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Grassland and Livestock Production: The East African case

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ABSTRACT
Grasslands cover over 26% of the world land mass and about 80% of the agricultural area. They are the source of a livelihood for about 1 million people in the developing countries. Livestock contributes 40% of the global value of agricultural outputs. Approximately 60% of rural households keep livestock. In East Africa there are a number of grasslands. The most extensive of these are the Acacia based Savanna grasslands. Others include the sudd flooded grasslands of South Sudan and the Miobo woodlands of Tanzania. More than 60% of the livestock and wildlife in this region are found on these grasslands. In Kenya about 60% of the red meat is produced from grasslands. The grasslands are, therefore, important to the countries of East Africa as livestock contribute at least 45% of the gross domestic product (GDP) and between 54-90% of the agricultural GDP. The grasslands of East Africa include the world famous Serengeti grassland ecosystem, famous for its tourist appeal.

Introduction
Grasslands cover over 26% of the world land mass and about 80% of the agricultural area. The Global Land Cover Characteristics Database of the US Geological survey classifies grasslands as open and closed shrublands, woody and non-woody savannas and grasslands. This includes the grasslands of eastern Africa, South Africa, South America, Central North America, Mongolia, Tibet, Russia and Australia. Grasslands are an important source of livestock products (meat, milk, fibre, manure (for fuel and soil fertility) and drought power) especially in the developing world where 68% of the grasslands are located. Grasslands have been the source of livelihoods for many people around the world and also provide other social/cultural products. They are also important in preserving eco-system biodiversity and of late the role of grasslands in reducing greenhouse gas (GHG) emissions have been recognized (DeFries and Rosenzweig, 2010).

Livestock contributes 40% of the global value of agricultural output and support the food security of about 1 billion people (FOA, 2009). Approximately 60% of rural households keep livestock and apart from providing food, livestock is a valuable asset especially for poor households. Poor households also use livestock as a store for their wealth, collateral for credit, drought power (ploughing and transport) and a source of income through sales of live animals and products like milk (Table 1). Globally livestock provides about 25% of the dietary energy, 25% of the protein and essential micro-nutrients. Apart from livestock production grasslands provide a number of products and services including ecosystem services, water catchment and biodiversity resources. However, in many developing countries production of milk and meat is a major output of grasslands.

East Africa has grasslands in high rainfall areas but is dominated by trees and shrubs. However the savannah grasslands cover over 60% of Kenya, Uganda, Ethiopia, Somalia and Djibouti. These grasslands cover a wide area of altitudes. The extensive grasslands are mainly in the semi-arid areas and are important for wildlife and livestock production. The region is home to approximately 300 million people and with a growth rate of 2.5 per cent per annum the population is expected to double every 30 years. The grasslands are important for livestock production and wildlife and hence tourism. In Kenya, 60% of the livestock and 70% of all wildlife outside protected areas are found in these grasslands.

Types of Grasslands in East Africa
1. The Acacia Savanna Grasslands

The Acacia savanna grasslands of East Africa are the most distinctive grasslands in the world. They have a dense concentration of large mammals and support a large number of livestock species. These grasslands have alternate wet and dry seasons making pasture and water availability seasonal. The main livestock
production system on these grasslands is nomadic pastoralism where the livestock keepers move in search of water and pasture. These grasslands cover a large part of Kenya, Southern Ethiopia and parts of Uganda. The most dramatic of these grasslands is the greater Serengeti grassland ecosystem.

2. **The sudd flooded grasslands**

The sudd flooded grasslands of the region cover parts of South Sudan, Uganda and parts of the Sudan/Ethiopia boarder. They are hot with alternating wet and dry seasons. The main grasses include combretum and elephant grass *Pennisetum purpureum*. There are over 1,000 endemic plant species in these grasslands.

3. **Miobo woodlands**

These are tropical to sub-tropica grasslands, savannas and shrubland. They are called Miobo is a Swahili word for Brachystegia trees which predominate these grasslands. They are found mainly in Tanzania.

4. **Ethiopian Montane Grasslands**

These are highland grassland areas at 1,800 to 3,000 above sea level. The natural vegetation include closed-canopy forests in the wetter areas and grasslands and bushlands in the drier areas. They have deep fertile soils and mixed crop-livestock agriculture is practiced.

These grasslands are home to most of the livestock in the region and are, therefore, a significant source of livestock products in the region as detailed below.

