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Restrictions on Herd Mobility and Its Implications on Pastoral Adaptation to Climate Change: Perspectives from Drylands of Borena in Ethiopia

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Abstract
The paper is based on action research conducted in three districts of *Borena* zone (*Yabello, Negelle* and *Moyalle*) in Ethiopia. Field work was conducted with pastoral elders using key informant interviews, focused group discussion and participatory mapping exercise. Primary data were generated on local perceptions of climate change and traditional coping mechanisms based on herd mobility. Long-term climate data were analyzed for three weather stations and moving averages were plotted. The results provide strong evidence for climate change and its impacts on pastoral livelihoods particularly when herd mobility is restricted due to various reasons (e.g., agri-business projects, establishment of ranches). Analysis of climate data and local perceptions suggest that there has been a serious climatic and ecological deterioration rendering pastoralists vulnerable to shocks and abject poverty. *Borena* pastoralists have living memories of series of drought and famine episodes of various magnitudes over the past several decades. They claim that this is partly because their traditional mobility patterns have been disrupted and access to important grazing sites has been restricted. The most immediate policy message is the need to protect and promote herd mobility which proved to be the best response and adaptation to changing climatic conditions in the dryland environments. In view of the growing environmental and livelihood concerns subsequent to sedenterization of pastoralists, we tend to challenge the generally held view that pastoral production based on mobility is outmoded, archaic and needs modernization and replacement.
Keywords: Climate change, drylands, herd mobility, pastoralism

1. Introduction

Climatic fluctuations have always been defining features of the dryland environments where pastoralists inhabit. Pastoralism is a livelihood system that enables the dryland people to cope with these fluctuations based on strategy of herd mobility between wet and dry-season grazing and watering sites. Pastoral production has shown itself resilient and capable of coping with harsh environmental conditions through mobility, flexible and low intensity use of dryland resources (Hesse and Cotula, 2006; IIED, 2008). The ability to move herds over large distances to graze the diffused and scattered vegetation allows pastoralists to maintain a delicate balance between pastures, livestock and people. However, global climate change is raising new challenges for pastoral systems. In other words, the rising temperatures and declining rainfall as a result of global climate change are undermining the delicate balance between pasture and livestock on which pastoral systems depend. Rainfall is particularly the most important climatic factor. For pastoralists, it determines the distribution, amount and quality of pasture and availability of water. But rainfall is becoming increasingly erratic and unpredictable over the coming decades (Hesse and Cotula, 2006; Maynard, k., Royer, F., and Chauvin, F., 2002). Under such unfavourable environmental conditions, herd mobility remains crucial in enabling pastoralists to adapt to climate change hazards. However, herd mobility has been curtailed by a combination of factors including expansion of agriculture, settlement, ranches and closures in the prime rangelands and increasing inter-ethnic conflict. The breakdown of the traditional adaptive capacity has, thus, predisposed pastoral communities to climatic shocks, draughts and famine over the past decades.

To compound the already dire situation, the global climate models predict most likely desiccation – i.e., decrease in the amount and predictability of rainfall, combined with an increase in evaporation caused by the warmer temperatures (Nassef et al, 2009; Brooks, 2006). For global mean temperature increases of more than $2^{o}C$, vegetation systems may collapse resulting in severe rangeland degradation and collapse of pastoral systems. But the picture at the local level is less clear and most likely to be mixed, for which local level empirical evidences are rather limited. This paper explores empirical and anecdotal evidences available for climate change and examine its impact on pastoral production particularly under restricted herd mobility. By considering *Borna* rangelands in Ethiopia as a case in point, the study highlights the trends and constraining factors on pastoral mobility vis-à-vis changing climatic and environmental conditions.

2. Study methods

The research reported in this paper was conducted in six villages of three districts (*Yabello*, *Negelle* and *Moyale)* in *Borena* zone of Ethiopia (Figure 1). Field work was conducted during February-April 2011 period. The study employed a combination of methods including review of mainstream literature on the topic, focused group discussion and key informant interview with pastoral elders. Discussions with elders generated information on local perceptions on climate change based on observations of changes in the seasons and cropping calendar. Participatory mapping exercise was employed to trace historical and current systems of herd mobility which is used as an adaptation to changing climatic conditions. The mobility route sketches drawn on flip chart were later overlaid on the *Borena* zone administrative map obtained from the Ethiopian Mapping Authority. GPS readings were taken for the various watering and grazing points used at different times of the year based on the assessment of range conditions. GIS (Geographic Information System) tools were used to integrate and analyse spatial data digitized from topographic maps and participatory maps on herd mobility drawn by pastoral elders. Time series climatic data were obtained from the Ethiopian Meteorological Services Agency (EMSA) to examine changes in the climatic conditions over time. Mean minimum and mean maximum temperature and total annual rainfall data were computed and plotted on a line graph to show trends and patterns in the climatic conditions over time. These were complimented by the local perceptions on climate change

