March 2017

Climate change and degraded ecosystem: Pastoral livelihood in Cross-road

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Summary

This paper highlights the eco-climatic setting of Somaliland. It sheds light to traditional use of the rangelands before independence and the impact of uncontrolled water development on mobility and ecosystem function. It narrates the relationship between livestock performance and vegetation components and the role of standing dry season feed on livestock and their role in droughts. It gives a personal view of effects of climate change prediction models to the current Somaliland environment.

The paper uses scientific names of plants and vernacular Somali names using the Somali script for common names.

Key words: Aridity drought climatic change range condition livestock performance resilience

Eco-climatic setting of Somaliland

Somaliland is located in one of the most arid regions of the world. Aridity is the negative ratio between mean annual rainfall and the mean annual potential evapotranspiration and the degree of aridity is therefore, inversely related to this ratio. Aridity indexes calculated for Somaliland using the Penman's standard equation of Potential Evapotranspiration (PET)= 0.65% X PE (Pan evaporation), and the precipitation (P) to Potential evapotranspiration ratio scale of aridity (UNEP1992), categorize different regions of the country as hyper –arid, arid, semi-arid and sub-humid dry areas (Table1). While the table is derived from the available record, the evaporation data may not be reliable and proper recording is required. The table however, can be a basis of improving weather records in the future.

Table 1. Scale of aridity for five stations of Somaliland

Station	Precipitation P (mm)	Evaporation (Mm}	PET	P/PET	Aridity
Berbera	50	3000	1950	0.03	Hyper -arid
Burao	192	3000	1950	0. 10	Arid
Lasanod	145	2000	1300	0.07	Arid
Erigavo	285	2100	1365	0.21	Semi-arid
Hargeisa	424	2450	1593	0.27	Semi-arid
Borama	524	1300	845	0.62	Dry sub-humid

The overall climate of Somaliland is monsoonal with northeast and southwest monsoon influencing rainfall and wind direction. Majority of rains are the effect of southwest monsoon. The rainfall pattern is different in the regions, the eastern regions have bimodal pattern of rainfall with two distinct rainy seasons and two dry seasons. The Gu season starting from late March with peak rainfall in May is followed by the Xagaa dry season followed by Dayr rains starting from September with peak in October followed by the dry Jilaal season. The eastern and the southern area with predominantly pastoral nomads is the drier part of Somaliland with total rainfall of less than 200MM per annum. Earlier reports (Gilliland 1952) indicated that climate is more severe in south and the eastern part of the country. Macfedyen (1950) reported rainfall of 70 to 105mm for Sol –Haud area. The coast area of the country has rainfall much lower the eastern and southern parts. An 11-year rainfall record of 51.7mm was reported for Berbera (Gillet 1941)

The western part of the country in addition to the Gu and Dayr rains all receive Karan and some times Xays thus with the exception of the winter, the region receives rains for more than eight months though the quantity and the distribution can be very meager. Annual rainfall of more than 400mm reported by Macfedyen is similar to those in the above table and the mean annual record for Borama of 476 mm confirm that the western part of the country is wetter than the east and the Haud.

The Golis-range Mountains running parallel to the coast receives relatively high rainfall. A rainfall of more than 20 inches (>500 mm) was reported for the escarpment (Gilliland 1952 and Box 1968). A high rainfall of 762mm was recorded for Gacan Libax (Macfedyen 1952). The high rainfall record in the mountainous Golis-range is attributed to orographic modification and high humidity mist clouds.

Analysis of rainfall data for station with rainfall records of more than 20 years show considerable variation of annual rainfall as indicated by the number of years where the rainfall was lower than the total mean annual (table 2) with frequency of drought years seem to be more related to the degree of aridity of the station (tables 1 &2).

Table2. Rainfall variation and frequency of droughts for five stations

Station	Mean annual (MM)	No of years of record	No of years below the mean	No of years below 50% of the Mean
Lasanod	145	21	11	4
Burao	192	56	31	6
Erigavo	285	34	17	3
Hargeisa	424	66	31	4
Borama	524	49	22	1

Drought year values where the total rainfall is less than 50% of the long-term mean mask seasonal droughts. For example, in Burao, the number where the Gu season was below the wet season 50% mean was 12 seasons while the value for the Dayr is 12. The impact of both the annual and seasonal variability of rainfall is critically important for the performance of the country's natural resources.

