



# Influence of Changes in Rainfall Patterns on Livestock Feeding Practices in Mailwa Sub-location, Kajiado County, Kenya

Gikaba James Mukuna<sup>1\*</sup>, Kamuru Susan Muthoni<sup>1</sup>  
and B. Bockline Omedo Bebe<sup>2</sup>

<sup>1</sup>Department of Applied Community Development Studies, Egerton University, P.O.Box 536-20115, Egerton, Kenya.

<sup>2</sup>Department of Animal Sciences, Egerton University, P.O.Box 536-20115, Egerton, Kenya.

## Authors' contributions

*This work was carried out in collaboration between all authors. The work was a component of a wider Masters study for authors GJM, KSM and BBOB were University supervisors of the candidate.*

*Authors GJM, KSM and BBOB made substantial contributions to the work from conception through data collection, analysis, drafting and revising the manuscript. All authors read and approved the final manuscript.*

## Article Information

DOI: 10.9734/BJAST/2015/12527

### Editor(s):

- (1) Rares Halbac-Cotoara-Zamfir, Hydrotechnical Engineering Department, "Politehnica" University of Timisoara, Romania.
- (2) Harry E. Ruda, Centre for Advanced Nanotechnology, University of Toronto, Canada.

### Reviewers:

- (1) Anonymous, Canada.
- (2) Anonymous, Kenya.
- (3) Anonymous, China.
- (4) Anonymous, Nigeria.

Complete Peer review History: <http://www.sciencedomain.org/review-history.php?iid=771&id=5&aid=7934>

**Original Research Article**

**Received 4<sup>th</sup> July 2014**  
**Accepted 7<sup>th</sup> January 2015**  
**Published 29<sup>th</sup> January 2015**

## ABSTRACT

Changes in rainfall patterns continue to affect pastoralism as practiced by the Maasai community in Kajiado County. The Maasai community is vulnerable to effects of the changing rainfall patterns induced by climate variability. The community has tried to cope with these changes by altering livestock feeding practices but knowledge gaps exist as to whether these characteristic responses adequately respond to the problem posed by changing rainfall patterns. Thus, this study established how changes in rainfall patterns influence livestock feeding practices of the Maasai community in Kajiado County. A sample size of 136 household heads was used for the study. Results indicated that most of the respondents had noticed changes in rainfall patterns (99%), 58.09% reported that

\*Corresponding author: E-mail: [jgikaba@gmail.com](mailto:jgikaba@gmail.com);

onset of rains was no longer predictable and 43.4% reported that rains lasted for an average of three months in a year. Analysis of rainfall data for last two decades indicated variations in both amounts and the number of rain days. The Maasai community has continued with traditional seasonal movement of livestock despite observed changes in rainfall patterns which poses a great danger to pastoralism in the area. Interventions proposed to assist the community cope with effects of changes in rainfall patterns include harvesting and preservation of natural hay for feeding livestock during the dry season, rehabilitation of the existing water pans and construction of new ones to enhance water harvesting during the rainy season, and promotion of alternative sources of livelihoods for the community due to threats posed to pastoralism as a result of increased land subdivision, growth of private ownership and change in land use patterns.

*Keywords: Rainfall patterns; climate variability; livestock feeding practices; Maasai community.*

## 1. BACKGROUND

In Kenya, arid and semi-arid areas are characterized by low rainfall amounts with erratic and unreliable timing associated with recurring droughts. Rainfall is the most obvious indicator of drought because it is a timely indicator of drought providing a signal few weeks before the vegetation responds and many months before livestock dies [1]. According to [2], close to 80% of Kenya's population is rural and dependent on agriculture for basic livelihoods and hence highly vulnerable to rainfall variability. Observations made by [3] show that reduction in food production is one of the impacts of climate change being felt in Kenya due to erratic and unpredictable rainfall patterns.

Analysis of patterns of observed climate change during the 1960–2009 periods in rainfall and temperature showed that large parts of Kenya have experienced more than a 100 millimeter decline in rainfall [4]. Alterations in rainfall patterns are likely caused by elevated atmospheric carbon dioxide (CO<sub>2</sub>) and other elements of climate change [5]. Drying of water sources in Tana River area of Kenya which receives an annual rainfall averaging 300 mm has been noticed as a result of prolonged drought exposing pastoral communities in this area to chronic water shortages [6]. Climate change is likely to induce variability in rainfall patterns leading to more frequent floods and droughts [7]. A correlation between rainfall and forage primary production has been established for regions where the rainfall is below 700 mm. In the low rainfall region south of the Sahara, 1mm of rain produces 2.5 kg of dry matter (DM) per hectare [8].