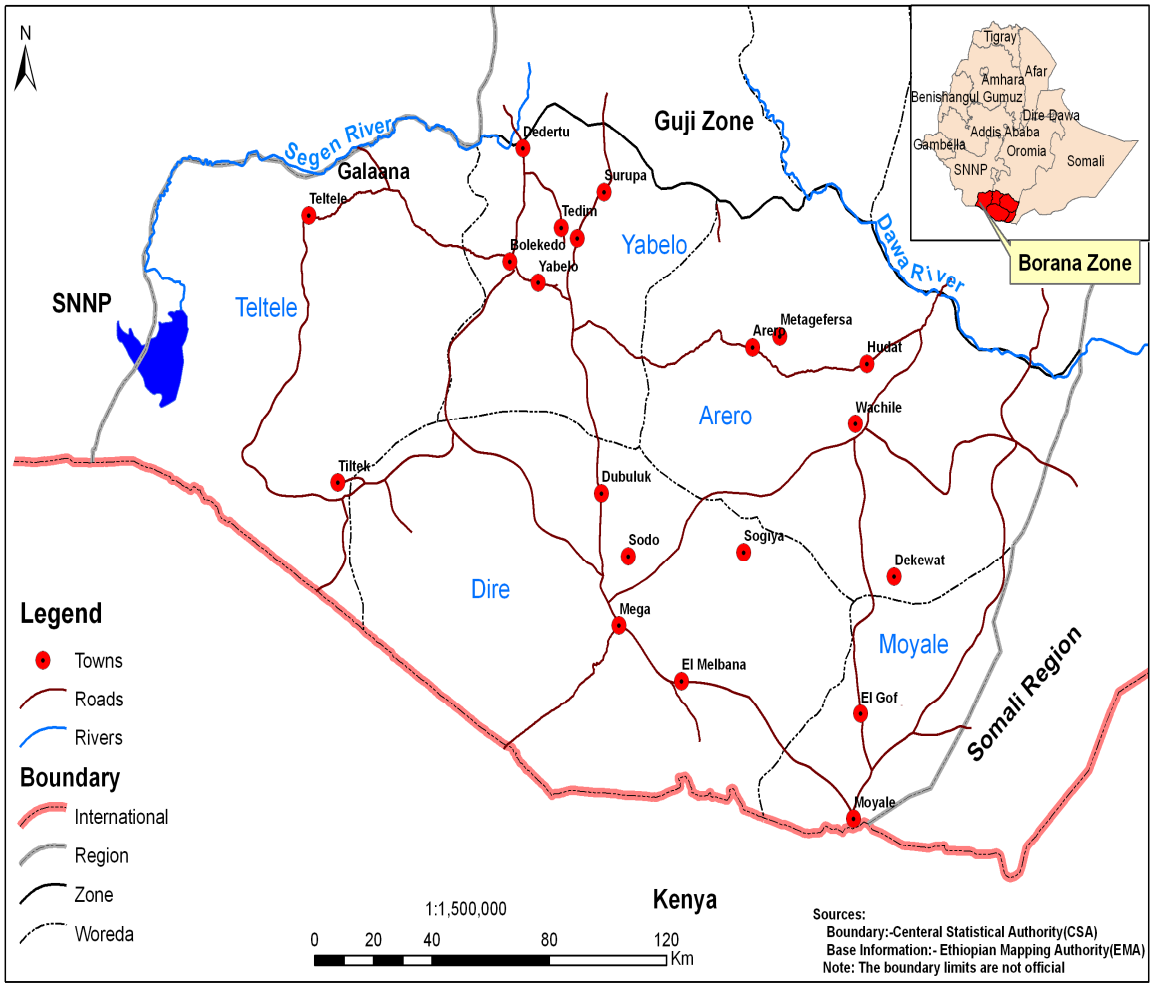

Figure 1. Location map of Borena Zone in Oromiya Regional State of Ethiopia

3. Results

3.1. Evidence for climate change

3.1.1. Time series data

Figure 2 presents the total annual rainfall data for *Yabello*, *Negelle* and *Moyalle* stations for a period of 33 years (1976-2009). The data depicts that moving average of total annual rainfall is constantly declining in all sites but more pronounced in *Negelle* and *Moyalle* district (Figures 2). The highest amount of rainfall (1309 mm) was recorded in *Negelle* station during the year 1981, which has fallen drastically to as low as 256 mm in the year 1999. This is over 20% decline in annual rainfall totals. Rainfall is extremely erratic and low. The long term

average is 600 mm and 500 mm per annum for *Yabello* and *Moyalle*, respectively. In *Negelle,* the moving average has fallen from 800 mm/annum in 1977 to less than 600 mm/annum in 2007 suggesting a 25% decline. During much of the 1980s and 1990s, *Yabello* area received below average amounts (less than 500 mm) of rainfall unlike the case in *Negelle* station (Figure 2). The lowest amount of rains were recorded for the period 1999-2001 which corresponds with the period of one of the worst drought and famine in the history of *Borena*, which claimed lots of lives and wiped out the bulk of the cattle herd. There was a sudden rise in rainfall amounts reaching peak levels (874 mm/annum) in 2004 that witnessed the recovery period. It has fallen sharply the subsequent years suggesting (below the long-term average of 600 mm/annum) leading to another episode of drought. Variations in the rainfall pattern is more spectacular in *Moyalla* area, which is characterized by the highest rates of inter-annual variability and low rainfalls (long-term average of only 500 mm/annum). There was a sudden rise to a peak level (1160 mm/annum) in 1997 but it soon had fallen below average for the remaining period (1998-2006), which has seen one of the worst droughts and famine of its kind.

Figure 3 presents the mean minimum and mean maximum temperature for *Negelle* (Figure 3a) and *Yabello* (Figure 3b) districts. Unlike the declining trends in rainfall amounts, the daily mean minimum temperature has shown a drastically increasing trend across all sites. The trend in mean maximum and mean minimum temperatures is more complex and dynamic in *Negelle* site (Figure 3). Two-three years of rise in temperatures are followed by couple of years of cooling and then rising pattern for much of the period between1977-1997 with the peak of 27 ^{0}C. A clear rise in temperature in *Negelle* is witnessed since 1998-2009 showing a tendency of hitting the peak. In *Yabello*, the mean maximum temperature has shown a significant increase for period 1989-1995 reaching a peak level (27 ^{0}C) in 1995 and remained statistic until 2007. *Moyalle* is not only the driest but also the hottest location within *Borena* with the long term average temperature (mean max temperature) of 28 ^{0}C. The peak in temperature levels in this site was recorded for the period 1982-1983 followed by a general decline for the period 1984-1998. For the remaining period there was an increasing trend in temperatures but still below the peak levels of early 1980s. These findings are in line with the global predictions that there will be likely desiccation in pastoral lowlands as result of declining and erratic nature of the rains coupled with increasing trends in the temperature regime (Brook, 2006; Nassef, 2009).

