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**Land Grabbing along Livestock Migration Routes in
Gadarif State, Sudan**
Impacts on Pastoralism and the Environment

Hussein M. Sulieman

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Land Grabbing along Livestock Migration Routes in Gadarif State, Sudan: Impacts on Pastoralism and the Environment

By Hussein M. Sulieman

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Abstract

Grabbing of pastoralists' traditional land to put it under the commercial farming system, which has widely been adopted as a development and investment strategy in Sudan, is creating a cruel dilemma of increasing both resource conflict and environmental degradation. This is one of the fundamental reasons that the country has earned the reputation as a home of bloody civil wars and the country is unlikely to see lasting peace until such issues have been addressed. My aim in this research is to provide evidence-based information by mapping out the encroachment of large-scale agriculture into transhumance migration routes in Gadarif State (eastern Sudan), with a two-fold approach. First, I tracked the land-use/land-cover (LULC) change using satellite imagery. Second, I interviewed transhumant pastoralists to obtain information about their perspectives on major problems facing them along the routes in their seasonal journey. It is clear that state policy has failed to provide support to pastoralists. Animal mobility in space and time are severely constrained. The average of the annual encroachment of mechanized farming along the routes is 3 percent. The most substantial LULC change occurred after 1999. Other challenges facing the routes are: lack of water resources, design of the routes and degradation of rest places. Due to the abolition of their native administrative system and lack of education, pastoralists have no way of influencing any decisions that impacted their system.

About the Author

Hussein M. Sulieman obtained his BSc in Natural Resources and Environmental Studies, MSc in Forestry and PhD in Natural Sciences. Currently he is affiliated to University of Gadarif, Sudan as Assistant Professor and Director of the Remote Sensing Unit. His work experience and professional are in the area of Remote Sensing and Geographical Information System. His main research interests include Socio-spatial analysis of land-use/land-cover changes, climate change and variability and scientific interpretation of local knowledge.

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1 Introduction

1.1 General

There is a growing realization amongst ecologists and economists that mobile pastoralists are the best custodians of drylands environments. However, mobile pastoralism still faces serious obstacles that threaten its potential. That is mainly because their stewardship is undermined by inappropriate policies and planning and by competition over their traditional land (Hatfield and Davies 2006; WISP 2008; Ahmed 2009). Nevertheless, dispossessing pastoralists of their traditional system and putting it under an unproductive farming system, which is largely a direct result of inappropriate development interventions, is creating a cruel dilemma of increasing resource conflicts and environmental degradation in Sudan. Despite that oil has shaped the political economy of Sudan since the late 1990s, the value and potential of livestock still contributes significantly to the country's welfare and economic wellbeing. Livestock products contributed 20 percent of the country's Gross Domestic Product (GDP) (Fahey 2007) and 80 percent of the agricultural GDP (Hatfield and Davies 2006). Therefore, understanding the rationale of pastoralism by policy and decision makers is a key component for the development of pastoralism. Behnke and Osman (2012) stated that it is essential that Sudanese policy makers recognize the centrality of pastoralism to the economy of the country and take sensible steps to support the livestock sector.

Surely, for pastoralists livestock value exceeded its economic worth. Being the means of fulfilling and satisfying nutritional, social, religious and cultural needs and also security against risks facing the family even the whole society, livestock defines the lives of pastoralists (Odhiambo 2006; Guliye *et al.* 2007). In many parts of Africa, pastoralists use livestock in marriage settlements to acquire wives and children and as compensation for injuries and death (Ahmed 1974; Sato 1997). Therefore, with these and a multitude of other social and symbolic functions, attention should be paid to understanding the special needs of pastoral communities.

1.2 The Rationale of Transhumance Pastoralism

Pastoral systems take many forms and are adapted to particular natural, political and economic environments. Compared to other types of pastoralism, e.g. resident pastoralism, transhumance pastoralism is based on more or less regular seasonal and cyclical migration of varying degrees between complementary ecological areas. Their mobility is a key strategy to gain access to seasonal availabilities of high quality forage and to reduce the vulnerability of livestock to local environmental risks (Kaimba *et al.* 2011). Actually, compared to all other natural resource-based land uses in the drylands, pastoralism functions best within the prevalent context of climate change and variability (Sulieman and Elagib 2012). Mobility allows opportunistic utilization of resources and helps in minimizing the effects of droughts. Such benefits include lower-cost fodder at minimal labour charge and increased resistance of animals to diseases. Ecologically when compared to continuous, sedentary grazing may result in lower pasture palatability and productivity, higher soil compaction and lower water infiltration, ultimately leading to pasture degradation (Niamir-Fuller 1999). To enable pastoralism to effectively use drylands, pastoralists need to move their livestock across the rangeland of patchily distributed meagre resources, highly influenced by low, variable, unpredictable rainfall (Manger 1996). They need to access dry season grazing areas found along rivers or where there are permanent water sources (Rugadya 2006). Thus, the stressing challenge to resource managers is not to maintain stability but to maintain diversity and flexibility (Sørbo 2003). According to Niamir-Fuller (1998) wherever the flexibility offered by mechanisms such as mobility has been curtailed, the production system has suffered and the community has lost its viability.

1.3 Grabbing of Grazing Resources

In the light of the arguments that I have mentioned, grabbing of grazing resources by other powerful land users should be expected. One of the major consequences of the rapid expansion of

mechanized farming in Gadarif, which started in the mid-1940s, is the creation of inequality in land distribution, a situation that creates intensive competition over land among different groups of users (Sulieman 2008). Nevertheless, this bias in the settlement of disputes was institutionalized during the British colonial period when the policy was that the rights of the cultivator be considered as paramount to nomadic pastoralists (SCC 1944). This means that land grabbing as a development strategy in the form of large-scale agriculture is not something new in the region or even in other countries in the African Sahel and Horn (Shazali and Ahmed 1999; Babiker 2011; Lavers 2012). Throughout history, the more powerful have used policy processes and legal systems to enable or ratify their grabbing of valuable common resources (Babiker 2008).

In recent decades, pastoralism has been in decline in Gadarif State because of threats posed by rapid encroachment of mechanized rain-fed agriculture, human population growth and other human activities that shift extensive livestock production to areas that are of increasing marginal primary productivity (Shazali and Ahmed 1999; Sulieman and Elagib 2012). Currently the economy of the Gadarif region depends on large-scale agricultural production and the state is home to some of the largest mechanized rain-fed schemes in Sudan on the grounds that the mean annual rainfall was sufficient to sustain such production and this would increase the productivity of the land as well as feed the growing population. Cumulatively the state has around 4.2 million hectares of cultivable land at its disposal (Figure 1.3.1). Only a few crops had been found suitable for cultivation in the cracking clay area. Sorghum had been the principal one followed by sesame. Much of this land was originally mixed savannah-woodland providing a large area of rangeland for transhumant pastoralists. This created a fundamental shift in focus from livestock production to crop farming. The land tenure system has created a situation of a few large-scale farmers with many smallholder farmers as well as restricting livestock herders to the marginal areas of the state (Glover 2005).