**Livestock products from grasslands**

Grasslands are the main source of feed for ruminants and therefore the meat, milk, hides and skins (Table 1). Other products for livestock include manure that is used as a fertilizer or fuel including biogas. Animals provide draught power for transporting farm inputs/outputs to markets and also land preparation. Other indeterminate products form livestock include; reduction of risk from crop operations, generation and accumulation of capital, generation of income and smoothing out cash flows. Unlike crops where the incomes are available seasonally livestock products such as milk are available throughout the season and provide not only nutrition to the households but are sold to generate income that is used to meet other household needs. Livestock are also used for social, cultural and religious needs and obligations (Table 1).

In East Africa over 90% of all the meat is produced from cattle, sheep and goats (Figure 1). The meat is produced mainly from grazing animals in the grasslands of the region. This underlines the importance of the East African grasslands in livestock production.

![Figure 1: Composition (%) of total meat production in Kenya](image)

**Importance of livestock to the Economy in East Africa**

The East African region is 60-100% arid or semi-arid (ASAL). The ASAL areas received between 600-250 mm of rainfall in a year and due to the high temperature they have a water deficit and are, therefore, not suitable for rainfed agriculture. These areas are, therefore, only suitable for livestock production as they can support pasture production. Livestock production is important as it contributes significantly to the GDP of the countries in the region (Table 2). Livestock contributed about 52.4% of the agricultural GDP in Kenya in 2000. Approximately 60% of the livestock products are from the grasslands of the country. In Djibouti livestock contributed 84.7% of the agricultural GDP in 2000. Unlike in Kenya the livestock is Djibouti is produced on the grasslands. This figure underline the importance of grasslands in East Africa.

**Table 1: Livestock Products**

<table>
<thead>
<tr>
<th>Immediate</th>
<th>Intermediate</th>
<th>Indeterminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>Farm draught power</td>
<td>Reduction and spread of risk from crop operations</td>
</tr>
<tr>
<td>Milk</td>
<td>Off-farm transport</td>
<td>Generation and accumulation of capital</td>
</tr>
<tr>
<td>Fibre</td>
<td>Manure as fertilizer</td>
<td>Generation of income and smoothing out cash flow</td>
</tr>
<tr>
<td>Hides and skins</td>
<td>Manure as fuel and for biogas production</td>
<td>Fulfilling social, cultural and religious needs and obligation</td>
</tr>
<tr>
<td></td>
<td>Weed control</td>
<td>Providing status or prestige in the immediate community sport, culture and recreation</td>
</tr>
</tbody>
</table>
Kenya, Uganda, Tanzania, Djibouti, Somalia and Sudan. These areas receive insufficient rainfall for rainfed crop production and are dominated by livestock production. The livestock production system that is predominant in these zones is nomadic pastoralism but in the wetter areas agro-pastoralism is practiced. Cattle is the main source of milk in the region which has a well-developed smallholder dairy system. In Kenya 80% of the marketed milk is produced by smallholder dairy farmers keeping between 2-10 dairy cows in a cut and carry system. In this system, Napier grass provides about 60% of the feeds and the rest is from planted pastures and crop residues.

### Consumption of livestock products in the region

The demand for livestock products has been on the increase in developing world. From the beginning of the 1970s to the mid-1990s, consumption of meat in developing countries increased by 70 million metric tons (MMT), almost triple the increase in developed countries, and consumption of milk by 105 MMT of liquid milk equivalents (LME), more than twice the increase that occurred in developed countries. The market value of that increase in meat and milk consumption totaled approximately $155 billion (1990 US$), more than twice the market value of increased cereals consumption under the better-known “Green Revolution” in wheat, rice and maize. The population growth, urbanization, and income growth that fueled the increase in meat and milk consumption are expected to continue well into the new millennium, creating a veritable Livestock Revolution (Delgado, Rosegrant, Steinfeld, Ehui, & Courboi, 1999).

