Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.9, No.14, 2018

The Shrinking Grazing Fields of the Maasai Land Under the Changing Climate System in Kajiado County, Kenya

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Abstract
The Maasai pastoralists have in the last decade experienced disruptions in their economies and livelihoods following climate shifts. For instance, they have been losing up to 30 % of their herd annually to drought related disasters, yet information on the various land uses is still fragmented. This has been worsened by the shortening famine cycles which has impacted pastoral livelihood system as they highly depend on natural resource. Yet, these key resources have been dwindling over the past 30 years compromising their ability to meet basic need such as food. To address this gap, the study focused on long term evaluation of land use. The study's objective was to determine land use transformations and their impacts particularly on the pastoral livelihood system.
Keywords: Climate change, Arid and Semi-Arid Lands, Natural resources, food insecurity, pastoral livelihood system, socio-ecological systems

Introduction

The impacts of climate variability and change has been felt across the globe, however, there is a general consensus that African continent is particularly susceptible (Boko et al., 2007). In the last decade alone, the African continent has been faced with serious food insecurity attributed to successive droughts (FAO, 2010). According to Intergovernmental Panel on Climate Change (IPCC, 2013) Fifth Assessment Report (AR5) African continent has experienced a general warming trend since 1960s. The AR5 report further reiterates that majority of Africans have limited capacity to adapt to climate shifts. Thus, such occurrences are likely to exacerbate the already existing dire conditions in the region characterized with inequitable land distribution and over-dependence on rain-fed agriculture system (Notenbaert et al., 2013; Lo´pez-Carr et al., 2014). Which have resulted into widespread poverty, food insecurity and land degradation (Notenbaert et al., 2013; Lo´pez-Carr et al., 2014). In the last decade, the Maasai pastoralists' in their large numbers have shouldered the disproportionate burden of food insecurity as a resultant in the climate shifts (Adger, 2001, 2003; Burton, Diringer & Smith 2006).

Study area, data and Method of analysis

The three data types were utilized namely: Landsat imagery (30 m), ancillary and settlement. The Landsat imagery (30 m) entailed Landsat 8, 4-5, 2-3 whereby 3 epochs: 1987, 2000 and 2015 were sourced from www.glovis.usgs.org. The process focused on the dry season imagery (January-March; July-September) according to Weeks (2003). The processing of these data types entailed band combination, sub setting and mosaicking using Arc GIS and impact tool (JRC) to analyze for trends for the five sub-counties of Kajiado for the period 1983-2014.

Visual Interpretation (on screen digitization) takes four stages namely:

- First draft interpretation (2015, 2000, 1987)
- Internal validation (Random stratified points-Google Earth)
- Final interpretation (2015, 2000, 1987

Food and Agriculture Organization Land Cover Classification system (FAO LCCS) was adopted hence the classes were: Forest land; Cultivated land; Bare land; Grass land; Shrub land; Wet land; Water body; Riverine; Built up/settlement. The first draft was generated. Thereafter, it went through validation from which the sample final draft was generated. This was accurately delineated and captured the features in the entire classification. Meanwhile, validation exercises went on concurrently mainly using Google Earth with occasional field visits guided by Global Positioning System (GPS) (Thomas and Ayuk, 2010; Kumar et al., 2014).

