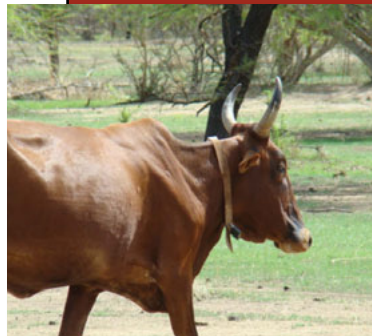
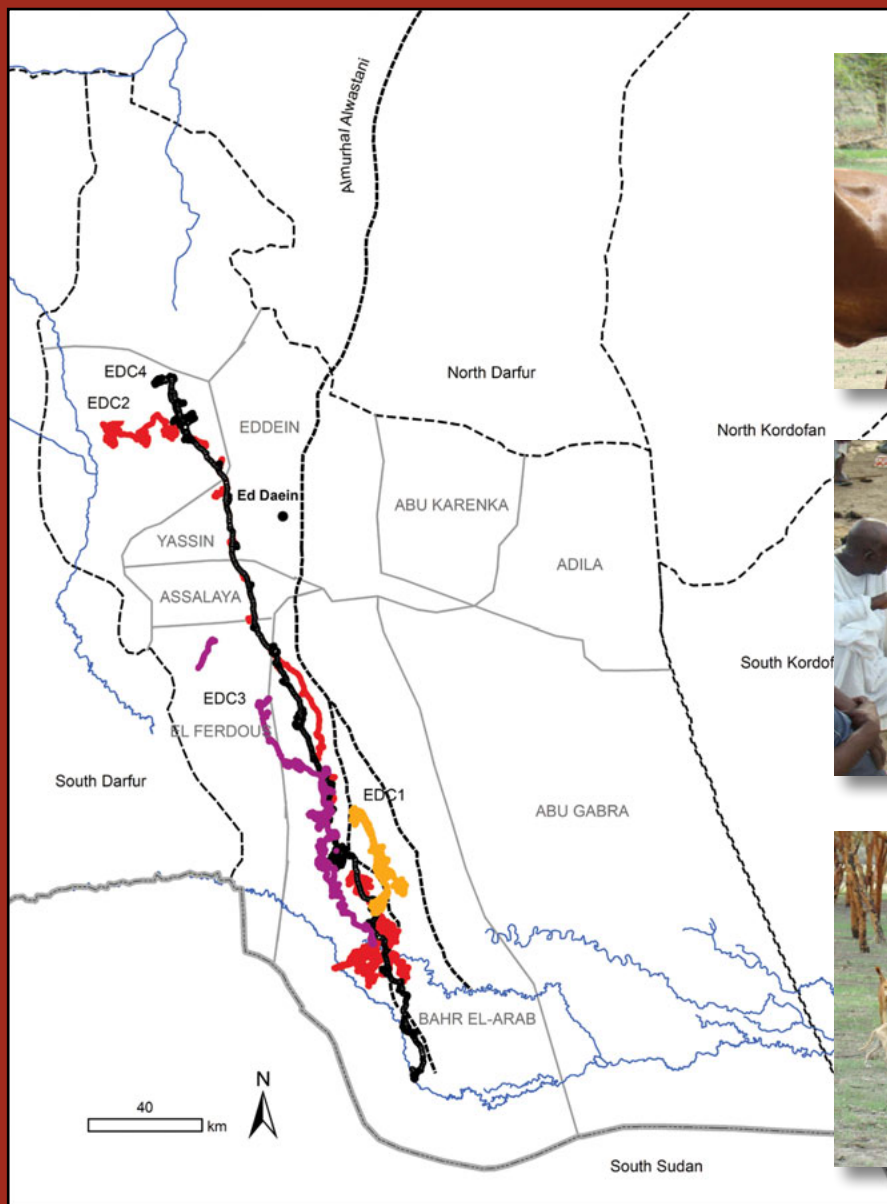






<http://unep.org/Sudan/>

First published in November 2013 by the United Nations Environment Programme
© 2013, United Nations Environment Programme

United Nations Environment Programme
P.O. Box 30552, Nairobi, KENYA
Tel: +254 (0)20 762 1234
Fax: +254 (0)20 762 3927
E-mail: unepub@unep.org
Web: <http://www.unep.org>

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder provided acknowledgement of the source is made. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from UNEP. The contents of this volume do not necessarily reflect the views of UNEP, or contributory organizations. The designations employed and the presentations do not imply the expressions of any opinion whatsoever on the part of UNEP or contributory organizations concerning the legal status of any country, territory, city or area or its authority, or concerning the delimitation of its frontiers or boundaries.

Report authors: Helen Young, Hussein Sulieman, Roy Behnke, and Zoe Cormack,
with Abdelhafiz Mohamed Adam, Samira Mohammed Ahmed, and Hamid Mohamed Abdelnabi

Editing: Liz Vincent
Photos: Hussein Sulieman
Report layout: Bridget Snow Design
Maps: Figures 6 to 10, 12, 15 and 16 redrawn by Bridget Snow;
Figures 17 to 24, and 26 by Hussein Sulieman

Printed by: New Life Press, Khartoum

UNEP promotes
environmentally sound practices
globally and in its own activities. This
publication is printed on recycled paper
using eco-friendly practices. Our distribution
policy aims to reduce UNEP's carbon footprint.



Pastoralism in Practice:

Monitoring Livestock Mobility in Contemporary Sudan

ACKNOWLEDGEMENTS

This work was made possible through the combined support of the Federal Ministry of Livestock, Fisheries and Range, the Ministry of Agriculture and Animal Resources in North Kordofan (MAAR), the Ministry of Animal Resources, Fisheries and Range in East Darfur (MARFR). Special thanks are due to the Director General Dr. Amar El Shikh Idris Omer, who personally introduced and facilitated this work in East Darfur, and has supported the teams throughout. Thanks also to Abubakkar Ahmed Abdulkarim for facilitating visas and permit applications.

In El Obeid, for support from First Lt. Gen. Mohamed Bashir Suleiman, Minister of Agriculture, Animal Resources and Fisheries, Mr. Faisal H. El-Jack, Director General (MAARF), and Dr. Adam Abdulatif Mohamed, Direct General of Animal Resources Directory.

In Ed Daein, for support and excellent facilitation, plus participation in the outreach visits and technical support: Dr. Bashir Abdalla, Director General of the Ministry of Animal Resources, and his staff.

For ongoing support and facilitation, plus inside knowledge of pastoralism: Mr. Ahmed Balah and Madam Haja Ghandour.

For supporting the field research and logistics in North Kordofan, the staff of SOS Sahel in El Obeid and Khartoum, including Salih Abdul Mageed El Douma, Manal Ahmed, and Sulieman Haroun Sulieman.

For supporting the field research and logistics in East Darfur, the staff of Al Massar Organization for the Development of Nomads, including Osman Hussein, Dr. Babiker Ibrahim Babiker, and Hamid Ahmed Mohamed.

For introductions to the pastoralist communities, insider knowledge, and hospitality, thanks to the tribal leadership and their families, especially Omda Aamir Mohamed Aamir in Abu Matariq, East Darfur, and Omda Abdelgadir Hamdalla in Tinna, North Kordofan.

For continuous practical support and encouragement, thanks to UNEP Sudan, especially Magda Nassef, whose exemplary commitment has made a significant difference to this work. For support with digitised legacy data on natural resources from the UNEP Sudan Archives Scanning Project, Mr. R. Neil Munro.

For helpful comments on the research and draft report: Magda Nassef, Youssif El Tayeb, Dr. Hamid Omer, Saverio Kratli, and all the participants at the Khartoum workshop in July 2013, including tribal leaders and herder representatives from both states.

For help with administration, logistics, and coordination: the Tufts staff in Boston and in London, especially Laura Banks and Matthew Lloyd-Cape. For liaison with field researchers, and data entry and cleaning, thanks to Janet Aamir.

For the initial evaluation of available technologies and mobile devices for tracking livestock, thanks to the Chris Hill, Hugh Darrah, and the team at the GeoData Institute, University of Southampton.

For support with the mapping, and access to UN mapping resources in Sudan, thanks to Ms. Anisha Thappa, Crisis Prevention and Recovery Unit (CPRU), UNDP.

For redrawing the figures and maps from the Sudan Archive and final formatting, thanks to Bridget Snow, and thanks to Liz Vincent for final copy editing.

Any words of thanks due to the twelve pastoralist participants will fail to adequately express our appreciation and gratitude for their exemplary and continuous participation for more than six months of this study. Their active support, interest, and commitment has sustained this work and enabled us to understand the real significance of the world of pastoralism. The successful completion of this first phase of the study is all thanks to them. For their support and hospitality during fieldwork, thanks also to their families.

This study was funded by UK aid from the Department for International Development under their support to the UNEP Sudan Integrated Environment Programme.

Contents

Acknowledgements.....	4
Summary	7
Chapter 1. Introduction.....	10
Chapter 2. Methodological innovation: new solutions to old (and new) problems.....	13
Introduction.....	13
Methods for the study of livestock and wildlife migration	15
Overview of the approach and methodology	20
National and local partnerships, and the research team	24
Limitations of the study	24
Chapter 3. Pastoralism in eastern Darfur.....	26
Part 1. The region from a pastoral perspective.....	26
Part 2. Profiles of the six pastoralist producers in East Darfur	34
Part 3. The governance of livestock mobility	37
Concluding remarks	40
Chapter 4. Pastoralism in North Kordofan	42
Introduction.....	42
Part 1. The region from a pastoral perspective.....	42
Part 2. Profile of the livestock producers in North Kordofan	46
Part 3. Governance of livestock mobility	49
Concluding remarks	52
Chapter 5. Livestock herd movements.....	53
Introduction.....	53
Last year's movements	54
This year's movements	61
North Kordofan movements.....	64
Concluding remarks	70

continued on next page

Chapter 6. Land, power, and pastoralist mobility.....	71
Perspectives on pastoralism and conflict from recent peace agreements	71
Political allegiances, tribal disputes, land, and power.....	74
North-South relations and cross-border pastoralist mobility 2005–2013	79
Chapter 7. Resilience in the face of adversity.....	81
Final remarks	81
Recommendations	83
References	87
Acronyms	94
Glossary	95
Plants	96
Annex 1. Initial evaluation report from the GeoData Institute, University of Southampton.....	98
Annex 2. Research schedule of visits to East Darfur and North Kordofan.....	99
Annex 3. Data downloading and analysis.....	100
Annex 4. Last year’s movements for herders EDC2 to EDC6.....	102

Annexes are not included in the online or print version of the report and can be found on the website of the Feinstein International Center <http://sites.tufts.edu/feinstein>

Summary

In recent years, livestock have taken on an increasing national importance for two reasons. First, the increasing recognition of the contribution of livestock production to the national economy and exports, the majority of which is produced by pastoralist systems of production that depend on livestock mobility to access the best pastures. The second reason is the cross-border mobility of Sudanese pastoralist groups, whose livestock depend on accessing pastures in South Sudan in the dry season, by crossing a new international border that continues to be contentious.

Given the spotlight on livestock mobility, this study aimed to develop and pilot new methods and approaches to investigating livestock mobility, in order to review the resilience of the pastoralist systems and related adaptations, and the wider trends influencing this. This report follows the completion of the development and pilot phase of the research and presents selected findings from the first three to five months of monitoring. While this is sufficient to pilot the methodological innovation, it is insufficient to capture all the seasons within the annual cycle.

Innovative approaches and methodologies

An innovative methodology was designed to address the practical challenges of field research focusing on pastoralists, while capturing the seasonal dynamics of herd management and livestock mobility. A partnership between national actors—national scholars, non-government agencies, government ministries, and Tufts University—contributed to the successful implementation of the pilot, increasing local and national ownership of the study, and enhanced research capacities at all levels. North Kordofan and East Darfur States were selected for study, and in each six herder groups were recruited—six cattle herders (*baggara*) in East Darfur, and three camel herders (*abbala*) and three sheep herders (*ghanama*) in North Kordofan. A unique longitudinal design included weekly interviews, regular outreach

visits, and GPS tracking of livestock movements for up to five months. Qualitative reviews of the livelihood profiles of the herders and their livestock movements the previous year were also applied.

The rationale for seasonal migrations of livestock

Patterns of natural resource availability determine the timing and direction of herd movements. A background on the natural environment of southern Darfur explains how migration enables livestock to shift from locality to locality, targeting quality pastures and avoiding scarcities in each area that they visit. The first step to understanding the general seasonal pattern of migration is recognizing what different parts of the landscape have to offer livestock at different times of the year. The “green-up” of vegetation starts in the south and progresses northwards, so herders follow the advance of rains and vegetation, passing through a number of distinct but broadly homogenous ecological zones. North Kordofan represents a dryer environment than East Darfur, favouring camels and sheep, with some cattle in the more central and southern part of the State.

Profiles of the herder groups

The six livestock producers in East Darfur are all *baggara*—cattle herders, and all also raised sheep, goats, and donkeys, with the exception of the producer owning the largest herd (more than 1,000 cattle). Cattle herd sizes varied, and all herds were predominantly female, reflecting the marketing strategy of the herders. Herders have adapted to the economic opportunities presented by the new sheep cross-breed (using local breeds) for which there is a large market demand, and which is adapted to the wetter conditions and clay soils. Livelihood profiles of the herders compare their household composition and hired labour, their farming activities and other income sources, as well as absent family members and their employment.

The six herders in North Kordofan included three sheep herders (*ghanama*) and three more

nomadic camel herders (*abbala*), with varying herd sizes. All herders kept mixed herds while favouring one species, with the exception of one herder who owned more than 200 camels. The governance of livestock mobility at the national, state, and locality level is reflected in a plethora of national and state-level legislation, and accumulated customary principles, norms, and traditions that are continually evolving. Despite significant changes over the past century, the tribal administration continues to maintain a strong presence and maintains its role and importance as the principal local-level governance mechanism connected through a hierarchical leadership structure which interfaces with systems of state-level government at all levels.

A pastoral approach to local-level resource management

A distinctly pastoral approach to local-level resource management is evident from several examples in eastern Darfur, including the institution and governance of summer markets, the coordination of movement along stock routes, and the regulation of cross-border movements. These descriptions of management institutions in East Darfur document how this pastoral system works. While these are preliminary results, they suggest the operation in East Darfur of a “parametric” approach to resource management, whereby management systems regulate access to natural resources—or the conditions that sustain livestock, but do not attempt to regulate the livestock population itself.

Livestock movements—last year’s and this year’s actual movements

Actual livestock herd movements in East Darfur and North Kordofan are presented in Chapter Five, which includes a retrospective analysis of last year’s movements, plus the more in-depth GPS monitoring of livestock movements for up to five months (the study started in the dry season and continued into the rainy season).

Last year’s movements based on herder recall illustrate the well-known north-south migratory patterns in both states, from north to south and

back again. This includes the herder’s descriptions of the different ecozones that pastoralists spend time in seasonally. In East Darfur, these include the “Boroya,” pasturelands in the southern region of Sudan, including part of South Sudan; the “Bahr,” referring to the region around the Bahr el-Arab River; the “Dahara” zone, which is immediately north of the Bahr and a little more elevated; the “Atmur,” which is a small transitional zone between the Dahara and the Qoz. The Qoz is an extensive sandy area to the north, and is the northern limit of migration journey. Typically, seasonal migration from the Bahr starts with the late hot dry season (*seif*), when herders either decide to remain and wait for the early rains or travel deeper to the south where the rains start earlier. The retrospective data indicate that herders spend up to 55% of their year in the Bahr area, and last year about 15% of their time in the Boroya (south of the Bahr); however, none reached the Qoz in the north.

This year’s movements illustrate the non-uniformity of migratory patterns as a result of irregularities in the timing and amounts of rain, and additional factors that complicate decision-making for individual herders with different resources and needs. During the northwards migrations of cattle in East Darfur, the distances covered by cattle are vast; one cattle herd moved 1,373 km in less than three months. The daily rate of movement also varies, and generally herds move fastest when they are targeting a new place; they can travel more than 20 km per day. Herders were shown to follow the same specific corridor but take different branches depending on resource availability, security conditions, and number and duration of stops. A major tribal conflict in the transitional zone severely disrupted the northwards migration, causing herders to return south to spend one week before proceeding once again and deviating their route to the west of the tribal conflict region.

The GPS tracking allowed the specific characteristics of the production system to be captured, demonstrating the local knowledge of herders and management practices in response to the variable natural environment. One example is the splitting of camel and sheep herds during the summer in North Kordofan as a result of

their different watering patterns. During the rainy season, the two herds are brought together, as water and pasture are more readily available (GPS tracking was only undertaken on the main herd species).

Environmental parameters drive migratory cycles, which are challenged by wide-ranging “externalities”

Environmental parameters drive migratory cycles and shape pastoralist livestock production systems in Sudan. The recorded movements indicate that the pastoralist imperative to move is driven primarily by environmental pull factors—the attraction of better-quality pasture and more favourable conditions. Evidence from old and new field research confirms that the benefits gained from targeting the best available pastures at different times of the year would be lost in an entirely sedentary system. In environments like those in western Sudan, migratory stock-keeping is as economic and productive as any known alternative.

Land, power, and livestock mobility

The economic incentives to move are tempered by a wide range of external factors that influence livestock mobility. Chapter Six reviews some of these, including the relationship between land, power, and pastoralist mobility. This is looked at from two perspectives: perspectives on pastoralism and conflict from recent peace agreements; and second how land is structurally linked with tribal power and political allegiance.

The concluding chapter brings together these findings, highlighting the significance of this pilot study. This includes carefully documenting the methodological innovation in order to allow future work to be properly costed and well planned, as well as highlighting the contribution to knowledge with regard to new evidence about local-level systems of natural resource governance, the crucial importance of livestock mobility for the productivity of herds, and an increasing understanding of the resilience of pastoralist production systems.

The study findings have implications for supporting the sustainable growth of livelihoods (and wider economy), as well as for social

relations, conflict, and security. The recommendations focus on specific issues emerging from the study, including: addressing misconceptions about pastoralism; recognizing positive modernising trends and adaptations; examining lessons learned about the commodification of natural resources; and the emergence of a local-level “parametric” system of natural resource management. Finally, the issue of land is considered, and its multi-dimensional character.

Chapter 1. Introduction

Livestock have a unique and special importance in Sudan as the mainstay of peoples' livelihoods throughout the country. There is plenty of evidence showing that raising livestock contributes to the livelihood assets of both pastoralists and farmers.¹ While in many countries pastoralist livestock production is a specialization practiced by a minority, in Sudan the vast majority of the national herd is produced under pastoralist production and depend on livestock mobility to enable livestock to take advantage of the variable distribution of pasture, fodder, and water between seasons and within seasons. This is a result of Sudan's climatic patterns, which provide an extensive and regular range of ecozones for raising livestock across the entire country, not only at the desert's edge or in peripheral regions.

Since the secession of the Republic of South Sudan from the Republic of Sudan, livestock have taken on increasing national importance, in terms of its contribution to the national economy and exports. The decline in national revenues from petroleum following the closure of the oil pipeline by the Republic of South Sudan in January 2012 reduced oil processing in the north and subsequently hit revenues hard. Livestock represent one of the few opportunities for filling this gap, which has raised the profile and importance of livestock production nationally. In February 2013, the Minister for Livestock, Fisheries and Range, Faisal Hassan Ibrahim, reported that the country's livestock exports had increased by 96.6% in 2012. Livestock exports earned around \$408 million at the end of November 2012, increased from roughly \$333 million earned in 2011 (Sudan Tribune 2013a).

Secession and the new international border

between Sudan and South Sudan have also highlighted the issue of cross-border mobility of livestock, as there are more than fifteen northern pastoralist groups who move their cattle annually into southern Sudan, crossing this border in order to access vital dry-season pastures and water. This long-established and widely practiced specialization is unlikely to stop as a result of a new political border, yet given the outstanding contested issues and continuing hostilities between Sudan and South Sudan in this border region, it is known that cross-border livestock mobility has been seriously affected. This new border is one of the longest in Africa at 2,100 km, and the adjacent area is home to more than 25% (12 million) of the combined total population of Sudan and South Sudan.

The policy responses to these new political and economic realities have been mixed. The national policy focus tends to be on livestock, not pastoralists nor the pastoralist system of production (Egemi 2013). The 2007–2011 National Strategic Plan aimed to significantly increase agricultural (including livestock) exports by 2011 (GoS/NCSP 2007, 44). Linked with this are longer-term national policy objectives of modernising the livestock sector through the introduction of new breeds, supporting privatization, and the promotion of livestock production as part of mixed farming. Modernisation and development is viewed in some official circles and policy documents as going hand in hand with the settlement of pastoralists, which is seen as a necessary consequence of development and the move towards more mixed sedentary farming.² This national modernising drive towards settlement of pastoralists contrasts with more locally driven

¹ Raising livestock is the most commonly reported livelihood strategy, adopted by more households than any other livelihood strategy, even farming, as reported in the 2008 census. N. M. Elamin Ahmed, 2008, Households Depending on Agriculture (Cultivation & Animal Husbandry) as a Main Source of Livelihood, Using 2008 Population Census Data, Data Dissemination Conference 5th Population Census, Ministry of the Cabinet, Central Bureau of Statistics.

² For example, the Executive Programme for Agricultural Revival in 2008 describes how “the main objective behind water harvesting and irrigated and rain-fed ranches is to create an environment conducive to the settlement of pastoralists and provide the necessary services beside water, range and pastures” (GoS 2008, 54). Under the Green Alert Programme, the settlement of moving herders is one of the five priorities in the animal wealth sector (Fahey and Leonard 2007).

initiatives to support livestock mobility, through opening of livestock corridors, and reallocation of land from mechanized farming to livestock pastures (Gebru et al. 2013).

This study builds on earlier research by Tufts and partners on the economic value of pastoralism nationally, supporting thousands of jobs and substantial markets well beyond the immediate task of livestock production, and the importance of the livestock trade in the Darfur region specifically (UNEP 2013, 2012). The earlier study “Standing Wealth” confirmed the importance of livestock production and the widespread practice of livestock mobility by both “sedentary” and “nomadic” producers (Ibid.). In North Kordofan, one of the major livestock-producing states in the country, settled sheep producers are strategically moving their livestock to benefit from the variable distribution of pastures, minerals, and crop residues.

While the importance of livestock mobility has been confirmed (Ibid.), little is currently known or documented about the actual day-to-day management of pastoral herds and their strategic and selective access to available pastures, water, and fodder. Even less is known about the decision-making of livestock producers in response to the wide-ranging obstacles, threats, and opportunities. Challenges to mobility are well documented, ranging from complete obstruction as in the case of physical barriers, such as closed borders or blocked migratory routes (FAO/ UNDP CRMA 2010, Young et al. 2009, Young et al. 2005), to less tangible but nevertheless severe hindrances associated with particular policies or institutional failures (Fahey and Leonard 2007). Little is known about how individual livestock producers navigate and potentially negotiate their way through this complex ecological and political landscape.

The dearth of field-based research in Sudan is partly because of the challenges of undertaking research with pastoralists in a context where insecurity is prevalent, and also because of the limitations of the currently available research methods. Pastoralist producers are relatively hard

to reach at the best of times and are rarely visible unless directly sought out. The mobility of pastoralists means they tend not to frequent more populated areas visited by researchers or development workers. Because pastoralists only temporarily reside in a region, their interests may be considered secondary or even not feature at all (in the case of cross-border groups), unless specifically sought after. A review of three years of international humanitarian programmes in the Sudan region highlighted the poor representation and low visibility of pastoralists within internationally funded projects (Fitzpatrick and Young 2013).

The objectives of this study were twofold: first, to develop and pilot new methods and approaches to investigate pastoralist livestock mobility; and second, to use these new approaches to monitor and appraise the utility of pastoral livestock migrations, including where possible the related decision-making and adaptations of the livestock producers and the wider trends that influence this. An analysis of these trends and local adaptations has implications for the resilience of pastoral systems, for livelihoods more broadly, and for social relations, conflict, and security. Hence the broader and longer-term aim of the study is to improve policy makers’ and practitioners’ understanding of pastoralist livestock mobility, from the perspective of the pastoral system and the “externalities”³ that are influencing it.

This report follows the completion of the development and pilot phase of the research, and presents selected findings from the first three to five months of monitoring. While this monitoring duration is adequate to pilot the approach, it is not sufficient to properly capture the complete annual migratory cycle. This report argues that for pastoralism policy to be evidence based, there is an urgent need to conduct similar longitudinal studies of longer duration, in order to properly understand the regional integration upon which pastoralism is based. This potentially represents a significant gap in understanding, or missing piece, in the analysis of the link between

³ Externalities refer to those factors operating independently and outside the focus of interest—in this case the pastoral system. While pastoralists are managing their livestock according to the underlying logic and rationale of the pastoralist system, their decision-making is likely to be influenced by these externalities. To not consider these externalities in the decision-making process would mean that decisions are likely to be misguided or even tragic (Tietenberg and Lewis 2011).

natural resources, livelihoods, and resilience and its links with conflict and insecurity at all levels. Such knowledge is crucial for the development of strategies for Sudan's economic future, and for peace and reconciliation from the local level upwards.

The report is laid out as follows. Chapter Two describes the process of developing the methodology and reviews the more innovative aspects, including the combining of qualitative and quantitative approaches, the use of GPS tracking of livestock, and also the successful research partnership involving multiple actors. Chapters Three and Four present the two case studies, East Darfur and North Kordofan, including a pastoralist perspective on the regions, and a comparative analysis of the sampled producers in each state. These chapters include select examples of how critical aspects of the pastoral system are managed, describing the institutions and how they perform in practice. Chapter Five presents some of the available data and preliminary analyses of livestock herd movements in each of the states. This is based on retrospectively reviewing last year's movements, and contrasting this with the more in-depth monitoring of livestock movements over about three to five months, using GPS devices, and follow-up interviews and outreach visits. Chapter Six examines the links between land, tribal power, and pastoralist migrations. The concluding chapter considers the implications of these findings for policies and peace processes, further research, and immediate investment or direct intervention.

Chapter 2. Methodological innovation: new solutions to old (and new) problems

Introduction

Conducting field-based social science research in rural Sudan is difficult at the best of times, and especially challenging when the population of interest—pastoralists—are poorly defined and whose location at any point in time is difficult to pinpoint. A combination of factors has hindered opportunities for research and learning (over and above the usual resource constraints), ranging from protracted insecurity and conflict that affects both the study population and researchers (in terms of safety and access), to the sometimes strained relationship between the national authorities and the international community that can generate suspicion and mistrust.

This chapter describes a process of methodological innovation⁴ intended to address both the practical constraints and the research questions, and through the partnership approach also aims to improve current research praxis in Sudan. Usually the most emphasis in designing methodology is on the technical issues arising from the research questions. In Sudan, past experience has shown that unless the institutional arrangements and practical constraints are properly identified and considered there may be little hope of undertaking local field research.⁵

The first half of the chapter presents a theoretical grounding for the methodology, by reappraising the utility of migratory grazing, and briefly considering resilience, before reviewing methods that have been adopted elsewhere for monitoring livestock movements (including experience in Sudan of retrospective mapping of livestock mobility).

The second part of the chapter describes the methodology, including the unique longitudinal

study design combining weekly interviews, GPS tracking of livestock, and regular outreach visits. The field research tools and the use and application of the GPS monitoring devices are described in detail, and the limitations of the current study are considered. The importance of the partnership between local-, state-, and national-level actors and research partners is emphasized.

Why study pastoral migrations? A reappraisal of the utility of migratory grazing

Nomadic settlement was once the official policy of most East African countries, and in some it still is. Even in countries where settlement is not officially promoted, many policy makers and heads of state view migratory stock-keeping as an embarrassing relic of underdevelopment and a potential threat to internal and cross-border security. From their perspective, the best reason to study pastoral mobility is to find a way to stop it. We disagree, and recent developments in the biological sciences support our scepticism.

In the latter half of the twentieth century, the *Journal of Range Management* was the single most authoritative source of scientific information on extensive livestock management, and grazing systems—schemes to move livestock through a sequence of fenced paddocks—were high on the list of topics under consideration. Between 1948 and 2003, roughly two out of every five articles in the journal were about these “rotational” grazing systems. Reflecting this enthusiasm, for the last fifty years international development agencies have promoted fencing as a modern substitute for migratory livestock-keeping in pastoral Africa. These efforts met with limited success. Occasionally, pastoralists did adopt fencing and deferred grazing, not

⁴ The process of innovation includes the recognition and analysis of a problem, the development of solutions for addressing this, and the implementation of a practical actionable plan to pilot the approach. For example, see <http://www.humanitarianinnovation.org/innovation/process>.

⁵ There are many examples of failed attempts to conduct field research in Sudan, including for example a recent major livelihoods study in the Darfur region funded by the EU, which had to be downgraded to a desk study that generated little new evidence.

necessarily because they thought it improved forage output or animal performance, but because it was subsidized or officially enforced, saved herding labour, or established privileged (and sometimes private) access to collectively owned resources. More commonly, donor-funded rotational grazing schemes collapsed whenever foreign personnel, money, or enforcement were withdrawn (Sandford 1983).

Interpreted at the time as irrational conservatism, pastoral reluctance to adopt rotational grazing now makes sense. About five years ago, a group of range scientists conducted a meta-analysis of rotational systems—a review of the results of a large number of individual studies. They had a plentiful supply of material to examine, and their results were not entirely unexpected, since several previous reviews had concluded that rotational grazing provided few proven benefits. Never before, however, had the utility of fenced systems of rotational grazing been so comprehensively evaluated, and the results were compelling. Despite in theory looking like they ought to work, rotational systems did not perform as expected: “[S]ubjected to as rigorous a testing regime as any hypothesis in the rangeland profession,” rotational grazing systems have been found to “convey few, if any, consistent benefits” and it is likely that “a continuation of costly grazing experiments adhering to conventional research protocols will yield little additional information” (Briske 2008, 11).

Fenced grazing systems are self evidently systems—organized ways of moving animals with the intention of producing certain anticipated outcomes. The systematic aspects of pastoral migratory movements, which often strike external observers as chaotic, unmanaged, and unstructured, are less obvious. In fact, migratory movements constitute a distinctive type of pastoral land use structured around different principles and with different objectives than fenced grazing systems. As scientific confidence in rotational grazing systems has declined, there has in recent years been a steady advance in the understanding of the ecological processes that underpin domesticated and wild

animal migrations. Contrary to the ambiguous performance of fenced grazing systems, migration sustains—in the air, in and under water, on land, from waterfowl to herring fishes and wildebeest—some of the greatest concentrations of animal biomass on earth. Unlike the debatable advantages of fenced systems, migration does have a measurable impact on the productive and reproductive performance of individual animals, on the viability of entire animal populations, and on the state of the resources that they use (Milner-Gulland, Fryxell, and Sinclair 2011).

Pastoral migrations have been around for many centuries, and some natural systems of wild animal migration have existed for millennia. It is becoming increasingly clear that these evolved systems are as technically sophisticated and effective as any “modern” commercial scheme for distributing and re-distributing grazing animals over space and time. That is why we need to better understand how migratory systems actually function in Sudan.

Why study resilience?

The concept of resilience has taken on a new importance as a result of its increasing application in a variety of fields ranging from disaster risk reduction, climate adaptation, to, more recently, its relation to ensuring greater coherence between humanitarian action, early recovery, and development (DFID 2011). This new interest has prompted a great deal of theorizing and conceptualizing of resilience.⁶ So far, the lessons learned from actual practice are relatively few, nor are there many research-based case studies that test and further develop these approaches (DFID 2011), a gap that this study hopes to begin to address.

Resilience is discussed in the social sciences in terms of society and ecology, and the interconnected nature of natural and social systems (Bahadur, Ibrahim, and Tanner 2010). Theorists differ on how they treat this interconnection, with some emphasizing resilience in ecological systems, others emphasizing social resilience (resilience in social systems), and those who see the two as inseparable, in terms of being part of “linked

⁶ The concept of resilience has been applied in a number of disciplines, including psychology, engineering science, and the social sciences.

systems of people and nature” (Simon 2009 quoted in Bahadur et al. 2010) or a complete “socio-ecological system” as implied by the notion of a “pastoral ecosystem.”

The resilience concept and the systems approach to operationalizing resilience is highly compatible with viewing pastoral ecosystems as non-equilibrium environments and recognizes the highly integrated nature of pastoral ecosystems (people, livestock, and natural resources). This ecosystem perspective of the resilience literature acknowledges that “disturbance has the potential to create opportunity for doing new things, for innovation and for development” (Folke 2006, 253–254).

Finally, a caveat about resilience approaches is that they risk ignoring how politics influences community-level and household decisions in the face of shocks or stresses, and vice versa. This potentially limits understanding and awareness of important community relations, power differentials, and the likelihood of winners and losers in any scenario. The positive emphasis on coping and adaptation risks, ignoring politically driven behaviours, can undermine the very social capital upon which pastoralist systems depend. This element of considering the relations between multiple users of natural resources and their linkages with a wider highly politicized institutional context was central to earlier studies by Tufts in Sudan (Young et al. 2005, Young et al. 2009).

Methods for the study of livestock and wildlife migration

The methodology used in this study is interdisciplinary, drawing on techniques developed in the fields of conservation biology, social anthropology, and applied development research. Past experience in Sudan among pastoralist populations has also shaped the methodology, including the experience of developmental and humanitarian organizations mapping pastoralist livestock mobility retrospectively. These approaches are briefly described below.

New technologies for monitoring mobility

The GPS tracking of monitored livestock in this study employs techniques and equipment first developed by field biologists. In the 1970s,

wildlife researchers pioneered the use of satellites to track free-ranging animals, but the early transmitting instruments were bulky, unreliable and, by today’s standards, inaccurate (Rutz and Hays 2009). Because of the combined weight of the transmitter and harness, early work focused on large mammals such as elk, caribou, and polar bears, and was designed as much to test the technology as to find out about their movements. Despite equipment limitations, satellite tracking was an advance over the lightweight VHF (very high frequency) radio transmitters that were already in use at that time. These radio transmitters had a limited signal range that forced researchers to stay in contact with the animals they were studying, which was difficult with species that migrated long distances or over rough terrain (Fancy et al. 1988).

By the late 1980s, technological advances had established satellite tracking as an operational field of research, especially for migratory marine animals such as sea birds, turtles, and mammals that were otherwise difficult to follow (Hart and Hyrenbach 2009). At present, the technology is increasingly used to answer questions about wildlife resource requirements and about the impact of human activities on the conservation of migratory species. The analysis of tracking data has, at the same time, been facilitated by increases in computing power and the development of GIS (geographic information systems) capable of digitally storing and interpreting large spatial data sets. GIS allows researchers to “layer” or link environmental information to animal locations, building a complex, statistical picture of the different factors—climatic conditions, topography, human activities, the presence of food or predators, and many other variables—that might explain animal distributions (Milner-Gulland et al. 2011).

Anthropological studies of livestock movements developed independently of wildlife research. Because livestock are domesticated and attended by herders, social scientists could live with and accompany the herds and those who cared for them. Observers could obtain reasonably accurate information about the location of migrating herds, and began doing so from the 1940s onwards (Gopen 1958, Stenning 1957). Notable examples of this kind of work in Sudan are *Baggara Arabs* by Ian Cunnison (1966), based on field work conducted in the 1950s just

before Sudan's independence, and *The Kababish Arabs* by Talal Asad (1970), based on field work conducted between 1961 and 1966. Most anthropologists were not interested in migration *per se*, however, but in the political or domestic organization of people who happened to be migratory, and a chapter on the natural environment and migration typically opened a book that then went on—as did Cunnison's and Asad's ethnographies—to focus on pastoral social organization (Asad 1970).

What anthropologists did excel in was explaining the principles behind migration. In this, they had an advantage over conservation biologists because they could talk to the people—the herd owners and managers—who controlled livestock movements, and their anthropological training encouraged them to respect the technical knowledge of those they were talking to. The published analyses of these conversations have stood the test of time. The reporting format used by Cunnison to summarize nomadic movements among the Humr of Kordofan provided a model for the presentation of data collected in this study. In 1964, Talal Asad delivered one of the earliest critical appraisals in Sudan of nomadic settlement policy, opening his critique with observations that still merit repetition:

I am concerned . . . to show (with special reference to the *Kababish*) that a pastoral nomadic economy is not necessarily an anachronism, and that the way the *Kababish* exploit their natural resources is in principle a rational one. To say that the *Kababish* are rational in the way they exploit their resources does not mean that they do not make mistakes, or that no improvements are possible in their system of resource-use. There is no system anywhere which can claim to be rational in this absolute sense. It means rather that they have certain basic economic aims (which are reasonable), and that their pastoral activities and decisions are directed towards the solution of these problems in the light of the knowledge and techniques available to them. (Asad 1964, 48)

Within the last decade, researchers have begun to apply satellite tracking to pastoral livestock, allowing them to re-examine old questions about mobility with new precision. Early work relied on hand-held GPS devices (Adriansen 2005, Coppolillo 2000) but GPS collars fitted on the animals are now standard. Recent research has examined the impact of fences and landscape fragmentation on cattle movements (Reid et al. 2008), the accurate measurement of grazing pressure (Moritz et al. 2010), the delineation of trekking routes (Sonneveld et al. 2009), and the response of livestock to seasonality and varying levels of plant biomass (Butt 2010).

Retrospective methods for tracking livestock mobility in Sudan

In the absence of satellite technology, field researchers have relied on mapping livestock migratory routes retrospectively. In Sudan, there are several examples of earlier studies and participatory workshops that have identified and mapped the livestock migratory patterns of pastoralists in the Darfur region, as described below.

In 2003, a major pastoralism baseline survey for the Darfur region was published by Al Massar. This was a landmark study that tailored its sampling design to reflect the hierarchical system of the tribal administration among pastoralist groups, rather than basing it on fixed settlements or villages.⁷

The report describes “the annual movements of nomadic livestock in Darfur . . . [as] based on an elegant symmetry of elongated ovals, with one set traced by the migrating *Baggara* and another followed by the *Gamala*. Each year, biting flies, rain and mud in the far south of Darfur force cattle northward to pastures vacated by camels moving into the desert fringes. A few months later, the cattle return south and once again yielded their summer grounds to returning herds of camels. The midpoint of the ‘oval’ is the traditional location of pastoralists semi-permanent settlements or *dammer*” (MONEC 2003, 62). See Figure 1.