Delgado, It is projected that the developing world will be consuming 65% of the meat and 57% of the milk consumed in the world (Delgado, Rising Consumption of Meat and Milk in Developing Countries has Created a New Food Revolution, 2003)(Table 4). However, the production and consumption of livestock products has remained

### Livestock Products in East Africa

Grasslands are the primary source of feed for ruminants and in East Africa and at least 60% of all the meat is produced from grasslands. Cattle milk is the most important in East Africa, although camel and goat milk is growing in popularity. Other livestock products produced from grasslands include manure and draught power. The importance of these products is discussed as below:

(i) Meat and Milk Production

Meat and its products are a source of high quality proteins and essential amino-acids. In the east Africa region cattle, goats, sheep are the main sources of red meat. The area has a total of 113.1 million cattle, 65.7 million sheep and 97 million goats (Table 3) (FAO, FAOSTAT, 2012). Ethiopia has the highest number of livestock followed closely by Tanzania. Most of the animals are kept in extensive systems and the main source of feed is natural grasslands, mainly in the arid and semi-arid zones (ASALs) of the region. The ASAL areas cover between 60-100 of the land cover of Ethiopia,

### Table 2: Importance of Livestock production in the East African Region

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Agricultural Contribution to GDP (%)</th>
<th>Livestock Contribution to AgGDP (%)</th>
<th>Livestock Contribution to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>1980</td>
<td>32.6</td>
<td>49.4</td>
<td>16.1</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>29.1</td>
<td>53.3</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>19.9</td>
<td>52.4</td>
<td>10.4</td>
</tr>
<tr>
<td>Uganda</td>
<td>1980</td>
<td>72</td>
<td>24.2</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>56.6</td>
<td>20.9</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>42.5</td>
<td>19.8</td>
<td>8.1</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1980</td>
<td>56.1</td>
<td>36.8</td>
<td>20.6</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>49.3</td>
<td>39.1</td>
<td>19.3</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>52.3</td>
<td>32.5</td>
<td>17.0</td>
</tr>
<tr>
<td>Somalia</td>
<td>1980</td>
<td>68.4</td>
<td>88.0</td>
<td>60.2</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>65.5</td>
<td>82.5</td>
<td>54.0</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>-</td>
<td>88.2</td>
<td>-</td>
</tr>
<tr>
<td>Djibouti</td>
<td>1980</td>
<td>-</td>
<td>86.3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>3.3</td>
<td>89.5</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>3.7</td>
<td>84.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Source: ILRI and (FAO, FAOSTAT, 2012)
low in Africa compared to other developing countries in Asia and Latin America.

In Ethiopia the meat consumption is about 19 kg per capita per annum (Ofcansky & Berry, 1999). This amount is very similar to the situation in Kenya where although meat consumption has been on the increase (Table 3) per capita consumption has been stagnant at about 20 kg (FAO, FAOSTAT data, 2005). The per capita meat intake in Uganda is estimated at 7.78 kg (IGAD, 2013). This level of consumption is low when compared to about 80 kg/capita in Brazil and 33 kg/capita for the developing world (Table 4).

(ii) Hides and skins

Hides and skins are an important livestock product both at producer and national level in East Africa. However, for various reasons they have rarely contributed their full value both at the household and the national (Wilson, 1992). In East Africa, Ethiopia has one of the most advance leather industry and earns a significant amount from hides and skins. In the 1980s Ethiopia earned an equivalent of 9.2% of the agricultural export earns from hides and skins and 29.5% of export earnings excluding coffee. Therefore, the region can earn a significant amount of export of they develop the hides and skins sector. Some of the major problems resulting from poor quality hides and skins from the region include branding, poor slaughter and skin removal techniques.

(iii) Manure

Manure is a valuable product from animals in the east African region. In mixed livestock-crop farms manure is used as a fertilizer and hence to improve food security of the households. In areas share firewood and charcoal are scarce manure is used for firewood. In the purely pastoral production system manure might not be considered a valuable product but in pastoral areas that boarder crop farming areas manure can contribute a significant amount to family incomes. For example the Maasai communities in Ngong and Kajiado sell manure to the peri-urban vegetable produces in near Nairobi at approximately USD 20 per tonne. Considering this is a by-product from the livestock sector this is a fairly high price.

(iv) Draught power

Although mechanization has been on the increase worldwide many people in the developing world still rely on animal for draught power. In Africa approximately 80-90% of the labour in agriculture is...
provided by people and the rest by draught animals (Figure 2). Animals provide only 10% of the labour in agriculture compared to about 30% in Asia.

Figure 2: Estimated contribution of power sources in agriculture 2000 (Wilson et al., 2005)

Livestock Production Constraints

Despite the low consumption of livestock products and the large numbers of livestock (Table 3) the region has a deficit of livestock products. The productivity of livestock in the region has remained low (Table 5).