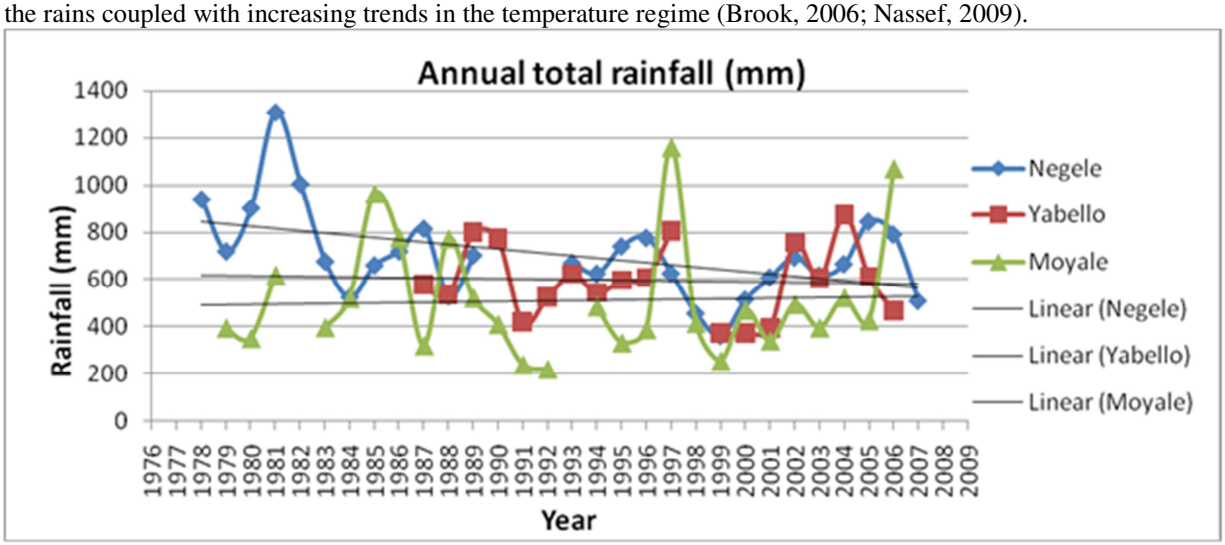

Figure 2. Trends in total annual rainfall for Yabello, Negelle and Moyale stations in Borena (Source: Raw data from EMSA)

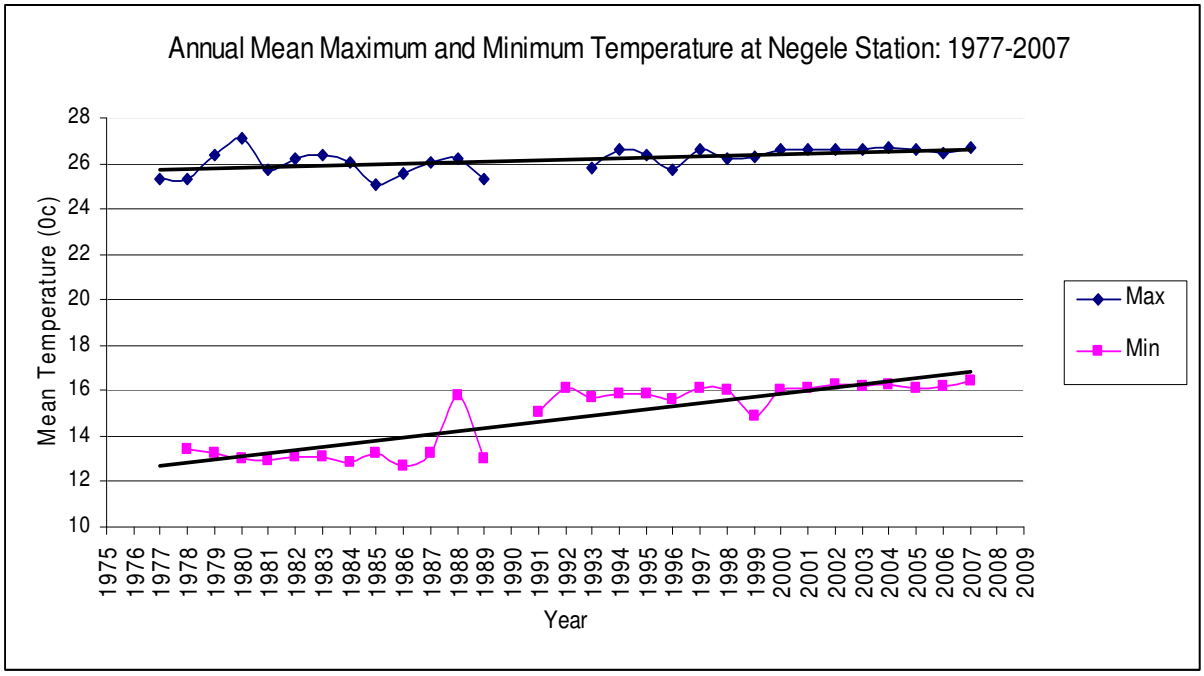

Figure 3a. Mean minimum and mean maximum temperature for Negelle district (Source: raw data from EMSA)