⁷ According to the report, “the 5th National Census ‘nomadic sample frame’ gave a comprehensive list of all the names of each Sheikh, number of followers, and his location during April 2003 (coinciding with the field period of this survey). Then 80 clusters were selected from across the region, ensuring at least one cluster from each locality where pastoralists were to be found. The teams would then liaise with the Sheikh and use the ‘random walk method’ to select households. Although households were not selected strictly randomly, they were distributed across throughout the low-level of the tribal administration system” (MONEC 2003).

Figure 1 usefully distinguishes between the geographically distinct rainy and dry-season pastures, and the importance of the *murhal*—stock routes—in linking them. This suggests movements in the seasonal pastures are different from the movements along the *murhal*—an important point that needs clarification. The 2003 report also notes the integration between camels and cattle herding, with different users making use of the same rangelands at different times of year, suggesting overlapping rights of different user groups. While the report recognizes the push factors driving mobility—biting flies, rain, and mud—it fails to capture the underlying rationale for mobility linked with capitalizing on the variable and unpredictable availability of resources—water and pasture. It also suggests that livestock migration is a smooth linear movement

from south to north and back again.

Nevertheless, this baseline study is the first comprehensive attempt to map the pastoralist livestock routes in the Darfur region, and the report describes and maps eleven officially recognized stock routes,⁸ which vary in total length from between 252 km to 606 km (the latter route stretches from Wakhaim in the north to Um Dafogg in South Darfur and on into Central African Republic).

A map of stock routes in South Darfur from the pastoralism baseline survey shows six official routes, the southern sections of which either cross into what is now South Sudan, or into Central African Republic. There are three stock routes within the region now known as East Darfur State (Figure 2).

Figure 1. Typical migratory pattern of nomadic groups in Darfur (MONEC 2003)

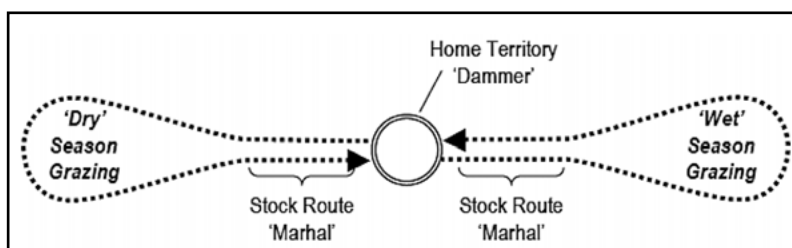
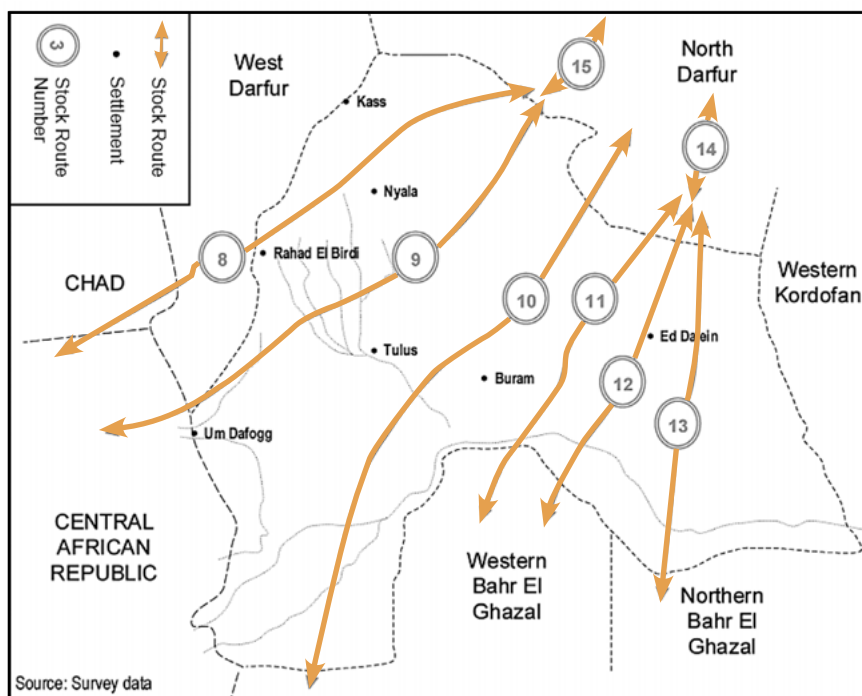


Figure 2. The six main livestock routes in South Darfur (before the existence of East Darfur) (MONEC 2003)



⁸ The eleven routes were declared official by a decree of the Wali, Number 10, 1991 (MONEC 2003).

Not long after this baseline study, in 2004, the Darfur rebellion and counter-insurgency erupted and spread across the region, affecting all livelihood production systems, including these livestock migratory routes. A livelihoods study conducted in September 2004 reported how the conflict “has critically affected the livestock economy in terms of ownership, production, marketing and migration patterns” (Young et al. 2005, 70).

Camels and sheep belonging to *abbala* groups were unable to migrate northwards to the *Gizu* during the rainy season, and were instead confined to areas south of the Jebel Mara Mountains. Standard qualitative methods were used, including key informant interviews and focus group discussions with some rapid appraisal techniques. The study team travelled by road to five selected case study sites in North, West, and South Darfur despite limitations imposed by issues of security and access at that time. Such unrestricted access is almost unimaginable now.

The findings from this study resonated strongly with the analyses generated by national and Darfuri stakeholders from a series of four livelihood workshops throughout the Darfur region in 2007 (Young et al. 2007). These workshops independently highlighted issues of blocked livestock corridors and restrictions to livestock migration (as a result of the conflict dynamics and control of specific areas by different factions), and also the limited outreach and contact by the humanitarian community with pastoralist groups (Young 2009, Young et al. 2009). These workshops raised awareness and to some extent prompted a shift in approach; pastoralism featured for the first time in the UN workplan for Darfur (with the United Nations Humanitarian Coordinator/Resident Coordinator Office and UNEP Sudan supporting further investigations), and generally the humanitarian community increased efforts to expand their programmes beyond IDPs to include pastoralists in their

programmes. However, with little prior experience and knowledge of pastoralism and also as a result of the problem of alienation because of pastoralists’ former exclusion, this was not an easy transition to make and remains a significant challenge for many agencies.

Recognition of this exclusion by the international community⁹ prompted a field-study of the Northern Rizeigat, the first study with a specific focus on *abbala* (camel-herding) pastoralists (Young et al. 2009). This study highlighted the impact of conflict on the long-distance camel migrations of the Northern Rizeigat and also their patterns of settlement (with rapidly expanding *dammer* and increasing talk of “settlement” in order to access basic services). The report mapped former recognized livestock migratory routes and highlighted the changes brought about as a result of the conflict and crisis. However, given the rapid and significant changes that were taking place, the study was unable to capture the actual livestock migratory patterns, or predict with any certainty the permanence of these changes to livelihoods, livestock movements, and lifestyle.

The last example of retrospective mapping of livestock mobility is from a UNDP/FAO series of Darfur workshops in 2010 that undertook a socio-economic mapping of pastoralist livelihoods, including mapping of livestock routes and their characteristics by local participants (see Figure 3). The section of the map of South Darfur showing the three livestock corridors in what is now East Darfur indicates that all three have major sections that are highlighted as “blocked,” with the Central Corridor being blocked completely. Importantly, these routes do not continue into southern Sudan or even as far as the Bahr el-Arab. Sections of the routes that are highlighted as “blocked” broadly correspond to known areas of tribal conflict, or areas controlled by rebels, and areas where there have been repeated clashes between rebels and government forces at that time in 2010.

⁹ Specifically, the United Nations Humanitarian Coordinator/Resident Coordinator’s Office.

These studies and workshops have succeeded in raising awareness about seasonal livestock migration, the importance of livestock corridors, and the differing patterns of pastoralist livestock production. However, all of the above retrospective approaches to mapping livestock mobility share certain limitations, for example:

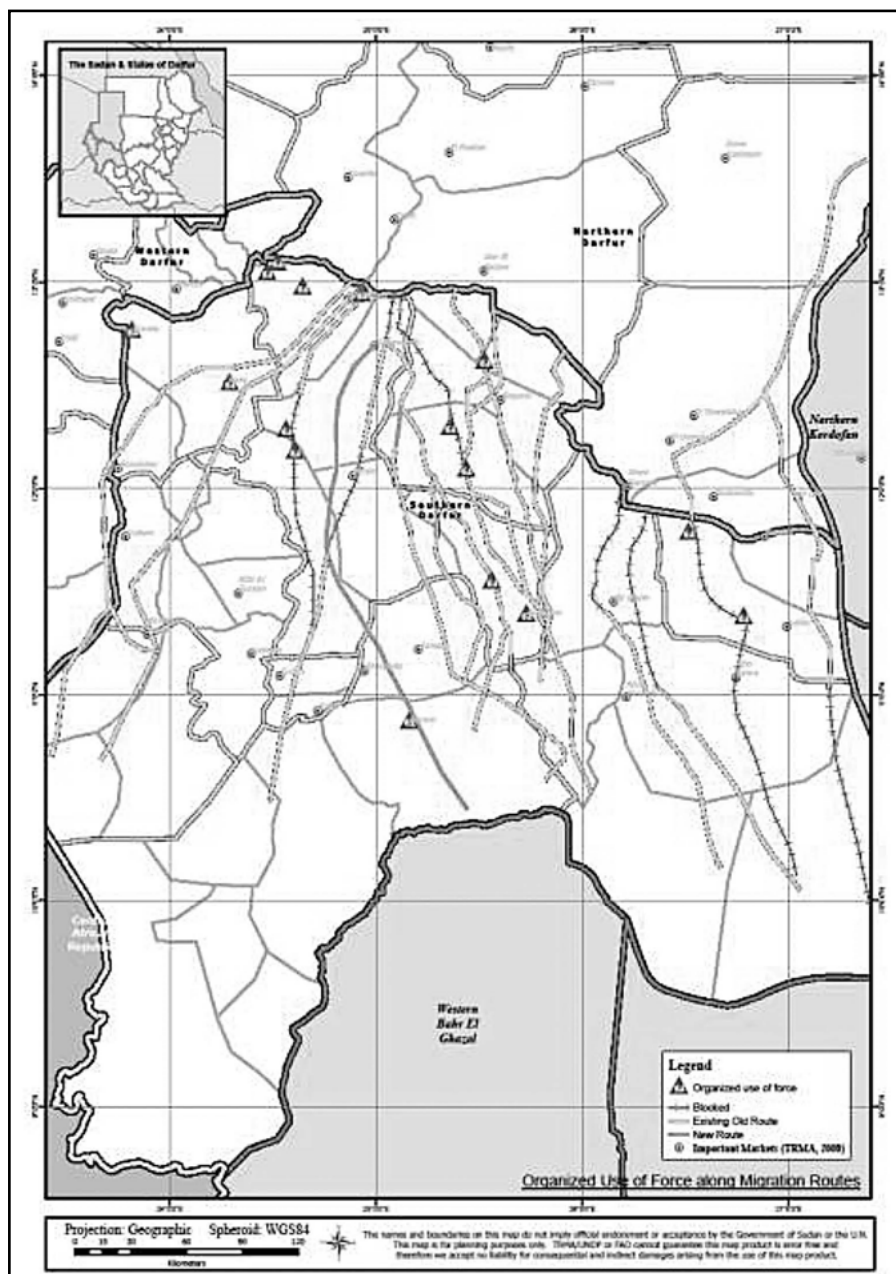
- The broad arrows that indicate migratory routes on many maps tend to suggest more uniformity of movement than

actually exists, and downplay the importance of distinctive movement patterns tailored to the individual needs of herds and their pastoral owners;

- Specific timing is not indicated, apart from the generalization that livestock spend the dry season in the south and the rainy season further north. How pastoralists decide when to move, why, and at what rate is unknown;

Figure 3. Livestock migration routes in South Darfur, 2009–2010

Socio-Economic Mapping of Pastoral Livelihoods — North (Jan '10), West (July '09) and South (Jan '10) Darfur States



(Source: CRMA. 2010. Socio-Economic Mapping of Pastoral Livelihoods. Darfur. FAO/UNDP Powerpoint.)

- There are vast rangelands that are not crossed by these mapped routes and so it is unclear how are they accessed by pastoralists;
- The maps tend not to indicate how the terrain changes, related land systems, and the implications for livestock;
- The routes tend to peter out often well inside Sudan's borders, with no indication of cross-border mobility nor the time spent in these regions;
- Important characterizing features of pastoralist herds and the pastoralist environment are missing; for example, details of herd size and composition, livestock species, and access to markets and other basic services are missing.

Overview of the approach and methodology

In summary, the methodology combines standard research methods (desk review and key informant interviews) with longitudinal monitoring of the seasonal livestock migration of twelve producer groups: six cattle herders in East Darfur, and in North Kordofan three sheep herders and three camel herders. The monitoring involves tracking of livestock mobility of each herd using GPS devices, complemented with weekly interviews with the producers by mobile phone or by outreach visit. Where weekly interviews are based on phone calls, they are supplemented with regular outreach visits to collect information that builds on the weekly interviews. The GPS data provide a detailed account of actual movements, including distances covered, speed, and time spent in specific locales. Weekly questionnaires covered rainfall conditions, natural resources (water, pasture, and fodder), use of supplements, livestock health, expenditure, and livestock sales.

Research methods and tools

The limitations of earlier studies prompted the development of a longitudinal research design that would enable researchers to keep in regular touch with actual producers during the different seasons, in order to monitor herd management practices and related factors.

The research design included an initial process of herder identification and selection, and the development of herder profiles at the start of each longitudinal study. This was followed by weekly interviews by a local researcher known to the producer, where possible by phone or otherwise by bimonthly outreach visits. While this longitudinal approach has not to our knowledge been applied among pastoralists before, the research tools (weekly questionnaires) are fairly standard.

The real innovation was the introduction of purpose-built GPS livestock tracking to complement the data collected in the weekly interviews, which we have not seen elsewhere. Because of the novelty of the approach, the use of these devices was essentially experimental, and so the study was designed in such a way that even should they fail there would be sufficient data from the field research tools to begin to address the research questions.

The devices we have used were especially designed for this study by Skorpa Telemetry¹⁰ following a review of available GPS monitoring devices by the Geodata Institute at the University of Southampton based on a technical specification for GPS archival monitoring devices (see Annex 1). (These devices were imported into Sudan by the Federal Ministry of Livestock, Fisheries and Rangelands, who supervised their use locally through the state ministries. This collaboration and leadership on the part of the Ministry was crucial for the success of this work/study.) These approaches were complemented by a desk review of key trends and policies influencing livestock migrations, plus a review of the UNEP Sudan archives, that include many of the original studies by Hunting Technical Services as part of the Southern Darfur Land Use Planning Survey of the 1970s and the subsequent Western Savannah Development Projects in southern Darfur, and for Kordofan, a series of FAO studies from the 1960s (Land and Water Use Survey in Kordofan Province of the Republic of the Sudan, by Doxiades Associates) and work supported by the Western Sudan Agricultural Research Project, based in Kadugli.

North Kordofan and East Darfur States were selected for study, as both are among the top four livestock-producing states (South and West

¹⁰ Skorpa Telemetry provides a range of GPS tags for wildlife research: <http://skorpatelemetry.com/>.

Darfur, and South and North Kordofan). Also, North Kordofan provided the opportunity to build on the earlier study on the economics of pastoralism (UNEP 2013). East Darfur was selected as a good contrast to North Kordofan, as East Darfur is a region of higher rainfall savannah dominated by cattle pastoralism, whereas North Kordofan is an area of more arid drylands favouring camels and sheep (see Figure 4). The two states combined represent pastoralist migrations from the southern borders with South Sudan beyond the Bahr el-Arab to the northern fringes of the Sahara desert and the favoured *Gizu* pastures of the *abbala*. Research partners also recommended East Darfur from the point of view of local security conditions.

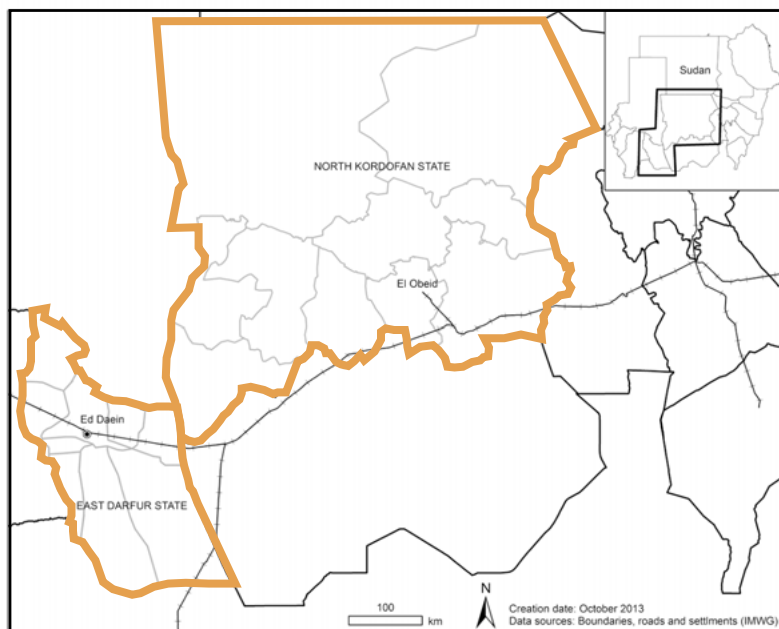
Within each state, the local teams purposively selected six livestock producers to represent the predominant livestock species of interest (sheep, camels, and cattle) in each region, with the support of the Tufts researchers. In East Darfur, this included six cattle producers, and in North Kordofan, three camel producers.

The research study was actively supported by each of the state ministries dealing with livestock and local partners, SOS Sahel Sudan and Al

Massar. A national team implemented the field research, supported by two international researchers who were unable to visit the field given security conditions. The national team included two research personnel from Tufts, working with two state-based teams including a local researcher plus three or four resource persons drawn from the state ministry, the national NGO (SOS Sahel or El Massar), and tribal leadership.

The research schedule is shown in Annex 2. The research work started in February 2013 with an introductory visit by the Director General from the Federal Ministry and study partners to East Darfur, to introduce the study to local stakeholders and select team members in each state. This also gave an opportunity to review the weekly questionnaire and profiling tools. Tufts' role was to provide technical support for the research, while local NGO partners supported the organization of field work and logistics. The state-level ministry personnel provided national and local experience and a strong grounding for the study locally. An introductory visit was also undertaken to North Kordofan.¹¹

Figure 4. Location of East Darfur and North Kordofan States, Sudan



¹¹ This work in North Kordofan followed on quickly after the earlier study—Standing Wealth, which the Ministry had directly supported. The Minister visited the research team in Khartoum to give assurances of his full support, and express his anticipation of receiving the study reports.

The work proceeded slowly, ensuring that key stakeholders were fully informed and understood how the livestock tracking devices worked. Once support and agreement was obtained, the Tufts research team returned to each state in March 2013, to select the herders and train the local researchers in the research tools.

This study employed a variety of interviewing techniques designed to elicit different kinds of information from herd owners about their mobility.

Initial in-depth **profiling interviews** with the participating households focused on herd and household characteristics that influenced migratory patterns, which are unlikely to change in the course of the study. These interviews also provided an opportunity to field test the standardized telephone interview questionnaires (see below), obtain informed consent from those participating in the study, and discuss and attach the GPS collars to livestock in the monitored herds.

Topics covered in the profiling interviews included:

- Household composition/hired labour—which will influence the labour available for livestock management in general and migration in particular;
- Absent family members engaged in non-pastoral employment, trade, education, etc. and the locations where these activities take place. Absent family members represent lost labour but potential gains in social networks, cash remittances, or knowledge that facilitates movement;
- Herd composition—species (cattle, sheep, etc.) and relative herd size—which will influence the extent and pattern of movement;
- Farming activities—their importance to the family livelihood, the nature of the household's involvement, farm location—factors that may inhibit or localize migratory movement;
- Herd movement in the previous year—as an indication of the general pattern of movement in the coming year.

Structured telephone interviews were conducted weekly in order to record conditions and husbandry activities during the past week, as described by herd managers. The objective of this survey was to link socio-economic data and herders' explanations of their movements to the spatial records generated by the GPS collars attached to their livestock. A questionnaire was designed to elicit direct answers that could later be entered into a pre-coded spreadsheet. The questionnaire was translated into Arabic and field tested before finalizing. Topics included information on weather, soil, vegetation, and stock-watering conditions, as well as information on livestock marketing, animal health, and impediments to migratory movement.

The objective of the **periodic outreach visits and interviews** with herders was to clarify any misunderstandings that remained from the weekly telephone interviews and to ask about issues that were too difficult, complex, or undiplomatic to talk about easily over the telephone. Unlike the telephone interviews, the face-to-face outreach interviews were semi-structured. Interviews were based on a checklist of topics and questions to be asked by the field worker, but (unlike the telephone interviews) the responses to questions were open-ended, and field workers were asked to record as much detail as possible. Topics were similar to those in the telephone interviews, but face-to-face meetings permitted more detailed discussions and allowed for the recording of spontaneous observations by herd managers.

The GPS devices, their application in the field, and data analysis

The GPS device used in this study is a variation on the “Microtrax Pathfinder,” which is an archival rechargeable battery-powered GPS tag. The GPS tag stores the GPS location readings, which are later retrieved and downloaded via a USB cable connected to a computer. The technical specification stipulated frequency of recordings (every five to ten minutes) and a rechargeable battery life of up to 120 days.

Nine devices were imported for testing, including four in each state, and one spare. Thus the livestock of two producers were not tagged

in each state, to allow a comparison of the two different data collection methods (weekly interviews alone, or interviews combined with tracking). The monitoring coordinator explained the study approach and background, including the principles of informed consent, before asking the producers to join the study.

To attach the device to the animals, we designed locally made leather collars (fitting cattle, sheep, and camels respectively) that included a leather pouch attached to the collar that securely encases the device (Figure 5). To ensure the device remains facing skywards, a counterweight in the form of a padlock was used, which also serves as a collar fastening, needed when removing the device for recharging.

The process of selecting individual animals for tagging was transparent. A prerequisite was the herder's informed consent (explained above), and also ensuring that the producer understood that he would be responsible for selecting the animal for tagging from his herd. Afterwards, they were asked to explain why that animal specifically was chosen. For example, often they chose a prized or valued animal that was healthy and also might have a name. These positive associations meant they would remain in the main herd and not be sold. Also, the animal's disposition was important; an animal with a calm disposition would allow the collar to be attached, and be calm during the process of data downloading.

A veterinarian accompanying the research team gave the animals a general animal health check, before tagging one with the device. Another benefit of having a vet present was for him to explain to herders that the device has no health side-effects. Other information recorded about the animal included: name, sex, age, pregnancy, date of tagging, time of tagging, and place of tagging. The purpose of keeping such detailed information was to establish consistent data storage procedures, keeping in mind that the process of device recharging and data download was expected to take place several times and not always with same team members.

The devices are "potted" in a waterproof and dustproof rubberized casing, which is hermetically sealed in order to prevent a build-up of condensation as a result of hot day temperatures and cooler night temperatures.

Figure 5. Locally made leather collars, plus a leather pouch attached to the collar and lock



(source: Hussein Sulieman, June 2013)

Each unit weighs less than 90 g and measures 3 x 5 x 2.5 cm. A small window in the casing exposes the GPS antenna to the sky, and a water and dustproof slot is used for the wire download. A blinking light in the antenna window indicates the operating status of the device (red means the unit is on and working). During the initial testing, the red blinking light could only be seen from a distance of about 10 m. This is an important feature so as not to attract attention from curious people in the surrounding area. On arrival at the location of each herd, and before fixing the device to the selected animal, the GPS was left permanently on for about 20 minutes with the antenna window facing skywards. This was to allow the full almanac to be downloaded from the orbiting satellites.

Data retrieval (reaching the herds, downloading, recharging, and storage)

To guarantee sound data collection, testing the download process was checked by the team three to ten hours after fitting the device. During the weekly telephone interview in North Kordofan or biweekly outreach visit in East Darfur, we asked the herder about their impressions of the device and also asked about its performance, i.e., blinking frequency. We organized regular visits to download the data and recharge the devices. The download process was done using USB cable and "GPSViewer" software (provided by Skorpa Telemetry).

The GPS data accuracy depends on a variety of factors, including view to the sky, prevailing weather conditions, time since last successful location, and the chosen antenna. Generally, accuracies of between two and ten meters are achievable, with the better accuracies more likely to happen when locations are taken at very frequent intervals. However, calculating altitude by GPS is always going to result in data of varying quality.

The process of data downloading and analysis is explained in Annex 3.

National and local partnerships, and the research team

The Federal Ministry of Livestock, Fisheries and Rangelands provided overall national leadership, support, and facilitation, through their national links with the Humanitarian Aid Commission, the Ministry of Communications, and direct institutional links to the two state-level livestock ministries in El Obeid and Ed Daein, who actively supported and collaborated in the field work. The work was additionally supported by the Council for the Development of Nomads, who participated in key meetings and provided guidance and support as needed.

Two national NGOs, SOS Sahal Sudan working in North Kordofan, and Al Massar Organization in East Darfur, supported the local-level organization and logistics, and often brought in-depth local knowledge and contacts that helped enormously.

At state level, the state ministries took a leading role—seconding key staff to advise on and support this work for its duration, and working with the local “Resource Person” responsible for the regular follow-up with producers. From the start, the local team worked with elders, often local tribal leaders, who provided guidance and support, as well as introductions to pastoralist herding groups.

Limitations of the study

Practical constraints included delays in starting up caused by the additional time needed for reviewing existing technology and developing, testing, and then producing the new tailor-made devices, and the time needed to get the necessary approvals for their purchase and

importation by the Ministry.

There were some technical difficulties with the devices, including the higher-than-expected frequency of measurements. While this increased the precision of the data, it reduced battery life. The remoteness of the developers to the local context in Sudan hindered access to and timeliness of technical support when needed.

International personnel were restricted from travelling outside of Khartoum for security reasons, and there were also sometimes local travel restrictions for national personnel depending on the security situation. As a result of these travel restrictions on international personnel, there is an undue reliance on a limited number of qualitative interviews and focus group discussions, resulting in limited cross-checking of results. There was also insufficient time to train the national team in the more exacting qualitative data collection methods.

National staff travel tended to be greater than originally expected or more challenging, for the following reasons:

- Limited phone coverage in some areas, requiring more frequent outreach visits in East Darfur during the dry season;
- Difficulties travelling in East Darfur during the rainy season;
- Shorter battery life meant more frequent visits to download data.

Coverage of the mobile phone network was generally good, although in East Darfur in particular this did not extend to the area south of Abu Matariq, or areas close to areas of conflict. Herders were well able to keep their phones charged and operating and were generally punctual or otherwise organized alternative times to talk.

There are important gaps in the analysis; for example, there is very little in the report regarding gender roles and responsibilities, which should be prioritized in any future work. The extremely heavy work schedules of pastoralist women were obvious, and it would be important for future work to capture their significant contribution to the pastoralist household and livelihood, as well as the implications for development. Differences were also evident between North Kordofan pastoralists and those living in East Darfur. When the study brought

together herder groups from both states for a workshop in Khartoum, this produced positive interaction and cross-learning.

The time available for full analysis of the data was extremely limited, with data collection continuing up to the end August. In particular, the analysis linking the data sets (weekly interviews with GPS locational data) is incomplete, and deserves full and proper attention.

Chapter 3. Pastoralism in eastern Darfur

The region of eastern and southern Darfur has long been associated with the *baggara* groups—pastoralist cattle producers, the largest of whom are the Southern Rizeigat tribe. Ed Daein is their tribal headquarters and residence of the Rizeigat Nazir, and is also the new state capital, since the creation of East Darfur State on 10 January 2012. Their tribal homeland, Dar Rizeigat, extends southwards to the international border with South Sudan and their neighbours (and before secession their compatriots), the Dinka Malual. To the east is South Kordofan and Dar Hamar and further eastwards is Dar Misseriyia. To the north of Dar Rizeigat is Dar Ma'aliya, an area of mixed rainfed farming through which the Rizeigat pastoralists traditionally cross in order to reach their rainy season pastures in North Darfur. This administrative and tribal geography impacts on pastoralist migration and so is important to understand.

With the start of the Darfur conflict in 2003, Young et al. (2005) reported the curtailed northwards migration of the *baggara* and their confinement to areas around or south of the railway line in East Darfur. Normally, they would be expected to travel further north, up to Parallel 13.5 close to El Fasher town (Young et al. 2005). More recently, since this study started, fighting erupted between the Ma'aliya and Southern Rizeigat on 9 August, and has continued, causing the displacement of more than 144,000 people (UNOCHA 2013b). This is the most serious episode of conflict in the history of these two tribes, with major implications for pastoralists and pastoralism as well as causing acute humanitarian needs.¹² See Box 5 in Chapter 6.

This chapter provides a background to the pastoralist production systems in the eastern Darfur region, including patterns of natural resource availability, the performance of migratory herds, and a detailed explanation of the causes of pastoralist livestock mobility in this

region of Darfur. This is followed by a review of the six livestock producers in the study, and a profile of their pastoralist livelihoods, including: household composition and hired labour; absent family members engaged in non-pastoral employment; herd composition; and farming and other income sources.

The final part of the chapter briefly reviews the wider policy and institutional context, including recent issues relating to borehole management, and presents examples of a pastoral approach to local governance, including management of livestock corridors, management of shallow well fields in the Bahr region, and finally management of cross-border mobility and access to rangelands and water resources in South Sudan.

Part 1. The region from a pastoral perspective

Patterns of natural resource availability

Migratory livestock production is a response to environments in which the natural resources needed to sustain livestock are not continuously available in any one place. Instead of bringing inputs to the animals, as a farmer would do whenever supplies fall short, migratory animals are taken to wherever resources are naturally plentiful. Migration is an option, however, only in natural environments where different places provide favourable conditions for livestock at different times of the year, so that the herd is never without a place to go. Migratory herds can then shift from locality to locality, taking advantage of productive periods and avoiding resource scarcities in each area that they visit. Understanding what different parts of the landscape have to offer livestock at different times of the year is, therefore, the first step to understanding the timing and direction of herd movement.

In terms of its natural environment, southern Darfur is well suited to the needs of mobile

¹² These are not the only tribal tensions in East and South Darfur; tension between the Misseriyia and Salamat tribes in Central Darfur continues to rise, causing displacement. OCHA Sudan, 2013, Humanitarian Bulletin, 16–22 September.

producers. The general pattern is one in which southern parts of the region are too wet for livestock in the rains, precisely the time when northern pastures are wet enough. The reverse holds true in the dry season when scarce water and diminished forage supplies in the north forces cattle southwards in search of year-round water sources and forage that becomes available in the dry season. This seasonal oscillation is, in part, a response to rainfall patterns. The rains begin earlier and are heavier in the south, and start later and are lighter in the north.

Figure 6 shows the regular north-south progression in annual rainfall isohyets for southern Darfur. The “green-up” of vegetation—the highly nutritious flush of grass at the beginning of the growing season—begins in the south where rainfall levels are highest and proceeds northward. For both wild and domesticated ungulates, the sudden abundance of high-quality forage early in the rainy season is an essential component of their annual cycle of growth and reproduction, and it is a resource that herd owners can ill afford to ignore. Herders who have spent the dry season at water sources in or south of the Bahr el-Arab simply follow the wave of fresh grass as it moves northwards. Those who have spent the summer north of the

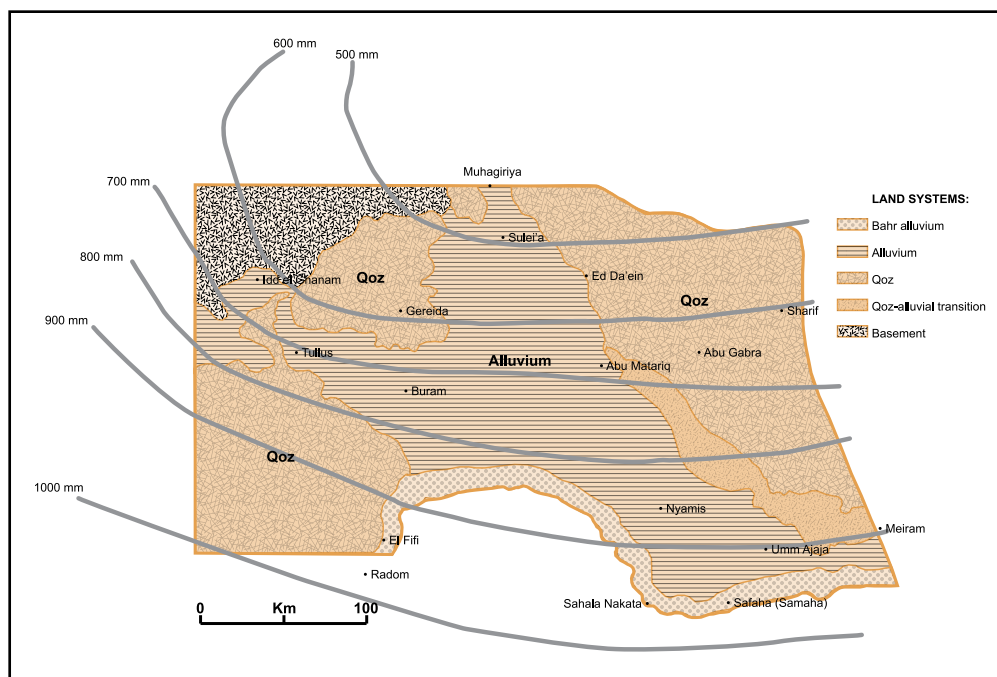
Bahr must wait the extra days or weeks at the end of the dry season for “spring” to arrive in their area, or dash south to catch the first rains, and then turn north to follow the advance of the rains and fresh vegetation.

As the herds move north, the weather changes, but so do the environments though which the animals move. Depending on the particular route they follow, herds in East Darfur can transit through up to four distinct agro-ecological zones or landscape systems characterized by “a recurring pattern of topography, soils and vegetation” (Christian 1958) From south to north, these four major environmental zones are the al-Buta/Boroya, Bahr el-Arab, Alluvium, and Qoz. Each of these ecological zones presents distinct challenges and opportunities for pastoral use (Figure 6).

Unless otherwise referenced, the following descriptions are taken from HTS 1986.

The **Boroya/al-Buta** lies south of the Bahr el-Arab, near or (in the case of the al-Buta) south of the international border with South Sudan. This is a valuable pastoral area because it contains year-round sources of freely available surface water and forage late into the dry season. The soils of this zone are fine-textured clays, with about a tenth of the area consisting of coarse-

Figure 6. Land systems and average rainfall in southern Darfur redrawn from figures in (World Bank 1985, HTS 1981)



textured soils on ridges. The topography is gently rolling with alternating ridges and broad, low-lying swampy areas.

As it passes through East Darfur, the **Bahr el-Arab** is a narrow strip of land north of the Boroya that is rarely more than 10 km wide on each side of the Bahr el-Arab River, which floods annually and remains flooded for most of the wet season. Access to this zone is difficult in the wet season, and the resident population is low, but the area is an important dry-season livestock refuge and the location of numerous hand-dug well fields located in the beds of watercourses that are re-excavated annually. Soils range from sands to alluvial clays depending on topography. In the mid-1980s, annual rainfall was estimated to be in the range of 800–900 mm.

Sandwiched between the Bahr to the south and the Qoz to the north, the **Alluvium** is an area characterized by heavy clay soils that have been eroded from other areas and deposited along ancient watercourses. The clay soils and flooding in low-lying wetland areas make the region difficult to access in the rains, but the zone is heavily used for early dry-season grazing, with the herds watered at a combination of natural pools, *hafirs*, boreholes, and shallow wells. The soils of the zone are fertile but heavy and difficult to cultivate using hand tools. In the mid-1980s, in what is now East Darfur, parts of this land system were unsettled and uncultivated (the “Eastern Regeba”), while other areas were heavily cultivated and densely settled (“Central Alluvium”). Cattle numbers were uniformly high across the zone. Estimated annual rainfall ranged from about 450 mm in northern areas over several dry decades, up to 800 mm in southern areas over a run of wet decades.

Located to the north and east of the Alluvium, the **Qoz** is a gently rolling sand sheet with small depressions containing heavier soils mixed with clay (*shagg*) that are more fertile and suitable for cultivation than the surrounding sands. Qoz soils are infertile but light and easy to cultivate by hand; cultivation tends to move through a typical cycle of initial clearing, cultivation, fallow for five to ten years, followed by re-cultivation or abandonment. In the mid-1980s, the intensity of cultivation and

settlement varied in those sections of the Qoz that now lie in Eastern Darfur. At that time, different sections of the Qoz were:

- Unpopulated and uncultivated (south of the railway and east along the Kordofan border, sometimes termed the “Qoz Rizeigat”);
- Had recently been settled and brought into cultivation (between 1970–85) with the provision of borehole water (called the “Central Rizeigat,” south of the railway in Abu Matariq and Adila Rural Councils);
- Or were intensively settled and cultivated following a programme of borehole development in the 1960s (north of the rail line largely in Ed Daein Rural Council, the “Qoz Ma’aliya”).

Estimated annual average rainfall ranged from a low of 400 mm/year for the northern sections of the Qoz Ma’aliya, up to 600 mm for the period 1940–70 for the Qoz and Central Rizeigat.

As described above, migratory herds move in their annual cycles through a small number of distinct but broadly homogeneous ecological zones. This large-scale variability at the landscape level is, however, cross-cut by a mosaic of local variations in soil type, topography, and vegetation. The complexity of these micro-environments is suggested by the following schematic cross-section (Figure 7) of the association between different soil types and crops in the Central Alluvium and Qoz Rizeigat zones of what is now East Darfur. For livestock, the relationship between soils and natural rangeland vegetation—for which we do not have a simple diagram—is at least as relevant as the relationship between soils and crops. Nonetheless, Figure 7 does illustrate a recurrent association between vegetation, soil and topography at the local level. This small-scale complexity offers herders an opportunity to exploit on a day-to-day basis a variety of different resource niches in the same general area. This complexity allows herders to make decisions about livestock movement on at least two very different temporal and spatial scales—on a seasonal basis at the landscape scale, and on a daily basis at the local scale.