As mean annual rainfall decreases, the variability of the rainfall increases. Hence drought is a recurrent phenomenon in Somaliland particularly in the eastern and southern parts, which can be characterized as drought prone areas.

The above discussion indicates drought is part of the natural system and will always be a feature that will affect the livelihood of the country. The issue then is, how to cope and be resilient to it.

Impact of drought and global warming (climate change)

Global warming and climate predictions models for east Africa conducted in Kenya indicate that average annual temperatures will increase by $1C^0$ by 2020 and $4C^0$ by 2100 (IPCC 2007). The implication of this is increased evapotranspiration and hence aridity. The following table (table 3) will be the state of aridity for six stations of Somaliland. Calculations are based on 1 C^0 rise in temperature will increase PET by 5.25% (Le Houerou 1995)

Table 3. Impact of temperature increase on aridity

Temperature	I C^0	2 C^0	3 C^0	4 C^0
Stations	P/PET	P/PET	P/PET	P/PET
Berbera	0.027	0.026	0.025	0.024
Burao	0.095	0.090	0.085	0.081
Lasanod	0.070	0.066	0.063	0.060
Erigavo	0.183	0.173	0.164	0.153
Hargeisa	0.256	0.243	0.230	0.218
Borama	0.587	0.556	0.527	0.499

Rise in temperatures will increase evapotranspiration, increased aridity and increase water deficit for crop and vegetation production. Although drought can happen in even very humid regions of the world, it appears it is related to aridity as arid regions generally experience more frequent droughts.

Global warming is attributed to increase of green house gases and particularly to carbon dioxide but in plant physiology increased CO2 and temperatures, increase photosynthesis and hence increase production. It is also known that it improves water-use efficiency through reduction of stomatal conductance (Le Houerou 1995). In Arid areas where the major limiting factor for plant growth is water, increased CO2 may not improve primary production.

Regional climate model analysis predicts precipitation increase under global warming for the whole of the east African region including Somalia (IPCC 2007, Shongae et al 2009). Conclusions from these studies directly quoted are as follows:

- Average annual temperature will rise between $1C^0$ and $5C^0$ typically by $1C^0$ by 2020 and $4C^0$ by 2100
- Climate is likely to become wetter in both rainy seasons
- Rains fail seasonality will be the same for both seasons

- Rainfall during wet seasons become extreme by 2100 consequently with floods events are likely in frequency and intensity
- Droughts are likely to occur with similar frequency as at present but to increase in severity
- This is linked to the increase in temperature

Impacts of climate changes on Somaliland rangelands

Climatic prediction models have three key elements that will affect ecosystem functions and livelihood of natural resource dependent societies. These key elements are 1) increased CO2, which will increase primary productivity 2) increased temperature that will increase potential evapotranspiration and 3) increased precipitation for most countries in the east African region.

The issue is how these predictions will affect Somaliland. To appreciate the impacts, it is worth giving a short overview of the historical use of Somaliland resources and the present condition of the key natural resource of the country, the rangelands.

Historical and present system of range utilization

The eco-climatic situation of the country as described above is water deficit with low primary production. Less than 10% of the country is classified to have some potential for agricultural production and with the exception of settlements; the rest of the country is rangeland, which produces forage for both domestic animals and wildlife. Forage production is however, extremely variable and is related to seasonal variability in rainfall. A common feature of arid land ecosystems is also spatial variability of rainfall. These characteristics result an ecologically imposed system of land use where mobility is the key to survival and sustainable production**.** Pastoral nomadism, based on mobile livestock production system was and still is the major activity in the country. Pastoral groups have practiced their seasonal mobility and livestock production in harmony with the environment and available resources**.** This low production ecosystem is the backbone of the livelihood of both pastoral and urban communities. Range-based livestock production is the single most important contributor of pastoral food security, national food security, and national foreign exchange earnings. And for most pastoralists, livestock play important social roles, provide cash income, represent a form of savings and provide extra security of subsistence under drought.