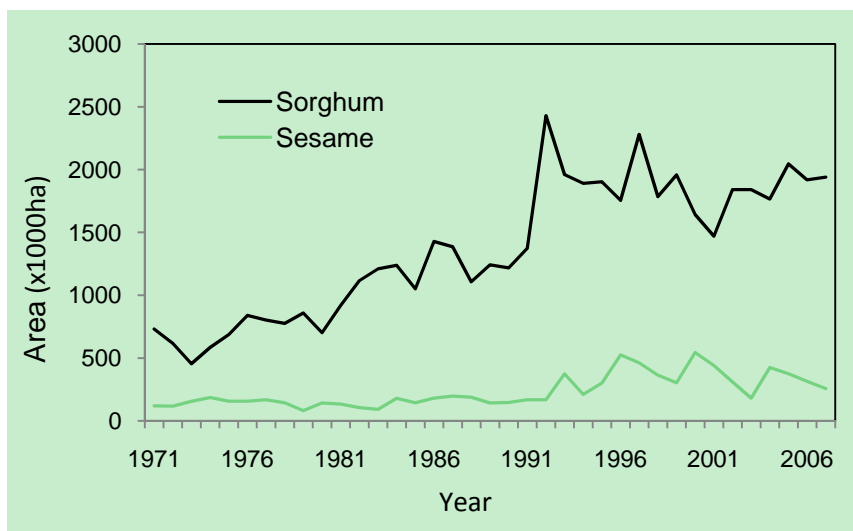


Figure 1.3.1: Area cultivated with sorghum and sesame in Gadarif State during the period 1971-2007

Livestock seasonal migration routes represent the life artery of any transhumance pastoralism system. Therefore maintaining these routes and keeping them functioning are vital components of the existence of such an endangered livelihood system. Those routes shouldn't be seen as transit routes for the trespassing of livestock to grazing resources. Larsen and Hassan (2003) and El Hassan and Birch (2008) explained that livestock routes must accommodate pastoralists' complete social life, such as trade, ceremonies and family commitments. Being mobile is associated with meeting relatives, making new contacts, and acquiring information. To move or to travel is seen as a way of developing knowledge and becoming educated. Even when mobility becomes less dominant for some pastoralist groups; it may remain an important component of their identities.

Today the problem is that livestock migration routes in Gadarif State are strips of lines crossing the vast mechanized agricultural field with very few and degraded rest points. Before the occupation of mechanized agriculture the routes are kilometres in width (Sulieman and Elagib 2012). However, under the condition of natural resource degradation and cycles of drought and famine, which threaten the lives of both people and livestock, the issue of land grabbing is becoming one of the main triggering forces for conflicts in Gadarif and in some cases extends to take transboundary dimensions (Sulieman *et al.* 2011).

1.4 Objectives

Despite the acknowledgment of grabbing of grazing resources as a major bottleneck of improving livestock productivity and natural resource conservation by policy makers, the issue of land grabbing has not yet being given considerable attention in Gadarif State. Therefore, my aim is to draw attention to the current situation of land grabbing along the livestock migration routes by providing evidence-based information for decision and policy-makers. In doing so, I have two major concerns. First, the paper will focus on patterns and rates of land grabbing along transhumance migration routes, and how powered large-scale farmer through biased land-use. Second, it will trace the social and environmental consequences of land grabbing and discuss its repercussions.

2 Study Region

2.1 Geographical Setting

Gadarif State is located in the eastern part of Sudan and extends over an area of about 72,000km²(Figure 2.1.1). The state is bordered to the east by Ethiopia and Eritrea. The four Sudanese states surrounding Gadarif State are Khartoum, Kassala, Gezera and Sinnar. The mean temperature in the Gadarif town is 29°C, the mean maximum is 37°C and the mean minimum is 21°C. May is the hottest month of the year. The area is characterized by a unimodal rainfall season most of which primarily occurs from June to September and controlled by the nature of the Inter-Tropical Convergence Zone. The annual rainfall in the area ranges between less than 300mm in the North to more than 800mm in the South. Analysis of climatic records from Gadarif Meteorological Station by Sulieman and Elagib (2012) showed that there is significant warming of the climate, increasing rainfall variability and seasonality and intensifying aridity conditions during the start and end of the wet season. Also there is an increase in rainfall concentration.

The dominant soil in the study area is dark, heavy, deep clay belonging to the vertisol group, which cracks widely during the dry season and expands during the wet season due to the high content of clay. This type of soil becomes very sticky in wet seasons. Clay soil in the area has a potential problem, as infiltration capacity and permeability when moist would be too low when it is dried. The management of vertisols is very difficult because of constraints caused by chemical and physical characteristics. The distribution of natural vegetation in the region depends largely on two factors: rainfall and soil. In particular, the amount of annual rainfall and the length of the rainy season, which vary along the climatic gradient from north to south, have significant impact on seasonal vegetation dynamics. Harrison and Jackson (1958) classified the vegetation cover of the study area into three major vegetation zones: semi desert vegetation cover in the north followed by low woodland savannah in the central part of the state and high woodland savannah in the far south.

2.2 Population and Land-Use

According to the 2008 census, the total population of Gadarif State is 1,336,662 persons with an annual population growth rate of 4.7 percent, which is higher than the national growth rate(CBS 2010).Followed agriculture, livestock rearing is the second economic activity in different forms,

namely traditional seasonal transhumant, village livestock raising and, as a recent element, livestock raising by large-scale mechanized merchant-farmers investing surplus wealth in sheep and cattle. Collecting and trading forest products and charcoal burning are other traditional forms of economic activity. Thus, the people derive their livelihood income from a mixture of combinations of the three main forms of land-use: agriculture, grazing and forest utilization. Livestock production in the state is dominated by pastoral and agro-pastoral traditional systems.

2.3 Mechanized Rain-Fed Agriculture

Agricultural mechanization was introduced in the Gadarif Region in 1944 when a government project was started to meet the food needs of army units stationed in the British colonies in eastern Africa during the Second World War. An average of about 6,000 hectares per year was cultivated between 1945 and 1953, producing mainly sorghum, under a sharecropping arrangement between the government and farmers who had been allocated land in the project. In 1954, the government began encouraging the private sector to take up mechanized farming in the area, a policy that continued after Sudan gained independence in 1956. Grabbing of grazing resources, however, was accelerated during the 1970s when the country was considered as the 'Breadbasket of the Arab world'. The idea behind this line of thought was to attract capital from the Arab World with the abundance of land and available manpower to increase food production to the extent of creating self-sufficiency for the region and beyond. The World Bank and other interested parties followed suit realizing the potential that such an arrangement may offer by mainly focusing on the expansion of agricultural production (Ahmed 2012).