Migratory herd performance

Environmental conditions made migratory stock-keeping feasible in southern Darfur and kept livestock out of harm's way, but this minimal level of achievement does not mean that migration was an especially effective production strategy. The question of the productive performance of migratory cattle herds was examined in a study conducted in South Darfur of the relative productivity of settled versus nomadic cattle, and the results were unequivocal. At every point of comparison, migratory animals out-performed the sedentary cattle owned by farmers and agro-pastoralists:

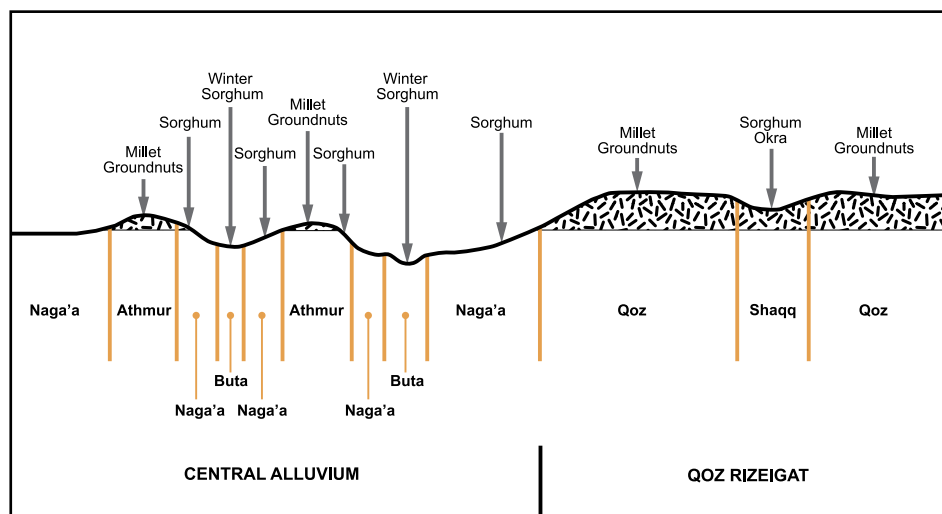
- The annual calving rate was 65% in migratory herds and 40% in sedentary herds;
- 65% of all migratory heifers calved at under four years of age, while the same was true of only 29% of all sedentary heifers;
- Total mortality was 15% per annum in migratory herds and 35% in sedentary herds, while calf mortality was 11% in migratory and 49% in sedentary herds;
- Meat production per kilogramme of breeding female was about twice as high among migratory as among sedentary herds (Wilson and Clarke 1976).

The high performance of migratory cattle is confirmed if we broaden the comparison to include the government-run ranch, Ghazala Gawazat, established in 1957 on 5,000 ha of land along the rail line about 20 km outside Ed Daein in East Darfur. Although no quantified evidence is given, according to a livestock specialist who visited the ranch in the mid-1970s: "Productivity at the station does not appear to be as high as it is in migratory herds in Southern Darfur" (HTS 1976a, 2). This poor result was achieved in spite of the station animals spending much of the rainy season outside the ranch boundaries in an attempt to reserve fenced pastures for later use during the dry season, a "strategy . . . largely nullified, however, by the low levels of protein in the natural grazing in the latter half of the dry season" (HTS 1976a, 38).¹³

Both the 1976 evaluation and a later one conducted in 1983 make it clear that the Ghazala Gawazat ranch was poorly managed, isolated, and neglected throughout the 1970s and 1980s (HTS 1983). It could therefore be argued that Ghazala Gawazat does not constitute a fair example of the performance of well-run ranches, which could be expected to perform better than migratory herds.

Though plausible, research both in Sudan and across Africa does not support this conclusion. Behnke (1985a) estimated the

Figure 7. Schematic cross-section of the Qoz and Alluvium areas of East Darfur showing the relationship of crops and soils (HTS 1986)



¹³ Aside from restricted northern water supplies, the declining forage value of northern grazing is one of the main reasons migratory livestock leave the area around Ghazala Gawazat in the dry season.

productivity of fenced, deferred-use pastures in the area east and south of Nyala, where grazing enclosures were being erected in the late 1970s and early 1980s. He calculated that deferred pastures in that area lost 75% of their feed value (largely due to consumption by termites and the loss of digestible protein due to volatilization) if left ungrazed from September to the end of the dry season in May. At this rate of loss, to sustain equal numbers of cattle or equal levels of livestock performance, fenced areas subjected to deferred grazing would have had to produce roughly four times more dry matter than unenclosed rangelands used on a migratory basis. Since fencing and deferred use were unlikely to increase forage production fourfold, using these areas for sedentary livestock-keeping would actually diminish regional livestock output levels.

While the implementation of the ranching model at Ghazala Gawazat may have been flawed, Behnke's calculations suggest the existence of general problems with the settled, ranching model in tropical Africa. Comparisons conducted in a variety of African countries support this supposition. These comparisons have shown that mobile pastoralism makes more productive and sustainable use of extensive rangelands than any competing form of land use, including industrial forms of commercial ranching (see Table 1).

Available evidence strongly supports the

conclusion that pastoralists consistently use natural resources more intensively and produce more livestock products per unit land area than do commercial ranchers.

Marketed output from migratory herds

However productive they may be, it is often assumed that pastoralists contribute little to their national economies because they keep their animals for reasons of prestige or status and are reluctant to sell them. What really counts, it is sometimes argued, is marketed output, and pastoral producers are poorly integrated into commercial markets and, hence, make little contribution to national welfare. At least in Sudan, there is little evidence to sustain this interpretation. Using official statistics compiled before the independence of South Sudan, livestock have in recent years consistently provided more than 60% of the estimated value added to the agricultural sector, and are a substantially more important contributor to national GDP (gross domestic product) than crop agriculture. Livestock's share of Sudan's agricultural exports is also considerable, and it is growing—up from less than 10% in the 1960s to just under 50% before the secession of South Sudan (Behnke 2012).

On a national basis, it is difficult to determine the proportion of total livestock output that comes from either migratory or settled production systems. For East Darfur,

Table 1. Comparative productivity of open-range pastoral production versus commercial ranching under comparable ecological conditions

Country	Pastoral vs. ranch productivity (ranching = 100%)	Units of measure
Mali	80–1066% (relative to United States) 100–800% (relative to Australia)	Kg protein production/ha/year Kg protein production/ha/year
Ethiopia (Borana)	157% (relative to Kenya)	MJ (megajoules)/ha/year of gross energy edible by humans
Kenya (Maasai)	185% (relative to East Africa)	Kg protein production/ha/year
Botswana	188% (relative to Botswana)	Kg protein production/ha/year
Zimbabwe	150% (relative to Zimbabwe)	Zimbabwe \$/ha/year
Uganda	667% (relative to Uganda)	Ug. shillings/ha/year

Source: (Behnke and Abel 1996; for Uganda: Ocaido, Muwazi, and Opuda 2009)

however, it would appear that the vast bulk of sales have for some time come from migratory herds. Figure 8 gives the total number of cattle marketed in 1974–5 at four of what were then the bigger livestock markets in East Darfur (HTS 1976b). Total supply peaked in October, but varied from market to market:

- Ed Da'ain September
- Abu Matariq July and November
- Furdus July and November
- Gimelaya¹⁴ August and October
(HTS 1976b).

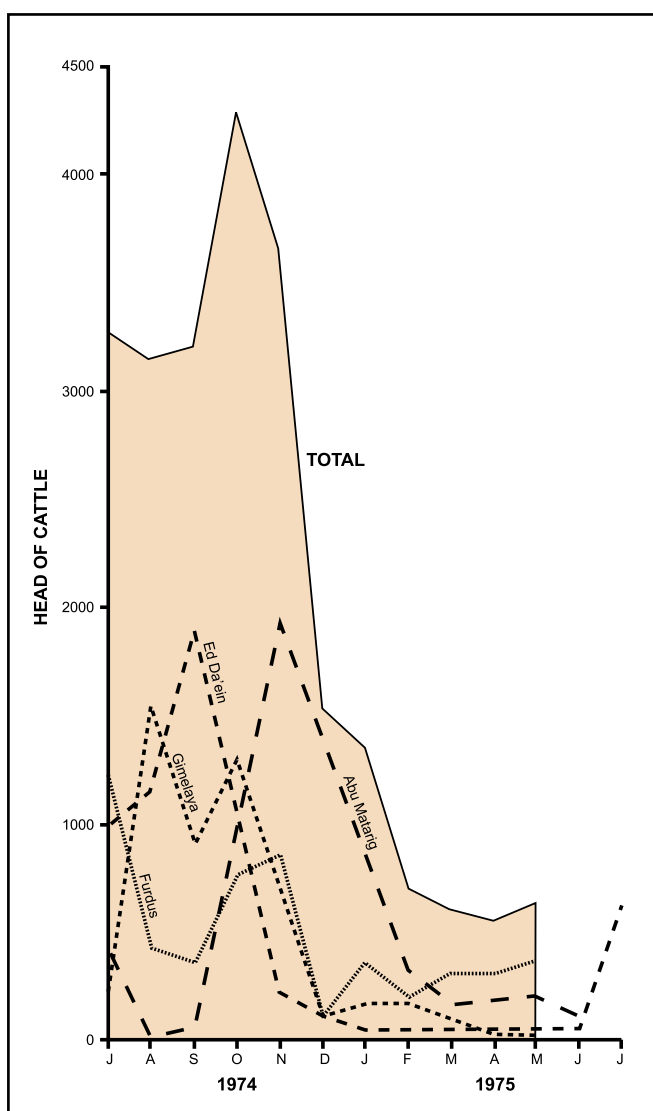
The seasonality of the cattle sales figures documents the dominant contribution of migratory animals to marketed offtake in East

Darfur, since migratory herds are in the vicinity of different markets at different times of the year, and supply peaks occur whenever the pastoralists are around:

The pronounced seasonality in the Rizeiqat area is clearly related to the fact that a large proportion of all the cattle migrate south to Bahr el-Arab during the dry season, returning north during the khareef when they are sold. Indeed, the small markets listed above exhibit the classic double peak sales, in July and August when the herds are moving north, and October and November when they are returning south.

(HTS 1976b)

Figure 8. Total cattle marketed at four principal markets in Eastern District Council, Southern Darfur, 1974–75 (HTS 1976b)



¹⁴ Now called Assalayaia.

It would also appear that high levels of commercial involvement are nothing new for migratory cattle producers. Figure 9 shows the number of cattle marketed at Ed Daein from 1967 to 1975. Based on the extreme seasonality in sales throughout this period, it would seem that migratory producers were the main suppliers of marketed cattle and that high levels of commercial involvement have been a characteristic feature of migratory cattle herding in East Darfur for nearly half a century.

Live animals were not the only livestock product that migratory producers were selling. It has long been appreciated that milk produced by the household herd and consumed by family members is a mainstay of pastoral diets, but the importance of milk as a marketed commodity is less widely appreciated. However, according to field research conducted in the mid-1980s, migratory cattle herds in southern Darfur with 5–6 milking cows (equivalent to a total herd size of 25–30 head) generated an estimated 40% of their cash income from the sale of milk products (Kerven 1987). These sales were largely made in order to purchase grain, with migratory cattle owners exchanging their surplus milk for surplus grain produced by the settled agro-pastoralists and farmers along their migratory stock routes, a trade that had gone unreported because it was conducted and controlled by women.

Herders in southern and eastern Darfur certainly migrate in order to avoid problems such as mud, insect pests, or a scarcity of water or grazing. But migration is not only about avoiding constraints—moving livestock away

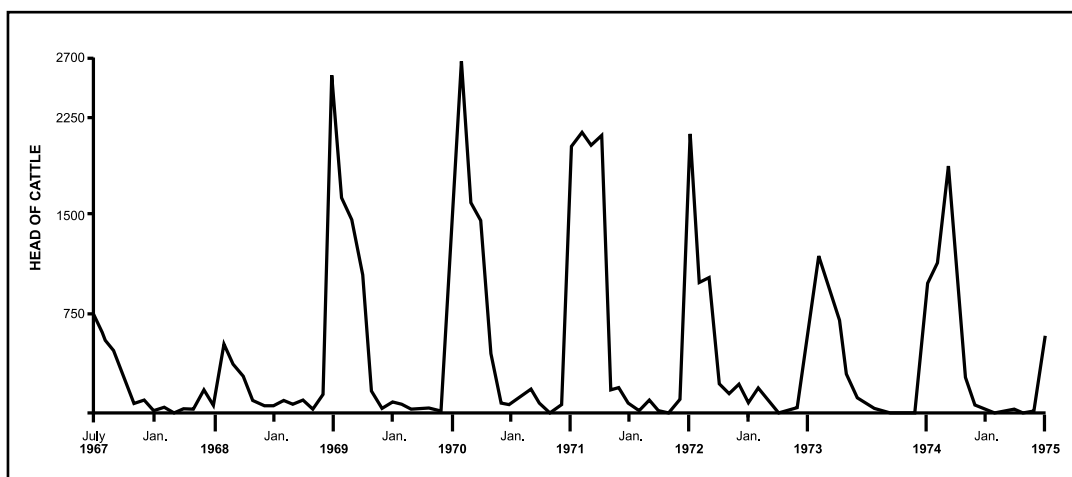
from trouble because their owners lack the capacity to redress constraints. It is also about exploiting the temporary availability of high-quality natural resources, often free of cost and abundant at particular times of the year. This strategy supports the most productive livestock herds in southern Darfur and has sustained high levels of livestock and milk sales to local consumers and national markets.

The causes of pastoral mobility: a Darfur illustration

Migratory movements reflect the interplay of socio-economic considerations, bio-physical variables, negative constraints, and positive incentives, all operating at different spatial and temporal scales. This complexity—and the multiplicity of movement patterns that result from it—makes the organization of migratory systems difficult for outsiders to comprehend. Much simplified, the following case study provides an overview of the migratory patterns that linked the pastures west of Nyala to the Bahr el-Arab in South Darfur, and pastures further afield in Chad and the Central African Republic in the mid-1980s (Behnke 1985b).

The larger and more mobile herds begin the migratory cycle at permanent southern water sources on the Bahr el-Arab or outside Sudan. With the onset of the rains, they are forced out of these areas by a combination of flooding, insect pests, and heavy mud that impedes cattle movements. The rains tend to be stronger and to come earlier to southern regions and to spread northward as the rainy season progresses. Pushed

Figure 9. Cattle marketed at Ed Daein—July 1967 to July 1975 (HTS 1976b)

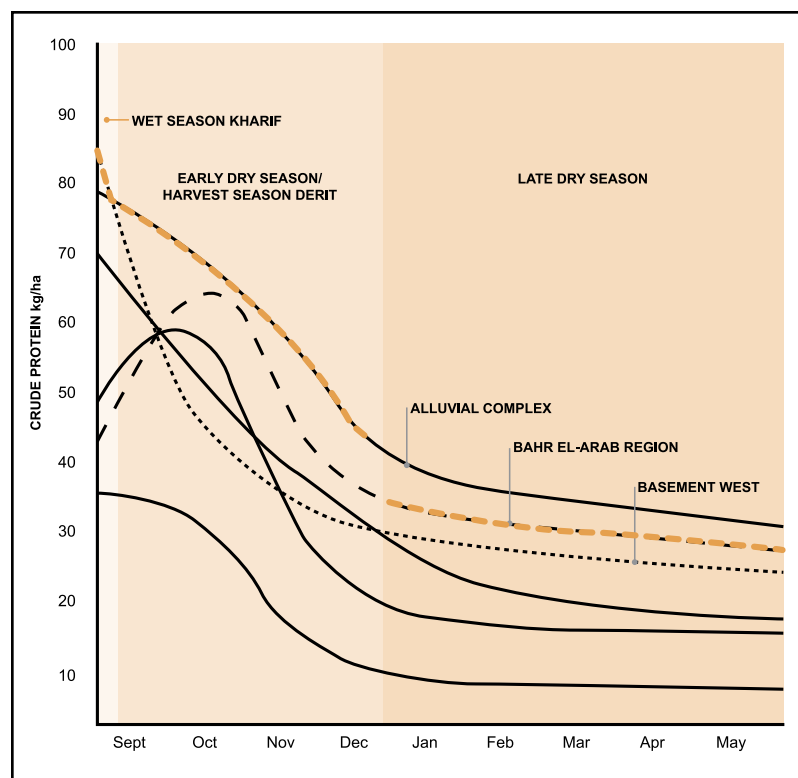


from behind by mud and flies, the pastoral herds follow the flush of fresh grass that accompanies the northward progression of the rains. At the end of the rains, the return trip to the south is timed to bring the herd back to secure summer water before the drying of intermediate water sources makes movement dangerous. These drying water points also provide green forage exposed by the receding water. Water sources that will last out the dry season are situated at lower elevations, on heavy soils, and in higher rainfall areas where flooding and insect pests have protected grass from grazing in the wet season. By the dry season, these grasses are rank and unpalatable, and they may be burned to induce fresh regrowth suitable for grazing.

Because rainfall levels are unpredictable, how intensively pastures are cropped varies from year to year. If the rains are strong, more pastoralists move further north and spend a longer time there. When the area is grazed out, they head back south. Their best strategy is to

exhaust the high-quality northern pastures before moving on. If the rains are weak and there is insufficient northern pasture, herders reduce the amplitude of their northern move, fewer enter the northern pastures, and these stay for a shorter period of time. They can do this because light rains that bring less grazing to northern pastures also reduce the mud and insect problems in alternative southern grazing areas. Thus, in drought years the nomadic herds enter their southern dry-season grazing grounds earlier, stay longer, and move further south. What they are pursuing is not access to a predetermined area, but a kind of resource—green forage—that is to be found in different quantities at different latitudes in different years. Movement patterns therefore need to be flexible, but this does not mean that they are haphazard. At a gross spatial scale, Figure 10 documents the targeting by herders of high-quality pastures, and conversely, the near absence of nomadic stock in areas with poor grazing.

Figure 10. Migratory herds and crude protein production from pasture, by land system 1972–73 under no grazing conditions, South Darfur, Sudan (Behnke 1985a, HTS 1974b, a)



Dashed coloured lines indicate the location by land system of the main mass of migrant livestock from the late wet to the late dry season in South Darfur. Black and white curves represent average crude protein levels—a measure of forage quality—for natural vegetation in different land systems in South Darfur. Only land systems with good pasture resources are occupied by large numbers of migratory herds and are labelled. Numerous land systems with poor quality forage are avoided by livestock; protein curves for these lightly used or unused zones are given in the diagram, but the zones are not named. While many other natural factors (such as mud, flies and water availability) play a role, at the landscape level it is clear that migratory herds gravitate seasonally to areas that provide the good quality forage, avoiding areas where the reverse is true.

(Behnke 1985a; HTS 1974a, 1974b)

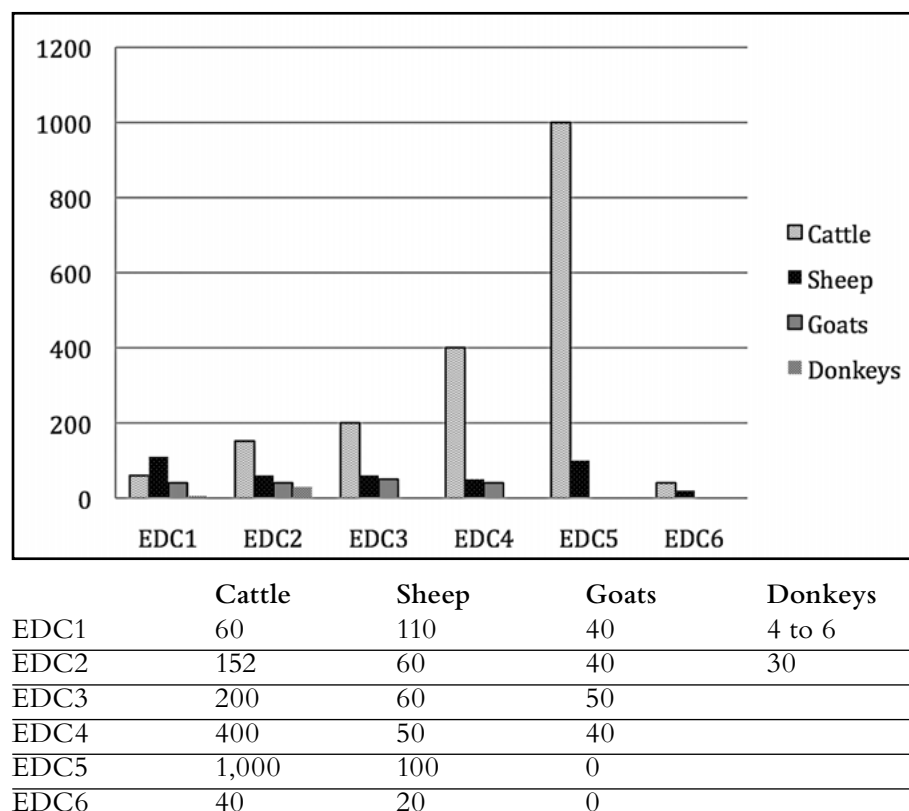
Part 2. Profiles of the six pastoralist producers in East Darfur

The six pastoralist producers selected for this study were all Southern Rizeigat *baggara* (cattle herders). In addition to their cattle herds, all but one producer raised sheep and goats and also kept donkeys. Livestock producers rarely share precise details of their herd sizes, so the numbers here should be taken as indicative rather than precise estimates. During the course of nearly three months of monitoring, the local researchers built up trust and inevitably became better informed about both the herd size and herd management practices. For the six producers, cattle herd sizes varied from 60 to over 1,000 head of cattle (see Figure 11), with three cattle herds of 200 or more, and three smaller herds below this.

Between 75% and 87% of the cattle herds are female, which reflects both a marketing and reproduction strategy; for example, EDC4 currently has 400 cattle, including 350 females, of which 70 are pregnant.

“*Baggara*” is also the name of the cattle breed commonly found in Western Sudan,¹⁵ which are mainly used for local consumption in Darfur. The *baggara* breed is well adapted to water shortages during the hot dry season and can reportedly survive on watering frequencies of three days. During summer, they can lose up to 10% of their body weight, which they regain and recover quickly with the onset of the rains. They are capable of extensive movements over long distances and travel relatively fast. Until this study, specific details of actual distances and speed of travel were unavailable. The largest herd in the sample belonged to EDC5, which had

Figure 11. Herd composition for the six livestock producers in East Darfur



¹⁵ “Sudanese cattle are broadly classified into two breeds: Nilotic cattle and North Sudan Zebu cattle. Types that are related to North Sudan Zebu cattle include: Kenana, Butana (Rofaah), White Nile, Western Sudan Baggara, Foja (Dar Al-Reeh cattle), Qash cattle (Baraka cattle), Arashie cattle, Red Um Bororo, Ingessana cattle and Sudanese Fulani.” Source: page 305 from I. M. K. Abdel Rahman, 2007, Sudanese Cattle Resources and Their Productivity. A Review, *Agricultural Review* 28(4): 305–308.

been built up over the past ten years.

With the exception of the owner EDC5 who owned 1,000 head of cattle, all the producers also kept sheep, with sheep herd sizes ranging between 20 and 100 heads. The practice of sheep herding among the *baggara* has become increasingly common over the past ten to twenty years, driven in part by their commercial value and shorter lifecycle (as compared with cattle). This has also been influenced by the crossbreeding of local breeds (Umbararow and Ub gaba, also known as *garag*) with the northern desert “*Hamari*” sheep, to produce a cross-breed known as “*banat serariy*.” The local cross-breed produces more meat than either separate breed, and also combines the desirable characteristics of each; the desert sheep, which are favoured in local and export markets for the quality and taste of the meat, and the local breeds, which are adapted to the southern ecology, with hooves better adapted to the red clay type of soils and higher rainfall, and coats that resist biting insects.¹⁶ Similar efforts to cross-breed local sheep to suit market tastes, including changing the black colour of the Zaghawa sheep breed, have also been reported in North Darfur and North Kordofan.¹⁷

Four of the six of the East Darfur producers kept between 40 and 50 goats, and two of the producers also kept donkeys. Interestingly, EDC2 had 30 donkeys, indicating the increasing importance of donkeys in East Darfur as a means of transportation and for carrying loads for trading purposes (and potential for hire by traders for cross-border transport during rainy season) and for use in herding livestock. Dogs are often kept and used to patrol at night in the camps to ward off jackals.

Livestock herds may be herded separately during some seasons. For example, during *seif* (the hot dry season), the cattle of EDC1 migrate southwards to the Bahr and more southern pastures, while sheep and goats are separated and stay further north.

The hot dry season is also the time when all of the producers supplement the diet of their weaker animals with fodder concentrates such as groundnut cakes, sorghum flour, and *khalta* (a mixture of maize, vitamins, and minerals), which are available from local markets. This supplementary feeding is the responsibility of the main or most senior herder.

Household demographics and education levels

All the producers selected for the study were mature with large well-established families, including between one and four wives and several children (between 6 and 10 sons, and between 4 and 22 daughters). Education levels were extremely low; all but one of the men were illiterate, with the one exception having completed his third year of primary school; he is just able to read and write. None of the daughters and only three sons had received any education. Three of EDC1's sons were sent to school in Ed Daein where they stayed with the producer's brother. Education services within the state are very limited, with only one high school in Abu Matariq (the locality headquarters). The Koranic school *khalwa*¹⁸ was attended by some of the male children of three of the producers.

Labour

Pastoralist livestock production is largely a family affair for all the producers included in the study, depending on sons to work as herders in

¹⁶ Personal communication, Dr. Bashir, 12 May 2013. Also, this phenomena has been reported in Southern Kordofan: “Within the region crossing or upgrading of some animal types (e.g., sheep) has started to be performed recently at an increasing pace. This is exemplified by the use of desert sheep rams, particularly ‘Hamari’ sub-type, for crossing/upgrading ‘baggara’ and ‘Garag’ sheep in south Kordofan. The major cause behind this tendency is the high market value (local and foreign) for desert sheep.” Source: page XI from F. M. A. EL-Hag, A. A. Khatir, et al., 2012, Livestock Breed Characterization in the Kordofan Region, Federal Ministry of Agriculture Western Sudan Resources Management Programme (WSRMP).

¹⁷ Personal communication, Omer El Dirani, 2012.

¹⁸ *Khalwa* is an indigenous traditional education system practiced intensively in Darfur and in other parts of Sudan; the main subjects are the Holy Koran and some Islamic studies. The typical traditional *khalwa* is mainly found in the remote areas where very limited facilities are available and students live together in a hostel. Usually there was one master teacher (Sheik) assisted by some adults students (*Hiran*). They have no books or pens, and use instead a *lough* (a wooden board) and local pen.

support of the male head of household. For example, the largest herd owner, EDC5, relied on five of his sons to help in herding 1,000 cattle.

Sons working as herders are usually rewarded in kind, including a number of head of cattle when they marry. EDC1 explained that each of his two sons will get 15 heads of goats, 30 sheep, and 3 cattle to start off their herds when they marry. Current in-kind payments include their daily food consumption, working clothes, shoes, and in case of illness, cost of treatment and medicine. Herding may involve other relatives; for example, EDC1 has a small herd of cattle, and so he manages his herd by combining it with his brothers; together they have about 120 head of cattle. He also hires one shepherd to look after his herd of 100 sheep.

Where there is insufficient labour within the household, herders must be hired, which is common practice. Cattle herders were hired by EDC4, and were paid either in kind (with young animals to allow them to build their own herds) or SDG 2,000 per month. Other payments included daily food, working clothes, shoes and, in the case of illness, cost of treatment and medicine.

Shepherds were hired by some of the producers. EDC1 hired one shepherd to look after his 110 sheep for two to four months and paid him 400 SDG per month plus in-kind payments of food, clothes, torch and batteries, sleeping mats, and plastic sheeting. EDC2 also hired one shepherd and paid him SDG 400 per month to look after 60 sheep.

Goats are the responsibility of women and young boys, many of whom remain in the farming areas in the more northern part of the state, while the cattle herds migrate southwards during the hot dry season and return in the *kharif*. For example, EDC1 leaves his older wife assisted by her children to cultivate the land while his younger wife accompanies him southwards. In contrast, the younger wife of EDC6 is settled in Abu Matariq while the older wife travels southwards to the camp near the Bahr el-Arab. Women also collect firewood and water, and are responsible for childcare and household duties like cooking and washing.

All women are usually engaged in milking

wherever they are—with the main herds or on the farms. Other relatives also support the producers as needed; for example, relatives including cousins may assist in vaccination campaigns, or as part of a *faza'a* (when an animal is stolen, a posse is put together to chase the thieves).

Farming and other sources of income

At least four of the producers owned small farms cultivating between four and fifteen *mukhamas*¹⁹ during the *kharif*. This usually requires splitting the family; for example, EDC1 owned six *mukhamas* of farm land, and, during the *kharif*, he leaves his elder wife assisted by her children to cultivate the land. They cultivate sorghum and groundnuts, and sometimes millet and okra. EDC2 owned fifteen *mukhamas* and last season cultivated sorghum and groundnut. Cultivation activities are the responsibility of his elder wife and her younger children. The elder members of the family may also camp around the farm land.

A comprehensive review of other sources of household income was not completed, although producers did mention other sources of income. For example, two of the producers had sons who owned shops, including a mobile shop servicing nomadic camps, and a permanent shop in Eldendoray.

Income is also generated by men through buying, fattening, and selling sheep, a common practice known as *mugalaja*, usually after the rainy season when they are moving southwards, or otherwise between the Islamic holy days Eid Elfitr and Eid Aladha. For example, EDC1 will buy a small sheep and after fattening will sell it in Abu Matariq.

Employment

Two of the producers accompanied the research team as facilitators and guides, one of whom had a responsible job as a Bahr el-Arab Traditional Administration Delegate for which he receives a monthly salary of SDG 350 (about \$60). EDC1 is the head of the local Peoples' Committee in Um Sagaia. This position is voluntary, and there is no income from it as such, although it carries a significant social status. Some of the producers described how they came

¹⁹ 1 *mukhamas* = 1.8 acres or 0.73 *ha*.

to have their current herds. For example, EDC2 started working as an on-hoof cattle drover from Dar Rizeigat in East Darfur to Omdurman. From this job he saved the capital to acquire livestock.

In summary, this small sample represents successful livestock producers following a traditional specialization while adapting to new economic opportunities such as raising the new sheep cross-breed, for which there is a large market demand.

Part 3. The governance of livestock mobility

The wider governance of livestock mobility is reflected in the institutionalized rules and regulations that relate to livestock corridors and stock routes, access to pastures, water, and borehole management, that arise from a combination of national and state-level legislation, judgments, and rulings and accumulated customary principles, norms, and traditions (Gordon 1986) that continue to evolve. For recent reviews, see (Mohamed and Egemi 2012, Siddig, El-Harizi, and Prato 2007).

Historically, the tribal administration controlled the availability of pasture and water within their *dar*. This authority dates back to the Anglo-Egyptian colonial system of indirect rule through the Native Administration, designed to provide a functioning local governance system, at minimal cost and with few staff. At that time, the Native Administration had full authority over resource allocation and use; regulating grazing activities of different tribes within an area (and outsiders) and averting conflicts between pastoralists, and between pastoralists and farmers. This included enforcement of boundaries, demarcating grazing and farming areas, regulation of the seasonal movement and routes of pastoralists and dates when they could access crop residues in harvested fields (*talaig*), and managing tribal “inter-mingling” in the grazing areas, and the management of water points (Shazali and Ahmed 1999).

Aspects of this model remain in place and continue to function, although there is a consensus in the literature that the Native Administration has been weakened, in part

because of the development of a local civil government framework and administration, which was first introduced in 1932.²⁰ Since independence, there have been several strands of legislative change affecting the authority and responsibilities of the tribal administration, including:

- **The shift to a property regime** in 1971 with the Unregistered Land Act, which placed all unregistered land as “property of the government,” which meant the abolition in theory of customary land use rights (Gordon 1986);
- **The shift in powers given to the state authorities** under the 1971 Local Government Act, which replaced the Native Administration and abolished the jurisdiction and administrative authority of the tribal leaders. The Native Administration was revived with the Native Administration Bill in 1987 (albeit with a more limited role) and strengthened further with the 1998 Local Government Act (Siddig, El-Harizi, and Prato 2007, el Hassan and Birch 2008);
- **A shift in authority from customary land use rights to authorizations by the state.** The Civil Transaction Act of 1984 allowed the state authorities to impose restrictions on grazing as to time and place, and also allocate land for grazing;
- **The re-organization of the administrative boundaries within and between states; for example** the 1995 re-division of the Darfur region into three States—North, West, and South; and on 10 January 2012, the creation of two new States—East and Central, so as to make five states, linked with DDPD. With the loss of official power of the Native Administration, tribes had sought strategic political power within the new government administration. Thus, any administrative re-organization affects the influence of tribal groups who are seeking local authority and political influence through this route.

²⁰ This developed under subsequent governments after independence; for example, the 1971 Local Government Act.

Despite these changes, the tribal administration maintains a strong presence throughout the Darfur and Kordofan regions, and maintains its role and importance as the principal local-level governance mechanism, connected through a hierarchical leadership structure that interfaces with systems of state-level government at all levels; hence, the tribal leadership potentially wields considerable power and influence.

Under the current Federal system of government, the states in theory have more autonomy over fiscal, administrative, and political aspects of governance. However, state authorities—especially sectoral ministries, are seen as weak, narrowly focused, and lack the ability to implement (and oversee) strong and helpful policies (Siddig, El-Hanzy, and Prato 2007).

East Darfur as a newly created state faces particular problems, with a recognized lack of organizational capacity and structures able to administer the official state duties and responsibilities. The new governor of East Darfur, Musa Kasha, reportedly refused the position initially, arguing that the “new State has no necessary infrastructures.”²¹ Since then, resources have been committed, in particular to the agriculture sector.

At this stage in our research, we lack more detailed information on the state-level and local institutions that currently govern resource use in East Darfur, and we have not had an opportunity to cross-check our data. Nonetheless, the broad outline of a distinctively pastoral approach to local-level resource management is becoming increasingly clear. The next section describes the different types of livestock water sources in East Darfur and their management regimes, including

a detailed example of pastoral management of shallow hand-dug wells in the Bahr area. Three further examples of this pastoral approach are described, including: the institution and governance of summer markets; the coordination of movement along stock routes; and the regulation of cross-border movements. These descriptions of management institutions in East Darfur document how this pastoral system works.

Livestock water sources and management in East Darfur: a pastoralist perspective

Pastoralists in East Darfur depend on a wide range of water resources, including natural sources and manmade features.²² According to an expert stakeholder group,²³ the five most important sources include: *donki*, pl. *dwanki* (wateryards); *hafir* (seasonal water reserves); the Bahr el-Arab River (or River Kiir as it is known in South Sudan; and *edad* (shallow-dug wells) and *ced* (dams).

Wateryards provide a year-round source of water and are accessible to all and thus are considered the main and most important source of water, especially in the dry season (Ibid.). There are three types of ownership: government, private sector, and NGOs. There are reportedly 400 drilled boreholes owned by the government in East Darfur that are functioning.²⁴ In addition, there are approximately 200 privately owned drilled boreholes, of which only 65 are functioning. A recent development has been the drilling of boreholes by NGOs, although since May 2013 these have been taken over by the East Darfur government, as they represent a valuable source of revenue.

The charges for water at government and privately owned wateryards (*dwanki*) are the same, while some agencies have provided water

²¹ <http://www.sudantribune.com/spip.php?article46044>.

²² At a workshop with local producers, leaders, and experts, they jointly identified the varied water resources in the state, including: rivers—Bahr el-Arab, known in South Sudan as the River Kiir; *Korakir*—swamps; *Towaki*—small *rahad*; *Mushragir*—small depressions in the ground that collect water; *Ada*—clay ground that holds water after rains (known as *Al Bouta* in North Kordofan); *Rijil*—small streams that take water to river (known as *Khor* in North Kordofan); *Donki* (pl. *dwanki*)—mechanized wateryards; *Ced*—dams; *Hafir*—seasonal water reserves; *Ragaba*—lakes formed by a stream changing course, after forming a neck and a lake; *Edd*—shallow-dug wells along the Bahr el-Arab; *Mada'kha*—water hand pumps; *Thaniya/Thawani* (pl.)—deep hand-dug wells; water drawn out by animals.

²³ East Darfur and North Kordofan Pastoralist Producer Workshop, University of Khartoum, July 2013, Tufts University and SOS Sahel Sudan.

²⁴ Personal communication Dr. Al Bashir, State Ministry of Livestock, Ed Daein.

for free. This has created difficulties and tensions with the State Water Corporation. It has also led to the recent taking over of all NGO *dwanki* by the State Water Corporation in East Darfur, and generated a fierce local response as communities protest about the charges. A hot local issue concerns how the profits from the government-operated wateryards are used; for example, for regular maintenance and provision of local services around the wateryards and investments in developing the resource. The agencies (Tamaz and Massar) are known to invest between 30% and 40% of the income for community services,

and are also known to be reliable in paying the local employees.²⁵

Hafirs (water reserves) are used seasonally by livestock, from *shita* to *seif*. They may be constructed by local government or NGOs, although ownership is public and use is free. Crowding tends not to be a problem because of their open access and seasonal use.

Shallow-dug wells (*edd*, pl. *edad*) are the main water source in the Bahr and Dahara zone during *seif*. Box 1 describes details of their construction and management.

Box 1.

Edd (shallow well) construction, management, and related labour

Edd is a shallow-dug well, about three “man-heights” in depth, that herders dig in the bed of a *ragaba* or *dahal* after the surface water has dried up, in order to water their animals. Adjacent to the shallow well, herders build a *tabareg* (an earthen tank) to collect the water that is pulled up from the shallow-dug well to water their herds. The shallow-dug wells at Um Sagea are not far from the summer market place and are for domestic use and livestock watering. The local Popular Committee (*lagna’ shabiyya*) that organizes the market place, and includes some local tribal leaders as members, governs or manages the shallow-dug wells system, which includes assessing, planning, and authorizing the distribution of new wells, allowing adequate space or corridors for the passage of people and animals, and giving permission for digging of new wells and renovation of old ones. The aim is to distribute the shallow wells and spread the herds so as not to interfere with traffic and provide water for all who need it. This committee is made up of representatives of the sub-tribe (*khashim bait*) in the area.

At Um Segea, the fees to renovate an old shallow-dug well are SDG 600, and the fee for digging a new shallow dug well is SDG 800. Newcomers must first get permission from the committee before they start to dig a new well. Permission needs to be renewed every year, or the well is abandoned.