Availability of water resources in Kenya has been decreasing over time as a result of persistent droughts and land-use patterns and the situation

has been aggravated by rainfall variability and increased evaporation due to high temperatures the impacts are largely felt in the marginal rainfall areas of the country [9]. The perception of the Maasai community in Kajiado district is that rainfall were reduced while periods without rainfall (droughts) were longer and more frequent [10]. This paper examined the influence of change in rainfall patterns on livestock feeding practices of the Maasai pastoralists.

The Specific objectives of the study were:

1. To describe the perceptions of Maasai pastoralists on changes in rainfall patterns in Mailwa sub location
2. To describe the actual rainfall pattern for Mailwa area, based on the available rainfall data
3. To describe traditional and current livestock feeding practices by Maasai pastoralists in Mailwa sub-location, Kajiado County
4. To establish the influence of change in rainfall patterns on livestock feeding practices in Mailwa sub-location, Kajiado County

The Hypothesis tested in this study was that change in rainfall pattern has no statistically significant influence on the current livestock feeding practices by the Maasai of Mailwa sub location of Kajiado County.

### 1.1 Study Area

The study was conducted in Mailwa sub-location in Kajiado County which was purposely selected because it is an ASAL area inhabited by Maasai pastoralists, still practicing pastoralism in the face of challenges posed by changes in rainfall patterns. The area is experiencing increased sub-division of communal grazing areas and

immigration of other communities in search of land for settlement. The pastoralists keep mainly cattle, sheep and goats, camels and donkeys. The average annual rainfall ranges between 500 mm to 1250 mm. The rainfall pattern is bimodal with short rains between October and December; and long rains between March and May. The average annual potential evapotranspiration ranges from 1600 to 2200 mm which means that for the greater parts of the year there is a moisture deficit. The population of the sub-location is 2,130. The vegetation cover is open grassland, wooded grassland and bushed grassland. Wood and bush land makes this area suitable for pastoralism.

## 2. METHODS

### 2.1 Data Collection

A cross-sectional survey was conducted in August 2013 in Mailwa sub-location of Kajiado County which was purposively selected as the area's inhabitants are Maasai who practice pure pastoralism. The study targeted 437 household heads (295 male and 142 female). Proportionate simple random sampling was used to ensure representation of both male and female household heads were included in the sample. A sample size 136 household heads consisting of 92 males and 44 females were selected. Interviews were conducted on each sampled household and responses entered in the interview schedule. Data collected through the survey indicated changes in rainfall patterns in the area over a period of 10-20 years.

## 3. RESULTS AND DISCUSSION

### 3.1 Changes in Rainfall Patterns

The findings of this study indicate that pastoralists were consciously aware of the changes in rainfall patterns in the area. For instance, a majority (99.3%) reported having noticed changes in rainfall patterns within the last 10 to 20 years (Table 1). This observation concurs with that of [11], who reported that emission of greenhouse gases caused rise in temperatures which in turn led to changes in and rainfall patterns.

### 3.2 Onset and Length of Rainy Seasons

Onset and length of rainy seasons were considered as important factors in this study. Majority of the pastoralists (58.09%) indicated that the onset of rains in the area was no longer

predictable and almost half (43.4%) indicated that when rains came, they normally lasted for period of three months in a year (Table 2). Pastoralists also reported that the amount of rainfall had reduced over the years. This observation is similar to that reported by [10], that the Maasai community perceived the rainfall have been reduced, while droughts were longer and more frequent. This phenomenon may be explained by the fact that due to drought variability, rainfall patterns had changed and rains were not coming at the expected time while heavy rains were being experienced out of season. According to [1], inadequate rainfall is a timely indicator of drought, which provides a signal a few weeks before the vegetation responds, and many months before livestock dies.

**Table 1. Perceived change in rainfall patterns by pastoralists in Mailwa sub-location**

| Noticed changes in rainfall patterns? | Frequency | Percent |
|---------------------------------------|-----------|---------|
| Yes                                   | 135       | 99.3    |
| No                                    | 1         | .7      |
| Total                                 | 136       | 100.0   |

Rainfall data analysis for a period of twenty years (1991-2011) obtained from the nearest weather station at MRTC Isinya displayed in Figs. 1 and 2 respectively reinforces the pastoralist's view that the amount of rainfall showed downward trend. Observations by [12] indicate that the most adaptive feature of pastoralism is the tracking of seasonal rains where pastoralists monitor changing weather patterns although they may not be accurate.