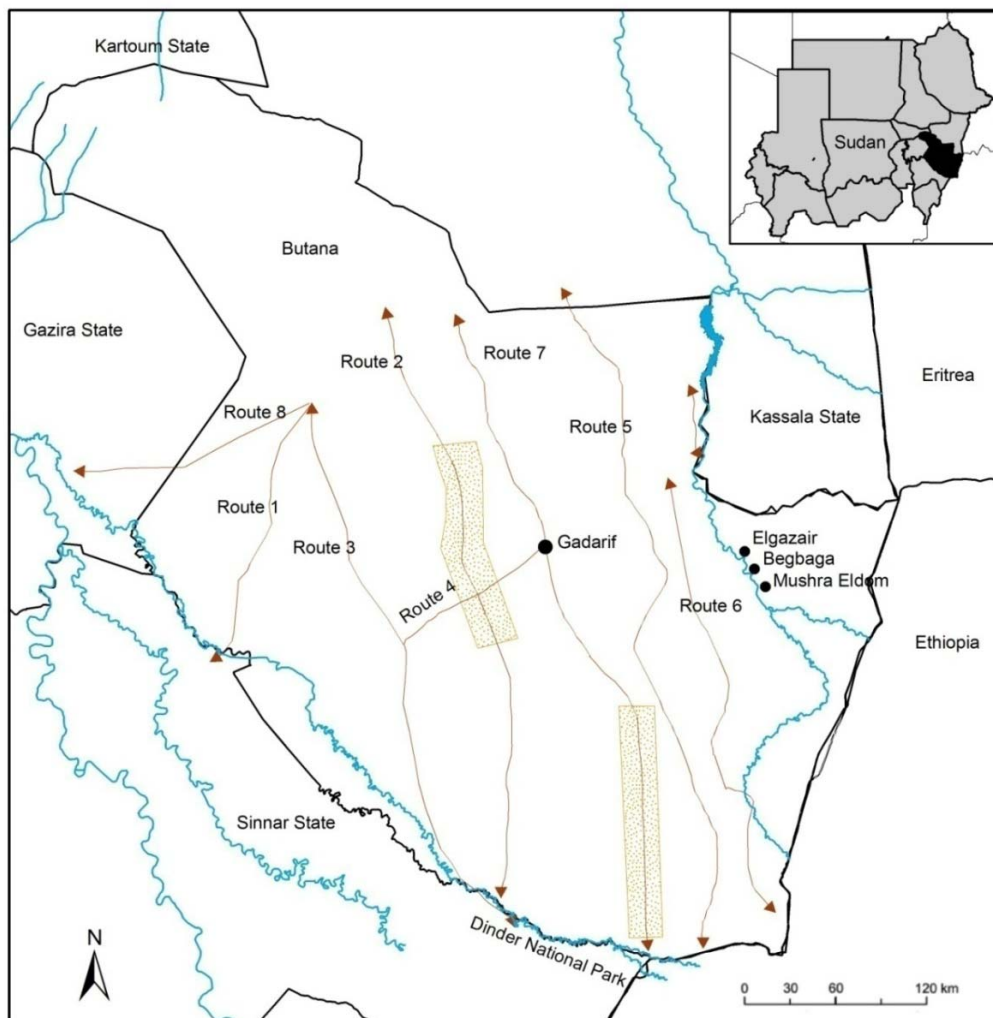


Figure 2.2.1: Map of study area showing the livestock migration routes and the location of the two study sites along Route 2 and Route 7.

2.4 Seasonal Migration Routes

Transhumance, the seasonal movement of herds occurring between two points and following precise routes repeated each year, is practiced by momentous groups of pastoralists in Gadarif State. They herd camel, sheep, goats and cattle. The herders and their animals migrate to the northern parts of the state looking for pasture in Butana area following specified routes (Figure 2.2.1). Table 2.4.1 shows details of eight livestock routes across the state. The northward movement of herders starts with the rains, approximately from late June to late July, until it is certain that there is enough water in *hafirs* (man-made water bonds mainly for human and animal use) and seasonal water courses on their routes. The actual start will be delayed if the rains are late. This movement involves a number of halts varying from a couple of days to around two weeks, depending on water and grass availability. The southward journey back to summer camping areas starts mid-September to early October and has to be done rapidly since water and grass become problems. The most difficult part of the movement occurs when herders trespass the cultivated agriculture land where in many cases conflict emerged between herders and farmers. Access to *hafirs* in this part is difficult because there are either villagers settled around them, or they are in the areas of the mechanized farms, which by this time are cultivated. There are few *hafirs* that have been made by the Department of Range, but they are not well maintained. The herders cover this part with minimum possible halts. The problem today is that the animal routes are very narrow, bare and the few rest places are almost degraded. Also water resources along the routes are very limited. Previously, the condition was totally different. The routes were some kilometres in width and were covered with dense vegetation cover. However, the current situation is a result of encroachment of farmlands since the introduction of mechanized farming in the area in the mid-1940s.

Table 2.4.1: General description of seasonal migration routes in Gadarif State

Route Number	Route name	Width (m)	Length (km)	Number of rest places	Number of <i>hafirs</i>
1	Eldareb Elaswad	300	145	3	3
2	Simsim	150	290	5	4
3	Um Trimby	150	230	5	4
4	Esika Hadid	150	66	2	2
5	Kerkora	150	290	5	8
6	Elmagataa	150	244	3	2
7	Shalia	150	290	6	5
8	Elkhiry	150	100	3	3

Source: Department of Range, Gadarif State

3 Methodology

3.1 Date Sets

I utilize a combination of remote sensing data from the last four decades and qualitative and quantitative social data based on interviews with key informants, pastoralists, other stakeholders (e.g. the Herders' Union) and large-scale mechanized farmers. I also report on field observations and photography of many other field features.

3.1.1 Remote Sensing Data

Remote sensing provides a viable source of data from which updated land-cover information can be extracted efficiently and cheaply in order to inventory and monitor these changes effectively. Thus change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality (Mas 1999). To assess land grabbing along the seasonal migration routes in terms of the land-use/land-cover (LULC) change, I selected two

study sites along Route 2 and Route 7 (Figure 2.2.1). Sites are about 100,250ha and 110,160ha, respectively. The primary reason beyond the selection and the allotment of the two sites depends on satellite data availability. The study mainly relies on open sources of satellite imagery from the Global Land Cover Facility (<http://glcf.umiacs.umd.edu/>). Nevertheless, the scale at which I pitch the LULC analysis to is also appropriate when it comes to providing recommendations to secure the continuity of mobile pastoralism. The multi-sensor satellite imagery I used in the LULC analysis is presented in Table 3.1.1.1. All imageries were acquired at the beginning of the dry season, so that the phenological stages of plant covers are not too different between dates.

Based on a previous study conducted in the region (Sulieman and Elagib 2012) and field visits (October – November 2011), I classified the LULC categories into three major classes, namely natural vegetation, bare land and agricultural land. Natural vegetation is the primary and secondary natural forest and woodland savannah, forests, protected areas, and vegetation on areas not suitable for cultivation confined to valleys and along watercourses and depressions. Agricultural land includes areas mainly under large-scale, rain-fed mechanized farming covered with crop residue or late emerging grass species debris. These areas are mainly cultivated with sorghum and sesame. Bare land includes the non-vegetated areas formerly under cultivation and now abandoned due to degradation. This class also includes unsuitable eroded areas characterized by bare rocks and gravels.