There is no selling of water in any season, although payments are paid for casual labour to transport water from the well (extracting water manually from the well and filling the *tabareg*). Payments for hired labour for watering using the *tabareg* depend on the herd size: from 40 to 70 cows the monthly payment is 400 SDG; from 100 to 150 cows the monthly payment is 600 SDG per month; and above 200 cows the payment is about 800 SDG per month. Hired labour to construct a *tabareg* costs between 150 and 200 SDG.

When herders migrate farther south, they must cover their well with branches and thorny sheets to alert others and avoid accidents. At this time, the shallow-dug well is available for others to use at no charge. If an accident happens, the shallow-dug well owner is liable, but if the new user removed the covers then he is liable to pay compensation for any damage. Similarly, people are expected to use the predefined crossings or corridors rather than cross at any point. The committee also deals with offences occurring in relation to the wells and crossings.

²⁵ Workshop, Khartoum, July, 2013.

Stock route (murhal) management on the Almurhal Alwastani, the Central Corridor, East Darfur

There routinely is heavy demand on pastures along the Bahr el-Arab as herds fall back on this zone in the dry season. In 2012–13, for example, the six herds monitored in this study spent from 39% to 60% of the entire year in the Bahr (see Chapter 5 of this report), by far the greatest concentration of grazing time in any zone, despite the restricted extent of the Bahr, a narrow strip of land along the river. To reduce the pressure on limited grazing resources and preserve sufficient grazing for what can be a long and difficult dry season, it is advantageous to slow the progress of herds moving rapidly to the south. The regulations governing this movement are developed by the native authorities (the Omda) working with the governor in Abu Matarig, the senior district-level administrator. Last year, herds were not permitted to go south of Um Sagea until 1 October; one month later they were permitted to proceed as far south as the vicinity of al-Kubbu, and after an additional month they were permitted to use the Bahr el-Arab itself. The system is enforced by a combination of different officials. A prominent local citizen (*mandoub*) is paid a modest salary (350 SDG/month) to serve as a link between the native authority and the locality government. The *mandoub*, police, and local administration patrol the restricted areas by car. Herders caught violating the system can be served with court papers and fined if found guilty.

The regulation of cross-border movement, Dahar id-Dabia area, East Darfur

Negotiations begin in February–March to permit Rizeigat herds to enter South Sudan, with representatives of the Rizeigat meeting representatives of the Dinka and also South Sudan local government officials in a market town in South Sudan (Mukwai).

For the last two years, the fee for herds entering South Sudan was 700 SDG (or a *madmuun*, a two-year-old heifer or steer) for use of the area during the entire dry season, irrespective of the size of the herd or the exact period of time that it stays. The fee is paid to a local government council (*lagna' mushtarika*) representative. Herders can either enter South Sudan and wait for a council or committee

representative to come to them, or travel to an administrative centre, pay the fee, and bring the papers showing proof of payment back to the people staying with the herd. Security is still an issue that constantly needs to be considered by herders, and some pockets across the border remain unsecured.

Concluding remarks

The pastoralist management institutions described here share several common features:

- They do not rely on voluntary compliance alone; they are supported by credible enforcement procedures;
- These enforcement procedures are hybrid management arrangements that combine native/tribal authorities, local herders or their representatives, and government administrators, in Sudan and South Sudan;
- While our sample is incomplete and certainly influenced by the season in which the study began, the management institutions uncovered thus far all pertain to resource use in the Bahr el-Arab, the most heavily used grazing zone in the study area, and the zone that sustains herds in the most difficult season, the late dry season;
- Aside from rules that limit congestion and control access to resources, individual herders are free much of the time to respond as they see fit to a wide range of environmental constraints and incentives;
- No attempt is made to control rates of resource consumption by directly regulating stocking rates or limiting herd growth.

Our results are preliminary, but they suggest the operation in East Darfur of a “parametric” approach to resource management. Parametric management was first described in a classic analysis of fisheries management (Acheson 1996). The authors of that paper were responding to the repeated failure of industrial countries and international agencies to successfully manage oceanic fish stocks through the imposition of scientifically derived numerical quotas on catch size. These failures were in contrast to the long-term management successes of pre-

industrial, artisanal fishing communities that had discovered ways to sustainably manage their fishing resources. Almost without exception, the artisanal management systems regulated **how** fishing was done and did not attempt to control **how many** fish were caught. In other words, artisanal fishers attempted to manage the parameters or stable conditions that sustained fish populations within certain limits, but not the population itself.

The scientific concept of carrying capacity and the attempt to manage rangeland resources through the imposition of set stocking rates are the rangeland equivalents of fishing quotas. As noted previously, local-level resource management techniques in South Darfur make no attempt to calculate or impose stocking rates, but they do regulate how crucial categories of resources are exploited. Well usage is controlled by the prior ownership of established well sites, the limited availability of new sites, and the rate at which wells recharge. Grazing in South Sudan is controlled by the purchase of permits, but apparently without a close calculation of the number of animals involved or the period of their stay. Grazing pressure along the Bahr el-Arab is regulated by opening the zone to grazing at an agreed date. All these management interventions regulate stocking densities by adjusting periods of use, restricting water availability, or providing access to alternative grazing resources, but no attempt is made to enforce limits on animal numbers. Livestock numbers are instead regulated indirectly by managing resource availability. The opposite process occurs with the development of large water points that alter productive parameters by shifting the balance of available water and feed. With stock water rendered suddenly plentiful, livestock populations that were once regulated by the availability of water are now limited by the availability of forage, which promotes rangeland degradation unless rural communities can devise new techniques to manage their changed environment.

The potential policy importance of understanding how local pastoral communities and government officials co-manage resources is suggested by the closing sentences of Acheson and Wilson's article on fisheries:

The idea that we in modern countries have much to learn about resource management from third-world societies does not easily suggest itself to scientists and administrators. However, we suggest there is a good deal to be learned and that such societies may have discovered the key to solving very serious problems with the world's major fisheries.
(Acheson and Wilson 1996, 589)

In parallel fashion, donor and national government policies for developing Sudan's rangelands might profit from an examination of how rural communities and district-level administrators currently work together to manage these resources; documenting and analyzing the actual practices of rural resource managers will be a focus of future research.

Chapter 4. Pastoralism in North Kordofan

Introduction

North Kordofan State is among the top three livestock-producing states in Sudan, with an estimated 13 million head of livestock. It is the main producer of the *Hamari* sheep, which represent about 50% of livestock exports. Camels are also significant, with North Kordofan contributing 16.2% of the national herd (Behnke and Osman 2010).

North Kordofan was selected for the earlier Tufts study on the economics of pastoralism, because of its national importance as a pastoralist livestock-producing state and also for practical reasons including conditions of security and the local support from the North Kordofan Ministry of Agriculture and Animal Resources (MAAR) and the partner organization, SOS Sahel Sudan.

The local security situation changed significantly during the course of this study, with clashes between Sudan Revolutionary Forces (SRF) and Sudan Armed Forces in North Kordofan in Wad Banda locality in early March 2012, followed by a major attack on 27 April on Um Rawaba. This was seen as a very serious escalation in the conflict, given the size and significance of Um Rawaba and its position on the main road between El Obeid and Khartoum. These events brought the border conflict playing out in neighbouring South Kordofan State into North Kordofan State and closer to Khartoum.²⁶

As reported in the first pastoralist study in North Kordofan, the evolving conflict in South Kordofan had significant direct and indirect affects: “Directly, by closing access to important grazing reserves and consequently introducing

important and still largely undescribed distortions in the complex circulatory system of livestock in the country. Indirectly, because the extraordinary grazing pressure it triggered elsewhere led to undesirable social dynamics and unhelpful (if understandable) reactions at local level, such as the refusal to sell fodder to the newcomers or to let their animals graze.”²⁷ It is these “undescribed distortions” in livestock migratory patterns that this study hopes to capture, as well as the decision-making linked with managing herds in a drylands environment.

As in the Darfur chapter, this chapter first describes the pastoralist production systems in North Kordofan, followed by a livelihoods profile of the three camel producers and three sheep producers included in the study. This is complemented with a brief review of aspects of local governance of pastoralist resources in North Kordofan.

Part 1. The region from a pastoral perspective

Patterns of natural resource availability

The principles that underpin migratory movements in North Kordofan are similar to those in East Darfur. As in Darfur, southern parts of the Kordofan region are generally too wet for livestock in the rains, exactly when northern pastures are wet enough, while conversely, northern areas are lacking in forage and water in the dry season, when these resources are available further south. The general axis of movement is therefore south in the wet season and north in the dry season. Because of its

²⁶ In April 2012, Sudan declared a state of emergency in South Kordofan State, White Nile State, and Sennar, totally shutting the border with South Sudan following events at Heglig. Between 6 and 26 May 2013, the Sudan Revolutionary Front (SRF) occupied Abu Kershola town in South Kordofan State near the border with North Kordofan State. Later, conflicts were also reported in the Sodari area of North Kordofan. The Sudan Revolutionary Front (SRF) is a coalition/umbrella group of rebel groups from Darfur, South Kordofan, and Blue Nile States, formed in November 2011. They are guided by “The New Dawn Charter,” which was signed in Kampala on 5 January 2013. The SRF’s core aims are for the formation of a new transitional government of national unity, the end to marginalization of the peripheries, the installation of a decentralized federal system based on a secular system, and a balance of foreign relations between the “Arab and African worlds.” (ICG 2013)

²⁷ First draft of Standing Wealth, 2011, 38.

more northerly position, however, these seasonal oscillations take place in North Kordofan in a dryer environment than that of East Darfur. Though highly variable from year to year in each state, average annual rainfall in East Darfur ranges from around 900 mm/yr. in the south to about 400 mm/yr in the north; for North Kordofan, the corresponding range of variation is from 350 mm/yr in el Obeid to 75–200 mm/yr on its northern border.

As in East Darfur, different herd species in North Kordofan are broadly associated with different rainfall levels. Sheep and camels are suited to dryer conditions and predominate in the northern parts of North Kordofan. Cattle pastoralists, on the other hand, become increasingly common as one moves from southern parts of North Kordofan and into South Kordofan. The picture becomes complicated in the transitional area south of el-Obeid, the capital of North Kordofan. Here the cattle pastoralists coming from the south—the Hawazma, Messeriya, and Habaniya—meet the camel and sheep pastoralists coming from the north—the Hamar, Shanabla, Maganeen, and Kababish. These two groups share resources, but often in different seasons—the camel nomads leaving the el-Obeid area for their northern pastures in the rainy season, to be replaced by cattle nomads who have arrived from the south, fleeing wet-season mud, flies, and flooding in their southern grazing areas. With the onset of the dry season, these movements are reversed; the camel and sheep nomads return from the north, and the cattle nomads depart to their dry-season grazing grounds to the south.

That, at least, was the situation that prevailed in the 1960s when it would appear that the last comprehensive study of nomadic movements was carried out for North Kordofan (Doxiadis and Lourie 1965). Subsequent work in the mid-1980s on the movements of the Kababish of Sodiri District demonstrated that movement patterns in this region had changed dramatically over time and in response to new political and climatic conditions, suggesting that migratory cycles today are unlikely to be what they were nearly half a century ago (UNEP 2013).

The history of Kababish territorial expansion in the twentieth century provides an illustration of the impact of political and administrative factors in shaping migratory schedules. Figure 12 summarizes the southward drift of the Kababish between 1900 and the early 1980s. Starting in 1900 at roughly at the latitude of El Fasher, by the early 1980s the Kababish were grazing around the Nuba Mountains south as far as the Bahr el-Arab. In the 1970s and 1980s, this southern drift may have reflected the loss of northern wet-season grazing due to a severe and protracted drought—deteriorating environmental conditions in the north forcing herds to the south. But the southern movement of the Kababish had begun decades before the 1970s drought and occurred during some of the wettest decades of the last century, so fluctuations in climatic conditions cannot explain the entire process. Political conditions were also instrumental in the expansion and contraction of the Kababish grazing area. In the early nineteenth century, the Darfur sultanate expanded into Kordofan and used the Kababish to reinforce Darfuri power and to enslave the transhumant Nubian communities that had previously occupied the area (Spaulding 2006). Subsequently, the British allied their interests with the Kababish, who had been preponderantly anti-Mahdi and suffered dislocation and losses during the Mahdiyya. In the Turko-Egyptian period, the Kababish represented the British on the frontier with independent Darfur and then supported the British conquest of Darfur in 1917 (Asad 1970). Based on their services and the perceived loyalty of the Kababish ruling families, Colonial officers used them to “look after their [British] interests in Northern Kodofan” (El-Sammani et al. 1984, 28), and the Kababish prospered accordingly. In short, the area occupied by the Kababish at independence was in considerable measure the result of a series of politically astute alliances with dominant external powers, first the Sultans of Darfur and later the British.

Whatever its political origins, the Kababish also made their grazing area function as a migratory unit. This was achieved by separating the family for much of the year from the main camel herd. In this system, the family and herd were typically united twice a year—once on the wet season pastures when the household could

take advantage of abundant milk supplies, and a second time in the dry season when both family and herd gravitated to permanent water sources (Figure 13).

For the main herds, the yearly cycle was organized around three main moves (Asad 1964, El-Sammani 1984, Asad 1970):

Figure 12. Grazing territory and migration pattern of Kababish nomads in time perspective (El-Sammani et al. 1984)

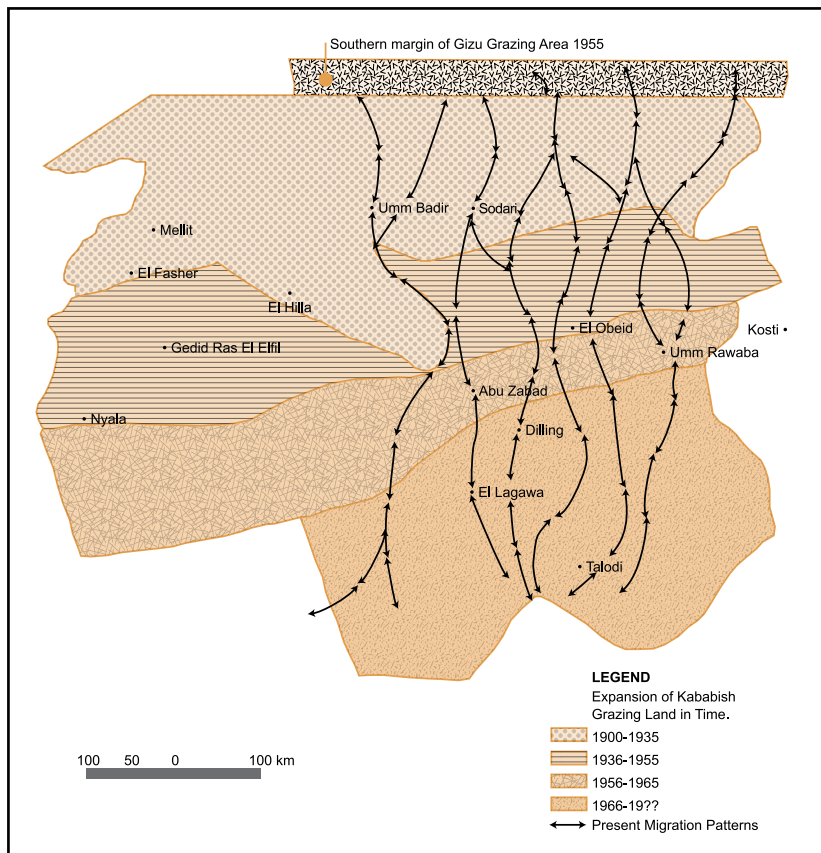
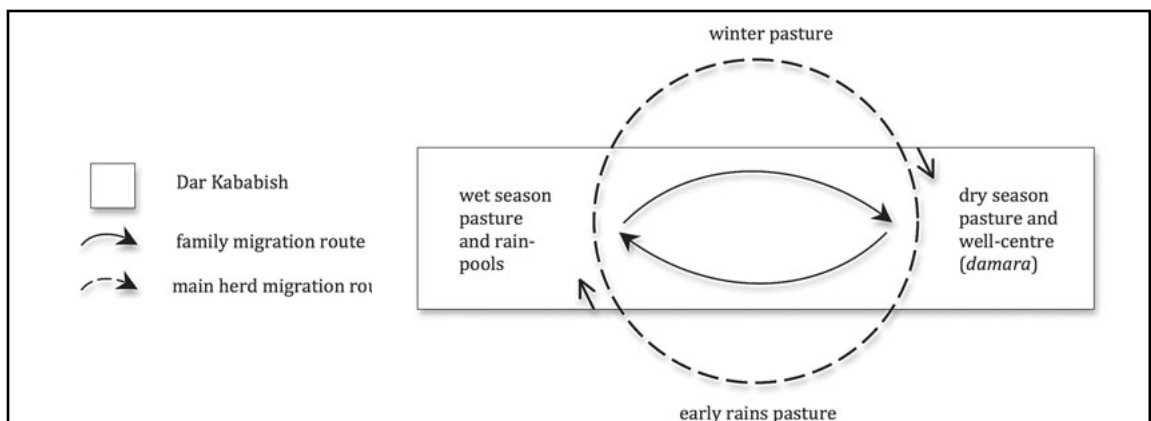


Figure 13. Kababish annual migration cycles, redrawn from (Asad 1976, 18)



- *Shogara*: This move typically took place in June in response to the first showers of the new rains. The direction of movement depended on where herds were located when the rains broke. Those that had spent the dry season to the south moved north, while those located in the north moved south to catch the first fresh regrowth of vegetation;
- *Nishoog*: This move took place during the rainy season, when herds moved north to their wet-season grazing grounds. How far north they moved and how long they stayed depended on the strength of the rains. In years of strong rains, herds would move into the far north seeking ephemeral desert pastures (the *Gizu*) as far away as the Libyan desert and linger to the north until March (Asad 1964, 1970). By the mid-1980s, a series of weak rainfall years had prevented the move to the *Gizu* for fifteen years, and herds were arriving back at their dry-season locations as early as October (El-Sammani et al. 1984);
- *Damara*: The *damara* refers to dry-season grazing, initially at natural water pools and with access to green forage and crop residues, but at the end of the dry season with herds concentrated around permanent water points. How far south the herds moved to find reliable permanent water in any year depended on the strength of the rains.

The preceding account documents the dual character of pastoral migratory territories, which function as “natural” environmental units suitable for year-round livestock production but are, equally, the consequence of political alliances, military conquests, and administrative fiat. In some instances, it would seem, pastoralists are able to craft migratory schedules that answer both to the productive needs of their herds and to political realities. At least into the early 1980s, the Kababish had successfully engineered such a compromise between political and environmental necessity, a process facilitated by territorial expansion. In other instances, restrictions on herd movement undermine irrevocably the viability of migratory production—a possibility to be examined in this study.

Market involvement and productive performance

As in southern Darfur, there is evidence of the involvement of Kordofani pastoralists in livestock marketing for at least 60–70 years. The following account refers to the Messeriya cattle pastoralists who circulated in the 1960s between el-Obeid and the Bahr el-Arab:

The economy of the tribe is based on cattle rearing. Cattle gives cash in two forms; selling of animals, and selling of milk products. Animals are mostly sold during the wet season when the tribe comes closer to El Obeid. Nearly all cattle sold during September at El Obeid market, comes from the Messeriya area.

(Doxiadis and Lourie 1965, 10)

Commercial involvement by the Habaniya (located near and south of El Obeid) is described as follows:

The income of the tribe comes from two sources: milk and milk products and agriculture. The cow in Habaniya country forms an important source of cash, as during the dry season families come close to the market centres where they sell milk to the town population. Milk is sold in the form of fresh milk, sour milk, or fats.

(Doxiadis and Lourie 1965, 15)

In the mid-1980s, cattle milk sales by Hawazma women were estimated to provide a third of family income, buttermilk being bartered for grain or flour in hamlets or small markets on days when the camp was not travelling, and raw milk being sold in bulk to seasonal cheese factories (Michael 1987).

On a national scale, the sale of sheep is the most visible if not the most significant commercial output from pastoralists in North Kordofan, which is one of the main sources for the sheep exported from Sudan (El Dirani, Jabbar, and Babiker 2009). Exactly how Kordofani livestock owners have adjusted their husbandry techniques or migratory schedules in response to export demand has not been documented, but the impact of the export market can be inferred from livestock census statistics. Table 2 shows the relative proportion of

different species in the regional herd, with the number of each livestock species converted to a standardized Tropical Livestock Unit (TLU) (in which camels equal 1, cattle are 0.7 and sheep and goats are 0.1 of a TLU).

Over a 35-year period, the proportion of sheep in the regional herd has increased nearly fivefold in response to a buoyant market for sheep. To argue that pastoral producers in North Kordofan are not market oriented or are only marginally involved in commercial production is not credible.

Table 2. Percentage contribution of different livestock species to the Kordofan regional herd

	cattle	sheep	goats	camels	Total
1975	34	13	9	44	100%
2010	9	64	6	21	100%

Source: Sudan National Livestock Census 1975; IFAD 2011

Part 2. Profile of the livestock producers in North Kordofan

In North Kordofan, the six selected livestock producers included three sheep herders (*ghanama*) and three camel herders (*abbala*), two of whom also raised sheep. Two of the camel herders were from the Kababish tribe, whose *dar* extends across the northern part of North Kordofan bordering the *Gizu* to the north, Dar Meidob to the west (also *abbala*) and Dar Hamar to the south and east. Soddari is the Kababish headquarters and residence of Kababish chief.

The third camel producer was from the Kawahla, a small tribe from northeastern Kordofan, who are also known traditionally as nomadic *abbala*. Two of the sheep owners were from the Hamar tribe (NKS1 and NKS3), with home residences in El Khwei. They identified themselves as sedentary sheep keepers (*ghanama*), in contrast to the Kababish pastoralists and Shenabla nomads. All are relying on livestock mobility to raise their animals.

All the producers selected for the study were older men between 45 and 54 years old, three of whom had one wife, and the other three had two wives. Numbers of children varied between six and nine, and because of the age of their parents, several were adult and working alongside their fathers as herders. Levels of education were somewhat higher than East Darfur, with two of the producers sending their

children to university, and several having gone to school.

Herd profiles

The livestock ownership of the six producers is illustrated in Figure 14. Primary camel herds were kept by NKC3 (200 head); NKC2 (70 head); and NKC1 (50 head). About 50 head is generally considered a medium-sized herd. Camel herds are sometimes combined, for example NKC3 combines his 200 camels with his brother's herd, and together they are managed by three herders (his son, his brother's son, and a hired herder). Camels were also kept as a secondary herd by NKS2, whose primary herd was sheep; he owned 600—the largest sheep herd in the sample.

All but one of the livestock producers raised sheep, either as their primary herd for the *ghanama*, or their secondary herd for the *abbala*, in which case numbers did not exceed 100. One producer did not raise sheep; his primary herd was larger—more than 200 camels—and his secondary herd of 60 goats was managed separately by his wives.

Sheep breeds

All five sheep producers kept the *Hamari* breed of sheep.²⁸ Flocks are usually about 78% female and 22% male, and average weight is 60 kg for a male and 50 kg for a female, although this varies by tribal type (El-Hag et al. 2012).

²⁸ There are more than four breeds and sub-types of sheep, with several desert sub-types in Kordofan region, including the desert sheep and the Nilotic (or Jebelli) sheep and their crosses (El-Hag et al. 2012). El-Hag describes several sub-types with tribal associations, including Hamari, Kabashi, Shenbali, Hawari, Selaim (Ibid.).

Goats are the responsibility of women and boys; for example, the wives of NKC3 are responsible for taking care of their herd of 60 goats, which stay around their camping area. Similarly for the nomadic Shenabla, around 40 goats were managed by the wives and kept around their tents. One of the two Hamer sheep producers kept small numbers of goats (10 goats that were the responsibility of his two wives).

As in East Darfur, livestock herds are predominantly female; for example, NKC3 owned 200 camels, including 190 females and 10 males; NKC1 owned 40 female camels and 10 male); NKS3 had 445 sheep, among which 85 were pregnant at the time of interview (7 May 2013).

Labour

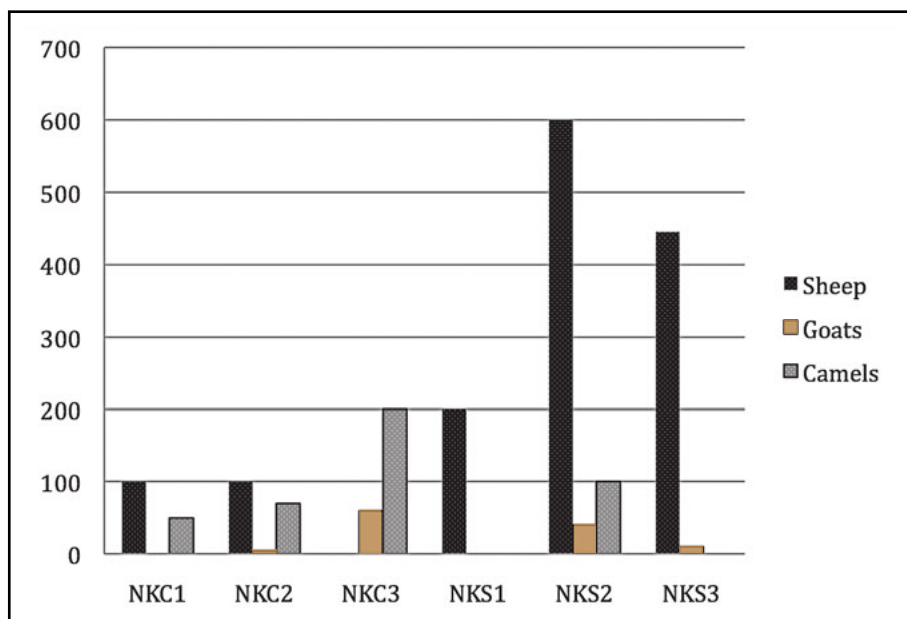
As in East Darfur, raising livestock is a family business and shepherds are hired only when herders cannot be found within the immediate family. NKC2 manages the camel herd with help from his brother and a hired herder. Hired camel herders are usually paid in

kind; for example, both NKC2 and NKC3 pay their two hired camel herds in kind, by giving them a *hashee*—a 4-year-old female camel, each year. NKC2 also hires one shepherd for his 100 sheep. Hired herders also receive their daily food needs, working clothes, shoes and in case of illness, treatment and medicine.

NKS1 has 200 sheep, and hires three shepherds. These include:

- One *wakil* paid 700 SDG per month; usually the role of the *wakil* is the overall management of the herd at field level (managing watering, movements, advice to owner, taking sheep to the market, etc.);
- One *khabeer* (pasture expert) who is paid in kind 20 head of sheep per year, of specific age (including 10 of six months plus 10 of one year or more), and gender (6 females and 14 males);
- One *al angaib*, younger men or boys who are paid 13 head of sheep, of which 6 are five months of age, and 7 are ten months of age; and 11 are female and 2 are male.

Figure 14. Herd composition for the six livestock producers in North Kordofan



	Sheep	Camels	Goats	Donkeys
NKC1	100	50		
NKC2	100	70	4	
NKC3	0	200	60	
NKS1	200			3
NKS2	600	100	40	
NKS3	445		10	

NKC2 has two sons working with him as shepherds, so only has to hire an additional shepherd, who is paid in cash—SDG 750 per month. Usually this payment is made for one year, then the customary (verbal) contract can be once again agreed upon between the two partners.

Other sources of food and income

Owning farmland and cultivation of crops was not as prevalent as among the producers in East Darfur, with only two small farms owned between the six livestock producers. Cultivation of crops is likely to be more risky or yield lower output in North Kordofan than East Darfur because of the lower rainfall and the less fertile sandy soils. Interestingly, the Shenabla camel herder who was partially nomadic (NKC3) owned five *mukhamas* of farmland about five km north of Tinna, which were cultivated by his wives and children, and he also owned a small garden (half of a *mukhamas*) in Tinna where his wives cultivated okra and tomatoes. The produce from both the farm and garden were for household use. One of the Hamar sheep producers (NKS3) had two *mukhamas* where his wives cultivated groundnut, okra, watermelon, and chickpeas.

As in East Darfur, a comprehensive analysis of household income was not completed. Examples of common sources of food and income included:

- Sending of remittances by the son of NKC2 who is working in the Gulf;
- Support to the family of about SDG10,000 per year from the son of NKC1 who is working in gold mining (about \$1,800 per year).

Two of the producers held responsible jobs or positions within the local community, including NKC2 who was a Member of the Village Peoples' Committee, and NKS1 who is the Head of the El Khowei Water Complex Committee, and the head of the Secondary School Committee, both of which are voluntary duties.

Becoming a pastoralist

The three camel producers started off their own herds, having first worked as herders for their fathers, and then separating from their fathers when they married, or inheriting livestock on the death of their fathers.²⁹

The Shenabla sheep producer only came to have his own herd five years ago, at the age of 50, when he separated from his father to have his own herd. The other two sheep herders built up their herds from scratch; NKS3 started out as a hired herder, and he was able to save sufficient earnings to build his own herd of sheep and currently has 445 head of sheep—a sizeable herd. The third sheep producer is also interesting as he represents a former dropout from pastoralism who subsequently rebuilt his herd after 20 years away from pastoralism (see Box 2).

Box 2.

Getting back into pastoralism

NKS1 dropped out from pastoralism in 1974 as a result of the loss of his family's livestock due to the mid-seventies drought. As a result, he left his village Ableg, seven km south of El Ehowei, and worked for more than 20 years in various casual jobs in Khartoum. With his savings he returned to his village in 1984 and restarted with a small flock of 20 female sheep, building it up to a middle-sized herd of 200 heads. Given his former circumstances, he has done very well for himself, and in addition to having eight children, six of whom are at university or are graduates, he has also raised a niece in his house. He also runs a small shop at the market where he sells daily consumable goods. He is a recognized responsible person in the community as he is the Head of the El Khowei Water Complex Committee, and the head of the Secondary School Committee, both of which are voluntary duties. He also owns three donkeys and a four-wheel-drive Land Cruiser (1985 model). His livelihood illustrates the potential associated with sheep rearing in the past two decades.

²⁹ NKC2 separated from his father 30 years ago.

In summary, these producers represent successful pastoralists with mid-size herds. For them, raising livestock is a family business where they employ their sons often as herders, or combine herds with their brothers, and split roles and responsibilities for stock within the family (for example, women and younger boys are responsible for goats). The commercial nature of sheep production allows for former pastoralist “dropouts” to get back into pastoralism, and also encourages herders and others to build herds from scratch.

Part 3. Governance of livestock mobility

As discussed in the East Darfur chapter, the performance of state governments and institutions affect pastoralist mobility and migrations. Pastoralists move with their livestock through an increasingly complex administrative landscape, passing through different state administrations as well as international borders, which are characterized by legal pluralism that combines national and state policies with local customary norms and practices.

Blurring of responsibilities and bureaucratic confusion

The introduction of federalism has contributed to a blurring of responsibilities between the federal and state level. Analysts have argued that an incoherent policy of decentralisation of natural resource management has been damaging. Since the 1970s, Sudan has seen the “creation of a series of local institutions with unclear or overlapping authorities and insufficient capacities, often linked to the national government by patron–client ties and rarely capable of penetrating into the social and economic fabric of the countryside. Despite recent progress, local government agencies rarely reflect their constituencies or local livelihood systems, and they are generally not very responsive (let alone accountable) to local resource users.” (Siddig et al 2007, 27). Despite the 1998 constitution and the Comprehensive Peace Agreement (CPA), which both make provision for decentralisation and federalism, there has not been real devolution of financial autonomy and political authority to state governments (Ibid.).

An example of this is the past failures of state

governments to enforce legislation. At the state level in Kordofan region, there have been several earlier attempts to pass legislation that integrates elements of customary institutions into formal regulations and management institutions, so as to formalise existing forms of resource access and entitlement that characterize mobile pastoralism. However, these laws are not always enforced because of weak state enforcement mechanism and lack of state investment (Siddig, El-Harizi, and Prato 2007, 32).

The North Kordofan and South Kordofan state authorities issued a Law of Stock Routes in 1999 (amended in 2003) and the State of South Kordofan issued a Law organizing Agriculture and Pastoralism in 2002 (Ibid.). These laws

“define stock routes, spell out duties and responsibilities of farmers and pastoralists, and establish penalties for trespassing or other violations such as stealing animals or polluting water points. However, neither law has been adequately enforced, partly due to lack of clear enforcement mechanisms and partly to lack of adequate state investment in water points, pasture, markets, and veterinary services along newly demarcated stock routes. As a result, these routes do not usually meet the needs and preferences of either farmers or pastoralists, who have little incentive to follow them.”

(Siddig, El-Harizi, and Prato 2007, 32)

Thus, even within the existing policies and legislations, there is a lack of clarity because of overlapping authority and responsibility. This is particularly clear in the case of water management (Siddig, El-Harizi, and Prato 2007, 33). Another study (Gaiballa 2013, 7) argues that the lack of coordination between state and central governments over the implementation of acts has been damaging to pastoralists. Part of the problem is that it is not clear where the dividing line between state and federal authority lies. Although the state in theory has control of legislation, it cannot properly implement or enforce it. On top of this, according to Siddig et al., the income of the state gets smaller every year, while the administrative costs (salaries) get higher (Siddig, El-Harizi, and Prato 2007).

Despite this rather pessimistic view presented in the literature, there are more recent examples

of positive policy change, associated with the developmental efforts of national NGOs working in partnership with state government institutions. The next section describes the management of water sources in North Kordofan and gives examples of some more recent local efforts to develop management of water resources and demarcate corridors.

Examples of institutions and policies influencing mobility

Water sources and management

The water sources used by livestock producers in North Kordofan are very similar to those found in East Darfur, although there are some differences in names used and in North Kordofan there are additional examples of local water storage, including inside *tebeldi* trees (*Adansonia digitata*) and a more recent innovation—the use of portable water “skins” or flexible rubberized water bags in dry areas; this has only happened in the past five years and is linked to a thriving commercial water sector.³⁰

There is not a uniform distribution of water resources. Some areas are well serviced; for example, the areas around El Khowei and Ennahud, where there is a concentration of more than 40 *dwanki*. Other areas are extremely dry. Even though they are permanent water sources, *dwanki* are used seasonally from March to July (*seif*), and are managed either by government or privately. The intense pressure of use means there is little time for maintenance, and so there are frequent breakdowns. The privatized *dwanki* are reportedly fixed more quickly as profits depend on it.

Bir (very deep wells and boreholes) are individually owned and managed, and there are sometimes payments attached to their use. Hand pumps, which are usually owned and managed by the community, are accessible, although there are examples of privately owned hand pumps in North Kordofan whose owners charge fees. Hand pumps need to be properly maintained, and generally breakdowns are common. *Hafir*—water pond reserves—are managed by Popular Committees with support from the State Water Corporation. They are only accessible once they are fully charged after the rains, and as the reserve is reduced, outsiders are excluded. *Hafirs* are generally not crowded and the water is free. See Box 3 for a description of *hafirs* in one area of North Kordofan. Similarly, dams are managed by the community, although normally built by the government, and water is free.

The use of different water points varies seasonally, with herds taking advantage of seasonal rains and surface water during the *kharif*,³¹ and relying on permanent water sources such as *dwanki*, deep wells, and boreholes, and the new portable “skins” during the hot dry season (see UNEP, 2012, 57–58).

Water is a major expenditure during the dry season—linked with a profitable and growing private water sector. UNEP (2013) estimated the total value of this water-related business serving primary production in North Kordofan to be not less than 14 million USD for the hot dry season alone. The study pointed out the lack of regulation, varying prices that are charged, and lack of even the most basic facilities for the waiting herds and herders, including, for

Box 3.

Development of *hafir* for use by pastoralist livestock producers

SOS Sahel has constructed 15 water reservoirs (*hafir*) for use by both animals and people, plus three *hafir* for nomadic livestock in the Omjajar area of North Kordofan. These pastoral water projects were implemented by SOS Sahel in close collaboration with the Western Sudan Natural Resources Management project and the Zakat Chamber. Hand in hand with this type of development is capacity building of grassroots water committees in the management of these water points.

³⁰ These bags are used to serve the camp or to enable animals to exploit otherwise unreachable good-quality pasture. They are refilled by a commercial tanker truck (two or more bags may be distributed along a planned route).

³¹ For example, “*ada*” (natural pits in the ground which fill between July to August).

example, parasite controls, provision of shade in waiting areas, or watering facilities (page 37). Mortality due to disease and abortion as a result of overcrowding around wateryards in the hot dry season was reportedly an increasing problem (Ibid.).

There are generally four types of management of water sources: community management; governmental management (*hidara*); private sector (*al gitar al fas*); and joint management (organization plus community). In North Kordofan, the issue of management of wateryards and associated income has been a hot issue. The Drinking Water Corporation Act of 1998 stated that all water resources in North Kordofan were to be managed by the State Water Corporation (SWC), who also kept the revenue. This law was subsequently changed in 2007, as a result of local advocacy and campaigning with support from SOS Sahel. Previously, the division of the income in government-controlled wateryards was 80% to the SWC, and 20% to the community. This has now been reversed, with the communities receiving 80% of the income. The other difference is that now, when organizations like SOS Sahel provide water resources, these are handed over to communities to manage, and not given to the government bodies to control. This experience in North Kordofan provides important lessons which were welcomed by East Darfur participants at the July workshop in Khartoum.

Recent experience in demarcation and development of livestock corridors

There is good experience in North and South Kordofan in the demarcation and construction of livestock corridors by the national NGO SOS Sahel working with the state-level rangelands administration, tribal administration, and local communities, including both pastoralists and farmers. The International Fund for Agricultural Development (IFAD) Western Sudan Natural Resources Management Project was also a key partner for aspects of this work.

From 2005 to 2006, SOS Sahel completed the restoration of 347 km of livestock corridors in North Kordofan, including Khrasan to Krakir (75 km); Abu Elgar to Awran-Pasili (95 km) Abu Elgar to Eldibilow-Hiair Salamat (85 km); Elbida

to Maitan to Shoshai (54 km); Odiat Kabiri to Karakir (38 km).

The objectives were wide ranging, and included:

- The development of key services along routes (water points, pastures, and health services, etc.);
- Raising awareness among farmers and pastoralists and promoting the concept of participatory co-management of natural resources;
- Identifying the tribes along the routes, including both settled and more mobile groups, and other key stakeholders to engage in this work;
- Mitigation of farmer-herder conflict, including promoting the concept of partnership in the utilization of natural resources and co-existing culture.