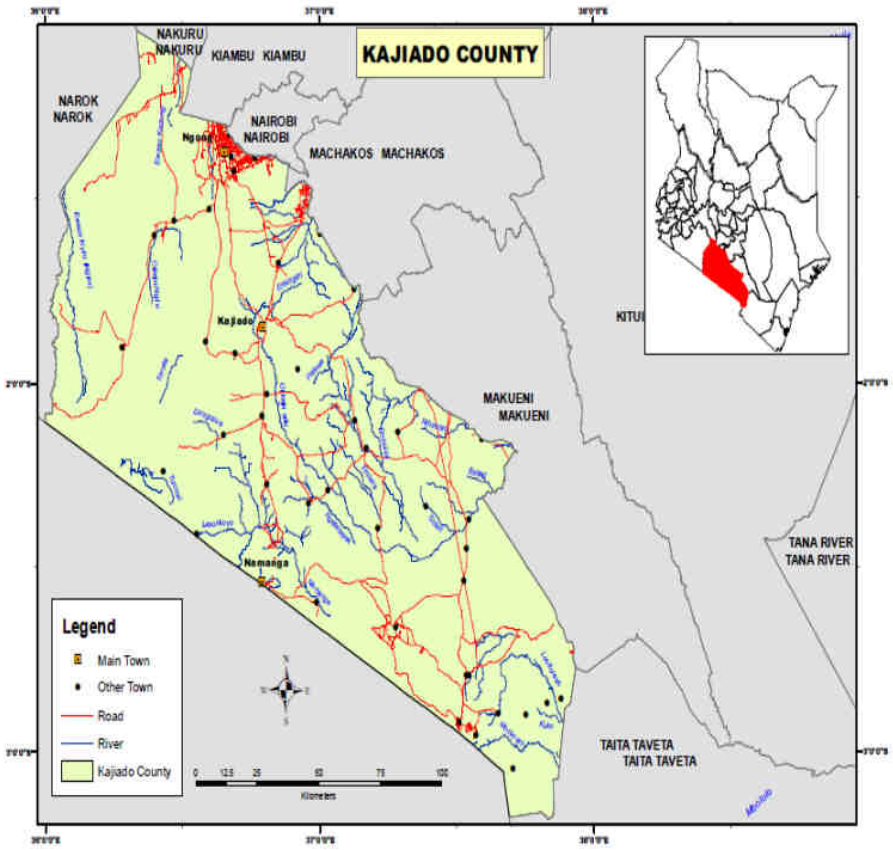

Figure 1: study area

Figure 1 shows that Kajiado County lies between latitude 1.85°S and longitude 36.78°E (Kajiado CIDP, 2013).