Table 3.1.1.1: Characteristics of satellite imagery used for LULC analysis

Satellite	Sensor	Path/row	Acquisition date	Spatial resolution (m)
Landsat 3	MSS	184/050	23 November 1979	60
Landsat 3	MSS	184/051	23 November 1979	60
Landsat 4	MSS	171/050	12 December 1989	60
Landsat 4	MSS	171/051	12 December 1989	60
Landsat 7	ETM	171/050	06 November 1999	30
Landsat 7	ETM	171/051	06 November 1999	30
Landsat 7	ETM	171/050	08 October 2007	30
ASTER	Terra	171/050	17 January 2006	15

In order to quantify the LULC in the two study sites, I used supervised classification based on maximum likelihood algorithm. I re-sampled the MSS images to a 30 X 30 m pixel size to allow multi-temporal comparison with the rest of the series. I geo-referenced the images set to obtain optimal super-imposition and minimize geographical deviation. Due to unavailability of historical data, i.e. aerial photographs and maps, I assessed the accuracy of the thematic LULC maps based on visual interpretation of unclassified images and later compared with classified images (Sulieman and Elagib 2012; Biro *et al.* 2011; Zheng *et al.* 1997). In so doing, I followed a stratified random sampling design to select a total of 30 pixels for each class from the raw satellite imagery based on visual interpretation. To generate the classification accuracy matrix, I followed producer's and user's accuracy approach (Richards and Jia 2005). The producer's accuracy represents the probability that a reference sample will be correctly mapped and measures the errors of omission. In contrast, the user's accuracy indicates the probability that a sample from a land cover map actually matches the reference data and measures the error of commission. The two measures together are extremely useful as they give the commission and omission errors. In order to quantify changes of certain LULC type during certain time period, I used the formula:

$$LULCC = ((U2 - U1) / U1 \times T) 100\%$$

LULCC is the change of certain LULC type for certain time period; U1 and U2 are the area of certain LULC type at the beginning and the end of a time period, respectively; and T is the time period. A positive value means that there is an increasing trend for a specific time period for an area of a certain LULC type; otherwise, a decreasing trend is occurring for the area assessed.

3.1.2 Social Survey

I used a scheduled interview as a main tool for collecting required quantitative social information from a group of 50 transhumance pastoralists. However, priory group discussion was also conducted to gather other relevant qualitative information. All respondents are from one ethnic group of Lahaween. Currently, Lahaween breed camels, goats, sheep and donkeys, which is called the multiple-stock herding. The balance among the various types of livestock varies according to socio-economic and environmental conditions. Their principal stock shifts gradually from pure camel stock to camels combined with goats and sheep, as aridity increases.

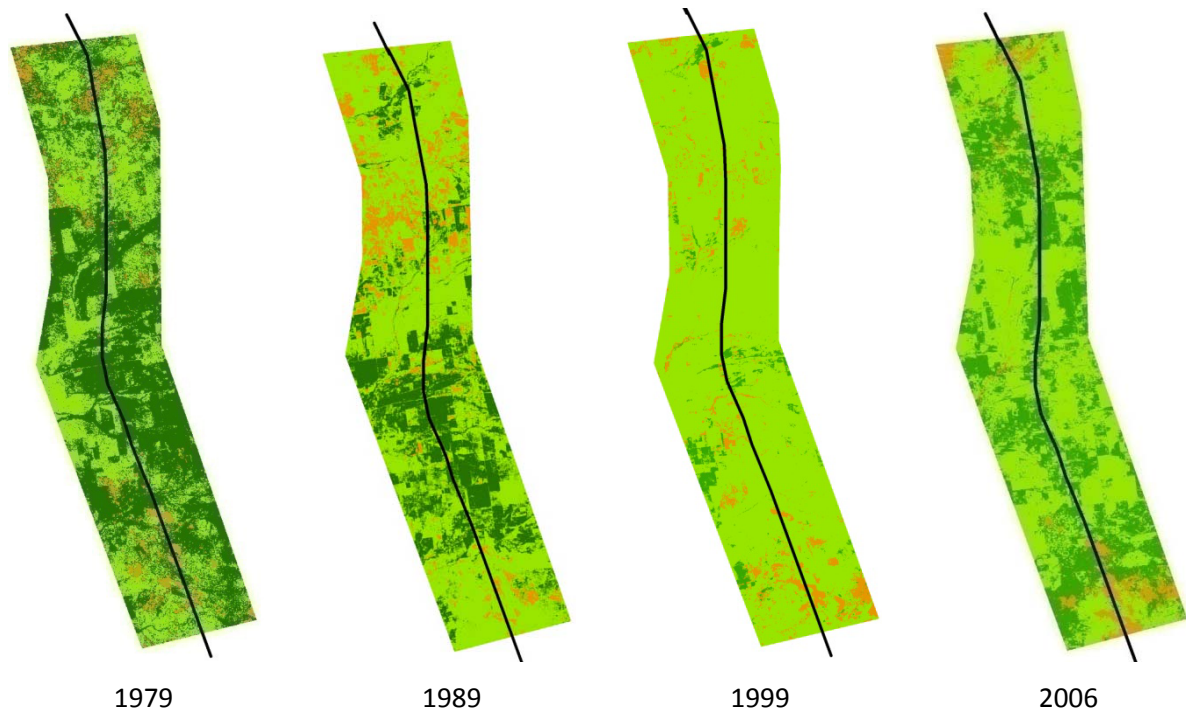
Interviews were conducted during November and December 2011 at three summer camping areas i.e. Begbaga, Mushra Eldom and Elgazair (Figure 2.1.1) located along the western bank of Atbara River. The pastoralists' scheduled interview was designed to be broader. It included questions pertaining to, among others, personal characteristics of the respondent, migratory patterns, information regarding changes in grazing resources (e.g. pasture and water resources, major problems facing pastoralism, climate change perception) and adaptation measures. Other groups that I have interviewed included pastoralists' traditional leaders, members of the Herders' Union and officials at the Range Department. I also collected and analysed relevant secondary data.

4 Results and Discussion

4.1 Satellite-Based LULC Change along Seasonal Migration Routes

The general patterns of LULC along the livestock routes using multi-temporal satellite imagery is mapped out in Figure 4.1.1, while Figure 4.1.2 shows the histogram. Annual LULC change rates are depicted in Figure 4.1.3. The natural vegetation cover represents the grazing resource during the passage of the livestock towards the communal grazing land in the north, i.e. Butana area (Figure 2.1.1). Most of this land was originally mixed savannah woodland providing a large area of rangeland for transhumant pastoralists. It is clear agricultural is the dominant LULC class. Mechanized rain-fed agriculture is the key driver of LULC change along the routes. Most substantial LULC change occurred after 1999 (Figure 4.1.3). Along Route 2, natural vegetation was the dominant LULC class in 1979, and it covers 55 per cent (55,360ha). This percentage has been reduced to around half in 1989 and further to 4 per cent (4,441ha) only in 1999. Recently however, e.g. 1999-2006, this class showed a very rapid annual increase and reached 89 per cent to represent 35 per cent (34,971ha) of LULC classes. Agricultural land continued to be the dominant class and increased from 39 per cent (132,000ha) in 1979 to 98 per cent (8,9115ha) in 1999 and reduced to 59 per cent (59,431ha) in 2006 with a -5 per cent annual change rate. Bare land remains as the minimal class in this site.