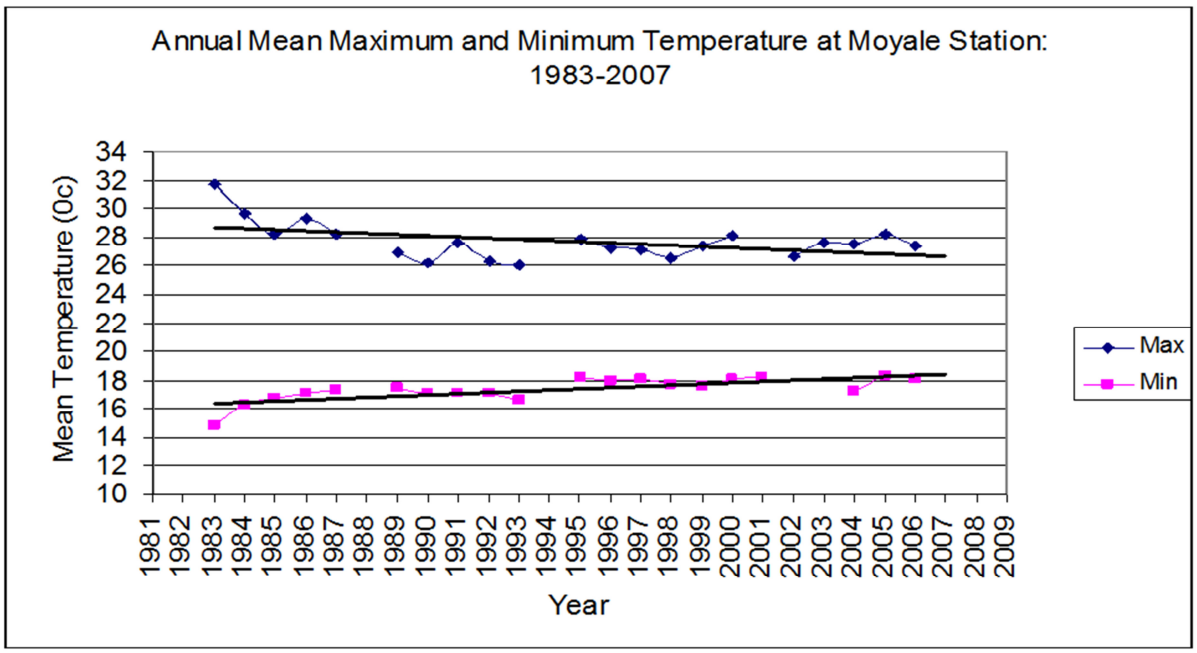

Figure 3b. Mean minimum and mean maximum temperature for Moyalle station (Source: raw data from EMSA)

3.2 Local Perceptions on climate change: Anecdotal evidence

Based on the years of observations in rainfall patterns, day and night temperature regimes and vegetation changes, pastoral elders perceive significant changes in the local climate. They state that they have been experiencing an unusual variability in climate resulting in unpredictable rainfall and drought occurrence. There has been a high variability in the occurrence and spatial distribution of the rainfall leading to range degradation, drying up of water ponds and decimation of livestock assets. A local elder from Yabello district, Yaya Kachora, 60 described the situation as follows:

> *When I was a young boy (some 50 years ago) there was an adequate rainfall and plenty of water in the plains and well clusters along the hills. Both the hagaya and gaana rains occur in time. There was plenty of grass for livestock and milk for children. We knew no drought before the period of Aba Goba Bule (a traditional gedda leader ruled during the period 1973-1980)*

> *during which time we experienced drought for three consecutive years. Recently, the rainfall has become even more erratic and low that the range does not produce enough pasture for cattle. The land became dry, water ponds have dried up and we have been hard hit by recurrent famines. Many households have already lost the bulk their cattle herd due to the spread of disease and drought.*

In the past two major rainy seasons were detected. The first one, the *Hagaya* season runs during October-November period characterized by the short rains that are used to grow early planting crops such as haricot bean and initiated grass (flush) for the animals. But in recent years it stopped raining during the *Hagaya* season meaning long dry season occurs until rains start in May. This has caused shortage of feed for animals and forced people to migrate with their animals to distant grazing and watering sites. Also, the fact that they could not grow short maturing crops such as haricot bean meant extended food gap months resulting in food shortage to the families. The second season, the *Gena* season, was the long rainy (May-August) which is used to grow long maturing crops such as sorghum, millet and sometimes maize. For animals, enough water is collected in the ponds and water wells to sustain animals, which are the single most important assets for pastoral households. But nowadays, the *Gena* rains delay in onset until July meaning extended dry season forcing migration to distant grazing sites such as *Konso, Segen, Elwaye* (Figure 6). However, movement to such new grazing sites are faced with faced with fierce ethnic conflict with the host communities such as the *Konso*, the *Gabra* and the *Burji* who have priorityaccess rights to the in these grazing and watering sites.The 2008-2010 period has left a particular scar in the minds of the *Borena* pastoralists due to the fact that both *Gena* and *Hagaya* rains stopped falling for three consecutive years resulting in an unprecedented drought and famine that hit hard the whole of the horn of Africa region. As confirmed by the recorded weather data, the insufficient rains in those years have tipped the region over the edge, following on the heels of one of the driest October to December seasons ever (TWN, 2011). Some suggest that this drought was due to a La Nina event - a periodic shift in global precipitation patterns that among other changes can dramatically reduce rainfall in eastern Africa.