SOS Sahel have developed a phased participatory approach to corridor demarcation, starting with an assessment and reconnaissance survey of the current situation, followed by the actual demarcation and development of the constructed corridors. The process starts in January to March, with consultation meetings with the target groups. Awareness-raising campaigns begin in January and continue up to October. SOS Sahel also produces maps of the routes and the dissemination of supportive legislation and acts, including the North Kordofan Transhumance Act 1998, and the South Kordofan Organization of Agriculture Act of 1998, which takes place from June to August. Follow-up monitoring continues up to the end of the year.

Linked with this work has been a series of local trainings and workshops on conflict resolution, with the native administration, relevant government departments, national and international NGOs, peace centres, and farmers and pastoralists. A significant outcome of this work has been the establishment of three conflict resolution centres in North Kordofan State (Abu Haraz Centre, Umkeridim Centre, and Elrahad Centre). Another positive outcome of this work has been the positive collaboration between state and non-state actors, and the state allocation of about 22 protected pasture reserves.

Concluding remarks

There is not one system of pastoralist livestock production in North Kordofan, but several, each with its own varying patterns of livestock mobility, often making use of the same locale but at different times of year.

The ongoing war and conflict in South Kordofan has had continuing repercussions since the last study, with increasing numbers of people and livestock moving from South to North Kordofan. These are the “unofficially displaced” who do not appear in humanitarian IDP statistics, but who nevertheless have been forced indirectly to abandon their usual habits and seek refuge further north, which has created some local tensions and is expected to further aggravate herder-farmer conflicts. A second development has been a recent shift of agricultural investors into North Kordofan; they are using heavy agricultural equipment to cultivate increasingly large areas of former rangelands, including Qoz soils. The soil systems of North Kordofan are not suited to this type of mechanized farming, and hence this shortsighted response risks increasing areas of land degradation and further exacerbating farmer-herder tensions.

Chapter 5. Livestock herd movements

Introduction

The following case studies illustrate in detail how individual herd movements are adjusted to the requirements of specific herding families, different herd species, and particular localities. The factors that influence these decisions are myriad—the locations of schools and farms, local soil characteristics, security considerations, the availability of markets, etc.—and the outcomes are correspondingly complex. Before immersing ourselves in these details, this introductory section reviews several of the common patterns that characterize migratory movements across our study sites.

Generalising very broadly, the monsoonal rainfall regime of Sudan dictates the direction and the timing of migrations in both East Darfur and North Kordofan. One of the most important features of this rainfall regime is the date at which the rains begin, which is mapped in Figure 15 for the region around el Obeid in central Kordofan. In an area approximately 300 kilometres from east to west and 200 kilometres from north to south, there is a large variation in the date of the onset of

the rains—from as early as the 10 May in the southwest of the area, to as late as the 1 July in the northeast, with a regular progression of dates for localities between these extremes.

For Sudanese livestock owners, the onset of the rains is important because it signals the end of what may have been a long and difficult dry season characterized by deficiencies of good forage and the absence of readily available or cheap water for livestock. How herders respond to the early rains will depend on where they have spent the dry season. Those located in the north will probably move quickly south; those in the far south will likely move slowly north. In cartographic terms, these moves appear to be quite distinct, with herds moving in different directions at different speeds; in functional terms, these apparently distinct movement patterns are identical, with herders in both cases searching for the first available fresh grass and surface water. The only difference is the direction that herds must go to find these resources, given the different places from which they begin their search. Northern herds dash south to catch the rains; southern herds follow the rains slowly north.

Figure 15. The onset of the rainy season in central Kordofan (Doxiadis and Lourie 1965)

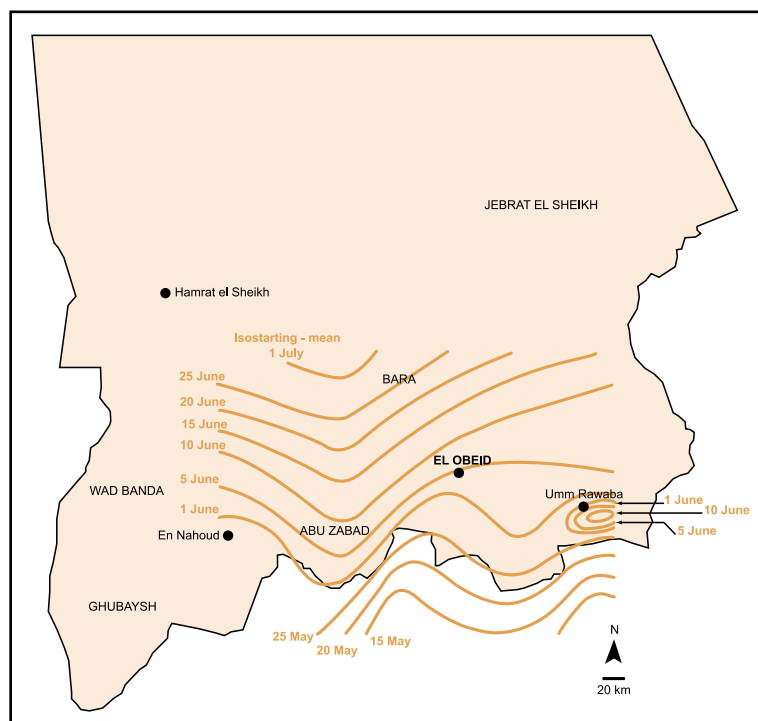


Figure 16, a map of mean rainfall levels for the same area covered in Figure 15, explains the axis of herd movement throughout the rest of the year, as the rainy season progresses and is followed by the dry season. On the typical Sudano-Sahelian pattern, rainfall levels are higher in the southern and lower in the northern parts of the mapped area. This is important for pastoralists because there is a general correlation—much complicated by variations in soil type and plant community—between rainfall levels and the kind of forage to be found in a particular place.

Broadly speaking, areas receiving low levels of rainfall produce small quantities of good-quality forage, while areas of high rainfall produce large amounts of poor-quality feed (Penning de Vries and Djitéye 1982). In the wet season, when forage is relatively abundant, herders can afford to be selective, and they move to areas where the grazing may be sparse, but it is nutritious (Schareika, Graef, and Moser 2000, Behnke et al. 2011). In southern Darfur and Kordofan, this often means moving north. They reverse the direction of movement in the dry season when feed is generally scarce, and they are forced to concentrate on obtaining sufficient amounts of forage, even if this means accepting lower quality. Often this means moving south

where higher levels of rainfall have produced more abundant vegetation. The seasonal availability of stock water—which is on the whole more abundant and permanent in the south than in the north—frequently reinforces the patterns of movement encouraged by fluctuations in feed quality and quantity.

In sum, regularities in the timing and amount of rainfall received by different localities lend a degree of predictability and uniformity to the timing and direction of migratory movements in Darfur and Kordofan. A host of other factors—including irregularities in the timing and amounts of rainfall from year to year—prevent the emergence of stable or uniform migratory patterns. The next section of this analysis focuses on how these additional factors complicate decision-making for individual herders with different resources and different needs.

Last year's movements

Last year's movement by cattle herders in East Darfur

During one yearly cycle, cattle herders in East Darfur move through a number of different ecological zones (Table 3). The following sections present the main features of each zone beginning from south to north.

Figure 16. Average annual rainfall (Doxiadis and Lourie 1965)

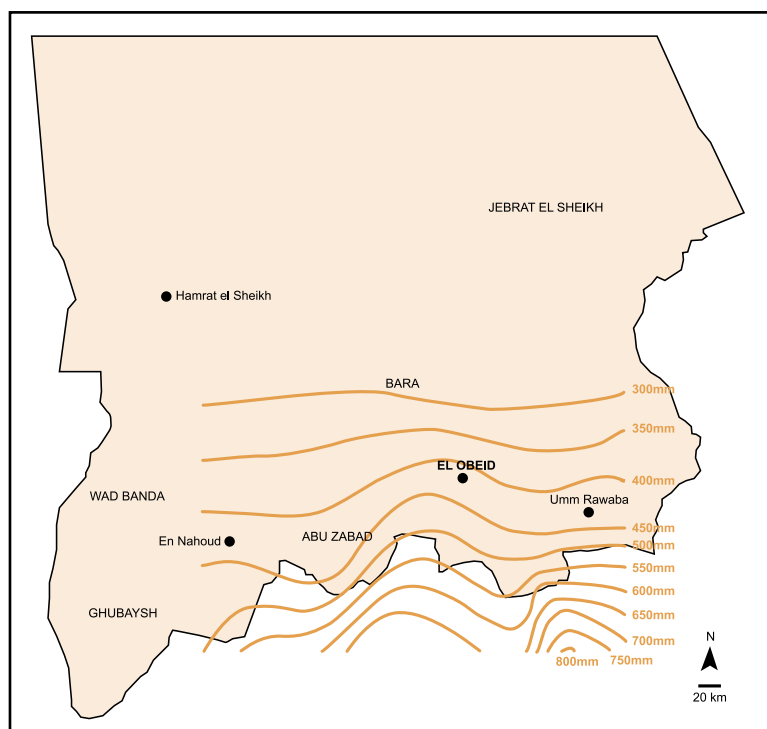


Table 3. Grazing zones of East Darfur

Grazing zone	Distinguishing feature	Natural water sources	Topography	Soils	Forage and browsing resources
Boroya	Year-round water, browse	Rivers, water courses (<i>kheiran</i>), swamps and lakes	Ancient floodplain of the Bahr el-Arab and Lol Rivers	Cracking clays and coarser soils on ridges	Thornless trees good for browsing, such as <i>Boswellia papyrifera</i> , <i>Combretum glutinosum</i> , and <i>Celtis integrifolia</i>
Bahr	Annually flooded	Natural lakes, rivers i.e., branches of Bahr el-Arab, rainwater pools (<i>ruhuud</i>), and hand-dug wells in <i>wadi</i> bottoms	Floodplain of the Bahr el-Arab	Clay mixed with sand	Rich in evergreen trees for browsing, such as <i>Fedharbia albeda</i> , <i>Acacia gerrardii</i> , <i>A. ethaica</i> , <i>A. Nilotica</i> , and <i>Khaya senegalesis</i>
Dahara	High ground	<i>Rugab</i> and rainwater pools (<i>ruhuud</i>)	Elevated area north of Bahr	Predominantly clay with pockets of sand	Mixed deciduous and evergreen trees such as <i>Acacia seyal</i> , <i>A. senegal</i> , <i>Balanites aegyptica</i> , and <i>Ziziphus spina-christi</i>
Atmur	Atmur soil	Small <i>duluul</i> and rainwater pools (<i>ruhuud</i>)	Small transitional zone between Dahara and Qoz	Atmur—sandy aeolian soils underlaid with alluvial clays	Dense grass cover and <i>Acacia mellifera</i> , <i>A. Nubica</i> , and <i>A. seyal</i>
Qoz	Gently rolling, stabilized dunes	Poor—rainwater pools (<i>ruhuud</i>) in depressions	Sand sheet	Stabilized wind-blown sands of low fertility	<i>Acacia nubica</i> , <i>A. Senegal</i> , <i>A. mellifera</i> , and <i>Guiera senegalensis</i>

Source: herders' accounts

“Boroya” is the local term given to pasturelands in the southern frontier of the state/country. It also included the northern part of South Sudan. In recent years, migration to this part is for limited periods not exceeding a couple of months. Herders proceed to this directly after the depletion and drying up of water in the Bahr area. This is around the period from late *seif* to early *rushash* or even early *kharif*. Major water resources are the Bahr el-Arab River and its branches and Keilak and Abyad Lakes. Also, during *rushash* (the onset of the rains), herders use water from *ruhuud* (rainwater collected in local naturally formed depressions). Herders describe the area as very rich in terms of tree species diversity: small evergreen thorn tree species such as Gafel (*Boswellia papyrifera*), Sereh (*Cadaba farinosa*), Habeel (*Combretum glutinosum*), and Muhagria (*Celtis integrifolia*). Soil is mainly light clay mixed with sands. For those who decide to cross the border to South Sudan, taxes or fees need to be paid (see Chapter 3).

During *shita* and *seif* (period from mid-December to end of April in the subsequent year), herders settle to the southern part of the state around water resources. The Bahr zone is preferred by most of them due to water availability from Bahr el-Arab, *duhuul*, and *rugab* during the whole period of *shita* until late summer, when they start to dig shallow wells. The dominant soil is dark clay, which becomes very sticky in wet seasons. This phenomenon plays a significant role in the outmigration of herders from the area before the establishment of the rainy season. Vegetation cover around the Bahr is dominated by evergreen tree species that are the main fodder source in the area, including Harz (*Faidherbia albida*), Saljem (*Acacia gerrardii*), Arad (*Acacia etbaica*), Mahogani (*Khaya senegalensis*), Sunt (*Acacia nilotica*), Aradeb (*Tamarindus indica*) and Heglig (*Balanites aegyptiaca*). Water is the main reason for staying around the Bahr. The duration of stay, timing, and distance of movement within the zone or the migration to the Bahr depend on a variety of factors, including the size of the cattle herd, water availability, the balance between herding and cultivation, presence of disease-carrying insects, disease outbreak, and security and conflicts issue.

The Dahara zone is located immediately north of the Bahr zone. It is an alternative zone

used by herders who do not like to stay in the Bahr. Also compared to Bahr this zone is elevated. The main water resources in the zone are *rugab* and rainwater pools (*ruhuud*). After depletion of available water resources, herders start to dig shallow-dug wells. It was observed that most of herders occupying this zone are of medium to small herd size. Vegetation cover is a mix of deciduous and evergreen species such as Taleh (*Acacia seyal*), Hashab (*Acacia senegal*), Heglig (*Balanites aegyptiaca*), and Sedr (*Ziziphus spina-christi*). While the dominant soil type is clay, pockets of sandy soil exist in the area.

“Atmur” is the term given to a small transitional zone between the Dahara and Qoz. Vegetation is dominated by scattered deciduous tree and shrub species with dense grass cover, including Kitr (*Acacia mellifera*), Laot (*Acacia nubica*), Taleh (*Acacia seyal*). Water resources in this zone are small *duhuul* and rainwater pools (*ruhuud*).

The Qoz area covers the northern part of the state. This term describes an extensive sandy area. In many locations, the sand builds up into ridges, with intervening hollows/depressions that collect rain and represent an important water source during rainy season. Qoz is the herders’ preferred area during *kharif*. Small stunted and scattered shrub species such as Laot (*Acacia nubica*), Hashab (*Acacia senegal*), Gebesh (*Guiera senegalensis*), and Kitr (*Acacia mellifera*) are the dominant features of the zone. Important herbaceous species include Shelinee (*Zornia spp.*), Gaw (*Aristida sp.*), Benu (*Eragrostis spp.*), Haskaneet (*Cenchrus biflorus*) and Senasena (*Cassia italica*).

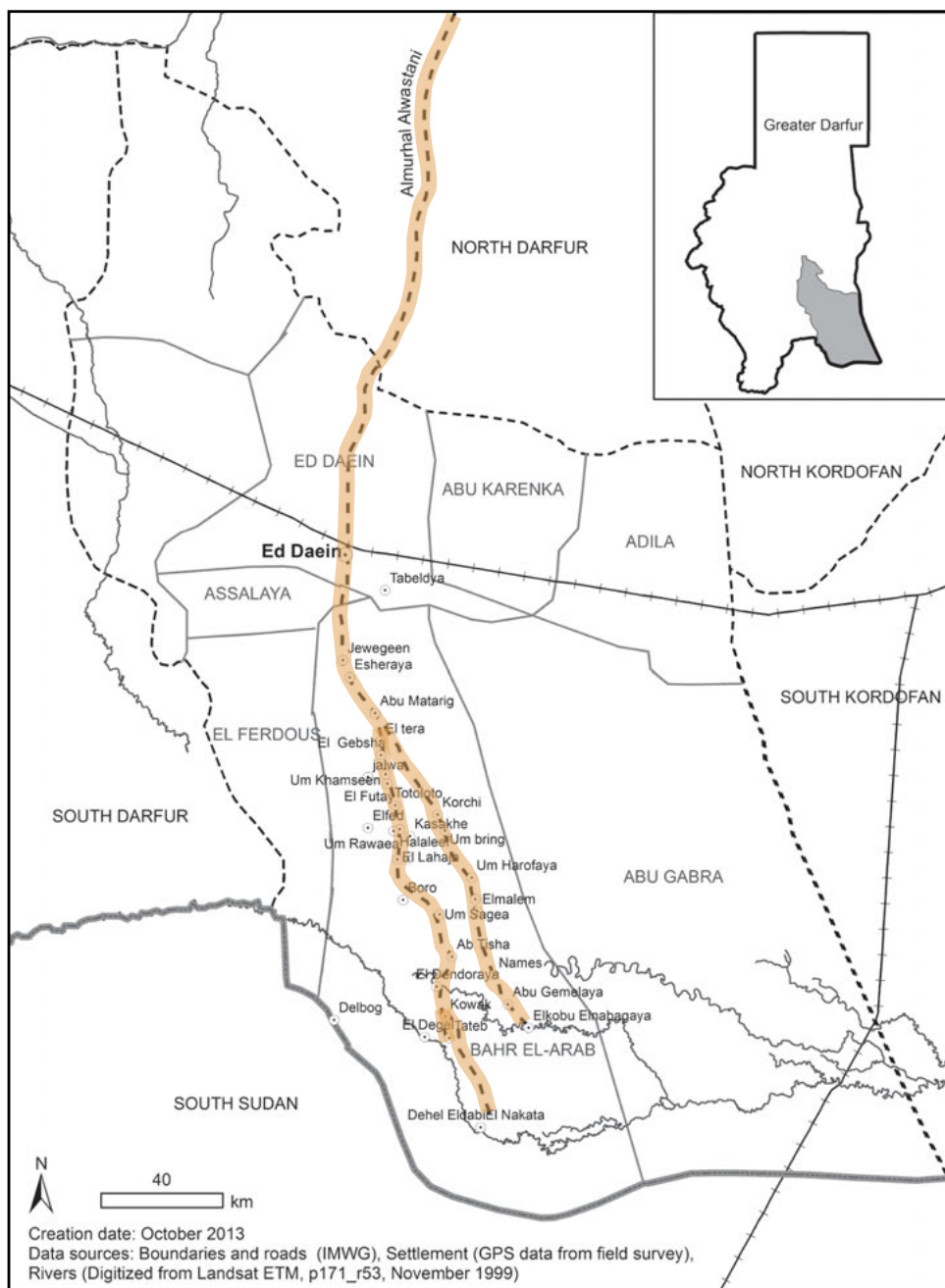
Table 4 summarizes the annual calendar of movement across ecological zones by monitored cattle herders in each zone of East Darfur over the last year along the *Almurhal Alwastani* (Figure 17). Cattle mobility patterns varied considerably among the monitored herders. These seasonal migrations follow a regular pattern, reflecting herders’ preferences for different ecological zones that are particularly suitable at different seasons of the year.

Bahr is where herders spend around half of their annual cycle. Normally, the length of stay in this zone is determined by water availability. Fodder is not a big concern because herders depend on browsing from trees. The herbaceous cover is expected to dry up around late *shita*.

Typically, seasonal migration from the Bahr starts with the late *seif*, when herders decide to remain and wait for *rushash* in the Bahr, or travel deeper to the south to capture early *rushash*, which normally starts earlier. Last year, five of the six recruited herders spend the period from late *seif* to *rushash* in Boroya. The main attractions of this zone are free water for the herd to drink when the water in the Bahr is depleted, and green browse and fresh green grass during early *rushash*. *Muwaata* is the term given to the most southern point of the migratory cycle.

Going to the Boroya is an indispensable option for those with large herds. EDC5 mentioned that every year he has to spend from one and a half months to two months in the Boroya, because it is not possible for him to water his 1,200 heads of cattle from shallow wells. Rainfall is the factor that determines the northward movement of herders from the Boroya. At this time, they quickly cross the Bahr, taking on average 13 days with not more than two stops. A number of factors determine the number of stops within each zone. For example, when they are crossing

Figure 17. East Darfur study area and the Central Corridor (*Almurhal Alwastani*)



Dahara zone during early *kharif* to the north, the greening up of grasses and amount of surface water collected from rains are the main factors. Sending out scouts to look for interesting areas is the technique used to direct the migration journey. Although the proportion of time spent staying in the Dahara is diminutive compared to other zones (Table 4), it is important because the Dahara is the place where herders position their animals to avoid the sticky muddy soils with many depressions in the Bahr. The term “Dahara” is normally used to describe more elevated locations. Moving to the north is a tough journey because the animals are weak after the long period of only browsing tree fodder and the long distances to *munshag* that must be covered. Another important factor is that if herders do not hear positive news about the greening of vegetation in the northern area, they need to stay longer in the Dahara zone. Herders will not accept having their cattle stay where there is nothing to eat and might even decide to return to the Bahr. In such a case, young men will return with the herd, while the rest of the family waits for him in the Dahara as a backup, gathering news about rains, and sending food and other needed supplies because the summer market places by this time are mostly closed up.

Atmur, although a small zone, represents the *munshag* area for those herders who would not like to proceed to the Qoz. It is worthwhile to mention that Dahara is where cultivation starts to appear, and this implies that herders need to follow specific routes in this area. Prior to this zone (i.e., in the Boroya and the Bahr) there are no permanent settlements along *Almurthal Alwastani*, thus no cultivation activities. For those

herders practicing farming, their land is located within this zone. According to EDC1, the practice of cultivation sometimes influences the period of stay in this zone, especially on their way back from the Bahr, which is about the time of harvest. Some of the herders leave part of their family (usually one of the wives and the children) to be responsible for the cultivation and proceed with the rest of their family to the Qoz.

The Qoz is the northern point of the migration journey, the favoured place for most herders during the rainy season, although security issues have hindered many of them from reaching the zone. It is a relatively open grazing area with no specified migration routes. Herders reach the Qoz toward the end of July, and mid-October is the latest date when they proceeded back. Given that the Qoz is located within the Sahel zone, rainfall is highly erratic, particularly at the beginning of the rainy season. Thus herders cannot usually make an advance plan as to where and for how long they need to stay. Also, the retrospective yearly movement schedule showed that the number of stops or stations within this zone is high compared to other zones. As the spatial and temporal distribution of rains is heterogeneous, grass reaches the state of optimal nutritional value in different places at different times. It is clear that mobility is not only motivated by the fact that the animals need to cover a certain distance, but the herders use spatial mobility as a tool to benefit from ecological processes. By the end of *kharif* in mid-October, the grass of the sandy dunes has already become dry and surface water collected in pools (*ruhuud*) is depleted, and herders think seriously about proceeding back.

Table 4. Total number of days spent by the six recruited cattle herders across the ecological zone during the last year (March 2012–February 2013)

	Boroya	Bahr	Dahra	Atmur	Qoz
EDC 1	51	200	33	81	0
EDC 2	0	222	51	46	46
EDC 3	30	182	77	76	0
EDC 4	31	143	31	63	97
EDC 5	45	143	65	15	97
EDC 6	51	199	33	82	0
Average	35	181	48	61	40
%	9	50	13	17	11

Last year, EDC1 spent 200 days (which counts as 55% of his annual movement) in the Bahr at Dehel Eldabi (Tables 4 and 5). The main reason that they stay so long in this area is water availability from *ragaba* and wateryards, and the green grass available until *shita* and thereafter fodder from the diverse tree cover in the vicinity. Dehel Eldabi is one of the main concentration areas for large number of herders due to the establishment of wateryards since 2008. Dehel Eldabi has a large summer market (Box 4). During *shita* and the early summer, water is available from the *ragaba*, and late herders have to buy water from the wateryard, which belongs to the government. As a contingency measure, herders also dig shallow wells after the depletion of water from the *ragaba* for use when the *donki* is not working for some reason.

While he remained with the rest of his family in Dehel Eldabi, EDC1 sent his elder son—with group of other relatives—to the Boroya, where his herd was to spend 51 days. He said, “We only send young men with the herd to the Boroya because the security situation in areas along the border with South Sudan or across the border is fragile, although it remains calm during the last few years. My son has to cross the border and he paid SDG 700 from South Sudan authorities.”

Last year, EDC1 began moving north from the Boroya with the start of the rains on the 20 June, when he was certain there was enough water for the herd along his route. The actual start of the migration north will be delayed if the rains are late in a particular year. This movement involves a number of halts, varying from a couple of days to around two weeks, depending on water and grass availability, until he reaches the Bahr, where he makes two stops at Dehel Eldabi and Eldendoraya. However, this time the stay at the Bahr should be short to avoid the sticky clay soil and flies. On the way to *munshag*, EDC1 made two stops at Martenda and Um Sagea, both located within the Dahara. Decisive to this movement is the herders’ consideration of soil types and topography.

Light clay soils on slightly higher places within the Dahara are considered to allow for a fast sprouting of grass and herbs, whereas the heavy dark clay of the plain area is considered to only allow for slow sprouting. The first light rains produce young shoots more quickly and early in light clayey soils than in heavy clay soils. Grass species like *Deresa* (*Cenchrus biflorus*), which prevail in those places, is appreciated by herders for quick sprouting and good nutritive value in earlier development stages. Later on their way back, they utilize the slow sprouting plants in the heavy dark clay soils. Herders recognize the relation between soil type and plant growth and use this knowledge to plan their movement strategy across different zones.

Staying in the Dahara, EDC1 spends *kharif* around the locality of Chulul. During this time he cultivates his six *mukhamas* of land. Last year, he cultivated sorghum, millet, and groundnut. EDC1 mentioned that he prefers to stay around Chulul because there is a sufficient number of *ruhuud*, and the quality of rangeland is good. Moreover, he said that with his small herd of cattle it is not necessary to reach the Qoz. Before when he used to be part of his father’s large herd they annually travelled to the Qoz. Chulul was the most northern point he reached last year.

In mid-October—the end of *kharif*—he turned south because the *ruhuud* were depleted, and the forage was drying up. Also, his herd movement was restricted in the area by farming. He stayed two weeks at Um Sagea, a large *ragaba* located in the Dahara, where there is at that time a summer market where he can sell his animals and buy supplies. From Um Sagea, he proceeded to Dehel Eldabi where he spent *seif*. At the end of the *seif*, the dry season, the grass is usually poor or even completely consumed and animals rely on fodder from trees. Animals consume the last residues of grass and therefore constantly lose weight. Some animals are possibly too weak to move to new pasture areas. At this time, he starts to provide supplemental food and concentrates for his herd.

Table 5. Number of days spent by EDC1 in different ecological zones during last year (March 2012–February 2013)

Period spent in each zone	Boroya	Bahr	Dahara	Atmur	Qoz
1 March–end April 2012		61			
1 May–20 June	51				
21 June–8 July		19			
9–25 July			17		
26 July–15 October				82	
16–31 October			16		
1 November –28 February		120			
Total	51	200	33	81	00
%	14	55	9	22	00

Box 4.

Dehel Eldabi summer market

Dehel Eldabi is one of the well-known summer markets located on the northern bank of the Bahr el-Arab. The market was started in 1982. The weekly market day for Dehel Eldabi is Friday. Summer markets along the Bahr are seasonal markets occurring from *shita* to early *kharif* (about six months) concurrently with movements of herders. The individual shops and market buildings are constructed from wooden materials. The governance of the market is the responsibility of *Sheikh Elsug* (the chief of the market), the market committee, and traditional/tribal leaders. According to *Sheikh Elsug*, Dehel Eldabi has around 320 shops this year, which has increased since last year due to security problems further east, which means that herders avoid going to Samaha summer market, which is around 30 km to the east, and stay in Dehel Eldabi. The main market commodities are daily consumable goods, animal concentrates, and veterinary medicines. Summer markets are the place where herders sell their animals and other products like milk, *samin* (butterfat), and *roob* (yogurt). Therefore, in Dehel Eldabi, not far from the shops, there is a yard where brokers and merchants buy animals from herders. Services provided in the market included five flour mills, five bakeries, seven tailors, one laundry, and reasonable numbers of restaurants and tea makers (both are mainly for women). There used to be an elementary school in Dehel Eldabi for four seasons, but this year it was absent. Besides the water from the Dahel tributary, there is a *donki* in Dehel Eldabi. In addition, a medical assistant visits the market on the weekly market day.

An important element of the summer market in Dehel Eldabi is a court, where herders pursue their cases. Judges are from the local tribal leaders, and their role is to resolve cases and if necessary apply penalties or promote reconciliation.

This year's movements

East Darfur

Figure 18 shows the movements of all four cattle herders in East Darfur. Generally, herders follow the same specific corridor (*murhal*), although details change from year to year. For example, they change the branches they follow within the main *murhal* depending on resource availability, security conditions, the number of stops they take in each resting place, and for how long they are going to stay at each stop.

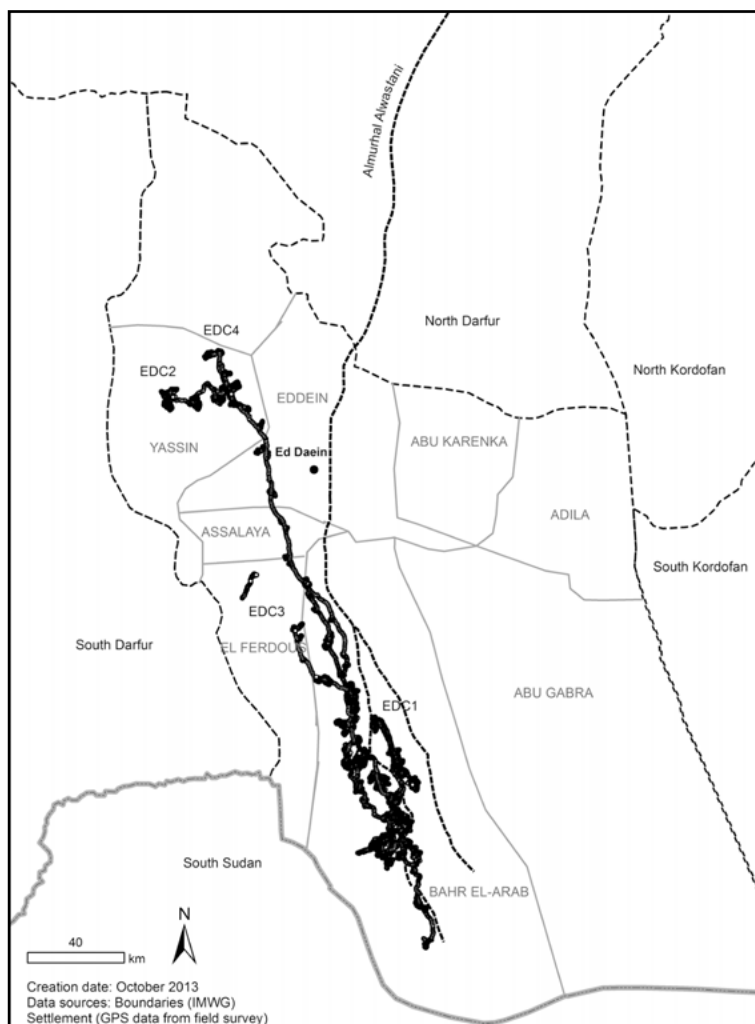
However, if a major incident occurs such as tribal clashes or conflicts they change their migration strategy and may even change the *murhal* itself. The general direction of all four herders is to move northwards by the start of the rainy season. However, in many cases, as they proceed they will need to go back and forth; for example, when there is a false onset of the rainy season and the new greening is not continuing.

Another case is when they return to avoid insecure places, like the case of EDC4 this year (see below).

The pace is variable, showing more time spent grazing in areas of lower population density with good grazing (in the southern part of East Darfur). The fast movement of herds through the central, more populated area to the north is critical to minimize any damage to crops. Herders are extremely cautious and careful to manage the herds so as to minimize any problems with farmers. This is a sensitive issue and further discussed in Chapter 6. There is a sense of relief once they have successfully passed through the farms to reach the Qoz area in the north, which coincides with the birth of offspring during the early rains. This is a period of celebration and parties.

The Bahr el-Arab has tributaries that spread over a wider area than often depicted on maps. Figure 18 also shows movements that are distant

Figure 18. Map of East Darfur showing movement of four cattle herders (EDC1 to EDC4)



from the official corridor in order to access different points along the Bahr area. These routes also allow passage through areas of dense vegetation.

As explained in the previous chapter, all of the East Darfur herders also own sheep. The sheep are separated from the cattle on two occasions: first, before they cross the South Sudan border (sheep remain around the Bahr area); and second, when they proceed to the north, and they are passing through the densely cultivated areas to the north, as sheep are unable to move as rapidly as cattle along these routes.

East Darfur Cattle Herder One (EDC1)—this year's movements

EDC1 has a small cattle herd size of 50 head. Figure 19 shows the herd movement generated from the GPS tag during the period from 20 May to 24 June 2013, which is equivalent to late *rushash* and early *khariif*. This is the time when herders leave the Bahr area and proceed north to

capture the newly emerging fresh grasses. However, the movement of cattle is determined by the rate of advance of the greening-up and availability of water. Thus, if the advance of the greening-up is halted, the northwards movements may be reversed. For example, this is what happened to EDC1 when he returned back to the south to around the area he had just left two weeks before.

Spatial patterns of daily cattle mobility varied considerably (Figure 20). Mean distances travelled day was 18.8 km during the 34 days of trekking. Average daily movement during the period from 20 to 28 May, i.e., before travelling to the north, was 17.8 km. In the northern frontier of his journey, i.e., 11 to 18 June, it was 14.1 km. Both cases were when they are overnighing at the same place. However, when they are targeting a new place, the herd walks more rapidly and covers a greater distance. For example, on 29 May they covered 22.7 km.

Figure 19. EDC1 herd spatial and temporal pattern of movement during the period 20 May to 24 June

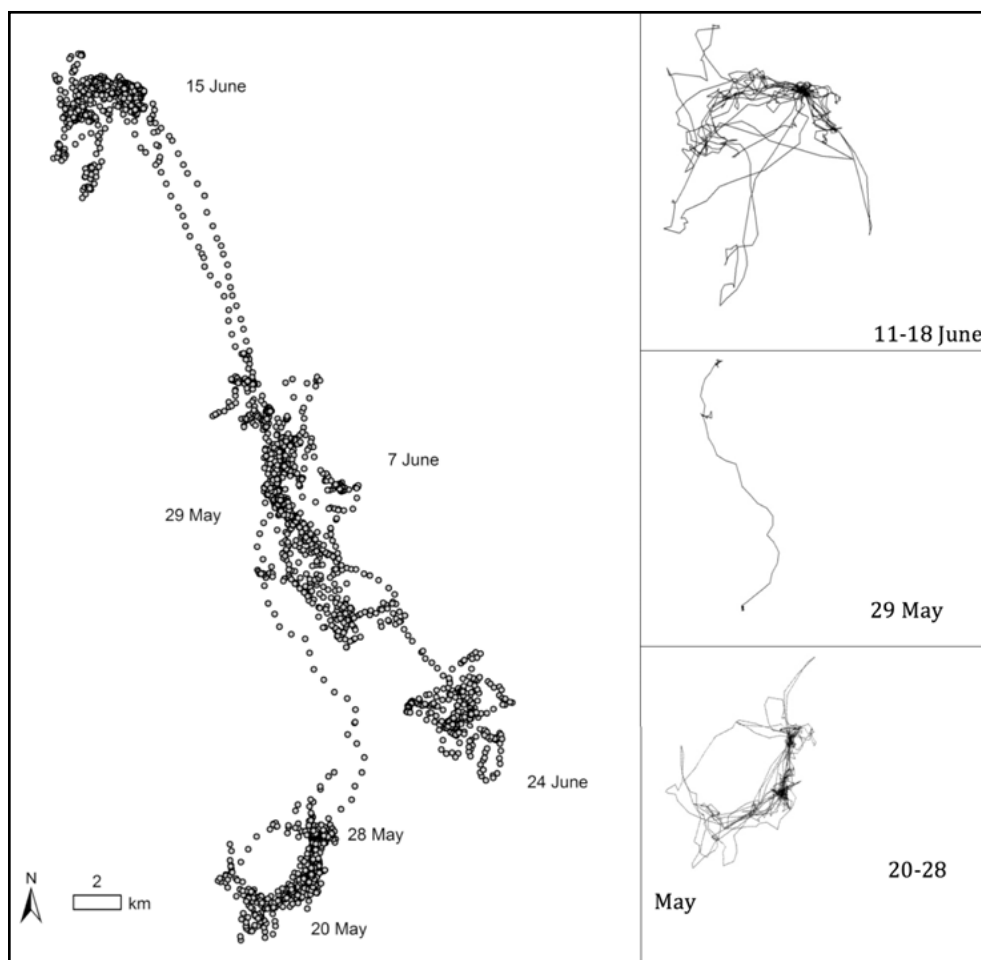
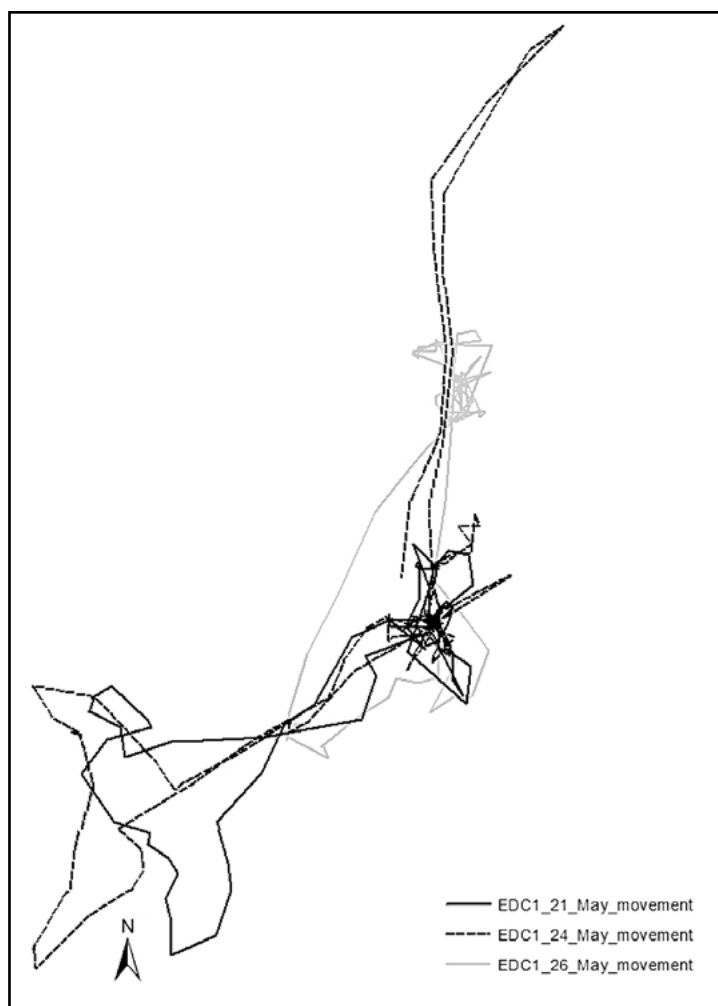


Figure 20. Comparison of daily spatial patterns of cattle movement EDC1



East Darfur Cattle Herder Four (EDC4) – this year's movements³²

The GPS tracking for EDC4 covers just less than three months, from 7 June to 28 August, including part of the *kharif* season. During this period, he moved 1,373 km with his cattle. The general trend of movement during this season is leaving the Bahr area and proceeding to the north. Figure 21 shows the spatial and temporal pattern of his movements. The starting point of our monitoring was Elnakata, when he crosses the Bahr in his way back from the Boroya. The average daily distance covered during this period is 15.3 km. He reached Rahad Eltor, which is located within the Qoz zone, on 9 August. When he heard about new tribal clashes near Rahad Eltor, he returned back to the area west of Ed Da'in, staying about one week before proceeding once again to Rahad Eltor on 16

August. The average daily movement during this period is 16.9 km. This back and forth movement is shown in Figure 21. In previous seasons he followed *Almurhal Alwastani* (Central Corridor) to reach the Qoz. However, due to the Rezigat–Ma'aliya conflict (Chapter 6, Box 5) that erupted on 9 August, he avoided going directly to the north and deviated his movement towards the west.