Along Route 7, natural vegetation was subjected to drastic reduction particularly during the period 1989-1999 when the annual decline was equivalent to 164 per cent. Natural vegetation was reduced from 76 per cent (84,089ha) in 1979 to 28 per cent (31,203ha) in 2007. The area under agriculture, which occupied 18 per cent (20,758ha) in 1979, has significantly expanded to 31 per cent (34,588ha) in 1989 and further to 64 per cent (70,275ha) in 1999. Nevertheless, it was reduced to 46 per cent (50,676ha) by 2007. Exceptionally, bare land extended to cover 30 per cent (33,519ha) of the site in 1989 and again after its reduction to 4 per cent (3,985ha) in 1999 jumped to 26 per cent (28,280ha) in 2007. The computed natural vegetation annual change rate in this site was negative throughout the period of the study, while the other two classes showed fluctuating behaviour. Overall, the average Producer's accuracy of the classification ranged between 98 per cent for bare land to 89 per cent for agricultural land. For the user's accuracy also the most accurately classified was bare land (97 per cent) and agricultural land was the least accurate class and reached 84 per cent. According to Anderson *et al.* (1976) these accuracies were sufficient for satellite-derived LULC maps. Other LULC change studies (e.g. Sulieman 2010; Biro *et al.* 2011) that have been conducted in the region showed almost the same range of accuracy.



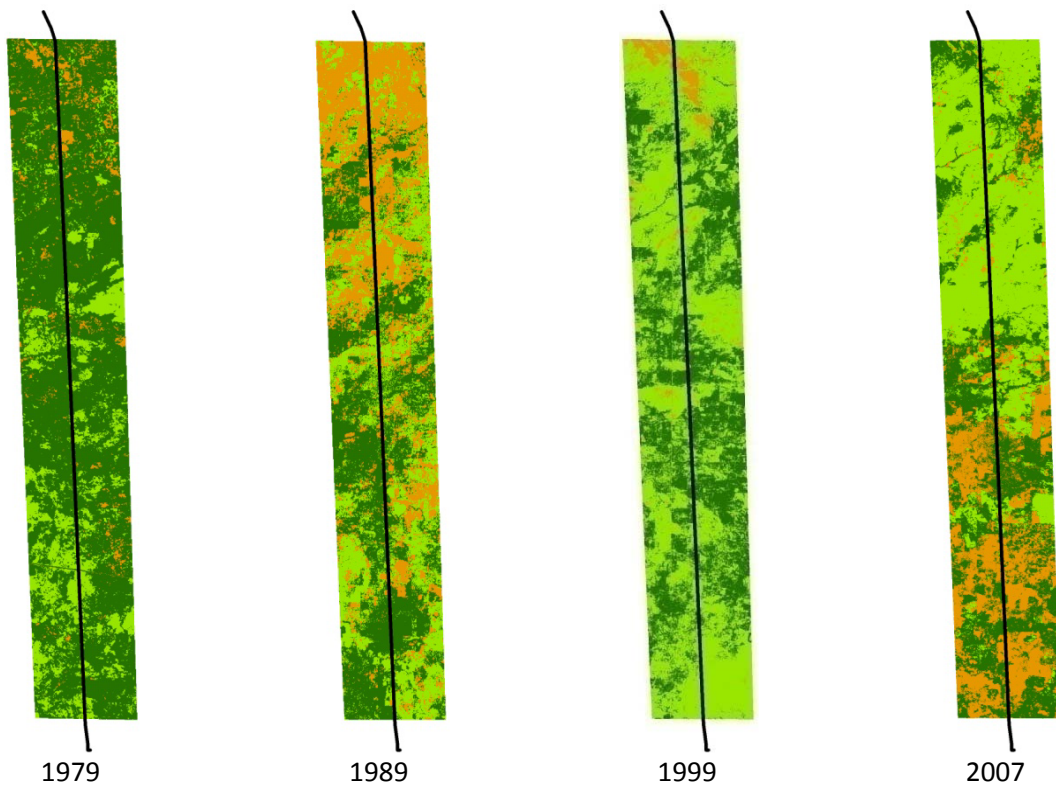
1979

1989

1999

2006

Route 2



1979

1989

1999

2007

Route 7



Legend: Natural vegetation  Bare land  Agricultural land 

Figure 4.1.1: Cartographic representation of LULC change along Route 2 and Route 7

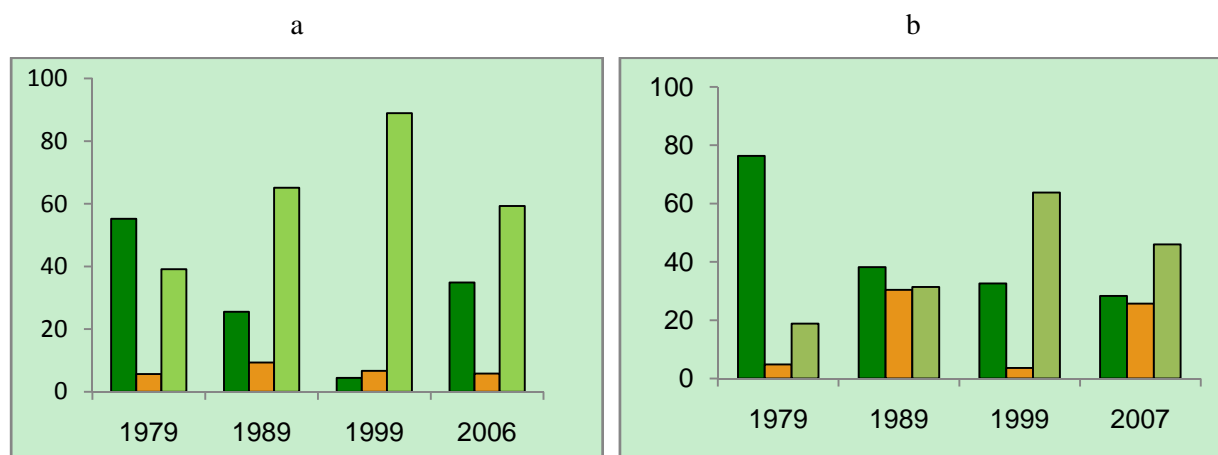


Figure 4.1.2: LULC change along Route 2 (a) and Route 7 (b)