3.2 Herd mobility as coping strategy to climatic shocks

3.2.1 The traditional system of herd mobility among the *Borans*

Like that of many other African pastoral communities, *Borena* pastoralists' mode of production is based on mobility across geographically distributed grazing units. Mobility of cattle and people between wet and dry-season grazing and watering sites is a deep-rooted traditional management of resources that ensure effective use of the dispersed dryland resources. Seasonal migration links two or more ecological zones based on predictions and assessment of ecological (range) and climatic conditions. In *Borena*, the geographically distributed grazing or herding units are locally known as the *Diida* units (Figure 4). Some prominent examples of herding units in include *Diidda Hara* (in *Yabello district*), *Diida Liben* (in Liben district), *Diida Wachille* (in *Dirre* district) and so on. There is a council called *dheeda* council under the *Geda* leadership that is vested with the responsibility of regulating movement of animals between wet and dry season grazing areas at different times of the year. The *dheeda* council is responsible to decide when to move, where to move and make the necessary arrangements with host communities. Conflict and security issues as well as prevalence of cattle disease are important aspects in deciding mobility routes. In practical terms, water is used to control grazing movements. And the principal sources of water are wells and ponds. *Dedh*a grazing areas are served by a number of well clusters (locally known as the *mada*) and ponds (Figure 5). And access rights to water points define rights to grazing lands. The community that depends on the same well clusters usually share the same grazing lands and have equal rights to grazing resources. Families can move across the *Dehda* grazing borders without restriction.

The livestock herd is also managed in two production units - the sedentary (*waara)* herds and mobile (*foora)* herd management systems (otherwise called satellite herd management). The mobile herd consists of young and dry cattle to graze on remote rangelands, particularly during the dry season. On the other hand, the *waara* herds consisting of milking cows, calves and old cattle are retained on the grazing lands around the encampments (locally called *ollaa*) for the most part of the year. Mostly the younger children and women take care of the *warra* herds while the strong boys and men travel over longer distances looking after the foraa herds. Such regular mobility to access distant pastures is locally known as *godansa foora*. The herds follow a seasonal rotational grazing between the wet and dry season grazing areas. Wet season grazing sites depend on temporary water sources in the natural pools and human made ponds. The herds move onto the dry season pasture around the well complexes (the *Tulla* deep wells complex in *Dubluque,* well clusters around *Yabello* hills, etc.) when the temporary water sources of the wet season grazing areas are exhausted. This pattern of seasonal grazing left the rangelands less overgrazed and resilient.

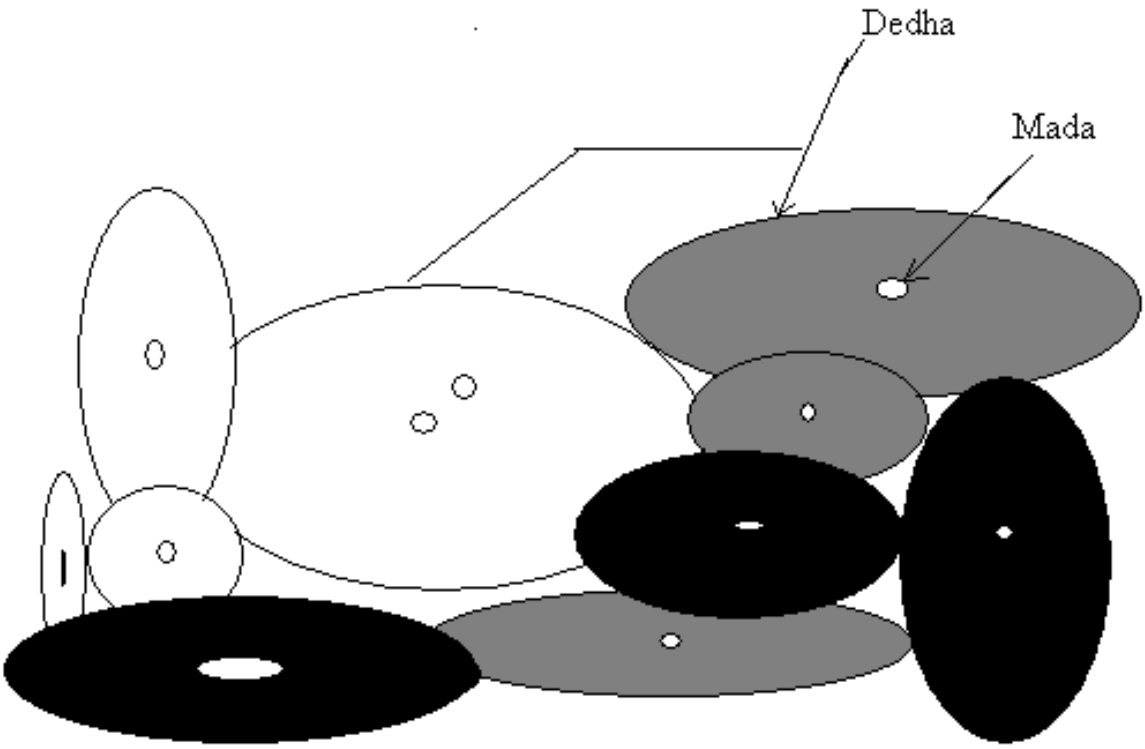

Figure 4. Schematic representation of Dedha distribution of Borena rangelands (adapted from Oba, 1998)