The herder explained that due to conflict conditions, Rahad Eltor is the furthest point north that he could reach this year, and he will stay there as long as there is fodder and water. Rahad Eltor is located in a populated area, and staying in such places is not an easy option as he needs to prevent his herd from trespassing or entering local farms in order to stay as long as possible without causing problems with farmers in the neighbourhood. In such conditions, he

³² Note only two detailed examples from the six herders in East Darfur are provided here (EDC1 and EDC4).

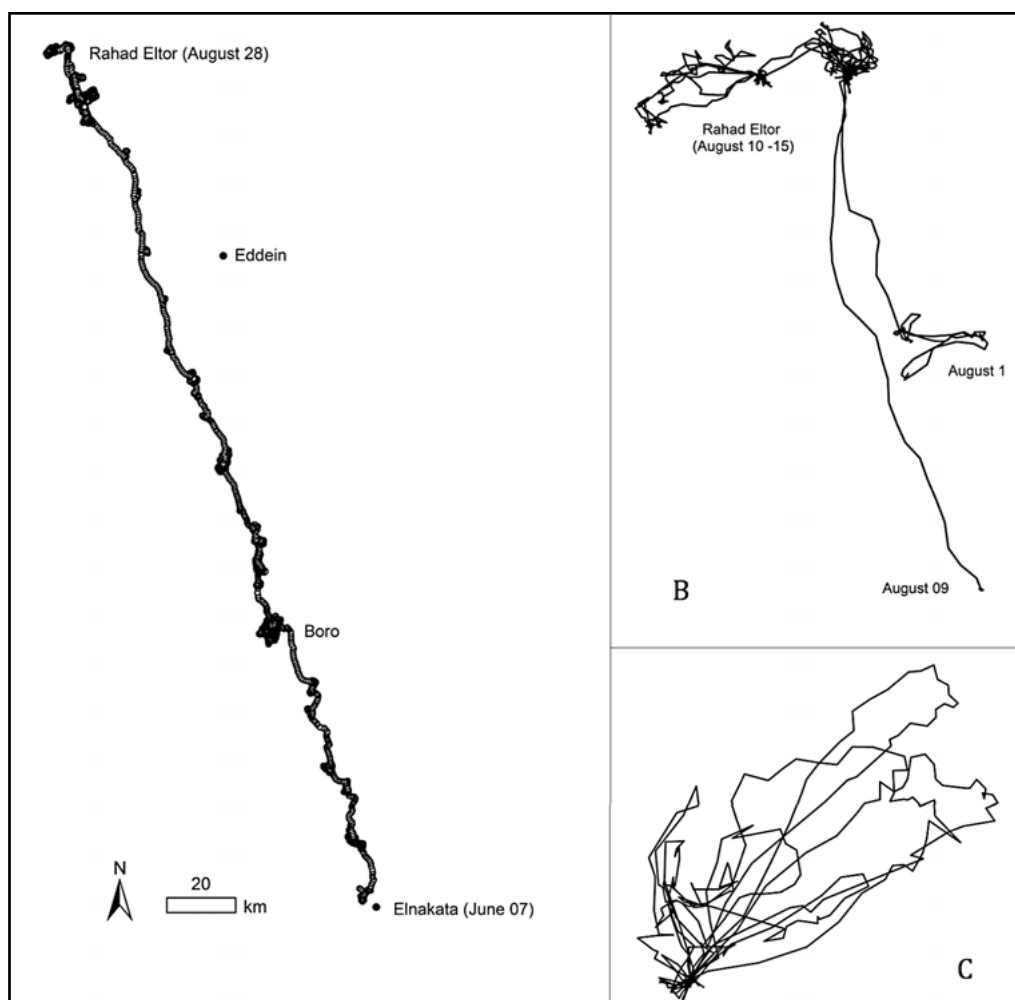
follows particular adaptation strategies, including increasing the number of shepherds to control the herd, and keeping good relations with villagers by providing them milk and *roob*. Moreover, during the field visit, we observed that there is a large number of livestock in the area.

North Kordofan movements

During the summer time, the sheep herders who own some camels leave the camels in the northern part of the state while the sheep are within the central, more southern area. Generally, camel herders are located further

north closer to their tribal home areas, while sheep are located in the central part of the state (Figure 22). Where herders have both sheep and camels, the herds are split during the summer season as they have different watering patterns: sheep are watered every two to three days, while camels are watered every seven to eight days. So at this time, both sheep and camel herds are concentrated in the vicinity of water points, but in different areas. The two herds are brought together in the rainy season, when water and pasture are more readily available (see Figure 23). This splitting of herds also applies when camel herds visit the Gizu region.

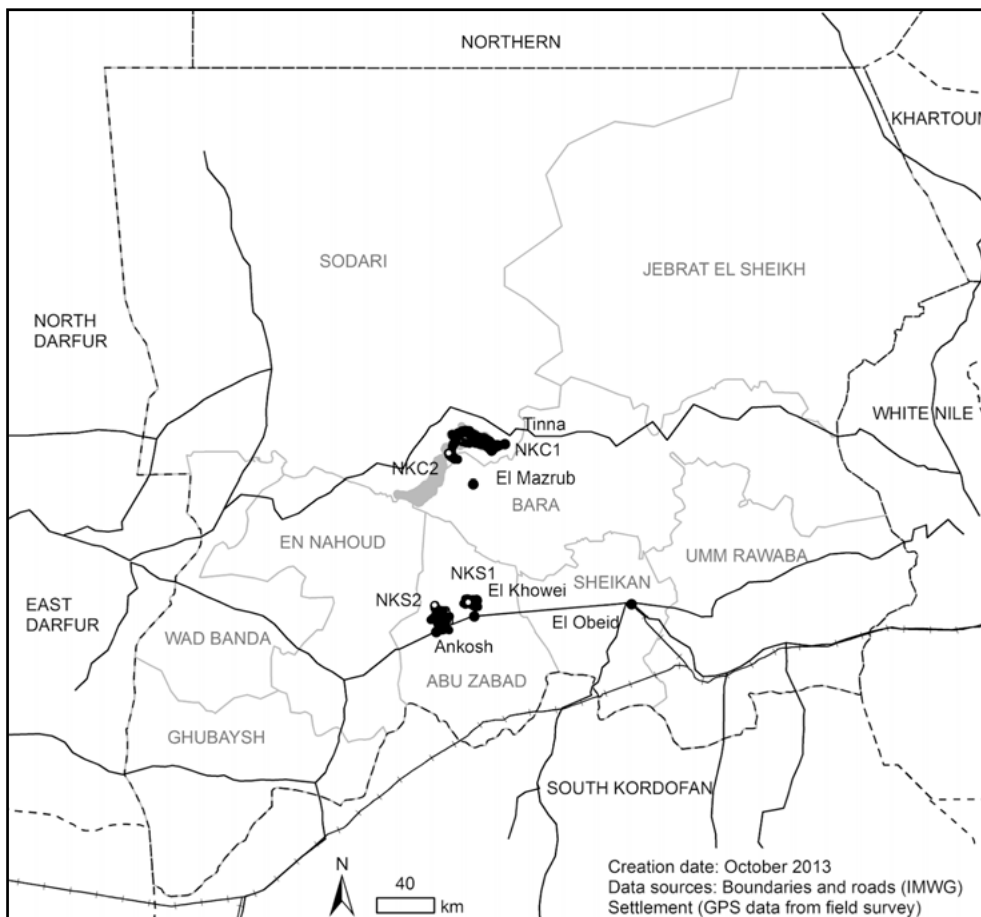
Figure 21. EDC4 herd spatial and temporal pattern of movement during the period 7 June to 28 August



B: EDC4 pattern of movement from 9 to 16 August, during which time he halted his northern migration to return back to a safe place so as to avoid the Rizeigat–Ma’aliya conflict area.

C: Daily pattern of movements from and to *farig* during 5–8 August.

Figure 22. Map of North Kordofan showing the general patterns of the two sheep and two camel herders during the early rains to mid-rainy season



North Kordofan Sheep Producer 2 (NKS2)—this year's movement

NKS2 is a nomadic sheep herder,³³ with 600 head of sheep, who was recruited as part of the study in early March 2013. The GPS monitoring started on 29 May and continued up to 17 August, which coincides with the *rushash* (early rains) and *kharif* (rainy season), as depicted in Figure 23. At this time of the year, the two major types of mobility are daily movements across the rangelands associated with grazing and, every three to four days, the longer journey for watering (*dema*).

The average daily movement during *rushash* is 10.7 km. The daily grazing activities for the desert sheep during *seif* (dry season) and *rushash* occur not only during daytime but also during a significant part of the night. To interpret the GPS data for daily movements, it is important to

Figure 23. NKS2 combined his sheep and camel herds during rainy season



(Source: Hussein Sulieman)

³³ While his primary herd is sheep, NKS2 also owns 100 camels and 40 goats.

fully understand the daily herd activity and related herd management during the monitoring period. Table 6 shows NKS2’s daily calendar during the *rushash* period. The GPS data show that during the nighttime, grazing activities are extended until morning, and around midday the herd and herder takes a rest (*magela*). This is an important strategy during *seif* and *rushash* to avoid the hot midday sun and consequently helps to lessen watering frequency. NKS2 explained that, following this intensive feeding schedule is a requirement in order for sheep to have twin or even triplet lambs. Sheep herders breed their

stock at certain periods of the year so lambs are born when range fodder is at its most nutritious and in abundance, which is the rainy season (*kharif*). A few females may miss the traditional breeding season and breed in the rainy season to lamb in winter (the cold dry season—*shita*). Sheep herders used *kinan*³⁴ to control pregnancy. NKS2 releases the *kinan* around mid-December, when breeding starts and lasts until around the end of February. Lambing is in June and July (*rushash* and early *kharif*).

Table 6. Daily calendar of NKS2 herd during *seif* and early *rushash*

Name	Time period over 24 hours (from–to)	Activities
<i>Mudhaya</i>	7–11	From sunrise to before midday, grazing always takes place in the surroundings of the <i>farig</i> , with lambs accompanying their mothers.
<i>Magela</i>	12–17	From midday to about 5 pm is the rest period to avoid grazing when the sun is at its hottest. Animals lay under trees nearby the <i>farig</i> . Lambs are separated from mothers but first-time lambers are kept with their newborn lambs for two or three days to avoid lambs refusing to suckle.
<i>Muashaya</i>	18–24	From around sunset to midnight, all young lambs are retained in the camp and guarded. Moreover, this is when herders prepare and cook dinner (<i>aasha</i> ; the name “ <i>muashaya</i> ” comes from this term), which means they are busy. Moreover, thieves will use the rest of the night to cover as wide a distance as they can before herders start to count their herd in early morning.
<i>Mabeet</i>	1–2	From about 1 to 2 am there is a short resting period where herders hand over duties to the next shift of herders.
<i>Serba</i>	3–6	This is the last grazing period, which extends into early morning of the next day.

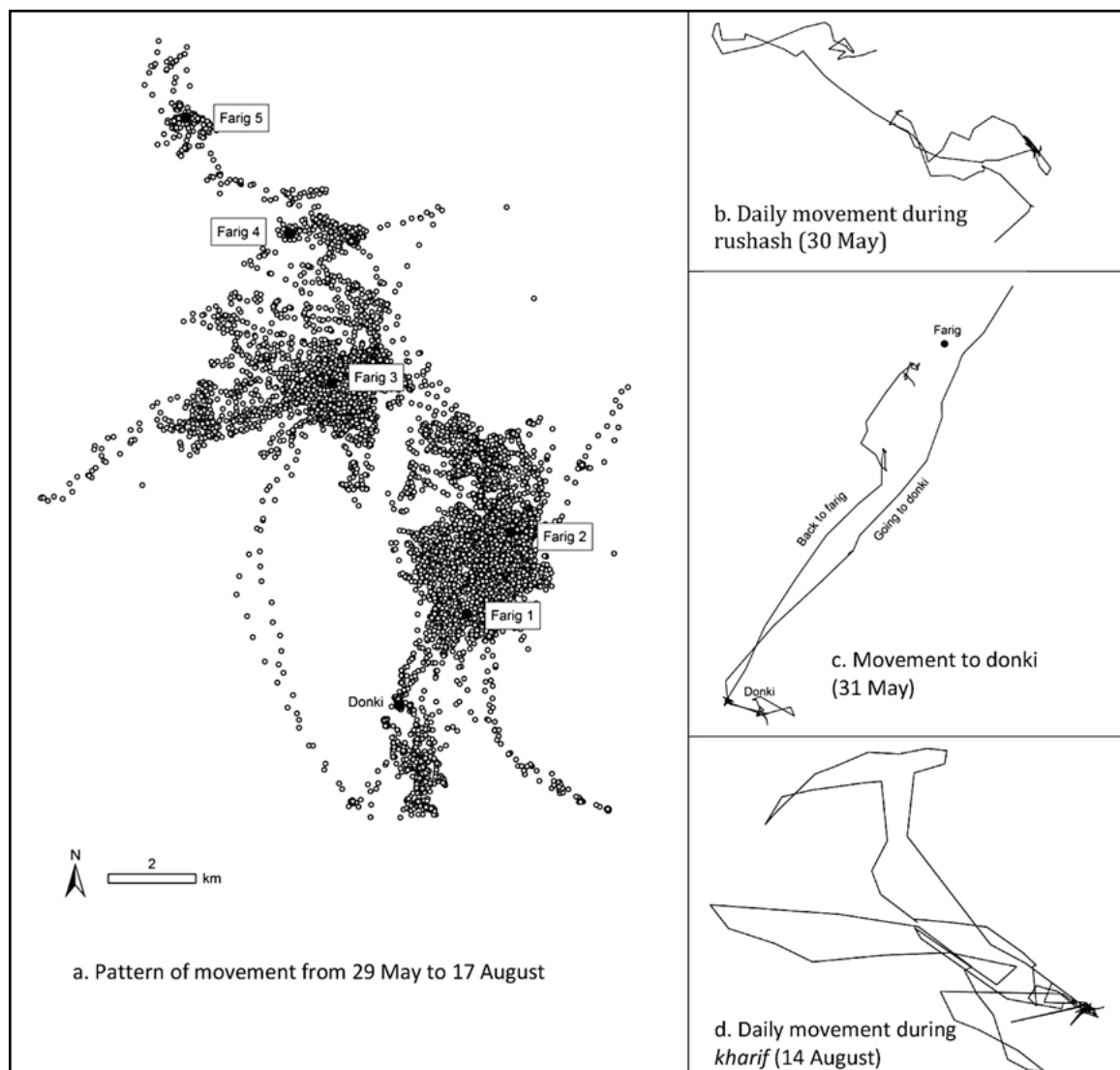
³⁴ This is a locally made loop of string fastened around the neck of the scrotum and the neck of the sheath of the sheep’s penis in order to prevent mating.

During the hot dry season and early showers (*seif* and *rushash*) of the yearly cycle, NKS2 utilized a *donki* (a wateryard consisting of a deep well or borehole connected to a container using a diesel pump) to water his herd. This journey started during *serba* (3 to 6 am), and the sheep reached the *donki* in the early morning. The earlier they arrive, the better chance they have to avoid crowds. By late afternoon, herders take their herd back, and around *muashaya* they reach the *farig*. On their way to the *donki* the speed with which the herd travels is more rapid than on its way back to the *farig* (Figure 24, map insert c). This time animals are sufficiently relaxed to graze fodder that they come across on their way. The two-way journey covers around 10.8 km. On average, NKS2 spends up to 11 hours at the

donki watering his 600 head of sheep. Normally, sheep drink water in three separate doses. In between each, they take a rest not far from the *donki* (Figure 24), when probably food supplements are provided.

In contrast to the previous months, during *kharif*, the grazing period is restricted to daytime. Herders even avoid early mornings, and they wait until a short time after sunrise to allow the dew to evaporate from plants. According to herders, diseases are known to result from grazing at night or early morning, when the grasses are cold and moist. NKS2 gave examples such as *Abu Delef* (foot rot) and *Abu Shalembo* diseases. Because of the moderate temperature and frequent clouds, the sheep will continue to graze and lie down in the open air until late in

Figure 24. The spatial and temporal pattern of movement of the sheep of NKS2 for different periods from 29 May to 17 August



the evening. Surface water collected in pools is the drinking source. Most of the *dwanki* are abandoned during *kharif* (Figure 25).

Figure 24 shows examples of NKS2's daily movement during rainy season (map d), where no *dwanki* are indicated, and livestock movements appear much greater and more irregular or scattered than during the hot dry season (map insert c) or the early showers (map insert b). The average daily movement during this season is 12.5 km.

The frequency of changing the location of the *farig* to a new location varies according to the seasons; during the summertime herders do not tend to change the place of the *farig* as often as in the rainy season. For example, during *seif* and *rushash*, which he spends around Ankosh, NKS2 changed the location of his *farig* only twice (depicted as *farig* 1 and *farig* 2 in Figure 24), while during *kharif* he moved his place every two weeks (depicted as *farig* 3, *farig* 4, and *farig* 5 in Figure 24, map insert a). According to NKS2, the main reasons for the high frequency of changes during the rainy season is to avoid the risk of disease from rotting dung, and moreover because sheep do not tend to graze fodder that is contaminated by dung.

North Kordofan Camel Herder 1 (NKC1)—this year's movements

The GPS data monitoring for NKC1's movements this year cover the period from 27 May to 6 August (Figure 26). As mentioned earlier, the herd size for NKC1 is 50 heads.

Grazing activities of camels are confined to daytime, i.e., from sunrise to sunset. NKC1 or his herders accompany the herd, and it is not important for them to return back to the same place every night. NKC1 does not have a *farig* (a temporary camp) that includes his wife and children as they stay permanently in Elgadesia; see Figure 26. *Taya* is enough for him. *Taya* is the place where the herd overnights; herders drop down their luggage and make a fire to cook meals and prepare tea.

Their average daily movement during the *seif* and *rushash* is 7.7 km. This relatively short distance compared to other types of livestock might be due to the nature of the rangeland. During this time of the year, the only grazing resources for the NKC1 herd in this Qoz landscape are Marikh shrubs (*Leptadenia pyrotechnica*). It was observed during the field visits that the entire herd was concentrated around the few scattered Marikh green shrubs (Figure 27). During *kharif*, the average daily movement of the herd is 12.1 km. By this time of the year, the rangeland is green, covered with diverse grasses, so camels have a wider range to selectively feed from.

During *seif* and early *rushash*, until enough water was collected in pools, NKC1 waters his herd at the *mushraa* (collection of boreholes for the domestic use of people from Tinna and for livestock) in Tinna. Watering frequency ranged from every 7 to every 10 days, depending on weather conditions, particularly temperature. The journey to the Tinna *mushraa* for watering

Figure 25. *Donki* Eltajamu at El Khowej during two seasons: crowded during the hot dry season (photo taken 24 February) and deserted during the rainy season (photo taken 19 August)



(source: Hussein Sulieman, 2013)

usually started the day before, and the herd overnights in the vicinity of Tinna and reached Tinna the morning of the following day.

The inset map of Figure 26 shows an example of 28 May 2013, which is a normal grazing day across the rangeland. In contrast, Figure 26 shows the herd travelling to Tinna from 30 May 30 to 1 June for watering the herd. On the first day (30 May), the herd travels around 27 km and overnights not far from Tinna. Early morning on the second day (31

May), they reach the Tinna *mushraa*, where they spend the whole day from morning to late afternoon, and thereafter they leave Tinna, having covered a total distance of 13.4 km from the grazing area to the *mushraa*. The third day (1 June), they returned back to a different part of the rangelands, travelling 8.8 km to reach a suitable grazing area.

Marikh shrubs are the only palatable plant species for camel that are still green during the dry season.

Figure 26. NKC1 herd: the spatial and temporal pattern of movement for NKC1's herd during the period 27 May to 6 August

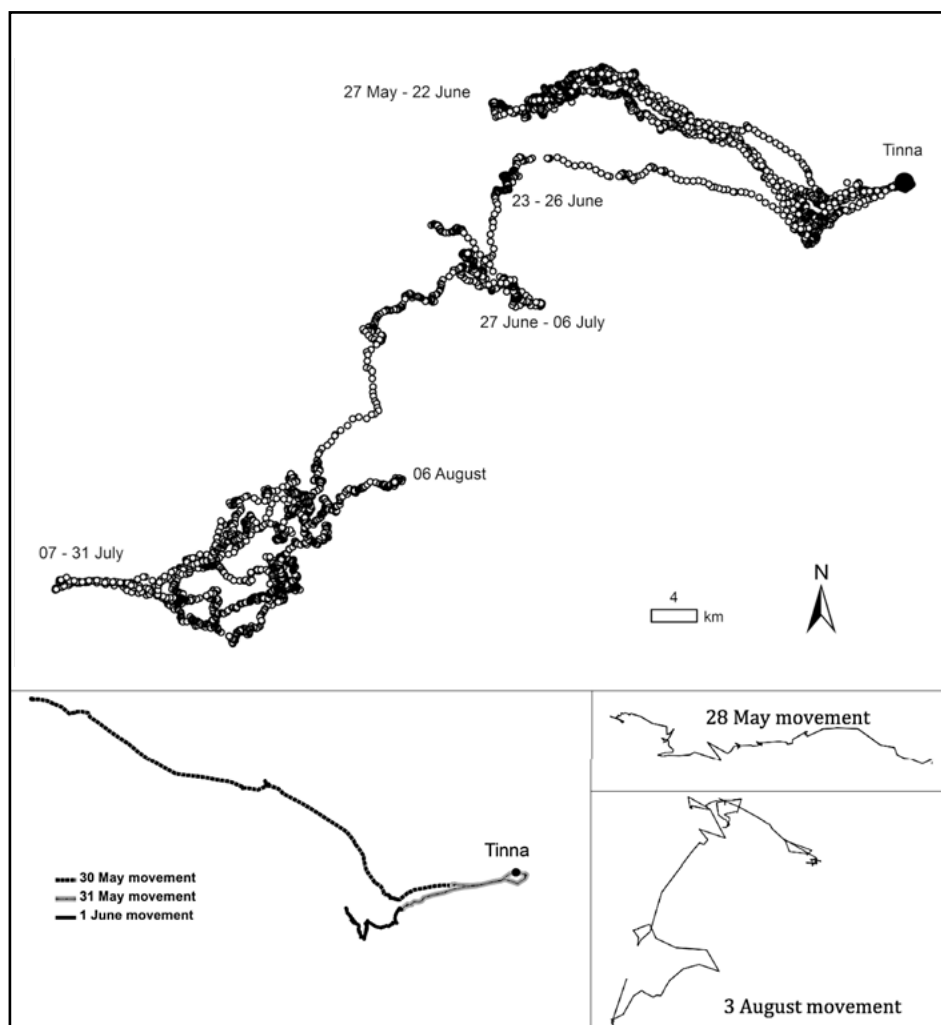


Figure 27. Marikh shrubs (*Leptadenia pyrotechnica*) in the Qoz area of North Kordofan



Concluding remarks

Patterns of mobility for sheep, cattle, and camels captured by the GPS tracking looked very different from the maps illustrating livestock corridors shown in Chapter 2 (Figures 2 and 3). Whereas the latter show a smooth uni-directional route, the GPS tracking illustrates the complexity of the seasonal and inter-seasonal movements of livestock, both in terms of the temporal and the spatial patterns.

The detail of the GPS tracking allows the specific characteristics of each production system to be captured; therefore provides clear evidence of the livestock mobility patterns for planners and decision-makers. This approach demonstrates the integration of local knowledge of herders and geospatial technology, in order to better understand the management practices in response to the variable and unpredictable natural environment, together with other factors that influence mobility.

As a consequence of this new way of looking at pastoral migration, planning of service delivery and distribution should be in line with the actual practices of pastoralists, thus promoting more appropriate and sustainable systems. For example, understanding the functioning of livestock corridors, and how the herder strategizes for navigating ecozones and adapts to the changing socio-political situation. The next chapter reviews some of these more complex issues and reviews how they influence livestock mobility.

Chapter 6. Land, power, and pastoralist mobility

The pastoralist imperative to move their livestock is driven primarily by environmental pull factors, attracting herders and livestock to the more nutritious pastures and more favourable conditions, which change seasonally in dryland contexts. The variable distribution of rainfall causes an unpredictable and scattered distribution of pasture—and so the skill of the pastoralist is to seek out the best and most nutritious pasture for his livestock, while at the same time maintaining access to sufficient water and optimum conditions for breeding and raising new stock. There are of course environmental push factors compelling movements away from a specific area or region; for example, the advent of pests and extremely muddy conditions in the south during the rainy season, but nevertheless the incentives to move are principally the rewards of abundant quality pasture and generally good breeding conditions further north.

The previous chapter on livestock movements captures this pattern of movement from south to north during the rainy season, and also shows how state-level policies and local governance regimes influence access to water and pasture. The livestock monitoring experience in both states reveals a range of other forces that impact and even sometimes dictate pastoralist livestock mobility, which are referred to in this report as “externalities.” This chapter reviews some of these “externalities” and analyses how they affect pastoralist livestock mobility, and in turn how pastoralists adapt to these constraints. This short chapter is not intended as a comprehensive analysis of all the issues, which is beyond the scope of the report, but it does highlight two of the major and interconnected sets of issues:

- The series of regional and multi-layered conflicts and related peace agreements. The lack of comprehension of pastoralist

livestock mobility within these agreements risks undermining both sustainable growth of pastoralist production and also peaceful relations with other land users;

- The political capital and allegiances of some pastoralist tribal groups, which, despite the considerable political power of pastoralist groups, have failed to uphold and protect pastoralist livestock production as a sustainable livelihood system.

Other key issues affecting pastoralism in both East Darfur and North Kordofan include the post-secession context and relations between Sudan and South Sudan and implications for cross-border mobility, and also the economy post-secession, which has raised the profile and importance of livestock and increased calls for its modernisation.

Perspectives on pastoralism and conflict from recent peace agreements

Over recent decades, civil war has been waged on multiple fronts in Sudan—from east to west and north to south—and has often been linked with tribal politics and localized conflicts. The regional conflicts have led to several parallel peace processes, and independent settlement agreements.³⁵ Despite a pattern of isolated peace processes, a number of authors, including the African Union High-level Panel For Darfur (AUPD), argued that these conflicts are interconnected and part of a wider Sudan crisis (AU 2009) that continues to play out and affect pastoralist mobility. For example, recent conflict developments in Abyei, South Kordofan, Blue Nile, and Darfur (and the relevant peace processes) post-secession are part of the context in which many pastoralist groups navigate and negotiate access to vital resources.

³⁵ These include the overarching Comprehensive Peace Agreement signed between North and South Sudan in 2005, the three Darfur peace agreements (the Humanitarian Ceasefire Agreement 2004; the Darfur Peace Agreement partially signed in Abuja 2006; and the Doha Document for Peace in Darfur (DDPD) 2011, and in the east, the Eastern Sudan Peace Agreement of 2006. The 2006 Eastern Peace Agreement makes very little reference to natural resource management and none to livestock mobility, so is not considered here.

Overview of Agreements

The Comprehensive Peace Agreement (2005) officially recognizes customary rights and claims to land and natural resources,³⁶ but does very little to engage with issues of natural resource use and management and is almost silent on strategic livestock mobility. There is an important exception. Article 1.1.3 of the Abyei Protocol recognized the Misseriyia right to their livestock migrations: “The Misseriyia and other nomadic peoples retain their traditional rights to graze cattle and move across the territory of Abyei (GOS/SPLM 2004b). Despite the recognition of pastoralist rights, since South Sudan’s independence a large number of northern pastoralist migration routes have been affected by the new border. This is further explored below.

The partial signing of the Darfur Peace Agreement (DPA) in Abuja in 2006 led to the break-up and subsequent multiplication of the Darfur rebel groups, and the fuelling of factional and tribal conflicts. In 2010, Julie Flint argued that since 2006 most deaths and casualties in Darfur have resulted from fighting between Arab pastoralists armed by the government to fight the insurgency (Flint 2010); hence the explicit link between pastoralists and both the counter-insurgency and tribal and inter-tribal conflict.

In the years that followed the DPA, disunity between rebel groups thwarted international efforts to bring them together and reach a common negotiating position. Subsequent peace agreements have been partially signed.³⁷ A stop, start, stalling peace process, characterized by periods of intense international support and activity,³⁸ finally resulted in the Doha Document

for Peace in Darfur (DDPD) being signed between GoS and the Liberation and Justice Movement (LJM) on 14 July 2011.³⁹

The following review of the main Darfur peace agreements shows how pastoralism and pastoralist natural resources are viewed officially. The point here is to illustrate how pastoralism has been captured in recent official discourse in relation to reconstruction, re-development, protecting IDPs, and peace-building. Highlighting the limitations of the official views helps to advance a more sophisticated understating of strategic mobility.

Pastoralist Identity

Darfur peace agreements treat pastoralism as a “traditional” cultural identity, rather than a dynamic production system. This simplistic understanding of pastoralism has implications for the way that pastoralism is integrated into the agreements’ provisions. For example, the “protection of cultural heritage” and “nomadic culture” (DDPD Article 17) is mentioned several times in both Darfur peace agreements with regards to land rights. Yet the assumption that relationships with land are only “traditional” creates a static picture of pastoralist production.

As “nomadic culture” is essentialised through this language, it is also stigmatized. For example, there are several provisions in Article 26 of the DPA on protecting IDPs and humanitarian supply routes that stipulate protecting “historic migration routes” to “ensure the safety of nomadic migration for the people of Darfur, including traditional nomads.” While the protection of pastoralist migration is critical, that it is captured within this section is

³⁶ The Wealth Sharing Protocol (GOS/SPLM 2004a) has most references to land and natural resources. Article 2.5 calls for “a process to be instituted to progressively develop and amend the relevant laws to incorporate customary laws and practices, local heritage and international trends and practices.” The CPA established four Land Commissions: the National Land Commission (Article 2.6, Wealth Sharing Protocol), the Southern Sudan Land Commission (Article 2.7, Wealth Sharing Protocol), and Land Commissions for both Southern Kordofan and Blue Nile (Article 9.3, Protocol on Resolution of Conflict in Southern Kordofan and Blue Nile).

³⁷ The Justice and Equality Movement (JEM) refused to sign the 2006 DPA, then had intermittent talks culminating in the signing of a framework agreement in February 2010, but that quickly broke down on both sides. On 6 April, 2013, a splinter faction, JEM-Bashar, signed the DDPD in Doha. On 12 May, the leader of the faction, Mohamed Bashar, and up to ten others were killed on the border between Sudan and Chad.

³⁸ For example, the series of talks at Abuja between 2005 to 2006, and the subsequent efforts by Qatar, Egypt, and the Arab League in 2010 in bringing together rebel groups, and also civil society consultations.

³⁹ The agreement established a compensation fund for victims of Darfur conflict, made provision for a vice-president from Darfur, and established a new Darfur regional authority to oversee the region until a referendum to determine its status within Sudan.

erroneous, and the link with IDPs suggests that “nomadism” is conflated with displacement and crisis.

The language of these agreements reveals the emphasis in official thinking of pastoralism as a “traditional” lifestyle and relative silence on pastoralism’s adaptive productive potential.

Land Use

Both the DPA and the DDPD prioritize the development and management of land and natural resources, and establish land commissions to oversee natural resource management. The DDPD is more explicit in taking traditional and historical rights to land into consideration, has more scope for providing compensation, and overall has a more detailed remit for the Land Commission.

Both the DPA and DDPD recognize “*hawakeer*” and rights to land as “traditional and historical;” for example, Article 34 of the DDPD states, “Tribal traditional land ownership rights (*hawakeer*), historical rights to land, traditional and customary livestock routes and access to water sources shall be recognised and protected ... and customary livestock routes shall be re-opened, whenever possible, or alternative routes shall be demarcated.” Thus, livestock routes and water points are recognized as part of *hawakeer*, and there is an official sanctioning of amending relevant laws to incorporate customary laws. Yet, this is a limited approach; taking livestock routes alone into account is not sufficient. There needs to be more consideration of livestock grazing beyond the limits of these livestock routes and the possibility of multiple land users sharing on a seasonal basis the natural resources available throughout the year on the same area of land, as this is a common and traditional feature of agriculture in Darfur (Osman et al. 2013).

In contrast to upholding the traditional land ownership rights in DDPD Article 34, Article 36 (Land Allotment) promotes individual land registration. This individual land registration reflects changes in land tenure arrangements and the increasing prevalence of private property regimes, especially in urban areas and areas of rich fertile soils, but is at odds with the usufruct

rights enshrined in the 1970 Unregistered Land Act and also the traditional *hawakeer*⁴⁰ (Osman 2013). According to Osman, “The native administration of the tribal *hakura* or *dar* administratively allocates land to individuals on the basis of a usufruct right” (Ibid., 29), which is a temporary or usufruct right linked with shifting cultivation and seasonal patterns of cultivation, involving sometimes multiple land users, including farmers, herders, and horticulturalists, and both men and women (all of whom make use of the same area of land at different times of the year).

Livestock and Agricultural Development

The Darfur Peace Agreement recognizes the importance of livestock, stating it “has a special significance in the economy and the lives of all Sudanese citizens particularly the people of Darfur States.” Accordingly, policies directed to its development shall be prioritized and emphasized”. (DPA Article 19, Economic Policy for Reconstruction, Investment and Redevelopment, paragraph 142).

Article 19 goes on to acknowledge the competition between livestock and agricultural production in paragraph 149 “Competition for pasture and water by nomadic herders and settled agricultural producers is an important problem. The problem shall be addressed in a comprehensive way, by developing policies to reverse environmental degradation and the decline in agricultural yields, gradually shifting the emphasis of herders from quantity to quality, developing a framework for equitable access by various users of land and water resources, as well as developing research capacities in these areas.” The assumption here is that “problematic” competition over natural resources lies in agricultural development linked with environmental protection, yet the link with peace-building is implicit (which may explain the need for research). The emphasis is on shifting from “quantity to quality,” a phrase that probably represents the old and discredited “livestock as a store of wealth” argument, which overplayed the extent to which pastoralists kept large numbers of low-quality animals because

⁴⁰ *hakura/hawakeer* (pl.)—the tribal traditional land ownership rights in Darfur.

they had a “cattle complex” and used the animals for prestige purposes rather than economic profit (Odhiambo 2006, Scoones and Wolmer 2006). The earlier sections of this report and the work of Kratli et al. (UNEP 2013) counter this argument by demonstrating a deep and longstanding market involvement.

Like the DPA, the DDPD recognizes the need for recovery and development and articulates a similar understanding of crop and livestock production as being in competition (opposition), and the policy shift from “quantity to quality” of livestock in paragraph 172. Overall, the DDPD policy and project focus is on rainfed agriculture; paragraph 173 states neglect of rainfed agriculture has been particularly damaging to the people of Darfur, and there should be policies and projects “formulated and directed towards promoting traditional rainfed agriculture, which shall be considered as a major national development priority.” There are no similar statements regarding the development of pastoralist livestock production as a national or even regional priority, which suggests a bias that risks ignoring and so potentially undermining pastoralist livestock production. These policies and their implications for pastoralism have been reviewed elsewhere (el Hassan and Birch 2008, Gaiballa 2013, UNEP 2013).⁴¹

In summary, several issues raised in these peace agreements have implications for pastoralist livestock mobility. The peace agreements fail to recognize the significance of pastoralist livestock mobility for livestock production in relation to local livelihoods and the national herd. At best this is a missed opportunity for promoting sustainable development of all groups, and at worst this could contribute to increasing inequalities, supporting a bias against pastoralists.

Conversely, the emphasis within the Darfur agreements is on pastoralist identity and culture. The Darfur agreements tend to view nomadic routes in relation to their “cultural” importance

and the “traditional” rights of nomads. This limiting view risks undermining their productive capacities, while delinking their culture from modernity and development.

While the agreements strongly advocate for the traditional rights of nomads, at the same time “nomadism” is conflated with the situation of IDPs and issues of humanitarian access, which again has serious negative implications for how nomads and pastoralists are widely perceived. There are obviously some definitional issues to be resolved here.

The Darfur agreements contain some important ambiguities (even contradictions) relating to pastoralism and other land use practices. For example, the agreements uphold and protect traditional land rights as represented by the *hawakeer*, including “traditional and customary livestock routes,” while at the same time make provisions for individual land registration, which would run counter to the traditional *hakura* system (the traditional customary land tenure system in Darfur).

The Darfur agreements recognize problems of competition between herders and farmers and propose agricultural development linked with environmental protection as the solution. This ignores the links between this local-level conflict and the wider conflict dynamics—between rebels and government forces, and tribal and inter-tribal conflict and power relations.