Results

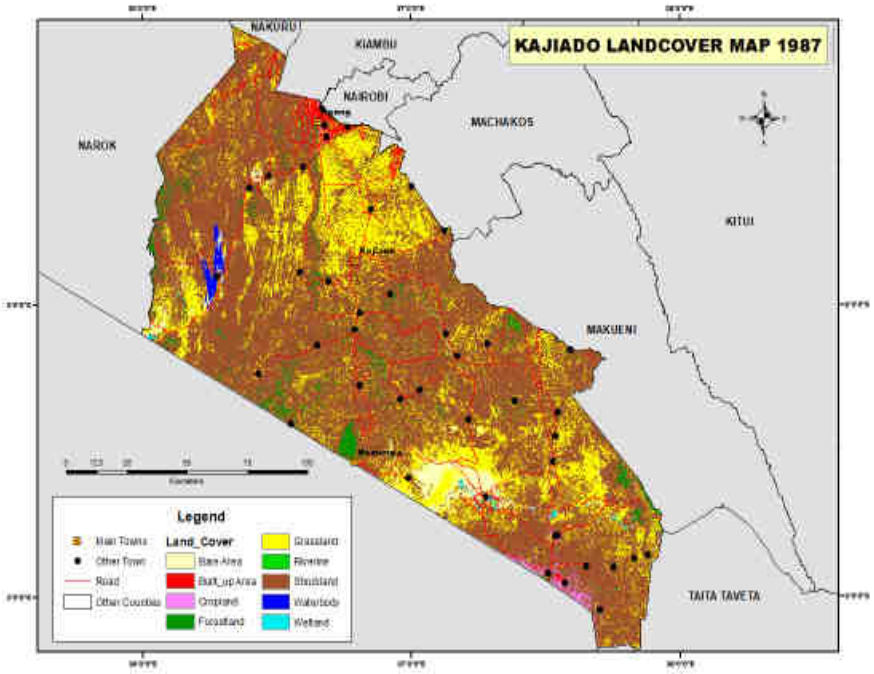

Figure 2: Kajiado land cover map 1987

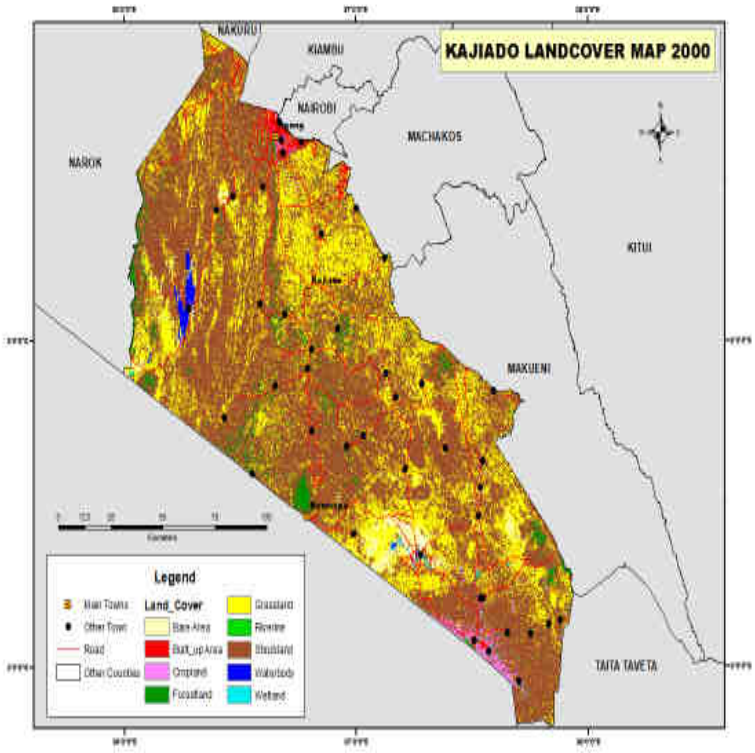

Figure 3: Kajiado land cover map 2000

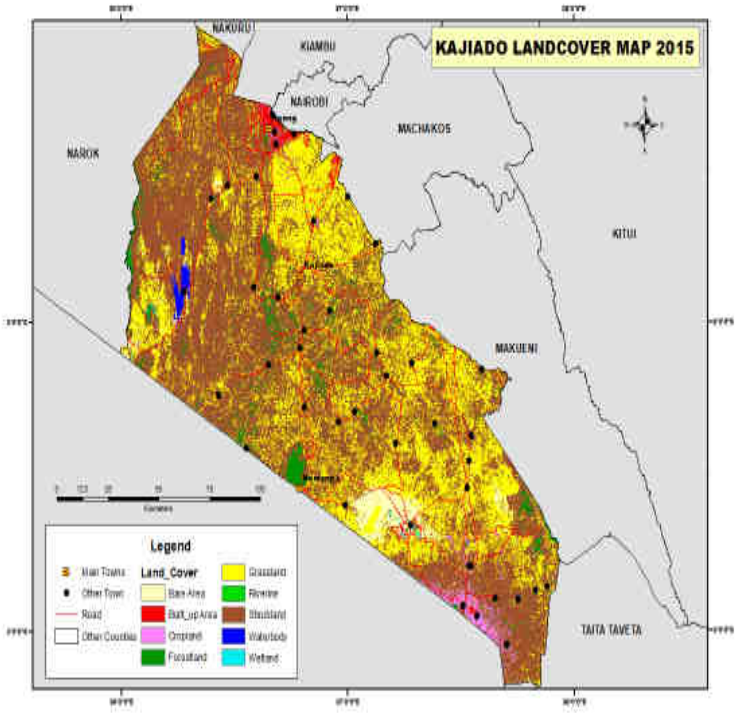

Figure 4 : Kajiado land cover map 2015

Table 1: Statistic report 1987-2015 LULC (+) = gain, (-) = loss

	Year: 2015	Year: 1987	Area change 1987 to 2015	% of change 1987 to 2015	% annual rate of change1987 to 2015
Land cover	Area(Ha)	Area(Ha)	Area(Ha)	Percentages	Percentages
Bare area	56,517.48	55,130.31	1,387.17	2.50%	0.09%
Built up area	942.12	326.88	615.24	188.20%	6.72%
Crop land	30,295.89	15,382.80	14,914.	96.90%	3.46%
Forested land	65,242.08	55,371.96	9870.12	17.80%	0.64%
Grass land	691,588.80	480,015.81	211,572.99	44.10%	1.57%
Riverine	8,370.18	9,292.50	-922.32	-9.90%	-0.35%
Shrub land	1,324,916.37	1,560,841.20	-235,924.83	-15.10%	-0.54%
Water body	9,646.47	9,862.20	-215.73	-2.20%	-0.08%
Wet land	2,544.84	3848.94	-1304.10	-33.90%	-1.21%

Generally, percentage rates of change from 1987 to 2015 with 1987 as the base year, namely: forest land, shrub land, grass land, crop land, built-up area and bare area gained while wetland, water body and riverine lost