Factors affecting livestock productivity from the grasslands of East Africa

(i) Seasonal availability (quantity) and quality of feed

The low livestock productivity is attributed to a number of facts the main one being availability of feed from the rangeland (FAO, World Agriculture Towards 2015/2030, 2002; Tolera & Abebe, 2007; Njarui, Gatheru, Wambua, & Keya, 2011). Tolera and Abebe report first calving of Borana cattle at 56.4 months in Southern Ethiopia (Tolera & Abebe, 2007). As indicated before the livestock in the region are produced within the ASAL areas. These areas have a very mark seasonal availability of pasture to the animals in grazing systems. During the wet season there is an abundance of grass of high quality but during the dry season there is a major shortage. This is made worse by overstocking and competition between livestock and wildlife for pasture. In the southern grasslands of Kenya the dry season can be as long as 6 months in a year (Table 6) and since feed conservation is not widely practiced they animals loss weight during this period. Compensatory growth may occur during the period of feed abundance but this results in low live and carcass weights. The period during which high quality pasture is available is short. While during the wet season the crude protein content of grass could be as high as 10% this declines rapidly to well below 7% required before intake and digestibility are affected (Table 6).

Apart from low rainfall, degradation as a result of overstocking and competition from wildlife reduces availability of pasture. Grasses are more susceptible to overgrazing compared to forbes and shrubs. This, therefore, results in more unpalatable grasses and shrubs taking over and dominating the grassland.

Table 6: Rainfall and Natural Pasture Quantity and Quality at Katumani, Kenya

<table>
<thead>
<tr>
<th>Month</th>
<th>Season</th>
<th>Rainfall -19-year mean (mm)</th>
<th>Dry matter(kg/ha)*</th>
<th>Crude Protein(%)</th>
<th>NDF (%)</th>
<th>IVDD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Wet</td>
<td>56</td>
<td>876</td>
<td>4.5</td>
<td>75</td>
<td>51</td>
</tr>
<tr>
<td>February</td>
<td>Dry</td>
<td>43</td>
<td>410</td>
<td>3.4</td>
<td>75</td>
<td>49</td>
</tr>
<tr>
<td>March</td>
<td>Dry</td>
<td>75</td>
<td>330</td>
<td>7.6</td>
<td>70</td>
<td>56</td>
</tr>
<tr>
<td>April</td>
<td>Wet</td>
<td>115</td>
<td>750</td>
<td>10.2</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>May</td>
<td>Wet</td>
<td>64</td>
<td>1205</td>
<td>6.4</td>
<td>74</td>
<td>58</td>
</tr>
<tr>
<td>June</td>
<td>Wet</td>
<td>11</td>
<td>1080</td>
<td>5.9</td>
<td>74</td>
<td>56</td>
</tr>
<tr>
<td>July</td>
<td>Wet/dry</td>
<td>4</td>
<td>752</td>
<td>5.3</td>
<td>73</td>
<td>56</td>
</tr>
<tr>
<td>August</td>
<td>Dry</td>
<td>4</td>
<td>342</td>
<td>5.3</td>
<td>72</td>
<td>51</td>
</tr>
<tr>
<td>September</td>
<td>Dry</td>
<td>7</td>
<td>250</td>
<td>5.0</td>
<td>71</td>
<td>51</td>
</tr>
<tr>
<td>October</td>
<td>Dry</td>
<td>29</td>
<td>216</td>
<td>4.7</td>
<td>74</td>
<td>48</td>
</tr>
<tr>
<td>November</td>
<td>Dry/Wet</td>
<td>154</td>
<td>665</td>
<td>10.2</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>December</td>
<td>Wet</td>
<td>80</td>
<td>909</td>
<td>9.9</td>
<td>75</td>
<td>61</td>
</tr>
<tr>
<td>Annual</td>
<td></td>
<td>642</td>
<td>2147</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: Tessema and Emojong 2004; * on dry matter basis; NDF=Neutral detergent fibre, IVDD=invitro dry matter digestibility)
The other factor affecting feed availability in the region is drought. Drought occurs when there is depressed rainfall compared to the long term average for two or more seasons. In the region major droughts occurred every 10 years but they seem to be occurring more regularly (about 5 years) in the recent past. These are periods of severe livestock feed scarcity and results in death of the productive assets (livestock) of the pastoralists and agro-pastoralists in the region.