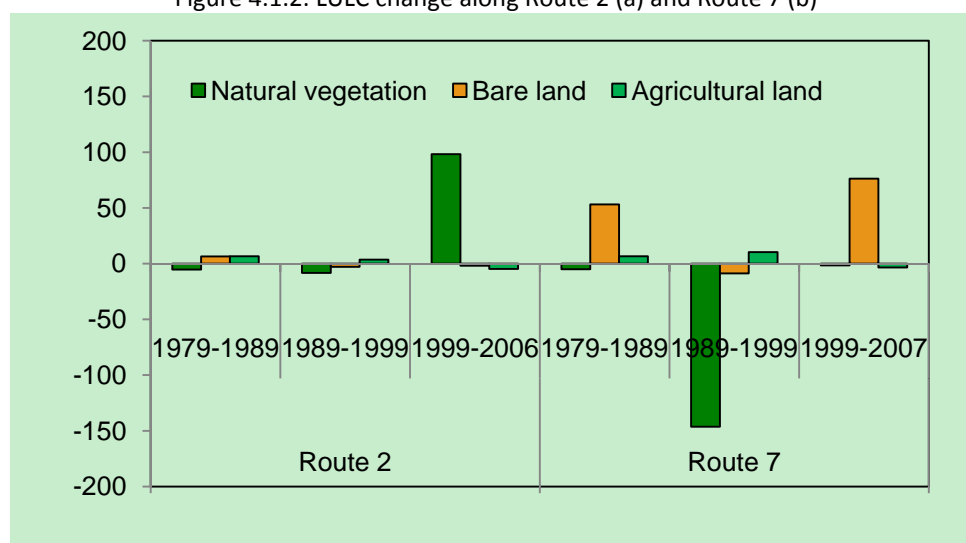


Figure 4.1.3: Comparison of annual LULC change rate across Route 2 and Route 7 during the study period

From the two study sites, it is clear that the trajectory of LULC change is non-linear and in some cases change in one class is associated with changes in another. Nevertheless, large-scale, rain-fed mechanized farming consistently represents the main agent of grabbing of natural vegetation along livestock routes. This trend of agricultural expansion can be closely related to the state policy that favours agricultural production at the expense of traditional livestock systems and smallholder farmers in the area. Investigations into possible drivers of agricultural expansion at the expense of grazing land in the region indicate that the state land-use policy is the main factor.

According to Sulieman and Elagib (2012), in many parts of the state the natural vegetation clearance rate was very high, exceeding the average national clearance rate (FRA 2005) for a country that has gained the reputation of highest deforestation rate in Africa (FAO 2003). Moreover, it is important to mention that considerable plant species in region were threatened due to the wide spread presence of mechanized farming (Sulieman *et al.* 2012). In cases where there is revival of natural vegetation, e.g. Route 2 (1999-2006), field visits and interviews with farmers showed that the main reason was land abandonment due to land degradation. According to one farmer, continuous mono-cropping is the main factor beyond land degradation. In comparison to other regions in East Africa, following/abandoning of agricultural land is a common practice in large-scale mechanized farms in Gadarif State. This could be due to the relatively large areas held per large-scale farmer, which allows them to leave part of their land abandoned (Sulieman and Buchroithner 2009). Such abandoned areas, however, are not freely accessible to pastoralists because they are owned by

farmers. Previously, local orders were annually issued stipulating the latest date for harvest, after which pastoralists were free to enter the cultivated area and graze. The colonial government strictly enforced these regulations, mainly through the native administrators who guarded the domain of pastoral activity (Shazali and Ahmed 1999).

The proportion of bare land has considerably been increased along Route 7. Such areas are subjected to further degradation if any rehabilitation measures are not taken. In this respect, rehabilitation of the natural vegetation cover on bare land represents one of the most effective conservation measures. It is clear that the establishment of large-scale mechanised farming on land that previously used to be covered with natural vegetation, e.g. forest and pasture, is destroying the environment due to unsound tillage practices (El-Tayeb 1985; El-Tayeb and Lewandowski 1983). By stripping away the vegetation cover with mechanised cultivation, the soil is laid bare to be carried away by water and wind erosion (Babiker 2011). Other studies showed that Gadarif State has become more prone to atmospheric drought and at the same time, the region is experiencing a drastic LULC change that leads to a significant reduction in grazing resources (Larsson 1995; Sulieman 2011; Sulieman and Elagib 2012). Nonetheless, the situation of a more dynamic climate and environment, in addition to the flexibility and mobility afforded by transhumance pastoralism, may increasingly provide security where other more sedentary models fail (Sulieman and Elagib 2012).

Lambin and Meyfroidt (2010) mentioned that human societies constantly interact with their environment through change, instability and mutual adaptation. Across the Sahelian region pastoral livelihoods historically have depended on negotiated, nonexclusive access to water and shared land use agreements between pastoralists and farmers (Dong *et al.* 2011; Brooks 2006). This traditional system, being flexible and competent to rapidly react to changing environmental conditions, has been well suited to the dominant ecological and sociological settings that characterize the Sahel (Marshall and Hildebrand 2002). However, the adaptability of pastoralism, which depends on water and pasture availability, is now being negatively impacted by unpredictable climate change, enhanced environmental degradation and a drastic increase in agricultural production to meet the demands of a rapidly growing population (Watkinson and Ormerod 2001).

4.2 Herders Perception of Challenges along Seasonal Migration Routes

Problems facing livestock routes and hence livestock mobility are among the most pressing issues facing pastoralism in the region (El-Tayeb 1985; Babiker 2011; Shazali and Ahmed 1999, Sulieman and Elagib 2012). Table 4.2.1 showed main problems facing pastoralists during their migratory journey.

4.2.1 Water availability Lack of Water Resources

According to their judgment, water availability is the most serious problem along the routes, especially when they were on their way back to summer camping area, e.g. mid-September to early October. By this time *hafirs* are the main water source during the migration period. In their northward journey to communal grazing land, seasonal water sources represent an important watering resource. Many *hafirs* that are specifically made by the government for livestock watering were blocked or dumped purposely by farmers in the vicinity (Figure 4.2.1). Another problem concerning water availability is that villagers did not allow transhumance pastoralists access to *hafirs* around their villages. All these factors have put more pressure on pastoralists and make them shorten their trip along the routes. It is known that cattle, sheep and goats should receive water every day, while camels wait for a week. As a kind of adaptation to water shortage, pastoralists water sheep and goats every next day. Pastoralists are complaining that such adaptation has negative impacts on the health and performance of their livestock. In other places in the region the situation is even worse. In Mwingi and Kitui Districts in Kenya during dry seasons pastoralists water their cattle once every 2-3 days, sheep and goats every three and two days, respectively (Opiyo *et al.*

2011). Another adaptation made by pastoralists in their attempt to address the issue of water shortages is to graze their herds during nighttimes and late evenings and to avoid doing so during midday, so as to minimize water loss. On the same line herders also tend to avoid trekking their herd during the hot midday as much as possible. A number of pastoralists transport water using tankers to water their animals. Such adaptation measures are only possible for wealthy pastoralists.