Figure 5 depicts the patterns of movements between dry and wet season grazing areas, particularly practiced by the *Yabello* pastoralists of *Borena* some 30 years ago. The green circles in the Figure represent the wet-season grazing plains while the yellow circles are dry-season grazing areas around water points (sometimes accompanied by permanent settlement. In the past, Borana pastoralists used three major wet-season grazing sites both within the national boundaries and across the border in Kenya (Figure 5). According to the pastoral elders, the prime wet season grazing areas were *Dedha hara* (plain north-west of *Yabello* town), *Malbe* plains bordering Teltele woreda (south-west of Yabello town), and very distant pastures in *Woyama* and Goflai plains in Dire woreda. The later areas are so far that people have to travel for about 2 weeks one way and stay there for at least three months. The *Dedha Hara* pastures were very vast such that people from as far as *Arero* and *Guji* used to migrate for wet season grazing. The area extends as far as *Kilkile* River that marks current boundaries between *Borena* and *Guji* zones. Golbo plains are located in Kenya where Kenyan *Borans* and *Gabras* and Ethiopian *Borans* share common pastures in a reciprocal arrangement. The pastures in the *Golbo* plains are believed to have special value in terms of milk production and fattening of animals. The pastures and rain water (i.e., the ponds.) in the plains of wet-season grazing areas sustain livestock for about 6 months. When the pastures and water in the plains are depleted, people move with their animals to the dry-season migration sites. There were a series of well clusters that represent the dry-season grazing areas around *Yabello* (see yellow circles in Figures 5). The movement pattern during the dry season varied depending on where one was during the wet season. For example, cattle that were grazing in the *Dehd Hara* and *Malbe* plains migrate to well clusters on the hill-sides surrounding *Yabello* town. Cattle staying in *Woyama* and *Gof Lai* plains migrate either to deep well clusters in *Dubluque, Hudet, Wachille* or return to the banks of *Dawa* River. The pasture along the river bank represented a prime dry season grazing area and the water of *Dawa* River is believed to be a remedy for the infestation of ticks and lack of access to this water has meant heavy infestation of animals with ticks.

3.2.2 Recent restrictions in herd mobility

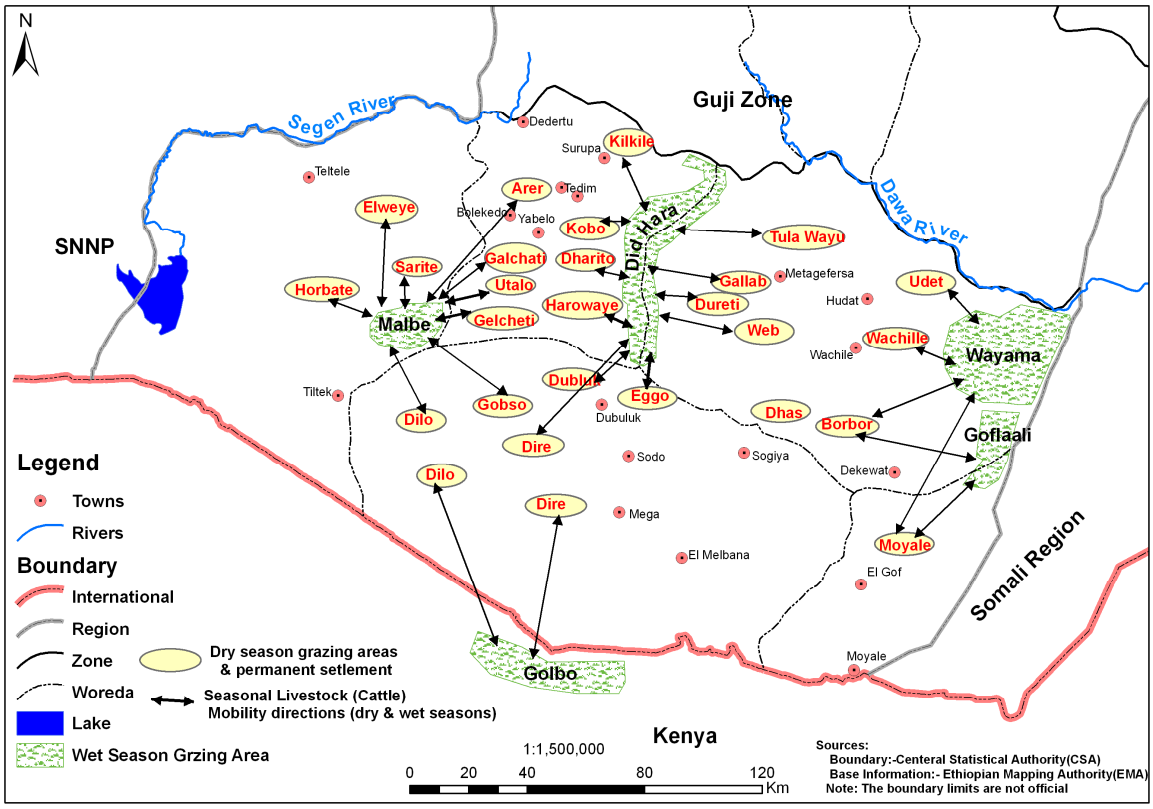

Figure 5. Seasonal migration sites in Borena in the past (some 30-40 years before).

Figure 6 presents the current very much restricted mobility patterns. The loss of many of the previously used prime wet season grazing areas is notable in the figure. This was due to alienation for non-pastoral uses, ethnic conflict and expansion of cultivation in the rangelands. *Borena* elders reported that there have been some fundamental and decisive changes in the seasonal mobility and grazing patterns over the past decades (see below for discussion on the causes that have imposed restriction on mobility). As can be seen from Figure 6, much of *Dedha Hara* is no more used as a wet season grazing site as it is shifted for non-pastoral uses such as ranches, cultivation and private closures. The two state ranches (*Dedha Tuura* and *Surupa*) that were established some 25 years ago and the recently established ELFORA ranch have taken more than 10,000 ha of the *Dedha hara* plains denying access to the former prime wet season grazing land by the *Booran* pastoralists. A significant portion (about 2,000 ha) of the prime wet-season grazing area in *Liben* (i.e., *Dedha Liben*) was alienated from pastoral use and given to an investment project in livestock fattening for export markets (i.e. the ELFORA project). Pastoral elders regret that the *ELFORA* ranch site in *Liben* represented not only a vital grazing and watering area but also cultural ritual site for annual *Geda* marching. Some remote pastures in *Malbe* (Teltele district) and *Golb*o plains (in Kenya) are still used for wet-season grazing. However, they have been subject to overgrazing and degradation due to concentration of livestock from all over *Borena* land. Where pastoralists are unable to move, there is concentration of cattle around little available pasture thereby exacerbating environmental degradation. Ethnic conflict over resources has become another serious problem sometimes resulting in violent clashes. The *Gabra* tribes across the Kenya border have the priority user-rights in *Golbo* plains. And as more and more *Borans* migrate to this site, they are faced with conflict and threatened by occasional animal raids it is also threatened by expansion of cultivation and conflict with the *gabra* tribes.