(ii) Breakdown of Community Governance Structures

Most of the grasslands of the region are utilized communally and the communities living in these areas had developed governance structures that controlled grazing and took care of environmental factors. The community therefore organized their grazing and designated dry season grazing areas that go by different names and any herder who disobeyed the directives was pushed by the community. However, such structures do not occur now and utilization of the grasslands has become chaotic resulting in resource conflicts and pasture degradation.

(iii) Invasive species

Due to overgrazing and degradation of the grasslands in East Africa, the area is experiencing increase in invasive species. The major ones at the moment are Prosopis juliflora and Ipomoea species. P. juliflora was introduced to control soil erosion in the grazing areas of Baringo in Kenya but it took over thousands of pasture land reducing the availability of grass and browse in the areas. Currently different management options including using the wood for power generation and charcoal production are being explored. Ipomoea species have invaded the southern rangelands of Kajiado and Narok.

Efforts to improve grassland productivity

Grasslands are the primary production on which ruminant livestock is dependent. Therefore, for developing countries in East Africa to meet the demand for meat and milk, the grasslands must be utilized more efficiently. Currently most of the red meat and milk consumed in the regions comes from the ASAL areas. In Ethiopia, natural pastures provide about 65% of the feed resources, and the rest are provided by crop residues (Jahnke & Asemenew, 1983). So one way of increasing livestock feed would be through pasture improvement.

A number of efforts are on-going to improve the productivity of the grasslands in the region a number of which are discussed below:

i) Improve quantity and quality of pasture
   a) Re-seeding of degraded pastures

   Degraded pastures do not regenerate even when rains are received as the soil seed bank has been depleted and therefore can only be regenerated by among other things re-seeding. A number of efforts to improve grassland productivity have been going on in the region. A major effort to reseed degraded land has been going on in the region. In Kenya (Mnene, 2006) evaluated options of re-seeding rangelands with or without the use of micro-catchment (Figure 3). From his result it was clear that deferring grazing alone will not improve degraded pasture but re-seeding together with micro-catchments improved seedling survival. However, implementing these strategies especially on communally utilized pasture areas has remained a challenge.

   Figure 3: The effect of different re-seeding strategies on seedling population (No./M²) for four grass species in southern Kenya (Mnene, 2006)

b) Integration of herbaceous legumes into pastures to improve feed quality has been tested in the region (Njarui & Wandera, Effect of cutting frequency of five selected herbaceous legumes and five grasses in semi-arid tropical Kenya, 2004; Njarui, Enhancing livestock feed supply by integrating selected forage legumes in semi-arid region of eastern Kenya, 2007; Kahurananga, 1985; Mwangi, 1999). While this has worked well at experimental level the adoption of the technologies has been low due to lack of legume seed and low persistency of the legumes in grazing systems.

c) Selection and breeding of more productive grasses

   East Africa is the centre of diversity of a number of tropical grasses including Bracharia species, Panicum species and Cenchrus cilirias. Therefore, the diversity available makes it possible to improve performance through selection and/or crossing the available
materials. Some of these materials i.e. *Bracharia* species have been collected in the area and improve in other regions. *Bracharia* species has been improved in Brazil and other parts of Latin America and now is the backbone of the livestock production in those areas. Therefore, the effort to improve productivity has taken a two prong-approach:

(i) Repatriate improved material

A number of *Bracharia* hybrids have been imported from Latin America and are being tested in Kenya, Uganda and Rwanda. These have been very promising and are already being utilized by farmers in the region.

(ii) Collection and evaluation of local species

Collections of *Eragrostis superba* and *Cenchrus ciliaris* eco-types are being evaluated in the semi-arid areas of Kenya (Kirwa, Njoroge, Chemining’wa, & Mnene, 2015). (Njauri, Gatheru, Mwangi, & Keya, 2015) evaluated over 20 ecotypes of Guinea grass and identified some suitable for drought prone areas.

**Grasslands and wildlife**

It would be a big omission to discuss the grasslands of East Africa without discussing wildlife and tourism which is a major foreign currency in the region. The grasslands of East Africa are the most distinctive grasslands in the world. They are home to a dense population of large mammals including the African elephant, buffalo, zebra, giraffe and many other ruminants.

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