### 3.3 Trend Analyses of the Rainfall Pattern for Mailwa

The results in Fig. 1 shows a slight downward trend (-1.651) in rainfall amounts, while Fig. 2 showed a very slight upward trend (0.209) in the number of rainy days. The latter trend tallies with the majority of the pastoralists' perception that the length of the rainfall season has increased. The normal rainy season for the Mailwa area is 3 months, while 80.9% of the pastoralists reported a rainy season of 3 to 4 months). Nevertheless, a downward trend in the rainfall amount, coupled with a longer rainy season may mean that, the amount received is not adequate for adequate forage growth. Besides, the distribution of rainfall within a particular season may be erratic and therefore, may not support enough pastures,

thus prompting the pastoralists to adopt alternative livestock feeding practices.

lesser extent included herd splitting and keeping of different species of livestock.

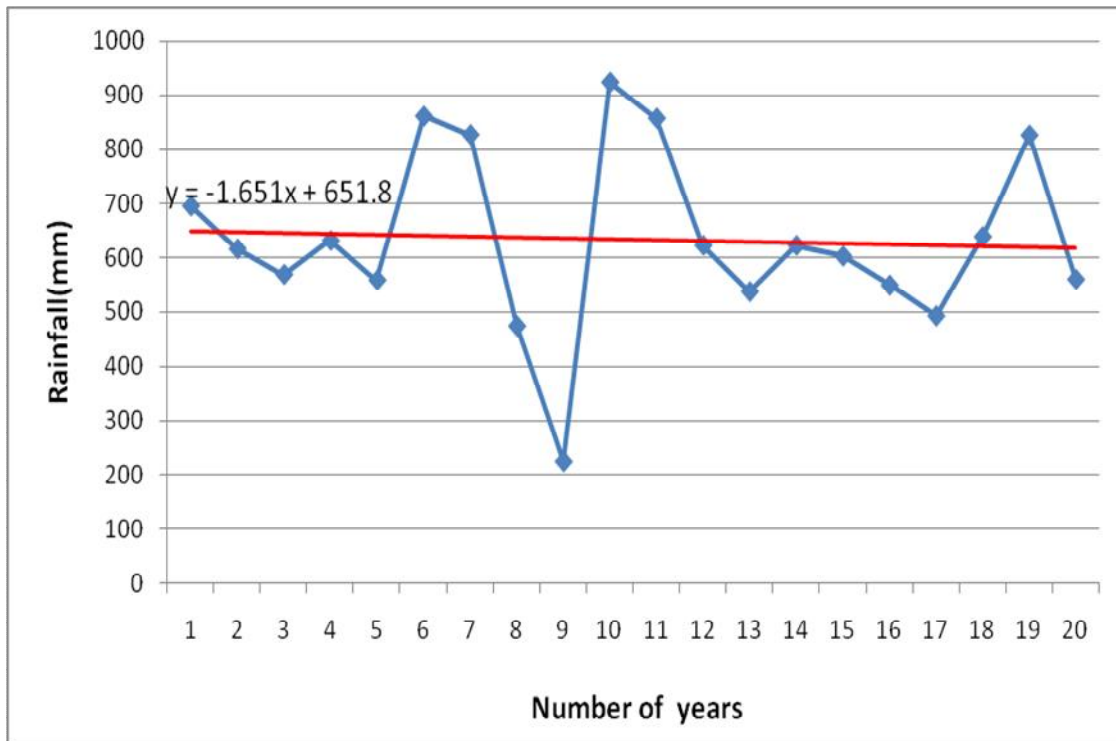
### 3.4 Livestock Feeding Practices

Respondents were asked to indicate traditional livestock feeding practices used to cope with rainfall variability in the past. Results in Table 3 show that the majority of them (87.5%) moved their livestock from one area to another in search of pasture and water. Other practices used to a

Pastoralists' production system is characterized by mobility and flexibility to counter extreme environmental fluctuations [13]. Further, [14] asserted that, mobility enabled pastoralists to use pastures that are only seasonally accessible and allow access to salt patches and other resources and services.