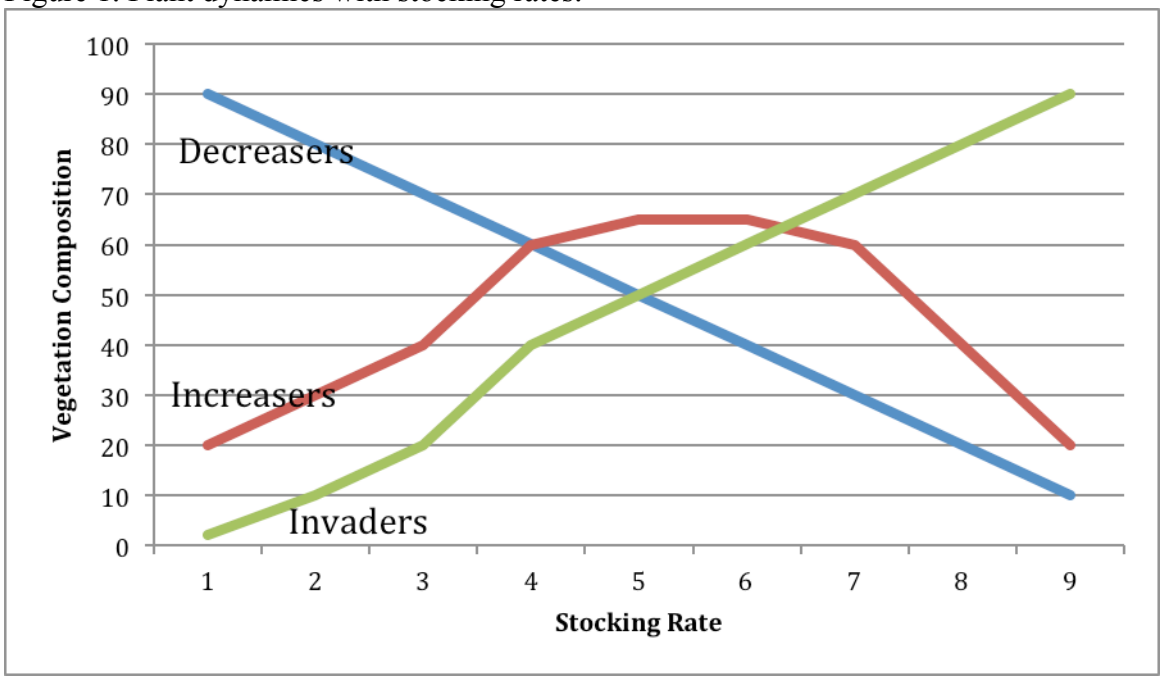
There was slightly fluctuating but relatively stable and sustainable rangeland production system before independence in 1960.

A key to sustained use of rangelands was the ecologically imposed mobility in search of best pasture and seasonal migration to water sources. This was default practice of rest or at least deferred system of grazing. The principal was movement of animals to pasture in areas where they can find good grazing during rainy seasons when water is available in temporary ponds or pools. During the dry seasons animals were moved back to where they can get permanent water and these were areas that rested during the rainy season. This pattern of range use was also excellent for livestock performance.

Macfadyen (1950) reported similar pattern of land use by pastoral nomads pasturing their livestock in Haud and Sol during the rainy season and withdrawing to the permanent water areas in the dry season leaving the Haud and the Sol virtually uninhabited by man and left for fauna which he described it as abundant. The fauna listed in his report were "lion, leopard, cheetah, hyena, jackal, many species of antelopes, wart-hog, and various smaller animals, birds (including the ostrich) and other groups of organisms".
This pattern of rangeland use was an insurance of sustainable livestock production fluctuating only with exceptional back-to-back seasonal drought and disease out- breaks. There were always enough feed reserve and particularly grasses as dry season feed making pastoral nomads more resilient to drought. Species like camel even used to thrive well during dry seasons in rangelands with a browse layer, a source of protein, vitamin and dry grass that serve as bulk-feed. Browse and dry grass as bulk and energy were balanced diet and if not limited by intake used to maintain animal weight during the dry season. It was a common practice of camel boys to closely watch camels in their late pregnancy to help them if they lie down, as they will not be able to get up of their own because they were fat and heavy.