On western rangelands, new distant grazing frontiers were also explored although it meant travelling hundreds of km (taking 2-3 weeks on one way trip); this is far beyond the normal range of movement looking for pasture and water. One such new wet season grazing site is *Saba* plain along the banks of *Segen* River. However, high incidence of t*ripanosomiasis* and conflict with other pastoral communities from South *Omo* and *Konso* has posed a major threat. The *Konso* and *Turmi* ethnic groups claim priority user rights on these pastures causing conflict with the Borans. On the eastern rangelands, drastic change has happened since 2003. The seasonal mobility to Goof Lai and *Woyama* plains is faced with major challenges of ethnic conflict due to border demarcations between Oromiya and Somali regional States. The *Boran* pastoralists complain that they have lost the much of *Woyama* plains in the eastern rangeland which and all of Goof Lai ranges as a result of border

demarcation. Through referendum in 2003, these areas were allocated to Somali region. Consequently, furious conflict erupted that denied Borans access to key grazing and watering resources including banks of the *Dawa* River. Urbanisation has also taken its toll to take up some of former dry season grazing sites such as *Dillo, Kilkle*, Miyo and *Dahaas*. These are small settlements around water points now grown into urban centres some, which assumed district status (e.g., *Dillo* and *Kilkile*). Welcome as they are, such developments have become detrimental for traditional pastoral mobility.