**Table 2. Onset and length of rainy season in Mailwa sub-location**

|   | Frequency | Percent |
|---|-----------|---------|
| <b>Onset of rainy season</b>            |           |         |
| Onset of rains is no longer predictable | 80        | 58.8    |
| Rains come earlier than normal time     | 5         | 3.7     |
| Rains come later than normal time       | 51        | 37.5    |
| <b>Length of the rainy season</b>       |           |         |
| 4 months                                | 51        | 37.5    |
| 3 months                                | 59        | 43.4    |
| 2 months                                | 15        | 11.0    |
| 1 month                                 | 9         | 6.6     |
| Less than 1 month                       | 2         | 1.5     |
| Total                                   | 136       | 100.0   |



**Fig. 1. Variations in total amount of rainfall for 20 years (1991-2011) recorded at MRTC Isinya rain gauge station**

### 3.5 Current Livestock Feeding Practices

The results in Table 4 indicate that although movement of livestock was the most popular feeding practice (97.8%), the Maasai pastoralists at Mailwa had adopted modern livestock feeding methods although at a very small scale (2.2%).

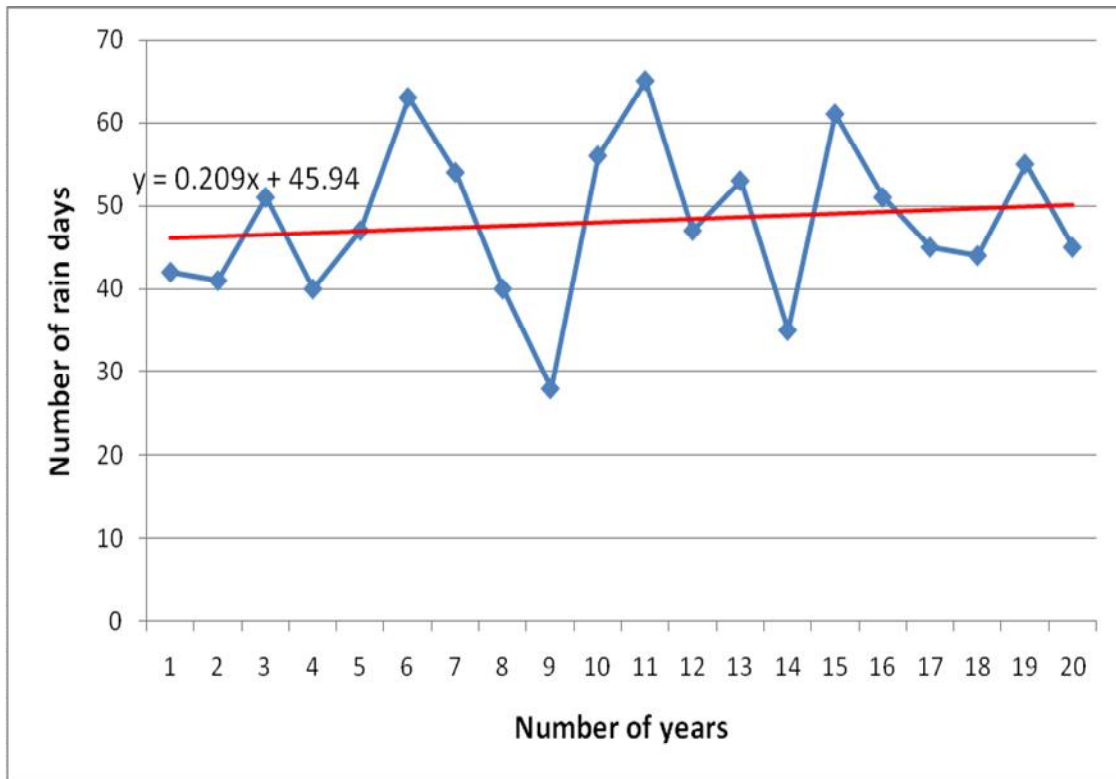
### 3.6 Influence of Change in Rainfall Patterns on Livestock Feeding Practices

To establish whether change in rainfall patterns had any influence on the current livestock feeding practices, livestock feeding practice adopted to cope with changes in rainfall patterns and the length of rainy season were cross tabulated for calculation of chi-square test of independence. The results in Table 5 showed that length of the rainy season significantly influenced livestock feeding practices ( $P < 0.05$ ) where almost all sampled pastoralists' households relied on movement of livestock in search of pasture and water as a coping strategy

against inadequate rainfall in the area. Findings by [15] indicate that quality, quantity and spatial distribution of natural pastures are mainly shaped by amount of rainfall. In the absence of supplementary feeding, pastoralists in this area almost solely relied on natural pasture to feed their livestock. Therefore how long rains persisted impacts on the availability of pastures and water which in turn influence movement of livestock to other areas. It has been noted that the day-to-day impacts of climate change such as erratic rainfall are increasing the pastoralists' inability to feed their animals [14].