Moreover, competition over water resources has caused many clashes between villagers and transhumance groups. Nonetheless, under the condition of climate change (which I clearly observed during the trips, e.g. early drying of *hafirs*, rapid vegetation dry-up) such clashes could easily be grown to local herder-villagers conflicts. Water resources should be considered as public goods, but the grazing areas rendered accessible under dry conditions are normally controlled by specific groups e.g. farmers, villagers, which might not be happy to open its access to every herder. As a practical indication of the problems and the risks involved in developing water points with unclear property rights, mechanisms have been a primary target of looting and destruction under civil strife in Somalia (Little, 2003). A similar fate has been reported for water schemes in other pastoral Sub-Saharan Africa, including Kenya and Botswana (Nori 2007).

Table 4.2.1: Problems along the seasonal migration routes according to herders perception

Problem	No.	%
Water availability Lack of water resources	50	100.0
Encroachment of mechanized agriculture into routes zone	49	98.0
The routes are narrow	48	96.0
Few and degraded rest places	34	68.0
Collection of taxes during migration	30	60.0
Blocking of routes	28	56.0
Poor vegetation cover	27	54.0
Others	2	4.0

4.2.2 Encroachment and Blocking of Routes

Other challenges facing the routes is the encroachment of mechanized rain-fed agriculture into the route zone and in some cases totally blocking the routes by cultivating the entire route area. During the field survey I observed that cultivation and the blocking of routes were done by large-scale farmers in order to minimize the number of livestock taking the route in the vicinity of their land. In many cases the route benchmarks were removed or replaced inside the route (Figure 4.2.2.1).



Figure 4.2.1: Comparison of *hafir* owned to Department of Range (a) and a nearby private *hafir* owned by a farmer (b)

Although the routes are officially demarcated due to many reasons, it is difficult for pastoralists to access their rights through formal legal processes in local courts against large-scale mechanized farmers who cultivated the route area. It is clear the matter of power plays a key role in such cases between transhumance pastoralists and wealthy farmers settled in the main cities in the State. Although governmental authorities know about such cases, no measures are taken against farmers who are invading livestock routes. Corruption among the representatives of the local or central authorities is obvious in such situations. And if a pastoralist group decided to take the dispute to the local courts, it takes months to handle such a case. This requires the pastoralist to stay in one place in order to follow up with the case, which is not possible for a transhumance way of livelihood. Additionally, the state failed to provide needed services such as education for purposes of developing human capital. Among 50 interviewed pastoralists, 44 are illiterate. When discussing the issue of mobile education with the Herders' Union, they told me the responsible Office of Education is arguing that mobile education is expensive. On the other side, 98 percent of large-scale farmers are literate and about 15 per cent of them are even college graduates (Mustafa 2006; Sulieman and Buchroithner 2009). Interviewed pastoralists critique the Herders' Union in Gadarif for being detached from pastoralism lives and systems. Moreover, the role of their traditional leaders has been abolished in a manner that they have no way to influence any decisions in the capital of the state when issues of transhumance pastoralism are discussed.



Figure 4.2.2.1: Encroachment of mechanized rain-fed agriculture into the route zone (a) and in some case totally removing the bench marks (b)

4.2.3 Livestock Route Design and Prevailing Conditions

Pastoralists were not satisfied with the current conditions of the routes and the officially customary arrangements. Table 2.4.1 shows that, with the exception of Route 1, which is 300m width, the other seven routes are 150m width. Practically, this width is too narrow for the trespassing of huge numbers of livestock for an average distance of 207km. According to the judgment of herders the optimum width is one to two kilometres. Rest places are also few (an average of one rest point every 52km) and moreover degraded. Most of the rest places are located in cross sections between the livestock routes and a major seasonal water course (Appendix 1) and has an area of few kilometers. Tree and shrub species dominated in rest places are *Acacia mellifera*, *A. nubica*, *A. seyal*, *Balanites aegytiaca* and *Ziziphus spina-christi*. Due to overstocking, signs of intensive grazing are clearly observed on the vegetation cover. Forest areas located across the routes are another type of livestock rest place. However, the selection of a rest place by transhumance pastoralists depends on the geographical setup and some predetermined arrangements. According to El Hadary and Samat (2012), pastoralists' justifications to have rest places included better grazing, buying their daily needs (sugar, coffee, cloths) from closer markets, rest for animals, to get some medicines for both and get rid of the weakest animals. In addition, rest places provide locations to celebrate their social events such as marriage and wedding.

It is obvious that livestock migratory routes served the dual purpose of providing a template for the development of essential infrastructure and services in rural areas, such as water catchments like small dams, seasonal river beds and natural depressions, *hafirs* and deep boreholes. They also mark recognized grazing land and passage ways through which pastoralists could move with their herds, avoiding contact and potential conflict with farmers and sedentary communities by circumventing areas of concentrated agricultural activity. One of the imperative components that are missing from the current architecture of the routes' design is the interconnectivity between routes (Figure 2.1.1). In the current situation, if a decision has been taken by a group of pastoralists to take any of the routes, it is not possible to cross to another route. This situation reduces the flexibility of the migratory pattern and also hampers access to import key resources, e.g. markets and veterinary services.

In some parts of the country during the past few decades, unfortunately, livestock routes have mostly disappeared due to unplanned expansion of agricultural land. In Blue Nile State the proposed width of such routes was supposed to be about two kilometres that extend all the way through the agricultural schemes area. However, the implementation of such policies did not last long, since neither the scheme owners nor the settled villagers kept the width suggested for the routes. Soon the width contracted to a few meters leading to intensive confrontation between pastoralists and others in the area (Ahmed 2012). In Darfur the situation was greatly aggravated due to the blockage of stock routes and lack of access to the traditional grazing lands leading to conflicts between farmers and pastoralists (WISP 2007). As key elements of the current conflict, delineation, rehabilitation and mapping of the routes has been cited as an immediate priority to resolve the problem between farmers-settlers and pastoralists in Darfur (DCPSF 2012, HIC 2005).

A newly introduced obstacle along the routes is the building of earth walls along both sides of the routes by wealthier large-scale farmers to protect their land from livestock (Figure 4.2.3.2). This practice is currently done along some parts of Route 6 and Route 2. Such practices are expected to isolate the route area from its surrounding context and hinder the flow of materials, such as plant seeds. Moreover, such practices may increase the susceptibility of soil sheet erosion, especially after heavier rains due to surface runoff.