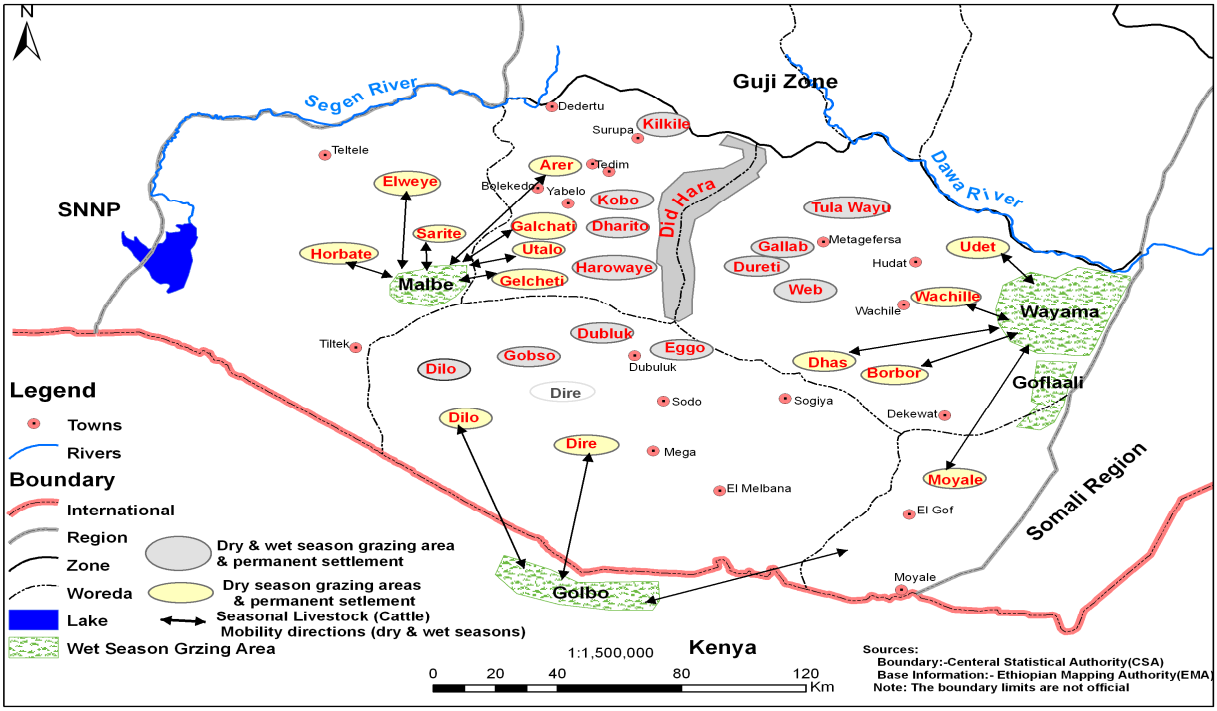

Figure 6. Restricted herd mobility sites in Borena recent years

3.3 Implications of restricted herd mobility

Curtailment of mobility has increased vulnerability of pastoralists vulnerable to frequent drought that decimated most if not all of their cattle. Overstocking of animals around permanent water points (e.g., wells and ponds) have attracted permanent settlement causing severe environmental degradation. Deforestation and soil erosion have become characteristic features of the *Borena* rangelands. Bush encroachment is another feature of range degradation, which is characterized by invasion of undesirable woody species and unpalatable fobs and loss of grass layer. Bush encroachment is prominent in rangelands where grazing pressure is high. Estimates show that about 50% of the *Borana* rangeland is covered by unwanted bushes, mainly *Commiphora africana* (Oba, 1998). It is believed that this species spread rapidly following the ban on the use of fire and due to seed dispersal through camel and goat dung. *Booran* pastoralist have living memories of series of droughts and famine (1973/1974; 1984/85; 1994-1997; 1999-2001; 2002/2003; 2005/2006; 2009-2011). These have wiped out livestock assets and increased pastoral vulnerability thus weakening future drought survival. After each drought it took many years for pastoralists to reconstitute (if at all) their cattle herd. Average number of cattle have reduced from 30 heads in the past to about 10 at present suggesting loss of a third of the livestock asset. Since the fact of being a pastoralist is the fact of being an owner and herder of large number of animals, many households have now become destitute. One survey in the area has found that 80% of the pastoral households are food insecure (Eyasu and Feyera, 2010). Food security for pastoral households depends on the availability of milk, which again depends on the supply of adequate pasture and water for the cows. With shortage of fodder and water for drought and decimation of livestock asset to drought pastoral households have become extremely vulnerable to climatic shocks (than farmers). Furthermore, milk productivity for the animal that remained, is low, contributing further to malnutrition among the already affected populations. Vulnerability to drought and famine has increased;

Although pastoral vulnerability has complex causations, restrictions of mobility and environmental degradation are the underlying causes (Eyasu, 2014). The system has been threatened by enormous external and internal pressures that caused land alienation from pastoral use. Opportunistic farming has expanded to supplement household food needs and diversify their means of subsistence. The impoverished were forced to

settle and start opportunistic farming to eke out a living. Presently, there is a growing trend towards crop cultivation and establishment of private enclosures reserve accompanied by land grabbing (i.e., fencing communal rangelands). These are some of the internal adjustments within the system in the face of degrading range ecology, climate change and increasing food insecurity. Livelihood diversification outside pastoralism is also employed as coping strategies to climate change. There are some cases of pastoralists moving into urban based commercial activities such as house rent, transport and hotel business. Some pastoralists are engaged in the informal cross-border trade of animals across the Ethiopia-Kenya borders. These activities involve trading in animals and contraband trade of used cloths along the *Moyalle-Negelle-Shashemene* route to benefit from small price differences between markets.

4. Summary and policy implications

We have shown in this paper that there is sufficient evidence for climate change in *Borena* zone. Both anecdotal evidence as well as time series data suggest that rainfall amounts have declined and temperature has increased considerably over the past decades suggesting a general trend of desiccation and warming. In line with model predictions, extreme weather conditions such as longer and more frequent droughts have become a common phenomenon in the *Borena* lowlands predisposing pastoral livelihoods. The already dire situation has been aggregated when the traditional coping strategy based on herd mobility has been disrupted. We agree with the existing body of literature (e.g., Mitchell et al 2000; Maynard et al 2002; Warren., 2006; Eyasu, 2014) that narrate that pastoralists are among the most affected communities and are the least able to adapt to climate change under the current scenario of restricted herd mobility. The view that pastoralists may benefit from climate change in the event of any increased rainfalls (e.g., Brooks, 2006) does not hold true in *Borena*, Ethiopia.

The paper has also highlighted the impacts and implications of climate change on pastoral livelihoods. We question the availability of pastoralism as a system given the increasing vulnerability of the community to drought and consequent famines. Whereas the traditional mode of production based on mobility is being disrupted, not visible alternative solutions have been implemented to support the community. The most immediate policy message is the need to protect and promote herd mobility which proved to be the best response and adaptation to changing climatic conditions in the dryland environments (IIED, 2008; Swift, 2008; Eyasu, 2014). The general view that pastoral production based on mobility is outmoded, archaic and needs modernisation and replacement is to be strongly challenged. Given the harsh realities of the pastoral lowlands, people should be allowed to migrate away from desiccating rangelands with their animals into riverine and less water stressed or humid areas. Policy makers need to address external imposed factors that curtailed herd mobility including agri-business projects and ranches on pastoral rangelands. Also, national climate change adaptation and mitigation programmes under the climate resilient strategy of the government should provide priori face consideration to the *Borena* and other pastoral communities that inhabit the drier and harsher environments in Ethiopia.

References

Brooks Nick, 2006. Climate change, drought and pastoralism in the Sahel. Discussion paper presented at the world initiative on sustainable pastoralism.

Eyasu Elias, 2014. Environmental rights and pastoral livelihoods: The case of Borena and Karrayu pastoralists in Ethiopia. Journal of Environment and Earth Science. Vol.4 No21, 2014.

Eyasu Elias and Feyera Abdi, 2010. Putting pastoralists on the policy agenda: Land alienation in Southern Ethiopia. IIED Gate Keeper Series No 145. International Institute for Environment and Development, London.

Hesse C, and Cotula, L., 2006. Climate change and pastoralists: Investing in people to cope with adversity. IIED, Sustainable development series.

IIED, 2008. Securing Livestock Mobility in eastern and Western Africa. International Institute for Environment and Development and SOS-Sahel, London.

Maynard, k., Royer, F., and Chauvin, F., 2002. Impact of greenhouse warming on the West African summer monsoon. Climate dynamics V19: 499-514.

Mitchell, J., Johns, T., Ingram, W., and Lowe, A., 2000. The effect of stabilising the atmospheric carbon dioxide concentrations on global and regional climate change. Geographical research letters 27 (18): 2977-2980.

Nassef M., Andreson S., and Hesse C., 2009. Pastoralism and climate change: Enabling adaptive capacity. Humanitarian policy group and Oversees development Institute, London.

Oba Gofu, 1998. Assessment of indigenous range management knowledge of the *Booran* pastoralists of southern Ethiopia. GTZ Boran Lowland pastoral development programme.

Swift Michael, 2008. Pastoralism and mobility. Key note paper presented at a regional workshop on securing pastoralism in eastern and western Africa. IIED/SOS-Sahel, November, 2008.

Warren, R., 2006. Impacts of global climate change at different annual mean global temperature increases.

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