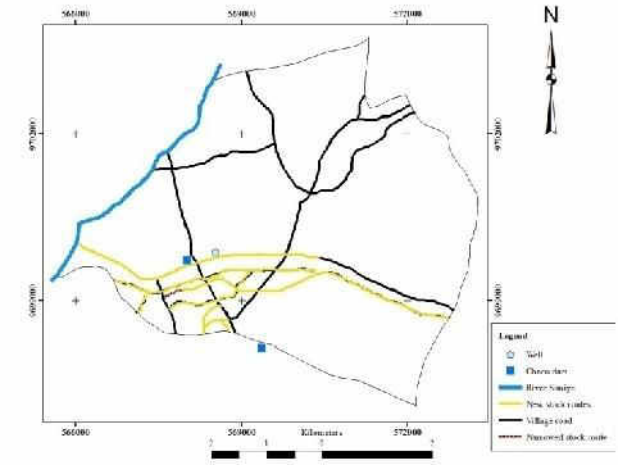
Note: Stock routes were used by livestock to water sources and pasture land, but now have become roads, lost and others invaded by crop farmers due to population increase and expansion of agricultural activities. Moreover, these land use changes have resulted to the decline of pasture land.

Figure 4: ***Map of Bubinza Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as roads used as stock routes***



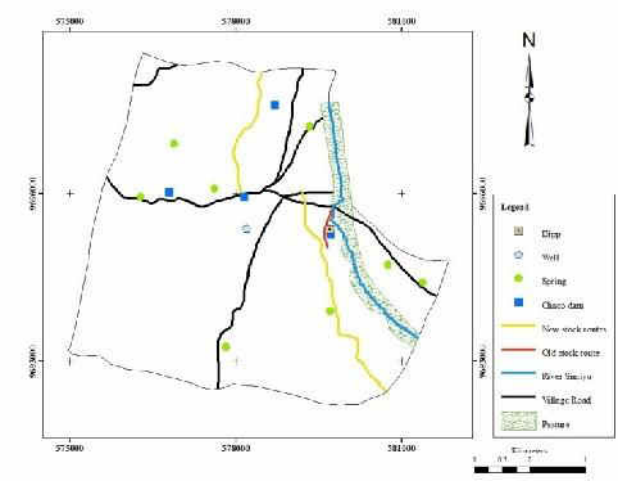
Note: Stock routes were used by livestock to water sources and pasture land, but now have become narrow due to expansion of agricultural activities and settlements. This has resulted to land use conflicts, as livestock are invading the crops.

Figure 5: ***Map of Kitongo Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as a road used as a stock route***



Note: Stock routes were used by livestock to water sources and pasture land, but now have become roads and narrow due to increase of settlements and expansion of agricultural activities caused by population increase. This has resulted to land use conflicts in the narrowed areas, as livestock are invading the crops. Moreover, land use changes have resulted to the decline of pasture land.

Figure 6: ***Map of Kabila Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as a road used as a stock route***



Note: Stock routes were used by livestock to water sources and pasture land, but now have become roads and lost due to increase of settlements and expansion of agricultural activities caused by population increase. Moreover, land use changes have resulted to the decline of pasture land.

Figure 7: ***Map of Shishani Village showing changes in stock routes in relation to water availability and pasture for livestock, as well as a road used as a stock route.***

5. Discussions

The assessment of spatial changes in livestock routes in response to water and pasture availability revealed that approximately 5% of stock routes have been lost, 3% have been narrowed, and 92% are now used as village roads. These changes have occurred due to the increase of settlements and cultivated area. Ernest et al., (2015) ascertained this by revealing that the coverage of anthropogenic activities (settlements and cultivated areas) has been increased between 1980 and 2010. These anthropogenic activities have resulted to a general decline of grazing land, water sources, woodland and land use conflicts between pastoralists and farmers.

Madulu (2005) found that the degradation of traditional communal grazing areas in rural Tanzania is accelerated by rapid population increase, which stimulates agricultural expansion to meet the population needs. This has led to more land use conflicts.

Moreover, rainfall is unreliable over the study area due to climate variability, which has led to the decline of water sources. Rainwater harvesting should be introduced and emphasized as an intervention for improved beef cattle production. Currently, rainwater harvesting is done

mostly from iron roofs into buckets and simtanks for domestic use. Also, there are old and local chaco dams in Magu District that are used for harvesting runoff water for domestic, livestock and agriculture use during both the rain and dry season. These existing chaco dams should be repaired and new ones constructed to ensure effective availability of water for improved beef cattle production.

6. Conclusion and Recommendations

The study puts emphasize on land use planning for improvement of beef cattle production in the face of changing climate. Also, stock routings should be modified to avoid conflicts between pastoralists and farmers.

Moreover, livestock keeping within the study area is still predominated with tradition methods, which keep the productions low (URT, 2008). Therefore, education on effective pastoral farming is highly needed to improve beef cattle production in the face of the ongoing climatic changes.

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