In the early sixties and immediately after independence, surface water development (Berkadas) in all areas where water was the limiting factor for continuous grazing was utilized. This was followed by mushroom of villages as permanent settlement. These had serious consequences on the rangeland ecosystem, its health and performance. The development of water, limited the mobility of the pastoral nomads, which was crucial for the rest-rotation or deferred system of seasonal use of the rangelands. The result has been continuous grazing of the rangelands. The berkadas and villages, which are also very closely spaced, increased stocking rates putting heavy grazing pressure of the vegetation. The result is seriously sick ecosystem with poor livestock performance.
There are two highly correlated components of rangeland productivity; these are range health and animal health. Under normal performing system, livestock productivity is highly related to components of the range, not in terms of biomass production but more important in vegetation composition. Animals have natural preference and selection of plants and plant parts. Natural vegetation under pristine and normal conditions are dominated by plants most preferred by animals called decreasers, examples of these are *Blepharis edulis* (Yamaarug), *Tribulis mollis* (Gaxadh), *Sporobolus variagatus* (Dixi), *Grewia sp* (Hohob) *Cordia ovalis* (Madheedh), *Grewia villosa* (Gomashaa), *Grewia tenax* (Dhafaruur), *Boscia minimifolia* (Maygaag etc.). Early and continuous grazing weakens these preferred species often described as ice-cream and with heavy grazing pressure loose vigor and may not reproduce. They are then replaced by less palatable species such as *Aristida migiurtina* (Maajeen), *Panicum maximum* (Baldhoole), *Indegofera sp* (Jilab) etc. These species are called increaser because they initially increase with heavy use of preferred plants. Continuous heavy grazing also affect increaser plants, invader plants such *Calatropis procera* (Booc), which have very low presence in fair to good condition then become dominant in vegetation structure (Figure I depict vegetation composition changes with increased stocking rate or grazing pressure).

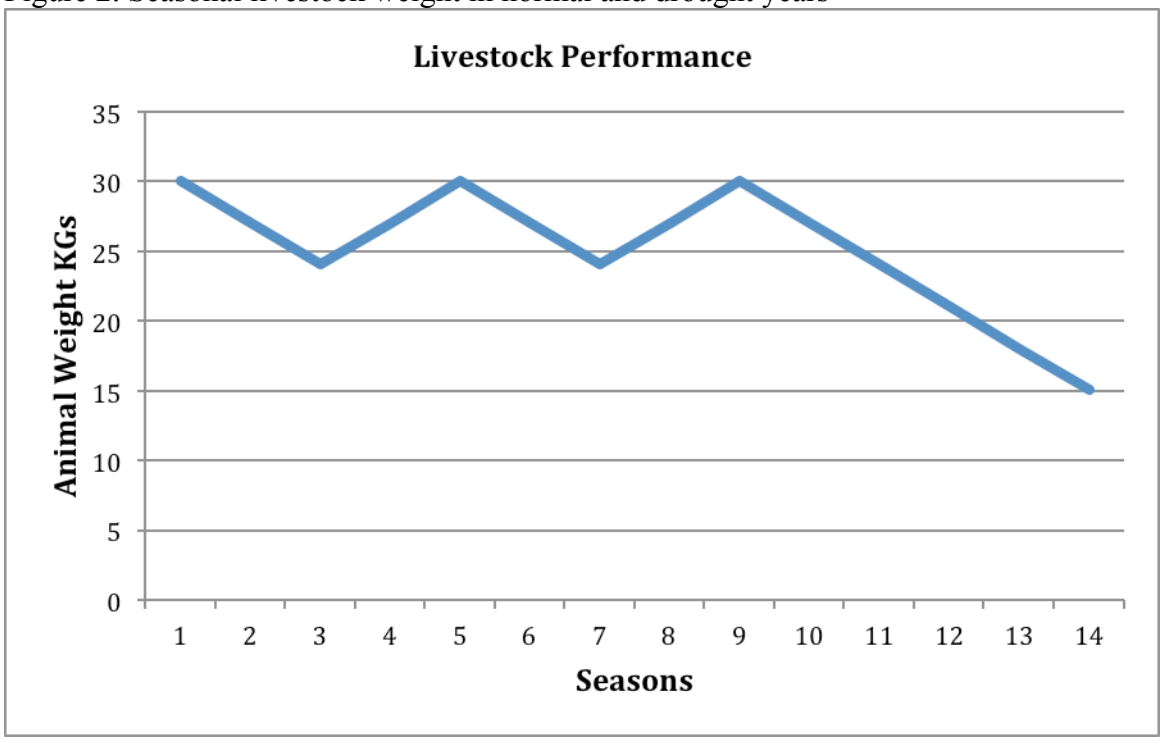
Figure 1. Plant dynamics with stocking rates.