Political allegiances, tribal disputes, land, and power

Tribal conflicts are rarely inseparable from national interests and wider political tensions, including regional, national, and even international disputes.

History of pastoralist political allegiances and their link to tribal militia

Close relationships and political allegiances between pastoralist groups in the Darfur and Kordofan regions with central political

⁴¹ Some of the key national legislation from 2005 to 2013 include the Strategy for National Agricultural Development Horizon prepared by GoS and FAO (2000–2015); the Green Mobilisation Programme (2006–2010) prepared by the Government of National Unity (GoNU); the National Adaptation Programme for Action (2007) prepared by the Higher Council for Environment and Natural Resources, and the Quarterly Centennial Development Strategy (2002–2027), which is primarily concerned with poverty alleviation and the protection of the environment and natural resources (Zaroug 2011).

movements have a long history, dating back more than a century. The role of the Southern Rizeigat as *Ansar*—followers of the Mahdi, in support of the revivalist Islamic movement, the *Mahdiyya*—was critical to the success of the military campaign that overthrew the Turco-Egyptian government of Sudan in 1885. Since independence, a number of national governments, from President Numeiri to Sadiq el Mahdi and more recently under President al Bashir, have mobilized and armed tribal militias to support and fight their cause. For example, in 1983 *murahaleen* tribal militias from south Darfur and South Kordofan were armed by the government to combat rebel threats to oil development in South Sudan. In the Darfur conflict, Arab tribal militia (*janjawiid*) supported government forces in putting down the Darfur rebellion. In both these cases, militia were predominantly Arab pastoralists, who were incentivized by the free license to raid cattle stocks and claim land of the local inhabitants (Keen 1994, Tanner 2006).

While members of the Southern Rizeigat were active as *murahaleen* in southern Sudan, they were not seen as the main protagonists in the Darfur conflict. It was widely reported that the Southern Rizeigat did not respond to the government's mobilization call to fight the insurgency in 2003 (Flint 2010), and today their political allegiances remain opaque and somewhat fluid (see below).

This violent history of pastoralist youth joining militia has shaped perceptions of Arab pastoralists, which according to the AUPD has led to “the stigmatisation of the Darfur Arabs” by the international humanitarian community and advocacy response (AU 2009).

The use of proxy militias is also a feature of the ongoing conflict and war in South Kordofan and Blue Nile, since 2011, although there is some ambiguity in recent reports over which pastoralist groups have taken which side. Popular Defense Force (PDF) fighters are often recruited on ethnic lines, and, as in the past, pastoralist groups provide many recruits. In South Kordofan, there have been regular reports of young men switching sides, for example in to SPLM-N (Sudan Peoples Liberation Movement – North) or SRF (ICG 2013, 9–10). An increasingly complex political and military landscape is reflected in the nature of

recruitment to PDF and other paramilitary and military organizations in the contested border areas.

Gramizzi and Tubiana describe the overlapping allegiances in the Darfur borderlands that reflect local interests and identities: “For some, particularly those in the South Darfur–Bahr al Ghazal borderlands, membership in the SPLA—or, alternatively, in Khartoum-backed militias—has been a viable way of promoting the local interests of their communities, to the extent of holding overlapping allegiances between North and South” (Gramizzi and Tubiana 2012).

The tactic of recruiting and arming tribal militia has to some extent backfired, with militia seen as beyond the government's control and examples of militia turning on the very government that created them, as in the outbreak of violent conflict between Sudan's National Security and contingents of the Central Reserve Forces, known as “Abu Tira” and pro-government militia in Nyala (Radio Dabanga 2013d). The assimilation of military power by individual tribes has spread as an increasing number of tribes have been able to establish their own military power, through their relations with national authorities and rebel groups and the access this gives them to munitions.

Links between land, power, and tribal politics

Historically, land is structurally linked with power and tribal affiliation: under the *hakura* system, “the allocation of the usufruct right to members of the community (tribe members) is bound to political allegiance to local authorities” (Osman 2013, 29, quoting Meek). For this reason, local-level land disputes easily translate to political struggles between competing tribal groups.

The escalation of local conflicts over land can be fuelled by the political allegiances of the users of that land and wider tribal politics. A local land dispute may threaten the tribe's wider interests, or alternatively can be used as a mechanism for mobilizing supporters for a wider conflict. Osman argues that this structural link makes people susceptible to ethnic manipulation for political support, which has facilitated their mobilization as militia. This has implications for pastoralist youth and for pastoralist communities.

In modern times, this structural link between land and political power is still evident.

Ownership of a tribal homeland or *dar* gives the tribe a strong constituency with which to secure their representation within the National Assembly. This is evident from a map of the tribal affiliation of the National Assembly members from Darfur, which resembles an ethnographic map of the region. There have been of course some exceptions; for example, in 1984 in Ed Daein, the Southern Rizeigat headquarters, a Zaghawa was elected as the locality member of the National Assembly. But this more liberal trend has been reversed, as witnessed by the consolidation of tribal power within local, state-level, and national institutions, and also within rebel movements.

The creation of new localities presents new political and administrative opportunities. This is also why the re-organization of local administrative boundaries as a result of the 1971 Local Government Act was considered the prime factor in triggering tribal conflicts, with up to 16 different rural council border disputes and conflicts in southern Darfur alone (Takana 2008).

Powers vested in official administrative, military, and political positions

There are reports that some tribes strategically target official positions within the State and Federal Administration, as well as in political positions linked to their tribal constituencies. For several groups in the Darfur region, the assimilation of military tribal power has been linked with their political allegiances and patronage, thus contributing a key element to their regional power and authority. An example of this is the numerous militias, who are often said to be beyond the control of the government (see next section). These processes of assimilating power are not recent and have been building over the past 30 years.

In the Darfur region, land, political capital, and military power of the tribe are intrinsically linked, and thus what appears to be competition over land between farmers and herders is potentially a far more insidious and deeply embedded inter-tribal conflict. The idea that this can be solved through agricultural development and environmental protection is to miss the point of power politics. Instead, this situation needs to be considered in relation to the tribal dynamics and interactions with other levels of power politics.

Box 5 describes a recent example of such inter-tribal conflict, and the way it is understood. Media reports of tribal conflict between the Ma'aliya and Southern Rizeigat describe the build-up and triggering of the hostilities and subsequent events, and give different perspectives on the underlying causes. Most reports indicate that disputes over land ownership and grazing are the cause, which suggests local resource issues to be settled by the local tribal administration. However, this conflict has far deeper and more complex historical roots, and this case shows how conflict over land is not only a local matter between the individuals and groups concerned, but rather transcends administrative boundaries from local level to the state and national level, and is even of specific interest to the President of Sudan. The reasons for this lie in the historical and more recent structural linkages between land and political power. This recent chapter in the history of these two groups has sadly generated increasing polarization between these groups, unlike the peaceful co-existence that existed in the past. This has major implications for pastoralist migrations (and other livelihood groups who depend on mobility and access) for whom this territorial and ethnic consolidation and polarization is a disaster.

Box 5.

Tribal conflict between Southern Rizeigat and Ma'aliya, August 2013

Up until 1918, the Ma'aliya had their own administration and thus a separate tribal identity from the Southern Rizeigat. Their Nazirate was dissolved under condominium rule, and the Ma'aliya were annexed under the Nazirate of the Southern Rizeigat, a position they resented. Following independence, they started to peacefully make the case for their own independent administration. The first major tribal conflict between the Ma'aliya and Southern Rizeigat was triggered in 1966 and was finally settled by a tribal conference that gave the Ma'aliya the deputy position to the Rizeigat *nazir*. While an improvement, they

Continued on next page

continued to work peacefully for a separate administration up to 2002, when a second round of hostilities occurred. A bitter and violent conflict ensued and, as part of the eventual settlement, the Ma'aliya were given their own tribal *dar* and Nazirate independent of the Southern Rizeigat.

The current hostilities and the third serious Ma'aliya–Southern Rizeigat tribal conflict, caused by a dispute over land, challenges the Nazirate administrations of both tribes. The dispute is over an area called Kileklee Abu Salama, northeast of Ed Daein. Warnings of imminent tribal clashes over land-related issues connected to the Abu Kilekle area were reported in early July (Radio Tamazuj 2013).

Violent clashes erupted on 9 August in Adila and Abu Karinka localities, leaving “hundreds dead and many wounded” on both sides (Radio Dabanga 2013a). The trigger for the violence was said to be the looting of 600 Rizeigat animals and also the alleged killing of a Ma'aliya merchant by Rizeigat tribesmen (Radio Dabanga 2013a). Others say that the violence was triggered by the Rizeigat looting 300 sheep, followed by a Ma'aliya *faza'a* going deep into Rizeigat areas to retrieve their animals, who then snatched the Rizeigat cattle (Personal communication).

The Governor of East Darfur, Abdelhamid Musa Kasha, initially blamed the clashes on rebels, who he reportedly said “have assisted the Agarba branch of the Ma'aliya tribe against Rizeigat tribesmen,” which the rebels subsequently denied (Radio Dabanga 2013a). On 14 August, Kasha announced that “the State was not able to control the situation or disperse the fighting and demanded that the military intervenes” (Radio Dabanga 2013b).

Governor Kasha, himself a member of the Southern Rizeigat, was then accused by the Ma'aliya of siding with the Rizeigat and supplying his tribesmen with government vehicles and weapons (2013a) and also of the “ethnic cleansing” of Ma'aliya from Ed Daein (2013b). Ma'aliya civil servants were dismissed from Ed Daein during the fighting (Radio Dabanga 2013c) and their houses looted.

By 22 August, both tribes signed a peace agreement in Taweisha, North Darfur, committing them to stop fighting and to resolve their differences peacefully. But sporadic fighting has continued, and on 25 August, Governor Kasha declared a State of Emergency in East Darfur, which extended the brief of the Sudanese Armed Forces (SAF) in the area. By this point, 209 people had been killed and 305 wounded in clashes (Radio Dabanga 2013c).

By early September, President Omer Hassan Al-Bashir became involved and personally directed the East Darfur Governor “to do everything possible to prevent the recurrence of tribal clashes,” and plans were initiated for a tribal conference to be chaired by a government committee (Sudan Tribune 2013b). The Government of Sudan's Humanitarian Aid Commission estimated 144,000 people have been displaced as a result of the conflict. This has prompted a humanitarian response hampered partly by a limited humanitarian presence, including of national agencies (UNOCHA 2013b). The UN Office for Coordination of Humanitarian Affairs (UNOCHA) continued to report armed clashes in their next bulletin but no details of response (UNOCHA 2013a). The UN Office for Coordination of Humanitarian Affairs (UNOCHA) continued to report armed clashes in their next bulletin but no details of response (UNOCHA 2013a).

The relationship between pastoralists and government or rebel forces

Internal politics, and the way that different pastoralist tribes position themselves and are able to negotiate with government or other tribes, influence livestock migrations. With both the

war in Darfur and following the secession of South Sudan, there has been tactical alignment between certain groups and the government or rebel groups controlling specific areas.

Sources of patronage and alliance have an effect on the negotiation of local agreements.

Political elites from many pastoralist groups have not been attending grazing meetings organised by state governments in South Sudan because they depend on patronage from Khartoum, and this lack of support undermines the efficacy of these agreements (Craze 2013, 12).

The ongoing conflict in the Darfur region and the end of the north-south civil war have produced a complex landscape of loyalties. There is speculation about an opportunistic split within the Rizeigat elite as some are attempting to align themselves with the state government in Northern Bahr al Ghazal, while others, with strong ties to the NCP (National Congress Party), are more hands off with the South (Craze 2013).

Rizeigat leaders have also become more vocal in distancing themselves from Government of Sudan tactics, and reaffirming their allegiance with the South. Following an attack near Kiir Adem in December 2012, the Rizeigat Nazir Mahmoud Moussa Madibo said:

The government of Khartoum is responsible for the attack. But the Rizeigat want to restore the relationship with the Dinka Malual and the Government of the Republic of South Sudan. We as Rizeigat emphasize that we don't have any connection to this attack. We have not at all been involved in any of these actions. The government of Sudan mobilized all of its troops and attacked the SPLA⁴² positions along the river. (Radio Dabanga 2012e)

Some have been more ambiguous with their support. Joshua Craze's analysis suggests this indicates there has been a split within the Rizeigat leadership and that the Rizeigat leadership is currently weakened. However, this may not be the case, as it may just be that the Rizeigat have a strategy of creating multiple allegiances. In February 2013, Mohamed Isa Aleu, head of the Rizeigat Shura Council, said

in an interview with Radio Dabanga, the Rizeigat are "at the mercy of the government of North Bahr El-Ghazal" (Radio Dabanga 2013e). He had previously claimed the SPLA had attacked the Rizeigat in the December 2012 conflict. This may suggest that loyalties are fluid and multiple in the current context as much as it suggests a split. Opaque and fluid as loyalties along the border may be, they have huge and complex political ramifications and impact on the political economy of livelihoods in both the North and South.

Another visible expression of this has been the dynamics of integration of irregular armed forces into national armies. There appears to have been various switches of loyalties.⁴³ The context has become more complex since southern independence, the outbreak of war in Southern Kordofan and Blue Nile State, and the continuation and transformations of war in Darfur. The increased number of armed groups associated with various conflicts in the region (in Darfur and South Kordofan) appears to be reflected in increased complexity of Rizeigat loyalties.

Our study in East Darfur also indicates that the Southern Rizeigat, at the local level, are building a strong relationship with their recent compatriots across the new border in Northern Bahr al Ghazal—the Dinka Malual. This is enabling their livestock to enter into South Sudan and benefit from the dry-season pastures, water, and other available services.

There has been considerable analysis of the integration of armed groups in South Sudan since the end of the war. This has mainly been because of armed rebellions and the potential for these groups to destabilise the peace. The International Crisis Group (ICG) have called the lead up to independence a "window of opportunity" for the SPLM, "in which relationships between, and among, state and non-state actors may be redefined" (ICG 2011, 5). The same notion could be extended for the

⁴² SPLA Sudan People's Liberation Army.

⁴³ Since the CPA, there have been reports that a significant number of Rizeigat armed forces (Concordis International imply they were former PDF) have switched their allegiance from Khartoum and joined the SPLA. In 2006, 2,000 Rizeigat fighters joined the SPLA under Cmd. Khalid Abu-Ageel based at Sahafa. They later reportedly split between the SPLA and SAF in 2009/2010. (ConcordisInternational 2010, 44). An research team from the Overseas Development Institute recorded that, in 2006, 13,000 Misseriya joined the SPLA, and the SPLA were believed to be attempting to recruit Misseriya and Rizeigat at this time as a potential fifth column or advance guard in case of the resumption of hostilities (Pantuliano et al. 2009, 24).

SPLM and SPLA's relationship with northern pastoralist groups. As these groups' relationships with the South are re-defined, this also transforms their relationship with Khartoum and the SAF. These recent transitions are not just military, as they potentially influence pastoralist access to certain seasonal pastures.

North-South relations and cross-border pastoralist mobility 2005–2013

The new international border between Sudan and South Sudan represents the boundary northern pastoralists must cross in order to reach their traditional dry-season grazing areas. Northern traders also pass through the border area to access local markets with southern communities and support the pastoralist migrations.

For the most part, the demarcation of the border has been agreed on between Sudan and South Sudan. However, several areas remain contested, and pastoralists are caught up in these disputes.⁴⁴ Because the political future of Abyei and other contested areas is uncertain, issues of resource sharing remain major political flashpoints between Sudan and South Sudan.

For many groups, seasonal cross-border movement into South Sudan has been limited since the CPA, although experiences vary. The Misseriyia in particular perceive themselves as victims of the CPA and believe their movements south have been restricted since 2005 (Pantuliano et al. 2009, 6). In July 2009, following the ruling by the Permanent Court of Arbitration in the Hague, Warrap State authorities announced that Misseriyia would still be able to enter Warrap, provided they were

disarmed. However, this was not a straightforward olive branch—many Misseriyia were reluctant (and felt unable) to disarm, not least because they were facing harassment by the SPLA. Humr Misseriyia migration south into Northern Bahr al Ghazal State (NBEG) since 2005 has been greatly reduced. (Craze 2013, 45). In contrast, our study shows that agreements between the Dinka Malual and the Rizeigat have enabled the Rizeigat to continue to cross the border.

A review by Concordis International of the 2011 to 2012 dry season showed that there was considerable variation in migrations at different parts of the border and for different groups (see Table 7) (Milner 2012). For example, Southern Rizeigat were able to migrate southwards into NBEG, while there was no migration of Misseriyia. Conversely, the Misseriyia migration into Abyei in 2011–12 was their most successful dry-season migration since 2005, largely because many Ngok Dinka were still displaced further south, giving the Misseriyia relative freedom of movement. (Craze 2013, 72). The following year, in the 2012–2013 dry season, the Misseriyia migration to Abyei was enabled by the presence of United Nations Interim Security Force for Abyei (UNISFA) (Craze 2013, 99). However, continued tensions over the oil-rich region of Heglig largely prevented the Misseriyia migration into Unity State (Craze 2013, 103), and relationships between Misseriyia and Bul Nuer and Pariang Dinka have almost completely broken down.

The cross-border movement of traders to the south is also significant in terms of building relationships with southern communities, which in turn can influence relations with northern

Table 7. Cross-border movement, 2011–2012 dry season (Milner 2012, 5)

Western Bahr al Ghazal State	No/extremely limited migration of Habbania and Rizeigat
Northern Bahr al Ghazal State	Large migration of Rizeigat No migration of Misseriyia
Warrap State	No migration

Continued on next page

⁴⁴ These areas include: Renk/Jabalain (Upper Nile/White Nile); Megenis (Upper Nile/South Kordofan); Kaka Town (Upper Nile/South Kordofan); Samaha on the Bahr el-Arab/Kiir River (Northern Bahr el-Ghazal/South Darfur); Kafia Kingi (Western Bahr el-Ghazal/South Darfur); and Abyei. For more details of these disputes see (ICG 2010).

Unity State	Migration proceeded but limited to select groups (notably Misseriyia, Awlad Omran)
Upper Nile State	Large migration of numerous Arab and Fellata groups but limited due to conflict in neighbouring states, uncertainty as to policy framework, and perceptions of high levels of taxation. But some staying longer.
Abyei	Large migration of Misseriyia through the eastern and western corridors and via the Central Corridor as far as Dokura (north of Abyei town)

pastoralists. There are reports of a series of actions and counter-actions by both governments on restrictions on movement of traders across the border, although it is almost impossible to verify the effect of these for the entire border area. Immediately before the South's independence, the Government of Sudan shut the border to trade from 2011 for all of 2012. The ban was unofficial, and the GoS denied doing it, but there were multiple reports of traders being blocked (Craze 2013, 11).

Trade, movement to the south, and relationships with southern communities are linked. This means that the worsening of relations, partial closing of the border, and bans on trade have major short- and long-term implications for pastoralists. In the case of Unity State, the ban of trade has meant the Misseriyia have been unable to import trade items from the north during their annual migrations. They were usually accompanied by traders, but the trade ban made this impossible (Craze 2013). In previous years, this trade helped establish and strengthen relationships with communities in Unity. The importance of trading and what have been dubbed "peace markets" in restoring north-south community relations towards the end of the war has been well documented from the point of view of southern communities (e.g., Nyaba 2002; Ryle 1994).

In some areas, movement of pastoralists and traders has been directly affected by the heightened tensions and conflict between north and south over the border. In these areas, it appears that there has been a shift in the control of grazing agreements from local level negotiations to state governments. Craze's interviews and observations suggest that in some

places there has been a shift in the way border communities imagine and negotiate authority over the border and access to grazing. They now see access to southern grazing as an agreement between themselves and the *state-level government*, rather than southern border communities.

The raft of local agreements over north-south community relations (Malual-Rizeigat in Aweil Jan 2012; Malual-Misseriyia in Aweil Feb 2012; Misseriyia-Nuer in Bentiu March 2012) were all organised by the government (and some supported by international donors). The involvement of the state in local agreements is not new, but what seems to be new is that now it is the responsibility of the state and the police/army to oversee the implementation of the agreement. Joshua Craze records that, in some cases, for example the migrations into Unity State, movement is now only possible when monitored by the army and the police. Without this supervision, the Misseriyia are not able to move in Unity state. Many Misseriyia feel that old grazing routes into Unity are now impassable (Craze 2013, 104). This almost total breakdown of relationships and movement is a "worst-case scenario" for the border and is bound up with the fractured history of this part of Unity State (Craze 2013, 105). This indicates a hugely important shift in the way that access to grazing is negotiated. It underlines that now, more than ever, it is impossible to separate mobility from the wider political context. It underlines that pastoralist livestock mobility depends on multiple levels of governance: local governance linked to the tribal administration, state-level and national government, and the governance structures of neighbouring countries, all of whom influence the movement of pastoralists.

Chapter 7. Resilience in the face of adversity

Final remarks

The national context of this study is the increasing profile and importance of pastoralist livestock production, as a result of secession and fall in oil revenues. This has promoted increasing recognition of the contribution of livestock production to the national economy and exports, and also raised questions and concerns about the implications of the new international border with South Sudan for cross-border seasonal livestock migrations of northern pastoralists. These new national realities have prompted a general policy call in Khartoum for increasing livestock exports and modernisation of the sector, which are seen by many as inseparable from the settlement of pastoralists and the move towards mixed farming. As this report has explained, this policy edict of settlement is at odds with the now well-recognized strategic mobility of pastoralist livestock, yet reliable evidence of how actual livestock production systems operate in Sudan to present to policy makers was lacking.

At the start of this work, current methodologies to generate such evidence were found to be wanting. As succinctly expressed by Folke in 2006:

Research challenges are numerous and include efforts clarifying the feedbacks of interlinked social–ecological systems, the ones that cause vulnerability and those that build resilience, how they interplay, match and mismatch across scales and the role of adaptive capacity in this context. The implication for policy is profound and requires a shift in mental models toward human-in-the-environment perspectives, acceptance of the limitation of policies based on steady-state thinking and design of incentives that stimulate the emergence of adaptive governance for social–ecological resilience of landscapes and seascapes.

(Folke 2006, 63)

The first objective of this study therefore related to methods—the aim was to develop and pilot new methodologies for investigating livestock mobility. The innovation involved a combination of introducing new technologies—GPS tracking and longitudinal monitoring—combined with new ways of working—national and international partnerships between government, civil society, and research organizations. Both elements were considered critical to the success of this first phase or pilot.

The methodology and general approach to the research has generated important lessons about research partnerships, stakeholder networks, and “ways of working” in contexts where international research collaboration is generally weak. In this work, fostering long-term relationships with key partners and stakeholders has been crucial for four reasons. First, it has promoted the development of “demand-driven” research ideas through a process of consultation at various levels, that has fostered the active engagement and local participation of key stakeholders from the first planning phases to the final review of policy implications, recommendations, and process of dissemination. Second, it helps to ensure that local and national stakeholders directly benefit from the research findings and learning process. (There is always a risk that research is extractive—serving the purpose of outsiders with little consideration of the interests of either national or local-level stakeholders). Third, it has helped to foster national networks, encompassing academics, staff of federal and state ministries, civil society organizations from different spheres, and tribal leadership, all with shared interests in pastoralism. Finally, it has helped diminish the high degree of mistrust and suspicions on both sides of the relationship between international actors and the national authorities, by building mutual respect and understanding of the relative roles and capacities of different bodies.

While methods are not usually the main focus of reports such as this, in this case the methodological innovations represent one of the major areas of learning that will generate new

evidence with potential to reshape the policy and programmatic response to pastoralist livestock production and even agriculture. Unfortunately, there was insufficient time to undertake a complete analysis of the panel data, which would involve professional statistical modeling. Neither the full data set nor the time and resources for its full and proper analysis were available on completion of this study. This limitation was known at the start of the study.

Apart from the methodological innovation and pilot testing, the significance of this initial work and pilot lies in three areas:

1. **A field-based review of natural resource governance**, and in particular how the pastoralist production systems in this study interface with the local, regional, and national context. Chapters 3 and 4 provide examples of how local institutions and customary laws and principles operate in tandem with the civil administration and wider federal context in the management of water resources, livestock corridors, and access to pastures. This newly available knowledge and understanding of local institutions and management of resources, while limited, nevertheless addresses a gap in current understanding, and challenges misconceptions about livestock mobility; for example, the notion that livestock are moving in an uncontrolled and non-strategic manner.
2. **The crucial importance of livestock mobility for the productivity of herds**, based on a review of the available evidence on livestock production systems, and most importantly studying the actual herd management practices and livestock mobility patterns of a number of herds in western Sudan. A literature review of the performance of the migratory herd in Sudan and across Africa indicates that, at every point of comparison, migratory animals outperform sedentary cattle (in terms of calving rates, age of calving, mortality, and meat production). The literature describes the pronounced seasonality of cattle sales coinciding with their

proximity to markets, in July and August when animals move south, and again when they return north in October and November. An actual representation of livestock mobility patterns based on GPS data, combined with in-depth panel data, illustrates how the pastoralist livestock production systems of western Sudan function. Chapter 5 contrasts the new methodology of GPS tracking with retrospective methods. This study has shed light on spatial daily and seasonal pattern of livestock movements. At the same time, the GPS data offer the potential for interpreting animal movement in relation to key resources and conditions, including conflicts, across the rangelands. Moreover, this approach could play a significant role in guiding future intervention for developing livestock services in both states.

3. **An increasing understanding of the resilience of pastoralist production systems** that differentiates between environmental, economic, and socio-political sustainability. The environmental sustainability of pastoralist production hinges on strategic mobility—the timely and reliable access to pasture when nutrients peak. As explained in the first study, this access depends on access to water, specialized stock, and access to fertile rangelands within certain seasons (such as the dry-season grazing reserves in South Sudan, or the rainy season grazing reserves on the fringes of the Sahara). It also depends on specialized human resources and institutions for managing this system. These environmental and social parameters of pastoralism have been well captured in this study.

The adaptation of pastoralist livestock production to the environmental context of Sudan is beyond question given the highly strategic pattern of mobility adapted to target the pastures when nutrients peak, and also the responsiveness of pastoralist producers to the national domestic and export market demands,

which are impressive to say the least. The conclusion of this report is that pastoralist systems are as technically sophisticated and effective as any “modern” commercial scheme for distributing and re-distributing grazing animals over space and time.

However, while the environmental bedrock of the production system has been proven, the realities of climate change represent an imminent and largely uncalculated challenge⁴⁵. Recent analyses of over 100 years of historical rainfall data in Sudan conclude that “any evidence of a persistent and coherent regional trend of diminishing rainfall is obscure” (Hermance 2014), yet there is clear evidence of “highly localized, interseasonal, interannual and multiannual variability of rainfall” (Ibid., 23). Herders try to turn these features into an advantage (in erratic or delayed seasons, grass reaches its best nutritional value in different places at different times and, by moving across rangelands, herds optimize their utilization).

Of immediate and ongoing concern are the continuing risks and hazards facing pastoralists and pastoralist production associated with weak and failing institutions, and thus failing governance, in multiple domains, and the myriad challenges as a result of multiple levels of conflict that directly and indirectly affect pastoralists.

Recommendations

The recommendations focus on issues that emerged from this stage of the study. The preliminary nature of the recommendations is also a result of the recognition of the need for partners and stakeholders to carefully review each of these areas in relation to their own interests and capacities, and shape these recommendations as their own. Each of the issues is addressed from three perspectives: (a) policy/legal framework; (b) investment/direct intervention; and (c) research. The recommendations are, respectively, for: (a) state-level and federal institutions; (b) development actors and donors at national and international level; and (c) higher education institutions and other national and international organizations promoting research.

Issue 1. Misconceptions of pastoralism: shifting the mental map

Within a wide range of policies, programmes, and peace processes in Sudan, perceptions of pastoralism are stuck in an outdated and wholly inaccurate paradigm, that either assume a more stable and uniform distribution of resources than exists in reality, or, alternatively, pastoralism is equated with cultural values and traditions, while largely ignoring the pastoralist production system itself (possibly because it is not well understood). In the Darfur region, in recent peace agreements, pastoralism is conflated with the situation of IDPs, with pastoralists threatening the process of returns and humanitarian access. As part of the herder-farmer conflict dynamic, the situation of pastoralist producers tends to be ignored, with the policy focus on increasing agricultural production. The gap between the policy context and the practice of pastoralism is vast, and a realignment of policy adapted to the realities on the ground is urgently needed.

New knowledge and understanding needs to be embedded within a wide range of institutions through a long-term process of co-learning and capacity development of different categories of institutions, ranging from universities and technical institutes, government bodies at federal, state, and locality level, and civil society, representing a wide range of constituencies and the international presence working in Sudan. While this might seem ambitious and even extravagant, the rewards and potential for positive change are enormous—ranging from integrated multi-sectoral development planning to conflict resolution and peace-building at multiple levels.

Policy/legal framework: Re-orienting policies, laws, and institutions to a new understanding of pastoralism requires strategic targeting of institutions, development planners, and decision-makers and supporting them with new evidence and analysis.

Direct intervention: As a consequence of this new way of looking at and understanding pastoralist livestock migration, planning of service delivery

⁴⁵ For more information see Nassef, Anderson, and Hesse 2009.

and distribution should be in line with the actual practices of pastoralists, thus promoting more appropriate and sustainable systems.

Research and learning: The full analysis of the panel data over a complete calendar year will reveal the complex relationships between natural resources, livestock movements, and the wide range of external factors that are either supporting or undermining this pastoralist system of production.

Issue 2. Recognizing positive modernising trends and adaptations

The resilience of pastoralist production systems partly lies in the modernising trends and adaptations evident in the systems in this study. These include, for example:

- The introduction of mobile water transporting means such as tankers and bladder tanks that enable access to pasture that would be otherwise unavailable;
- Investment strategies that reflect the regional market demand for sheep. In North Kordofan, over the past 35 years the proportion of sheep in the regional herd has increased nearly fivefold;
- The expansion of the cattle herders in eastern Darfur to mixed herds, including sheep, and the introduction of a sheep cross-breed adapted to the higher rainfall and clay soils, yet still producing meat of similar quality and taste to the desert sheep;
- The widespread careful targeted use of feed supplements during the dry season;
- The careful avoidance of zones of conflict that entail long diversions, and additional efforts to minimize conflicts with farmers when passing through densely cultivated areas by fostering better relations, making agreements, etc.;
- The privatization of a wide range of support services, as illustrated by the temporary summer markets in the south of East Darfur;
- Over a relatively short period, the use of mobile phones by pastoralists has become ubiquitous, with simple local systems for recharging. Information and communications are vital for economic, environmental, and security reasons, and

this change has undoubtedly shaped the way pastoralists do business.

Earlier work by Tufts highlighted that not all “modernising trends” were positive, and in conflict settings were often damage containment solutions and even potentially mal-adaptive, in that they incurred further damage or otherwise undermined local livelihoods (Young et al. 2009). It is therefore crucial that modernising trends are carefully analysed to ascertain their sustainability in the longer term.

Policy/legal framework and direct intervention:

While these examples may be partially known by policy makers, their full implications are not well understood, and thus are not incorporated or reflected in the wider policy and programmatic domains. For example, the role of the private sector appears to be much greater than generally appreciated, yet how that private sector is performing and the constraints faced are not part of the policy debate. Herders need to be encouraged to invest in basic services. Such services may include buying of vehicles and sending children to school.

Research and learning: Building on the first issue, policy makers need an accurate and detailed picture of these evolving trends and adaptations combined with an understanding of pastoralist livestock production, so that positive developments might be identified and supported, while effectively mitigating negative trends. Thus contrasts can be better understood and efforts to mitigate them can be initiated.

Issue 3. The commodification of communally managed pastoral natural resources

The commodification of a resource opens it up to the global market, and thus turns resources defined by local users into resources defined by the market (which are controlled by other users and their forms of use). Where there is an imbalance in purchasing power and political influence, this process of commodification can lead to the loss of it to the weaker party. The process of commodification of natural resources in both states is ongoing; for example, the fencing of rangelands or charging for grazing of crop residues, or the contrast between communal management of water (e.g., shallow-dug wells)

and the privatized or public (government-owned) mechanized provision of water in the dry season through wateryards. In both states, the management of wateryards and use of the income generated has been contentious, with different situations evolving in each state.

Policy/legal framework and direct intervention:

This area of policy and direct intervention has been treated differently in both states, and there needs to be an opportunity for cross-learning and sharing of experiences, involving both government bodies, and also civil society who are actively engaged in this sector.

Research and learning: With the exception of the work by Osman (2013), there has been little or no attention to the issues of commodification of communally managed resources. This has major implications for local livelihoods and local economies, and the integration of different livelihood systems.

Issue 4. A new “parametric” approach to resource management

There would appear to be a significant number of rangeland management success stories involving co-management of resources by pastoral communities, local government, and other resource users. In the absence of effective and relevant national policy, it would appear that local experimentation has taken off. These experiments are diverse—as are the issues they address and the local areas in which they operate. Examples are given in the report of local-level “parametric” systems of natural resource management that regulate stocking densities by either adjusting periods of use, restricting water availability, or providing access to alternative grazing resources. Conversely, these systems do not attempt to calculate or impose stocking rates. The success of local governance regimes based on regulating access, and hence stocking densities, is an important lesson and provides an alternative approach to controlling numbers.

Policy/legal framework and direct intervention:

This experience of local-level natural resource management provides a hitherto undocumented example in Sudan of current natural resource management systems that appear to be functioning in an otherwise extremely

challenging environment. This experience needs to be better recognized, and attention given to protecting and upholding it—particularly where new interventions or policies are being planned.

Research and learning: These results are preliminary and further research is needed to document and evaluate the factors that lead to successful and unsuccessful outcomes in Sudan, so as to inform policy makers and to reduce the gap between policy and practice.

Issue 5. Recognizing the multi-dimensional character of land accessed by pastoralists

Land in Darfur and North Kordofan plays multiple roles and functions and is often shared by different users throughout the year. Land that functions as a suitable habitat for livestock production may be shared by different livestock species; for example, camels migrate southwards during the dry season using the grazing area in the south of North Kordofan, during which time the cattle are further south. Then as the camels head northwards during the rainy season, the cattle return to replace the camels in that same area.

Similarly, in parts of Darfur, particularly fertile land may have multiple users who alternate their use of the same land throughout the year. This might include the main rainy season planting and harvest, followed by livestock grazing crop residues during the post harvest period, and last, if irrigation allows, a winter season cultivating vegetables (Osman et al. 2013). Thus the same area of land might support several users and multiple livelihood systems that by their nature are integrated.

Chapter Six explains how access to rangelands is often the consequence of tribal and political alliances, or alternatively rangeland may be inaccessible because it falls within a region under the control of rebel forces, or a rival or competing tribal group. The structural links between land, political allegiance, and tribal power are historical, and in modern times tribal power has evolved as a result of the re-organization of administrative boundaries, the creation of new tribal homelands, and the strategic positioning of tribal members in official positions. The case study of East Darfur, and specific example of tribal conflict between the

Rizeigat and Ma'aliya, illustrates how these issues conspire to block or at least undermine pastoralist livestock mobility. It is difficult to see how such conflicts can be resolved until the root causes are properly understood.

From the perspective of their production system, pastoralists are not after territory; they are instead seeking access to different kinds of resources that may be located in different places from season to season or from year to year. This makes for both problems and opportunities. In a system of resource access based on territorial exclusivity, the fleeting nature of pastoral resources creates chronic conflict as groups jostle each other and reposition themselves relative to shifting resource distributions. In such a situation, pastoralists make for uncomfortable neighbours. On the other hand, in a system based on resource sharing, pastoralists can often be accommodating partners in resource use since their needs are limited to certain time periods and kinds of resources, leaving the rest of the year and non-pastoral resources to others. Since they are specialized economically, pastoralists may also welcome non-pastoral neighbours as producers of trade goods that pastoralists need. Consideration needs to be given to the role of the larger political setting in “flipping” pastoral resource management strategies back and forth from mutualism and resource sharing to aggressive and often quite violent territoriality.

Policy/legal framework: Recent peace agreements either oversimplify or ignore the root causes of tribal and natural resource conflict, which limits any debate as to how the work of the Land Commissions might influence the links between tribal power, land, and conflict for the better or worse. The co-existence of multiple users of an area of land, and thus overlapping rights, needs to be more widely acknowledged and taken in consideration.

Direct intervention: There are many peace-building initiatives seeking to resolve natural resource conflict or build increased awareness and understanding between groups. Many of these implicitly deal with these deeper issues, although their implicit nature hinders any wider debate. A more informed approach might facilitate local solutions by local actors.

Research and learning: The impact of conflict blocking livestock migrations is rarely considered in humanitarian and other assessments, yet this potentially has a significant impact on pastoralists' humanitarian needs, their food security, local livelihoods, and relations with other groups. More work is needed on this area, and in particular on herder adaptations in the face of blocking of livestock mobility; in other words, how herders manage their herds and their livelihoods in such situations.

This report argues that for pastoralist policy to be evidence based, there is an urgent need to conduct similar longitudinal studies of longer duration, in order to properly understand the regional integration upon which pastoralism is based. This potentially represents a significant gap in understanding, or missing piece, in the analysis of the link between natural resources, livelihoods, and resilience and its links with conflict and insecurity at all levels. Such knowledge is crucial for the development of strategies for Sudan's economic future, and for peace and reconciliation from the local level upwards.