Figure 4.2.3.2: Examples of barrier built by large-scale farmers along the livestock routes

4.3 Impact of Land Use Policy on Transhumance Pastoralism

The empirical findings, which I presented above, clearly show that livestock mobility is being challenged more than ever before in Gadarif State. Both during the colonial and postcolonial eras, the attitude of governments towards pastoralism has ranged from absolute resentment to benign neglect in Sudan (El-Tayeb 1985). Ahmed (2012) stated that when governments have intervened in pastoral areas, the result has been failed projects informed by imperatives that are totally

inconsistent with the reality of the dry lands. Similar situations have been reported in other parts of East Africa. According to Oxfam (2008), pastoralists are the most politically marginalized group in East Africa and there is an increasing acceptance that the major issues in pastoral development are related to policy and governance (Morton 2005). However, pastoralists' political marginalisation is understood as the result of an imbalanced power relation between the state and pastoral civil society. On the one hand, the political marginalisation of pastoralists' communities is the result of long-standing governance failures, nonresponsive and unaccountable institutions and politicians and policy-makers lacking the will and incentives to include pastoralists' interests in national policy debates (El-Tayeb 1985; Ahmed 2012). On the other hand, pastoralists often lack the ability to organize themselves and sustain the collective action required to exert political leverage in policy circles (Pavanello 2009). In addition, the members of the pastoralist civil society groups who should represent pastoralists and maintain their rights and voices in modern governance institutions, such as state parliaments, have in some cases become detached from pastoral lives and systems (Shazali and Ahmed 1999; Ahmed 2001; Pavanello 2009). Moreover, the role of their traditional leaders has been abolished in a manner such that they have no way to influence any decisions which impacted their system (Ahmed 2001).

Traditionally, land was owned communally, and this system made it possible to practice nomadic pastoralism, which ensured sustainable livestock production as well as smallholder farming. However, because of government policy, communally owned land is being subdivided into individual mechanized rain-fed schemes. Land privatization has meant that the formerly communal rangelands have been subdivided into individual plots for which titles have been allocated to registered large-scale farmers. In such situations, livestock routes have been confined to just narrow strips allocated between adjacent farms.

5 Conclusions and Recommendations

Pastoralism, which historically was the dominant livelihood system in Gadarif State, is currently totally marginalized due to a land tenure system that favours large-scale farming at the expense of other traditional land use systems. In the following points I would like to give a number of concluding remarks and forward some recommendations:

- Understanding the rationale of transhumance pastoralism and recognizing the centrality of pastoralism to the economy of the country by policy and decision makers is a key element for the development of the system. In this regard, it is imperative to have land tenure legislation and land use systems that comfortably accommodate transhumance pastoralism and prevent the livestock routes from the encroachment of other land users, such as large-scale mechanized farmers. This means that maintenance of mobility and flexibility in grazing management strategies will remain particularly important. Grazing areas have to be clearly demarcated, beyond which large-scale agriculture is prohibited, have to be stipulated and strictly enforced.
- Based on LULC change analysis using multi-temporal satellite imagery and perception of transhumance pastoralists of major problems facing them during their migratory journey, Gadarif State is suffering from rapid clearance of natural vegetation and a considerable proportion of land was left bare. The rapid expansion of mechanized farming is expected to call the traditional transhumance land use system by blocking and degrading the livestock routes. There is an urgent need to rehabilitate the livestock migration routes so as to be considered as an ecosystem and not only land strips trespass the mechanized agricultural land. Therefore, protecting and securing stronger rights to land and resources and migration routes for pastoralists are needed. This is fundamental if pastoralism is to survive as the effective production system.

- There has long been tension between pastoralists and farmers over pastoral routes and grazing rights. This tension in some parts of the Gadarif State has been caught in a complex tangle of climate change and variability. According to UNDP (2006), the combined impact of weak local governance and the lack of institutionalized mechanisms for land and water rights and usage have been leading to widespread seasonal tensions between pastoralists and farmers on one hand and between traditional farmers and large-scale mechanised farmers on the other in many parts of the country.
- It is obvious that transhumance pastoralists need support in devising survival strategies through the development of their human capacity (e.g. through education) and institutional settings in order to enable them to bring their claims to policy and decision making institutions. They are complaining that the current setup of the bodies such as the Herders' Union is no longer representing their voice.
- Pastoralists are currently responding to changes that occurred along the routes and trying to adapt to climate, social, political, and ecological processes. It seems, however, that livestock-rearing options have become narrowed and the risks intensified for most pastoralists. The changes have disrupted the traditional transhumance systems, resulting in greater grazing pressure at local landscape levels.
- Despite the acknowledgment of land grabbing as a major bottleneck of improving livestock productivity and natural resources management by policy makers, the issue of land degradation was not considered as a top priority in the national policy of food security in Sudan.
- The baseline information generated from this study is expected to be of immense help in effective responses for formulation of policies and programmes required for pastoralism development and planning.

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Appendix

Photo documentation for some field features





LDPI Working Paper Series

A convergence of factors has been driving a revaluation of land by powerful economic and political actors. This is occurring across the world, but especially in the global South. As a result, we see unfolding worldwide a dramatic rise in the extent of cross-border, transnational corporation-driven and, in some cases, foreign government-driven, large-scale land deals. The phrase 'global land grab' has become a catch-all phrase to describe this explosion of (trans)national commercial land transactions revolving around the production and sale of food and biofuels, conservation and mining activities.

The Land Deal Politics Initiative launched in 2010 as an 'engaged research' initiative, taking the side of the rural poor, but based on solid evidence and detailed, field-based research. The LDPI promotes in-depth and systematic enquiry to inform deeper, meaningful and productive debates about the global trends and local manifestations. The LDPI aims for a broad framework encompassing the political economy, political ecology and political sociology of land deals centred on food, biofuels, minerals and conservation. Working within the broad analytical lenses of these three fields, the LDPI uses as a general framework the four key questions in agrarian political economy: (i) who owns what? (ii) who does what? (iii) who gets what? and (iv) what do they do with the surplus wealth created? Two additional key questions highlight political dynamics between groups and social classes: 'what do they do to each other?', and 'how do changes in politics get shaped by dynamic ecologies, and vice versa?' The LDPI network explores a range of big picture questions through detailed in-depth case studies in several sites globally, focusing on the politics of land deals.

Land Grabbing along Livestock Migration Routes in Gadarif State, Sudan: Impacts on Pastoralism and the Environment

Grabbing of pastoralists' traditional land to put it under the commercial farming system, which has widely been adopted as a development and investment strategy in Sudan, is creating a cruel dilemma of increasing both resource conflict and environmental degradation. This is one of the fundamental reasons that the country has earned the reputation as a home of bloody civil wars and the country is unlikely to see lasting peace until such issues have been addressed. My aim in this research is to provide evidence-based information by mapping out the encroachment of large-scale agriculture into transhumance migration routes in Gadarif State (eastern Sudan), with a two-fold approach. First, I tracked the land-use/land-cover (LULC) change using satellite imagery. Second, I interviewed transhumant pastoralists to obtain information about their perspectives on major problems facing them along the routes in their seasonal journey. It is clear that state policy has failed to provide support to pastoralists. Animal mobility in space and time are severely constrained. The average of the annual encroachment of mechanized farming along the routes is 3 percent. The most substantial LULC change occurred after 1999. Other challenges facing the routes are: lack of water resources, design of the routes and degradation of rest places. Due to the abolition of their native administrative system and lack of education, pastoralists have no way of influencing any decisions that impacted their system.



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