Livestock productivity is very closely related to vegetation composition. Rangelands where preferred species are either dominant or make significant contribution in the vegeation mix give good animal performance. Livestock performance in Somaliland follow bimodal pattern dicated by the bimodal nature of rainfall therefore, there are four trophs (figure 2) in their performance. In a healthy ecosystem the range produce vegetation of different life forms which include both annuals and perennial. There are annual forbs, legumes , grasses annual and perennial grasses in the lower of the vegeation and mid browse species and tall trees in the upper layer.
These plant life forms supply different nutrients for range animals. In aridland ecosystems, annual species are the most abundant during rainy growing seasons and are the principal diet of grazing animals. They are rich in nutrients : proteins, vitamins, minerals and energy , they are also the most preferred and make the bulk of animal intake. They are also major contributors of the compensatory weight gain (Mirreh 2008) after weight losses in the dry season. Early and continous grazing will not allow these important compnent of the vegetation to produce seeds. Perennial grasses, shrubs and tree

also contribute to forage intake of grazing animals during the growing season but their role is more important during the dry season. Grass component is a bulk dry season feed and also supply some energy . Browse layer serves as a complementary feed and supply some of the protein, vitamin and phosphorous needs of range animals.

Figure 2. Seasonal livestock weight in normal and drought years



Range condition, climate prediction and drought resilence

The current ecological condition of the rangeland ecosystem is extremely poor. A key indicator is vegetation composition dominated by least palatable plants to grazing animals . Key forage plants and particularly grasses no longer contribute to available forage for grazing in most areas. Species such as *Sporobolis variagatus*, (Dixi) *Aristida migiurtima* (Majeen), *Crolotaria dumosa* (majeen), *Panicum maximum (baldhoole)* and the endemic tussock grass, *Andropogon kelleri* (Duur) are no longer present in many of their habitats. Some altogether disappered and these were key dry season feed for livestock. Animals used to get bye with carry-over standing dry grass biomass in droght years.

Habitats where the vegetation completely changed from grass dominatant to brush and acacia tree dominant , are the open grass plains . Nomads renamed some of the grass plains because of change in vegetation type. For example, the open grass plain between Waraabeye and Nasiye previously known as Qaaxawaye (deep throat) is renamed as Qodoxwayne (great thorn plain) because it is completely obliterated by acacia (Mirreh

2014). The result of vegetation composition and habitat changes, is a loss of biological diversity , reduced carrying capacity , poor meat and milk production , deminished biological and economic value and worst of all poor resilence to both seasonal and extended drought periods. The takeover of all grass plains by acacia will help CO2 sequestration but this will not benefit Somaliland as this change will deminsh the bio-economic value of rangelands.

This poorly performing system is the cummulative effect of water development without rangeland management, reduced mobility affecting the traditional rest rotation practices imposed by water limitation, increased livestock population and ferocious land grab. The current trend of land acquisition and removal of best grazing lands, further marginalize or push pastoralists into areas of increasing adversity.

As more grazing land and particularly the highly productive lands with higher carrying capacity for grazing animals is removed, more grazing pressure is exerted on the remaining areas further declining quantity and the quality of forage produced from the rangelands.