References

- Acheson, J., and J. Wilson. 1996. Order out of chaos: the case for parametric fisheries management. *American Anthropologist* no. 98 (3):579–594.
- Adriansen, H., and T. Nielsen. 2005. The geography of pastoral mobility: a spatio-temporal analysis of GPS data from Sahelian Senegal. *GeoJournal* no. 64:177–188.
- Asad, Talal. 1964. Seasonal movements of the Kababish Arabs of Northern Kordofan. *Sudan Notes and Records* no. 45:49–58.
- Asad, Talal. 1970. *The Kababish Arabs: Power, Authority and Consent in a Nomadic Tribe*. London: Hurst.
- Asad, Talal. 1976. Seasonal Movement of the Kababish Arab of Northern Sudan. In *Some Aspects of pastoral Nomadism in the Sudan*, edited by Abdal Ghaffar M. Ahmed. Khartoum: Sudan National Population Committee and The Economic and Social Research Council.
- AU. 2009. Darfur: The Quest for Peace, Justice and Reconciliation. In *Report of the African Union High-Level Panel on Darfur (AUPD)*, edited by Africa Union. Addis Ababa, Ethiopia: African Union.
- Bahadur, Aditya V., Maggie Ibrahim, and Thomas Tanner. 2010. The resilience renaissance? Unpacking of resilience for tackling climate change and disasters. In *Strengthening Climate Resilience Discussion Paper 1*. Brighton: Institute of Development Studies.
- Behnke, R., M. Fernandez-Gimenez, M. Turner, and Stammler F. 2011. Pastoral migration: mobile systems of animal husbandry. In *Animal Migration: A Synthesis*, edited by E. Milner-Gulland, Fryxell, J. and Sinclair A., 144–171. Oxford: Oxford University Press.
- Behnke, R., and Abel N. 1996. Revisited: the overstocking controversy in semi-arid Africa, a series of three papers: Intensification or overstocking: when are there too many animals? Stocking rates for African pastoral systems, and sustainability and stocking rate on African rangelands. *World Animal Review* no. 87 (2):3–27.
- Behnke, Roy. 2012. The economics of pastoral livestock production in Sudan. Medford, MA, USA: Feinstein International Center, Tufts University and United Nations Environment Programme.
- Behnke, Roy H. 1985a. Open-range management and property rights in pastoral Africa : A case of spontaneous range enclosure in South Darfur, Sudan. London: Overseas Development Institute, Pastoral Development Network.
- Behnke, R. 1985b. Rangeland development and the improvement of livestock production: Policy issues and recommendations for the Western Sahara Project. Makoro Ltd: Brill.
- Behnke, Roy, and Hala Mohamed Osman. 2010. The Contribution of Livestock to the Sudanese Economy. In *IGAD LPI Working Paper No. 01 - 12*: IGAD Livestock Policy Initiative, Odessa Center.
- Briske, D., J. Derner, J. Brown, S. Fuhlendorf, W. Teague, K. Havstad, R. Gillen, A. Ash, and W. Willms. 2008. Rotational grazing on rangelands: Reconciliation of perception and experimental evidence. *Rangeland Ecology and Management* no. 61:3–17.

- Butt, B. 2010. Pastoral resource access and utilization: Quantifying the spatial and temporal relationships between livestock mobility, density, and biomass availability in southern Kenya. *Land Degradation and Development* no. 21 (6):520–539.
- Christian, C. 1958. The concept of land units and land systems. *Proceedings Ninth Pacific Science Congress* no. 20:74–81.
- Concordis International. 2010. More than a Line: Sudan's North-South border. Concordis International.
- Coppolillo, P.B. . 2000. The landscape ecology of pastoral herding: Spatial analysis of land use and livestock production in East Africa. *Human Ecology* no. 28 (4):527–560.
- Craze, Joshua. 2013. Dividing lines: Grazing and conflict along the Sudan-South Sudan border. Geneva: Small Arms Survey.
- DFID. 2011. Defining Disaster Resilience: A DFID Approach Paper. London: UKAid from the Department for International Development.
- Doxiadis, S., and R. S. Lourie. 1965. Land and water use survey in Kordofan Province of the Republic of Sudan: The project area's nomadic tribes. Athens: Doxiadis Associates.
- Egemi, Omer. 2013. Pastoralist peoples, their institutions and related policies. In *Working Paper Series*, edited by Helen Young and Laura Banks. Medford, MA, USA: Feinstein International Center, Tufts University.
- El Dirani, Omar Hassan, Mohammed A. Jabbar, and Idris Babiker Babiker. 2009. Constraints in the market chains for export of Sudanese sheep and sheep meat to the Middle East. Addis Ababa, Ethiopia: International Livestock Research Institute, Ministry for Animal Resources and Fisheries (Government of Sudan).
- El Hassan, B. A., and I. Birch. 2008. Securing pastoralism in East and West Africa: Protecting and promoting livestock mobility. Sudan desk study. Draft.
- El-Hag, F. M. A., A. A. Khatir, F. H. El. Jack, M. A. Mekki, and M. D. Ahmed. 2012. Livestock breed characterization in the Kordofan Region. Federal Ministry of Agriculture, Western Sudan Resource Management Programme (WSRMP).
- El-Sammani, M., B. Abdalla, G. Tateb, and M. Suliman. 1984. Nomads of the Semi Desert Belt of Northern Kordofan and Darfur Regions: Vol. 1 Study of Sodiri District. In *Economic and Social Research Council Research Report. Khartoum*. Khartoum: ESRC.
- Fahey, Dan, and David K. Leonard. 2007. The political economy of livestock and pastoralism in Sudan. *IGAD LPI Working Paper No. 06 - 08*.
- Fancy, S., L. Pank, D. Douglas, C. Curby, G. Garner, S. Amstrup, and W. Regelin. 1988. Satellite telemetry: a new tool for wildlife research and management. In *Fish and Wildlife Resource Publication 172*. Washington D.C.: U.S. Department of Interior.
- FAO/UNDP CRMA. 2010. Socio-economic mapping of pastoralist livelihoods Darfur. Powerpoint presentation.
- Fitzpatrick, Merry, and Helen Young. 2013. Livestock, Livelihoods and Disaster Response: Part One: A Review of Livestock-Based Livelihood Projects in Sudan. Feinstein International Center, Tufts University, SOS Sahel Sudan, Ministry of Livestock, Fisheries and Range. United Nations Environment Programme

Flint, Julie. 2010. *The Other War: Inter-Arab Conflict in Darfur*. Switzerland.

Folke, C. . 2006. Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses. *Global Environmental Change* no. 16:253–67.

Gaiballa, A. Karamalla. 2013. Natural resources, governance and pastoralism in Sudan. In *A Policy Review on Pastoralism in Sudan. Working Paper Series*, edited by Helen Young, Laura Banks and Merry Fitzpatrick: Feinstein International Center, Tufts University.

Gebbru, Getachew, Hanan Yousif, Abdelhafiz Mohamed, Belihu Negesse, and Helen Young. 2013. *Livestock, Livelihoods and Disaster Response: Part Two: Three Case-Studies of Livestock Emergency Programmes in Sudan; and Lessons Learned*. Medford, MA, USA: Feinstein International Center, Tufts University, United Nations Environment Programme.

Gopen, C.E. 1958. *The Pastoral Fulbe Family in Gwandu*. London: OUP for the International African Institute.

Gordon, Carey N. 1986. Recent Developments in the Land Law of the Sudan: A Legislative Analysis. *Journal of African Law* no. 30 (2):143–174.

GoS. 2008. *Agriculture and Articulate a Future Vision and Action Plan for Agricultural Revival: Executive Programme for Agricultural Revival*. Khartoum: Republic of Sudan Council of Ministers General Secreteriat.

GoS/NCSP. 2007. *The Five Year Plan for Sudan (2007–2011)*. National Council for Strategic Planning (NCSP).

GOS/SPLM. 2004a. Chapter 3. Wealth Sharing signed at Naivasha , Kenya on 7th January, 2004. *The Comprehensive Peace Agreement between the Government of Sudan and the Sudan People's Liberation Movement/Sudan People's Liberation Army*.

GOS/SPLM. 2004b. Protocol Between The Government Of The Sudan (Gos) And The Sudan People's Liberation Movement/Army (Splm/A) On The Resolution Of Abyei Conflict, signed at Naivasha, Kenya May 26th, 2004.

Gramizzi, Claudio, and Jérôme Tubiana. 2012. *Forgotten Darfur: Old Tactics and New Players*. In *Small Arms Survey*.

Hart, K., and K. Hyrenbach. 2009. Satellite telemetry of marine megavertebrates: the coming of age of an experimental science. *Endangered Species Research* no. 10:9–20.

Hermance, John F. 2014. *Historical variability of rainfall in the African East Sahel of Sudan. Implications for Development, SpringerBriefs in Earth Sciences*. Rehoboth: Springer.

HTS. 1974a. *Southern Darfur Land-Use Planning Survey: Annex 1. Soil and Vegetation Resources*. Khartoum: Hunting Technical Services, Ministry of Agriculture Food and Natural Resources, Borehamwood, UK.

HTS. 1974b. *Southern Darfur Land-Use Planning Survey: Annex 3. Animal Resources and Range Ecology*. Khartoum: Hunting Technical Services, Ministry of Agriculture Food and Natural Resources, Borehamwood, UK.

HTS. 1976a. *Savanna Development Project Phase II: Livestock and Range*. Hunting Technical Services, Borehamwood, UK.

HTS. 1976b. *Savanna Development Project Phase II: Livestock Marketing*. Hunting Technical Services and FAO, Borehamwood, UK.

- HTS. 1981. South Darfur Rural Development Project: Livestock and Range Development Programme 1981–1984. Hunting Technical Services, Borehamwood, UK.
- HTS. 1983. Savannah Development Project: Report on a Visit by Consultant Livestock Specialist April–May 1983. Khartoum: Ministry of Agriculture, Food and Natural Resources, Borehamwood, UK.
- HTS. 1986. An Indicative Land Use Plan for the Western Savannah Project. Western Savannah Development Corporation, Nyala, South Darfur. Hunting Technical Services (under assignment by the Overseas Development Administration), Borehamwood, UK.
- ICG. 2010. Sudan: Defining the North South Border. Policy Briefing. Juba/Khartoum/Nairobi/Brussels: International Crisis Group.
- ICG. 2011. Politics and Transition in the New South Sudan. Africa Report No. 172. Nairobi: International Crisis Group.
- ICG. 2013. Sudan's Spreading Conflict (I): War in South Kordofan. In Africa Report No. 198: International Crisis Group.
- IFAD. 2011. A base-line livestock survey Kordofan Region 2010. Unpublished records. International Fund for Agricultural Development.
- Keen, David. 1994. *The Benefits of Famine: Political Economy of Famine and Relief in Southwestern Sudan, 1983–1989 (Hardcover)*. Princeton University Press.
- Kerven, C. 1987. The role of milk in a pastoral diet and economy: The case of South Darfur, Sudan. Addis Ababa: International Livestock Centre for Africa (ILCA), Bulletin no. 27.
- Michael, B. E. 1987. Milk Production and Sales by the Hawazma (Baggara) of Sudan. *Research in Economic Anthropology* no. 9:105–141.
- Milner, Christopher. 2012. Crossing the line: transhumance in transition along the Sudan South Sudan border. Concordis International.
- Milner-Gulland, E. J., John M. Fryxell, and Anthony R. E. Sinclair. 2011. *Animal Migration: A Synthesis*. USA: Oxford University Press.
- Mohamed, Yagoub Abdalla, and Omer A Egemi. 2012. Environmental Governance in Sudan. An Expert Review. Khartoum: United Nations Environment Programme.
- MONEC. 2003. Pastoralist Baseline Survey, Greater Darfur. Al Massar Charity Organization for Nomads & Environmental Conservation (MONEC).
- Moritz, M., E. Soma, P. Scholte, N. Xiao, L. Taylor, T. Judran, and S. Kari. 2010. An integrated approach to modelling grazing pressure in pastoral systems: the case of the Logone Floodplain (Cameroon). *Human Ecology*. no. 38 (1):775–89.
- Nassef, Magda, Simon Anderson, and Ced Hesse. 2009. Pastoralism and climate change: enabling adaptive capacity. London: Humanitarian Policy Group, Overseas Development Group.
- Nyaba, Peter Adwok. 2002. Report of the Trade Consultancy Conducted in Northern Bahr el Ghazal. Nairobi: Save the Children.
- Ocaido, M., R. T. Muwazi, and J. Asibo Opuda. 2009. Financial Analysis of Livestock Production Systems around lake Mburo National Park, in South Western Uganfa. *Livestock Research for Rural Development* no. 21 (5).

Odhiambo, Michael. 2006. Review of the Literature on Pastoral Economics and Marketing: Kenya, Tanzania, Uganda, and the Sudan. Nairobi: RECONCILE.

Osman, Abdal Monium Khidir. 2013. *Agricultural Change, Land and Violence: An Examination of the Region of Darfur, Sudan*. Medford, MA, USA: Gerald J. & Dorothy R. Friedman School of Nutrition Science and Policy, Tufts University.

Osman, Abdal Monium K., Helen Young, Robert F. Houser, and Jennifer C. Coates. 2013. *Agricultural Change, Land, and Violence in Protracted Political Crisis. An examination of Darfur*. In *Oxfam America Research Backgrounder series*. Boston: Oxfam America.

Pantuliano, Sara, Omer Egemi, Babo Fadlalla, Mohammed Farah, and Mohammed Elamin Abdelgadir. 2009. *Put Out to Pasture: War, Oil and the Decline of the Misseriyya*. London: Overseas Development Institute.

Penning de Vries, F. W. T, and M. Djitéye. 1982. *La Productivité des Pâturages Sahéliens*. Wageningen: Centre for Agricultural Publishing and Documentation.

Radio Dabanga. 2013a. *Bloody tribal clashes leave 'hundreds dead, many wounded' in East Darfur*. August 11.

Radio Dabanga. 2013b. *Death toll of Ma'alia-Rizeigat clashes in East Darfur reaches 305*.

Radio Dabanga. 2013c. *Sudan State of Emergency Declared in East Darfur -Governor*. 25 August 2013.

Radio Dabanga. 2013d. *Sudan: Breaking - Nyala Locked-Down After Fighting, Looting in South Darfur Capital*.

RadioDabanga. 2013e. *Rizeigat: Potential conflict at Sudan border over grazing rights*. 1 February 2013.

Radio Tamazuj. *Ma'aliya warn of land tensions with Rizeigat*. 25 July 2013. Available from <https://radiotamazuj.org/en/article/ma%E2%80%99aliya-warn-land-tensions-rizeigat>.

Reid, R., H. Gichohi, M. Said, D. Nkedianye, J. Ogutu, M. Kashatriya, P. Kristjanson, S. Kifugo, J. Agatsiva, S. Adanje, and R. Bagine. 2008. Fragmentation of a peri-urban savanna, Athi-Kaputiei Plains, Kenya. In *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*, edited by K. Galvin, R. Reid, R. Behnke, and N. T. Hobbs, 195–224. Dordrecht: Springer.

Rutz, Christian, and Graeme C. Hays. 2009. New frontiers in biologging science. *Biology letters* no. 5 (3):289–92.

Ryle, John, and Bapiny Tim Chol. 1994. *The Price of Survival*. Bright Star Productions.

Sandford, Stephen. 1983. Management of pastoral development in the Third World. In *Public Administration in Developing Countries*. John Wiley & Sons Limited.

Schareika, N., F. Graef, and M. Moser. 2000. Pastoral migration as a method of goal-oriented and site-specific animal nutrition among the Wodaabe of South-eastern Niger. *DIE ERDE* no. 131:311–329.

Scoones, Ian, and William Wolmer. 2006. *Livestock, Disease, Trade and Markets: Policy Choices for the Livestock Sector in Africa*. Working Paper 269. Institute of Development Studies.

Shazali, Salah, and Abdel Ghaffar M. Ahmed. 1999. *Pastoral land tenure and agricultural expansion: Sudan and the Horn of Africa*. FAO.

- Siddig, El Fatih Ali, Khalid El-Harizi, and Bettina Prato. 2007. Managing Conflict Over Natural Resources in Greater Kordofan, Sudan: Some Recurrent Patterns and Governance Implications. In *IFPRI Discussion Paper 00711*: International Food Policy Research Institute.
- Sonneveld, B. G., M. Keyzer, K. Georgis, S. Pande, A. Ali, and T. Takele. 2009. Following the Afar: using remote tacking systems to analyse pastoralists' trekking routes. *Journal of Arid Environments* no. 73 (11):1046–1050.
- Spaulding, Jay. 2006. Pastoralism, Slavery, Commerce, Culture and the Fate of the Nubians of Northern and Central Kordofan under Darfur Rule ca. 1750–ca. 1850. *International Journal of African Historical Studies* no. 39 (3):393–412.
- Stenning, D. J. 1957. Transhumance, migratory drift, migration: patterns of pastoral Fulani nomadism. *Journal of the Royal Anthropological Institute* no. 8 (1):57–3.
- Sudan Tribune. 2013a. *Sudan Livestock Exports Almost Double in 2012, Minister says*. 12.02.2013.
- Sudan Tribune. 2013b. *Sudan: Bashir tells East Darfur Governor to Prevent Tribal Violence*.
- Takana, Yousif. 2008. *The Politics of Local Boundaries and Conflict in Sudan: The South Darfur Case, Sudan Working Paper*: Chr. Michelsen Institute (CMI).
- Tanner, Victor. 2006. *Soil and Oil: Dirty Business in Sudan*. Washington D.C.: Coalition of International Justice.
- Tietenberg, Tom, and Lynne Lewis. 2011. *Environmental & Natural Resources Economics: International Edition*. 9th ed: Pearson.
- UNEP. 2012. *On the Hoof Livestock Trade in Darfur*. Feinstein International Center, Tufts University and United Nations Environment Programme.
- UNEP. 2013. *Standing Wealth. Pastoralist Livestock Production and Local Livelihood in Sudan*. Khartoum: Feinstein International Center, Tufts University, United Nations Environment Programme, SOS Sahel Sudan, Ministry of Animal Resources Fisheries and Range, Nomad Development Council.
- UNOCHA. 2013a. *Humanitarian Bulletin. Sudan, 16–22 September 2013*. OCHA Sudan.
- UNOCHA. 2013b. *Humanitarian Bulletin. Sudan, 26 August–1 September*. OCHA Sudan.
- Wilson, R. T., and S. E. Clarke. 1976. Studies on the livestock of Southern Darfur, Sudan II. Production Traits in Cattle. *Tropical Animal Health Production* no. 8:47–51.
- World Bank 1985. *Staff Appraisal Savannah World Bank , Sudan Western Savannah Project—Phase II*. World Bank, Washington D.C..
- Young, H. 2009. Pastoralism, Power and Choice. In *Environment and Conflict in Africa: Reflections on Darfur*, edited by Marcel Leroy. Addis Ababa: United Nations University for Peace.
- Young, Helen, Abdal Monium Osman, Ahmed Abusin, Michael Asher, and Omer Egemi. 2009. *Livelihoods, Power and Choice: The Vulnerability of the Northern Rizaygat, Darfur*. Medford MA: Feinstein International Center, Tufts University.
- Young, Helen, Abdal Monium Osman, Yacob Aklilu, Rebecca Dale, Babiker Badri, and Abdal Jabbar Fuddle. 2005. *Darfur—Livelihoods Under Siege*. Medford, MA, USA: Feinstein International Famine Center, Tufts University.

Young, Helen, Abdalmonium el Khider Osman, Margie Buchanan-Smith, Brendan Bromwich, Karen Moore, and Stacey Ballou. 2007. Sharpening the Strategic Focus of Livelihoods Programming in the Darfur Region. A report of four livelihoods workshops in the Darfur region (June 30 to July 11, 2007). Medford, MA, USA: Feinstein International Center, Tufts University.

Zaroug, Mahgoub G. 2011. Volume I: Background. In *Natural Resources Management Strategy*.: Western Sudan Natural Resources Management Programme. IFAD.

Acronyms

AUPD	African Union High-level Panel For Darfur
CPA	Comprehensive Peace Agreement
DDPD	Doha Document for Peace in Darfur
DPA	Darfur Peace Agreement
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GoNU	Government of National Unity
GPS	Global Positioning System
ICG	International Crisis Group
IDP	Internally Displaced People
IFAD	International Fund for Agricultural Development
JEM	Justice and Equality Movement
MAAR	Ministry of Agriculture and Animal Resources
NCP	National Congress Party
NGO	Non-Governmental Organisation
NK	North Kordofan
PDF	Popular Defense Force
SDG	Sudanese Pound
SPLA	Sudan People's Liberation Army
SPLM	Sudan People's Liberation Movement
SPLM/N	Sudan People's Liberation Movement/North
SRF	Sudan Revolutionary Front
SWC	State Water Corporation
TLU	Tropical Livestock Unit
UNISFA	United Nations Interim Security Force for Abyei
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNEP	United Nations Environment Programme
USD	United States Dollar

Glossary

<i>abbala</i>	camel herders
<i>abu shalembo</i>	foot and mouth disease that affects cattle, goats, and sheep
<i>adda</i>	clay ground that holds water after rains (known as <i>al bouta</i> in North Kordofan)
<i>al angaib</i>	young shepherd
<i>al gitar al fas</i>	private sector-managed water sources
<i>Almurhal Alwastani</i>	Central Livestock Corridor
<i>baggara</i>	cattle herders
<i>bir</i>	very deep wells and boreholes
<i>boroya</i>	local term given to pasturelands in the East Darfur southern frontier
<i>ced</i>	dams
<i>dahal/ duhuul</i> (pl.)	a big pond formed within a riverbed when the river currents have reduced or ceased
<i>dahara</i>	elevated locations
<i>damara</i>	dry-season grazing at southern permanent water points
<i>dammer</i>	semi-permanent settlements of pastoralists
<i>dar</i>	tribal homeland
<i>delef</i>	footrot
<i>donki/duvanki</i> (pl.)	wateryard (motorized water station)
<i>edd/edad</i> (pl.)	shallow-dug wells in river beds or close to permanent water sources
<i>farig</i>	temporary pastoralist camp
<i>faza'a</i>	posse that chases livestock thieves
<i>ghanama</i>	owners or producers of sheep herds
<i>gizu</i>	ephemeral desert pastures
<i>hafir</i>	seasonal water reserve
<i>hakura/ hawakeer</i> (pl.)	tribal traditional land ownership rights in Darfur
<i>hashee</i>	four-year-old female camel
<i>hidara</i>	government-managed water resources
<i>khabeer</i>	shepherd who specializes in pasture
<i>khalta</i>	mixture of maize, vitamins, and minerals
<i>khalwa</i>	pre-school, for teaching the Holy Koran
<i>kharif</i>	wet season
<i>kheiran</i>	water courses
<i>lagna' mushtarika</i>	joint committee that includes all sides, e.g., representatives from both sides of the border
<i>lagna' shabiyya</i>	local popular committee

<i>madmuun</i>	two-year-old heifer or steer
<i>mandoub</i>	prominent local citizen
<i>mugalaja</i>	buying, fattening, and selling lambs as a source of income
<i>mukhamas</i>	1 <i>mukhamas</i> = 1.8 acres or 0.73 <i>ha.</i>
<i>munshag</i>	movement during the early rainy season to follow the greening of the pastures
<i>murah</i>	livestock herds
<i>murahaleen</i>	tribal militias
<i>murhal/ marhal</i>	livestock route or corridor
<i>mushraa</i>	a collection of boreholes
<i>muwaata</i>	the most southerly point of a migration cycle
<i>nazir</i>	highest level of tribal administration for Arab groups, e.g., Southern Rizeigat in Darfur
<i>nazirate</i>	either the area under the <i>nazir</i> , or the institution and authority of <i>nazir</i>
<i>nishoog</i>	second main herd movement to the north during the rainy season
<i>omda</i>	tribal leader, head of an <i>omdiya</i>
<i>ragaba/rugab</i> (pl.)	area where rainwater collects and remains as a pool during or after the rains; also applies to the area once surface water has dried up
<i>rahad/ruhuud</i> (pl.)	pools of rainwater that collect in natural depressions
<i>rijil</i>	small stream that takes water to river (known as <i>khore</i> in North Kordofan)
<i>rushash</i>	onset of the rains
<i>samin</i>	butterfat
<i>roob</i>	yogurt
<i>seif</i>	hot dry season
<i>shagg</i>	heavier soils mixed with clay
<i>sheikh elsug</i>	chief of a market
<i>shita</i>	cold dry season
<i>showgara</i>	first main herd movement in response to early rains
<i>tabareg</i>	an earthen water tank
<i>talaig</i>	the time when post-harvest crop residues are made available for grazing by livestock
<i>taya</i>	a place where a herd overnights
<i>thaniya/thawani</i> (pl.)	a deep hand-dug well, water drawn out by animals
<i>towaki</i>	small <i>rahad</i>
<i>wadi</i>	valley surrounding a seasonal watercourse
<i>wakil</i>	the person authorized and entrusted with a large herd (in this context, a herder who is directly responsible for the herd)

plants:

arad (*Acacia etbaica*)
aradeb (*Tamarindus indica*)
benu (*Eragrostis sp.*)
deresa (*Cenchrus biflorus*)
gafel (*Boswellia papyrifera*)
gaw (*Aristida spp.*)
gebesh (*Guiera senegalensis*)
habeel (*Combretum glutinosum*)
harz (*Faidherbia albida*)
hashab (*Acacia senegal*)
haskaneet (*Cenchrus biflorus*)
heglig (*Balanites aegyptiaca*)
kitr (*Acacia mellifera*)
laot (*Acacia nubica*)
marikh (*Leptadenia pyrotechnica*)
mahogani (*Khaya senegalensis*)
muhagria (*Celtis integrifolia*)
saljem (*Acacia gerrardii*)
senasena (*Cassia italica*)
sereh (*Cadaba farinosa*)
shelinee (*Zornia spp*)
sedr (*Ziziphus spina-christi*)
sunt (*Acacia nilotica*)
taleh (*Acacia seyal*)
tebaldi (*Adansonia digitata*)

Annex 1. Initial evaluation report from the GeoData Institute, University of Southampton

Introduction

An evaluation was undertaken of available technologies that could provide a suitable mobile device for longitudinal monitoring of livestock mobility. We restricted the assessment to the use of GPS Tracking, the use of collars that use global positioning system to acquire the location of the animal. Locations are logged to the device, and these can then be downloaded from the collar.

Criterion	Justification
Tracking capability	Ability to track stock across c. 100s of miles of migration. This does not need to be highly accurate (coarse GPS fix would suffice). Only need periodic fixes, c. 2 or 3 times/day might be suitable.
Relatively cheap	So that multiple devices can be deployed concurrently. Current anticipated budget of c £3,000, for multiple devices—c. 10 + ideally. Collar devices tend to be £2k–3k).
Sampling approach	Sampling of stock rather than the herder—herders may not be same person day on day, risk of loss of the device/sale etc. The potential use of mobile phones for tracking was discounted, but the option for narratives and community contributions by phone is also considered outside the tracking.
Long battery life	e.g., 100 days + (at sampling regime)/or rechargeable/solar charging
Short wake-up times	GPS devices with rapid wake-up and acquisition of fix. May need to balance between these factors to maximize sampling period.
Programmable sampling frequency	To enable device power savings.
Parameters	With parameters location, time, and possibly other parameters such as temperature, diagnostics—battery power levels
Waterproof/ weatherproof	Environmental conditions may be hard, and need to be able to withstand rain and high temperatures.
GPS based and with remote download (via SMS) GSM	Ideally systems that can up download remotely not reliant on line of sight via sms when in range. Selected over a system that relies on download following retrieval of the device – this might be a viable option.
Stored locations when not in GSM range	Ability to store records of fixes and send when in range.

Continued on next page

Potentially upload via SMS/GSM	Potential to upload data to the device to modify the sampling frequency and set details of the download.
Security	Device that does not disclose its position or cannot be interrogated or intercepted directly, so prevents herders being tracked by others.

Options:

A wide range of well-described standard collar-based systems are available with VHF-, Satellite-, or GSM-based communications for large stock monitoring. These are typically large devices, with long life power life, based on periodic wake-up and sampling frequency. They tend to be very expensive so the target has been to seek alternatives, the main challenge being the power management. A sample of systems has been compared.

Annex 2. Research schedule of visits to East Darfur and North Kordofan

Purpose	East Darfur	North Kordofan
Introductory visit to meet local stakeholders and explain the study purpose and approach and seek local approval and engagement	16–20 Feb	23–26 Feb
- Selection and recruitment of camel and sheep herders - Profiling interview - Filling retrospective yearly movement schedule	13–18 March	6–11 March
ED Biweekly outreach visit i	1–2 April	
ED Biweekly outreach visit i	15–16 April	
ED Biweekly outreach visit i	3–4 May	
NK Outreach visit ii		10–11 April
North Kordofan midterm visit - Profiling interview - Filling retrospective yearly movement schedule		5–9 May
East Darfur Midterm visit - Profiling interview - Filling retrospective yearly movement schedule - Fitting and testing of GPS devices		19–24 May
North Kordofan fitting and testing of GPS devices		26–31 May
- Data download - Recharge and check devices	23–28 June	30 Jun–2 July
Outreach visit	18–19 July	12–14 July
-Data download	16–21 September	17–20 August

Annex 3. Data downloading and analysis

The downloaded data was saved in a folder with three files:

a) Data.logg: This is GPS data—space separated and in Excel importable format. The Data.logg file must be imported to Excel from within MS Excel and must be imported as a tab and space delimited file. Figure 3.1 shows an example of data imported from EDC1 device. The excel sheet contains the following data:

WNO: GPS Week Number

TOW: Time of Week passed in the WNO

TIME: Time calculated using GPS WNO and TOW, which is UTC universal time. It is like GMT.

DATE: Date calculated using GPS WNO and TOW

DECEF_X DECEF_Y DECEF_Z: Change from last ECEF Values recorded

ECEF_X ECEF_Y ECEF_Z: Location in ECEF coordinate system

Speed: Speed in km/h

Longitude and Latitude: In decimal format

Altitude: In meters

Mode: Mode 1, long data stored (takes 18 bytes), Mode 2, short data stored in just 8 bytes to save memory.

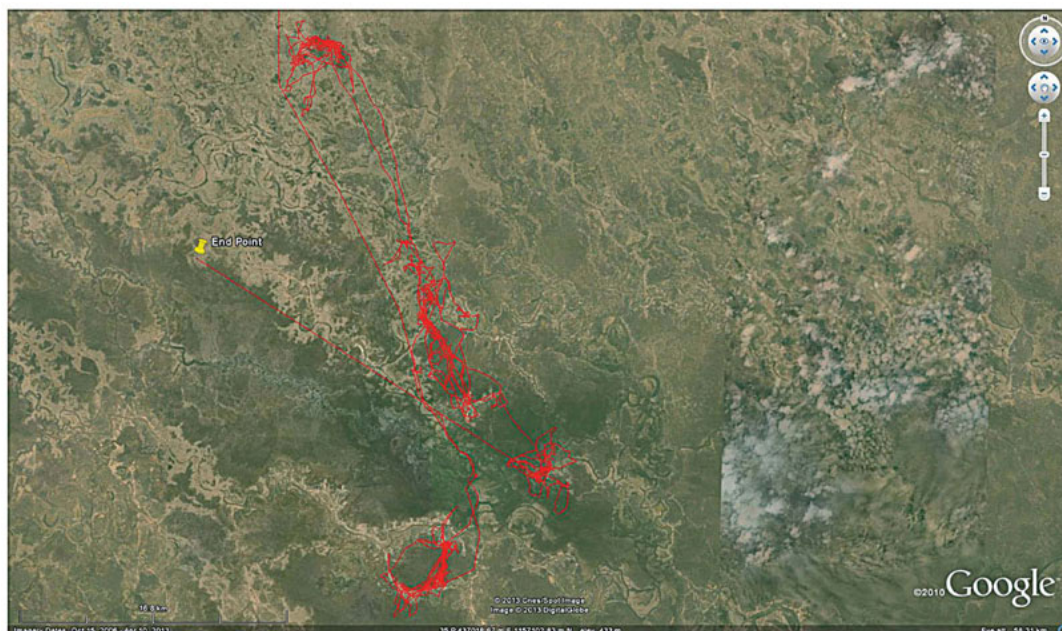
b) RMD.nmea: Data in NMEA format. It is not recommended that this file is used.

c) Data0.kml: Is the Google Earth version of the same file in a format that can be read from within Google Earth (Google Earth needs to be installed to use this file). Figure 3 gives a visual interpretation of EDC1 herd movement during the period 20 May–26 June 2013.

Figure 3.1 Screenshot showing an example from data downloaded from EDC1 device

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	WNO	TOW	Time	Date	DECEF_X	DECEF_Y	DECEF_Z	ECEF_X	ECEF_Y	ECEF_Z	Speed	Longitude	Latitude	Altitude	Mode
1	1741	129570	11:59:15	5/20/2013	0	0	0	5622877	2787695	1135430	2	26.37117	10.32246	411.3883	1
2	1741	130068	12:07:33	5/20/2013	0	0	0	5622884	2787715	1135338	2	26.37131	10.32162	409.8137	1
3	1741	130681	12:17:46	5/20/2013	0	0	0	5622922	2787661	1135292	0	26.37071	10.3212	411.4689	1
4	1741	131264	12:27:29	5/20/2013	0	0	0	5622927	2787565	1135379	4	26.36991	10.32203	389.5137	1
5	1741	131864	12:37:29	5/20/2013	0	0	0	5623030	2787475	1135337	0	26.36875	10.32157	433.4506	1
6	1741	132479	12:47:44	5/20/2013	0	0	0	5623042	2787454	1135332	0	26.36853	10.32153	433.9561	1
7	1741	133075	12:57:40	5/20/2013	0	0	0	5623039	2787451	1135354	0	26.36852	10.32173	433.9426	1
8	1741	133683	13:07:48	5/20/2013	0	0	0	5623052	2787449	1135296	0	26.36845	10.32119	434.1358	1
9	1741	134289	13:17:54	5/20/2013	0	0	0	5623031	2787479	1135305	0	26.36878	10.32128	430.3464	1

Figure 3.2: EDC1 herd mobility during the period 20 May–26 June



GIS Data analysis

Using GPS data in GIS environment allow us to visually interpret the spatial and temporal livestock movement during the whole period of the study. Benefiting from the mapping potential of the GIS software, the team has mapped both temporal (i.e., daily), seasonal and spatial (i.e., within and across ecological zones) livestock movement. This approach incorporates two complementary strategies: the mobility and the geographic localization of resources that are expected to be used by herds and their animals.

The downloaded GPS data can be imported into a GIS. Recording the animal location with precision over time allows researchers to evaluate pasture utilisation, animal performance, and behaviour. The GIS layer is essential in order to understand livestock mobility.

After formatting Data.logg in Excel sheets, the GPS data were imported into GIS software as event point *layers* and converted into shapefiles. The data captured by hand-held GPS using field trips were also downloaded into MapSource and then converted to shapefiles and transferred into Microsoft Excel.

The resulting GIS layers had all the GPS points, including recordings of the following features: distance between each recorded point, speed of movement. The results were overlaid with other GIS layers. Format of all location data is WGS84 projection.

Using a hand-held GPS, observed features, team members recorded coordinates and location name. Key environmental features of interest were:

- Water sources
- Seasonal water sources
- Major rivers
- Resting places
- Markets
- Settlements
- Livestock routes

Secondary GIS data sources included UNDP Sudan Crises and Recovery Mapping and Analysis Project and GPS data collected by the East Darfur State Ministry of Animal Resources and Range. Data layers collected from other sources included administrative boundaries, roads, etc.

Annex 4. Last year's movements for herders EDC2 to EDC6

EDC2

Period spent in each zone	Broya	Bahr	Dahara	Atmur	Goz
	0				
1 March–10 June		102			
11 June– 30 June			20		
1 July–31 July				31	
1 August–15 September					46
16 Sept.–30 September				15	
1 Oct.–31 October			31		
1 November–28 February		120			
Total	00	222	51	46	46
%	00	60	14	13	13

EDC3

Period spent in each zone	Broya	Bahr	Dahara	Atmur	Goz
1 March–31 May		92			
1 June– 30 June	30				
1 July–31 July			31		
1 August–15 October				76	
16 October–30 November			46		
1 December –28 February		90			
Total	30	182	77	76	
%	8	50	21	21	

EDC4

Period spent in each zone	Broya	Bahr	Dahara	Atmur	Goz
1 March–30 April		61			
1 May–31 May	31				
1 June–7 June		7			
8 June–23 June			16		
24 June–10 July				17	
11 July–15 October					97
1 November–30 November				46	
1 December–15 December			15		
16 December–28 February		75			
Total	31	143	31	63	97
%	8	39	8	18	27

EDC5

Period spent in each zone	Broya	Bahr	Dahara	Atmur	Goz
1 March–30 April		61			
1 May–14 June	45				
15 June–21 June		7			
22 June–30 June			9		
1 July–5 July				5	
6 July–10 October					97
11 October–20 October				10	
21 October–15 December			56		
16 December–28 February		75			
Total	45	143	65	15	97
%	12	39	18	4	27

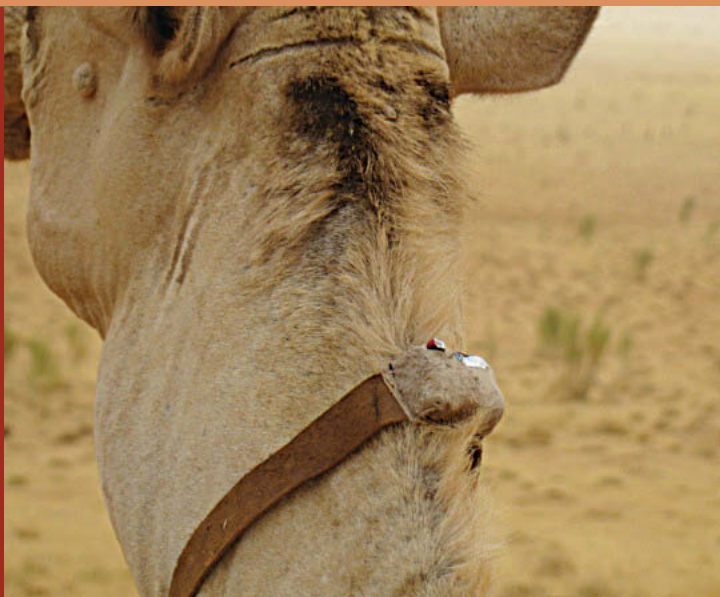
EDC6

Period spent in each zone	Broya	Bahr	Dahara	Atmur	Goz
1 March–30 April		61			
1 May–20 June	51				
21 June–8 July		18			
9 July–25 July			17		
26 July–15 October				82	
16 October–31 October			16		
1 November–28 February		120			
Total	51	199	33	82	
%	14	55	9	22	

Further technical information may be obtained from the UNEP Post-Conflict and Disaster Management Branch website at: <http://www.unep.org/disastersandconflicts/> or by email: postconflict@unep.org



<http://unep.org/Sudan>



Feinstein International Center
Tufts University
114 Curtis Street
Somerville, MA 02144, USA
tel: +1 617.627.3423
fax: +1 617.627.3428
<http://sites.tufts.edu/feinstein/>

www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel: +254 (0)20 762 1234
Fax: +254 (0)20 762 3927
Email: unepub@unep.org