Table 2: Statistic report 2000-2015 (+) = gain, (-) = loss

	Year: 2015	Year: 2000	Area Change 2000 to 2015	% of change from 2000 to 2015	% annual rate of change 2000 to 2015
Land cover	Area (Ha)	Area(Ha)	Area(Ha)	Percentages	Percentages
Bare area	56,517.48	48,676.95	7,840.53	16.11%	1.07%
Built up area	942.12	672.66	269.46	40.06%	2.67%
Crop land	30,295.89	23,997.24	6278.65	26.25%	1.75%
Forested land	65,242.08	59,386.56	5,855.49	9.86%	0.66%
Grass land	691,588.80	609,967.78	81,620.82	13.38%	0.89%
Riverine	8,370.18	6,578.19	1,791.99	27.24%	1.82%
Shrub land	1,324,916.37	1,426,699.78	-101,782.98	7.13%	0.48%
Water body	9,646.47	11,169.99	-1,523.52	-13.64	-0.91
Wet land	2,544.84	2,987.10	-442.26	-14.81	-0.99

Generally, the percentage rates of change from 2000 to 2015 with 2000 as the base year, namely: forest land, riverine-gain, grass land-gain, crop land, built-up area, bare area gained while wetland, water body and shrub land lost.

Conclusion and recommendation

The LULC indicated that the shrub land cover had been depleted and the expanding bare land thus reducing the pasture available for livestock. The resultant livestock death in their large numbers while the once who survive are emaciated with poor body conditions compromising their productivity. Moreover, this is the main source of diet i.e. milk and meat which is not sustainable. Yet, majority of them were not able to afford alternative basic foodstuffs from trading. Such circumstance translated into increased malnutrition levels especially among the young children, women and the elderly whose mobility were constrained.

The emerging ecological transformation taking place in ASALS as a result of climate shifts overlaid by other factors requires that the pastoralists' perceptions on climate science be enhanced. The enhanced knowledge should be proportionate to the impacts on their livelihood systems. Such an attainment requires platform such as a wide broadcast coverage in local dialect. Indeed, mass communication will sustain public education and awareness on the localized climate trends. In addition, it will also facilitate accessibility to weather forecast to enhance their level of preparedness. Meanwhile, as a long term plan, capturing their interest at early childhood stages will be paramount especially on weather instrumentation platform such as weather stations installation in schools to enlighten pupils on the various weather attributes with a possibility of sharing similar information with the community at large to reduce climate related risks.

Pastoral livelihood system dictates for expansive land to accommodate mobility. However, the dynamism in this system as a result of climate shifts overlaid by other factors has gradually distorted some traditions. Key among them is the preference for individual land ownership which had contributed to the distortion of grazing cycles and labour sharing. Such preference for sedentary lifestyle was pushed by the previous government without adequately consulting the pastoralists, yet the attainment of judicious management of these natural resources needed bottom up approach whereby the community is actively engaged. Therefore, ongoing review on the land use policies, currently at the committee stage at the national assembly in Kenya needs to capture interests of the local pastoralists'. Indeed, their involvement in the past has not been adequate thus leaving out

several issues affecting their livelihood. Nevertheless, pastoralists' have informal social structures, however they lacked the backing of the legal arm and can easily be challenged in the courts. Moreover, they lack the binding component and at time might not be honoured. Therefore, their harmonization and recognition in the ongoing land use policies review might give the local community authority on issues such as land and natural resources for their wellbeing considering the critical roles they have played in the conservation of biodiversity and the preservation natural resources in the ASALs over the years.

Moreover, pastoral livelihood system remains the dominant livelihood system in the ASALs counties in Kenya. However, the existing marketing structure are exploitative for the herder in favour of the middlemen. The harsh conditions in the marketing structures have forced the herders to conform to the injustices including being ripped off through charging huge commissions. These marketing structures need to be overhauled to clearly indicate the roles of the key stakeholders including the middlemen, the herders and the buyers in the marketing of livestock. Moreover, information flow should be facilitated for easy trade and to prevent the middlemen from taking advantage from the gullible herders.

Indeed, interventions such as easy access to critical resources and local joint management of land resources are all aimed in sustaining livestock sub-sector in the ASALs. Nevertheless, it is inevitable that with the projected climate shifts, relying on a single livelihood will not be sustainable. Under such circumstance, the pastoralists must diversify their livelihood systems in line with the anticipated climate related hostilities. In addition, they need to reflect more on diversifying adoption options by embracing programme such as insurance. Livestock insurance had attracted few household, yet there were huge number of potential households left out of such a strategic adaptation option. Thus, more sensitization and support should be given to households in order to improve the enrolment rate. Similar support should be enhanced to boast complementary income generating activities alongside the traditional ones in the ASALs.

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