The system of water harvesting making long canals for the highly dense Berkads found throughout the grazing lands with changing transportation method from camels to trucks is a major destabilization factor of the rangeland. Change of transport mode affords quick access to distant rangelands, which was not previously possible with use of camels. Mobile phones and trucks are key contributors of early grazing which is a detrimental factor when plants are most sensitive to grazing. This early grazing will not allow for good biomass production and seed setting, further affecting the carrying capacity of the land. Truck-made dirt roads crisscrossing the rangelands and canals for berkads have significantly contribute to the loss of vegetation cover. The result is poor water infiltration to replenish soil moisture for plant growth and increased runoff and soil erosion.

Climate models as indicated earlier in this paper, predict the east African region will experience increase in precipitation with some predicting as much as 40% increase in Kenya. Models are also predicting both rainfall seasons will be wetter and may often be very heavy causing floods. Another prediction is increasing temperatures as result of increase of greenhouse gases. Models also predict that frequency of drought may remain the same but its severity may increase.

Somaliland is suffering very badly from drought this year and the animals are dying to a level where many pastoral nomads lost all their animals. Although people are blaming the current drought, loss of animals and particularly sheep and cattle even without drought was predicted (Mirreh 2012) because of the severely degraded rangeland ecosystem. The high mortality in the current drought is the cumulative effect of a poor performing system. Studies carried out in West Africa during the 25 years of drought in the Sahel region reported that large state-owned ranches in which stocking levels were adjusted to long-term carrying capacity did not under go any serious deterioration (Le Houerou 1995).

It appears that Somaliland will suffer more even under increased rainfall because of the current poor condition of rangeland natural resources and its lack of management. With poor vegetation cover and continuous downward trend of rangeland resources, predicted

heavy rains will produce more runoff, flood hazard and soil erosion. Predicted frequency of droughts with no carry-over feed from rangelands makes pastoral nomads even more vulnerable.

The situation of range-livestock production system, which is the backbone of the Somaliland economy and the major source of livelihood for more than 60 % of population, is reaching the break point. It is easy to misuse natural resources but extremely difficult to reclaim it. This is more so with a very fragile arid land ecosystem such as Somaliland.

It is not an easy task and there may not be quick fixes to reverse the current situation. It is very challenging and there should be no illusion that the status quo is no longer an option for Somaliland.

The following will be important step serious address the situation:

General Recommendation

- A political will and government Commitment to take action is needed
- A national land use policy based on the land resource potential (land capability) with clear demarcation and none contradicting institutional mandates is essential
- Livestock production is an industry which is the back bone of Somaliland's economy and livelihood of the pastoral and agropastoral communities. As every industry needs rawmaterials, forage from rangelands is the cheapest rawmaterial that produce organic products of meat and milk for the country and major GDP and foreign currency earnings. Somaliland however, is a waterdeficit country with no potential for large scale irrigated forages, it is therefore extremely important that rangelands which is the only source of feed for the country's livestock (crop residue is insignificant) should be high in the priority of the government's development strategy.

Specific Recommendation

1. National drought management strategy with national drought early warning system is needed
2. A system approach to resource management rather then the current practice of having several ministers often with conflicting mandates. It is desirable if all the ministries dealing with renewable natural resources become one entity, similar to the Department of Natural Resources (DNR) during the colonial period
3. Systematic and regular ecosystem monitoring including climatic and biotic factors necessary for policy and strategy options is essential.
4. Reverse the current trend of rangeland deterioration through a system of land management that will promote mantaining the grass component and other herbaceous vegetation of rangeland as a dryseason feed.This will perhaps

require community based seasonal reserves. Management can be combined with assisted regeneration using improvement techniques.

5. In sutu conservation of different perennial grasses as seed source for national seed multiplication programme for rehabiltating rangelands. This will require survey and identification of relict areas and fencing small exclosures with the full participation and agreement of the pastoral communities and by fully engaging customary laws of the communal system
6. Somaliland is blessed with national treasure of wildlife many of them endemic but sadly many are already under IUCN (International Union of Conservation of Nature) list of threatened species.
   Although not in the picture or not clearly developed, wildlife diversity in Somaliland is a viable national wealth that can contribute to the national economy through eco-tourism. This national resource is under serious threat from both habitat degradation and illegal hunting and trade. It appears that there is profound lack of awareness at all levels of the society including the government about the importance of the national fauna**.** Wildlife conservation should be part of needed biodiversity conservation program

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