**Table 3. Traditional livestock feeding practices**

| Livestock feeding practice | Frequency | Percent |
|----------------------------|-----------|---------|
| Seasonal movement          | 119       | 87.5    |
| Herd splitting             | 12        | 8.8     |
| Livestock mixes            | 5         | 3.7     |
| Total                      | 136       | 100.0   |



**Fig. 2. Variations in the number of rain days for 20 years (1991-2011) recorded at MRTC Isinya rain gauge station**

**Table 4. Livestock feeding practices adopted by Maasai pastoralists to cope with change in the rainfall pattern**

| Livestock feeding practices   | Frequency | Percent |
|---|-----------|---------|
| Movement of livestock to other areas in search of pasture and water | 133       | 97.8    |
| Purchase of hay   | 2         | 1.5     |
| Purchase of commercial feeds  | 1         | .7      |
| Total   | 136       | 100.0   |

**Table 5. Relationship between rainfall patterns and livestock feeding practices**

|                               | Number | Livestock feeding practice adopted to cope with changes in rainfall patterns |                  |                              | Total (%) |
|-------------------------------|--------|--|------------------|------------------------------|-----------|
|                               |        | Movement of livestock to other areas (%)                                     | Purchase hay (%) | Purchase commercial feed (%) |           |
| <b>Length of rainy season</b> |        |  |                  |                              |           |
| 4 months                      | 51     | 98.0   | 0.0              | 2.0                          | 100.0     |
| 3 months                      | 59     | 100.0  | 0.0              | 0.0                          | 100.0     |
| 2 months                      | 15     | 100.0  | 0.0              | 0.0                          | 100.0     |
| 1 month                       | 9      | 77.8   | 22.2             | 0.0                          | 100.0     |
| Less than 1 month             | 2      | 100.0  | 0.0              | 0.0                          | 100.0     |
| Sample (n)                    | 136    |  |                  |                              |           |
| Overall (%)                   |        | 97.8%  | 1.5%             | 0.7%                         | 100.0%    |

Calc.  $\chi^2= 30.93$ , crit.  $\chi^2=15.51$ ,  $df = 8$ ,  $p = 0.001$

This implies that the length of the rainy season is likely to influence the amount of pasture and water available for livestock in the area and ultimately influence livestock feeding practices. Water pans are the only sources of water for livestock in the area. Most of water pans are silted and depend on the amount of rainfall to recharge after the dry season. This implies they are unable to hold adequate amounts of water and hence are depleted fast when rains stop. Inadequate rainfall results in poor pasture establishment hence reducing livestock carrying capacity. This is also supported by [16] who reported that drought variability affects pastoralism by reducing carrying capacity of rangelands by inducing changes in plant species compositions. This results in the reduction of favourable species and increase in less palatable ones and at the same time reduced availability of water for livestock use. The end of the rainy season marks the beginning of the dry season in which the amounts of pasture and water are likely to progressively decrease. This in turn may cause the pastoralists to move their livestock which is the most important livestock practice adopted to cope with inadequate rainfall in the study area.

#### 4. CONCLUSIONS

This study tried to determine the influence of change in rainfall patterns on livestock feeding practices among the pastoralists in Mailwa sub-location, Kajiado County. The Maasai community has continued with traditional seasonal movement of livestock with limited uptake of supplementary feeding practices using commercial feeds and hay despite observed changes in rainfall patterns which poses a great danger to pastoralism in the area. This should attract the attention of development agencies to formulate interventions that promote harvesting and storage of natural hay to be used for feeding of livestock when rains are inadequate. Rehabilitation of the existing water pans and construction of new ones should be undertaken to enhance water harvesting during the rainy season. In addition, the increase in land subdivision, growth of private ownership and change in land use patterns, livestock production which is a key source of livelihood for the Maasai of Mailwa is at stake. Therefore, alternative sources of livelihoods for the community should also be part of planned interventions.

## ACKNOWLEDGEMENTS

The authors acknowledge the financial support given by the Rockefeller Foundation, through the Climate Change Adaptation Project (CAPro) of Egerton and Laikipia Universities. Our sincere appreciation to the Maasai pastoralists in Mailwa sub-location of Kajiado County for their time and cooperation during interviews.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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