Food and Agriculture Organization
of the United Nations

BASELINE AND GOOD PRACTICES STUDY ON WATER AND FODDER AVAILABILITY ALONG THE LIVESTOCK TRADE ROUTES IN THE HORN OF AFRICA

Water and fodder availability along livestock trade routes in the Horn of Africa

A baseline report

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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©FAO/Simon Maina (sheep at a water point)

©FAO/Giulio Napolitano (cattle)

©FAO/Simon Maina (a herd of goats and sheep)

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Preface

The livestock export trade operation from the Horn of Africa (HoA) is often considered to be one of the largest export movements in the world. The livestock trading originating from the HoA to the Middle East is also one of the oldest and most vibrant cross-border livestock trading systems in the world. The value of the cross-border trade is directly translated into an assortment of goods and services including food which are shipped from the Middle East back to the populations in the Horn of Africa. There are however, a number of challenges that negatively impact trade performance. A sub-regional project (GCP/RAF/490/ITA) implemented by SFE in collaboration with IGAD addresses the capacity building gaps for pastoralists, traders and exporters to enhance the competitiveness of the commodity trade and to expand and improve the trade and market share in the Middle East market.

Within the project, FAO is supporting livestock and rangeland production along the trade routes to sustain livestock trade activities, including identification and dissemination of best practices on rangeland productivity and rehabilitation of water infrastructure. This is especially important since severe and recurrent drought has caused degradation of rangelands resulting into scarcity of pasture and freshwater along the export trade routes.

During 2016, the FAO Sub-regional office for Eastern Africa (SFE) undertook a regional study to consolidate findings from previous activities by FAO and other stakeholders to identify:

- the location and direction of the main livestock trade routes,
- appropriate sites for rehabilitation & development of strategic livestock water sources,
- appropriate sites for adaptation of good practices on fodder production and commercialization units as well as rehabilitation of natural rangelands in production areas and along the livestock export trade routes.

Together with local stakeholders in the four focus countries (the Republic of Djibouti, the Federal Democratic Republic of Ethiopia, the Federal Republic of Somalia and the Republic of the Sudan), priority interventions for water infrastructure development / rehabilitation and fodder production were identified in the four focus countries – which will form the basis for field activities during the second phase of the GCP/RAF/490/ITA project.

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Abbreviations and acronyms

ASAL	Arid and Semi-Arid Lands
CEWARN	Conflict Early Warning and Response Mechanism
CLMC	County Livestock Marketing Council
FGD	Focus Group Discussion
FSNAU	Food Security and Nutrition Analysis Unit
GCP/RAF/490/ITA	Italian Government funded "*Improving supply of safe and quality livestock and meat exported from the Horn of Africa to Middle East and Gulf Countries*" project
GDP	Gross Domestic Product
GIS	Geographic Information System
HoA	Horn of Africa
ICPALD	IGAD Centre for Pastoral and Arid Livestock Development
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority on Development
ISTVS	IGAD Sheikh Technical Veterinary School and Reference Centre
KLMC	Kenya Livestock Marketing Council
KRDP	Kenya Rural Development Project
KSC	Kenya Seed Company
Kshs	Kenyan Shillings
LoA	Letter of Agreement
LTU	Livestock Tropical Unit
MoL	Ministry of Livestock
MoLD	Ministry of livestock development
NDVI	Normalized Difference Vegetation Index
PCI	Project Concern International
PFS	Pastoralist Field School
SAPARM	Satellite Assisted Pastoral Resource Management
SFE	Sub-regional office for Eastern Africa of the Food and Agriculture Organization of the UN
SLRC	Sudan Livestock Route Company
Sl.Sh	Somaliland Shillings
SWALIM	Somalia water and land information management
UNHAS	United Nations Humanitarian Air Services
WHO	World Health Organization

Executive Summary

Introduction

Livestock export from the Horn of Africa (HoA) to the Middle East forms an economic system that provides jobs and livelihoods for millions of poor (agro-) pastoralists. Livestock export trade enables economically marginalized pastoralists to access essential goods through barter, but it also provides a basis for cementing social and political relations between Ethiopia, the Sudan, Djibouti and Somalia.

However, severe and recurrent drought has caused degradation of rangelands resulting into scarcity of pasture and freshwater along the export trade routes. This often leads to poor animal body condition, resulting in low prices for producers. During severe droughts it also leads to high livestock mortality. This loss contributes to the already high vulnerability of pastoralists to environmental hazards and economic shocks. Enhancing productivity and health of degraded rangelands to improve animal feed availability during all seasons as well as availability of water resources along the livestock routes is therefore essential for improving resilience of millions of poor pastoralists in the HoA.

Therefore, the FAO Sub-regional office for Eastern Africa (SFE) undertook a regional study to consolidate findings from previous activities by FAO and other stakeholders to identify in the four[1] focus countries:

- the location and direction of the main livestock trade routes,
- appropriate sites for rehabilitation & development of strategic livestock water sources,
- appropriate sites for adaptation of good practices on fodder production and commercialization units as well as rehabilitation of natural rangelands in production areas and along the livestock export trade routes.

For this study a collaboration was forged between the GCP/RAF/490/ITA[2] field programme and the SFE Regular Programme. The latter as part of the Africa Regional Initiative 2 "*Sustainable Production Intensification & Value Chain Development in Africa*" (P/S 2010307).

Methodology

Data collection involved desk review of relevant documents, reports and maps from FAO and partners on their previous activities relating to livestock trade routes, as well as available scientific literature and good practices on rangeland rehabilitation and fodder commercialization. The information obtained from the desk review was validated through key informants (KIs) interviews during country missions. A total of 59 KIs were interviewed, including government officials, community members, traders, FAO experts, etc. Additionally, Focus Group Discussions (FGDs) were held in several locations during six field missions.

Maps that show existing livestock export routs from the Horn of Africa to Middle East and Gulf Countries, and livestock water points along the export routes were produced using Geographic Information System (GIS) software. The process involved collecting different relevant data and information, reviewing the data, organizing and analyzing it and converting the information into maps. Data was collected from various sources like government offices, FAO country offices, the internet, individuals, atlases, Google Earth and Open Street Map. The types of data and information obtained include published and unpublished documents, soft copy and hard copy maps, GIS shapefiles, satellite products, key informants and stakeholder interview responses, and field observations. The major software packages and applications used to analyze data and prepare the

[1] This report covers Somalia, Sudan, Ethiopia and Djibouti as they currently are the only countries in the region that export (or in case of Djibouti, act as a transit point for) livestock to the Middle East and Gulf Countries

[2] Italian Government funded "*Improving supply of safe and quality livestock and meat exported from the Horn of Africa to Middle East and Gulf Countries*" project, implemented by FAO and IGAD.

maps were ArcGIS for Desktop 10.4, Adobe Illustrator and Google Earth Pro.

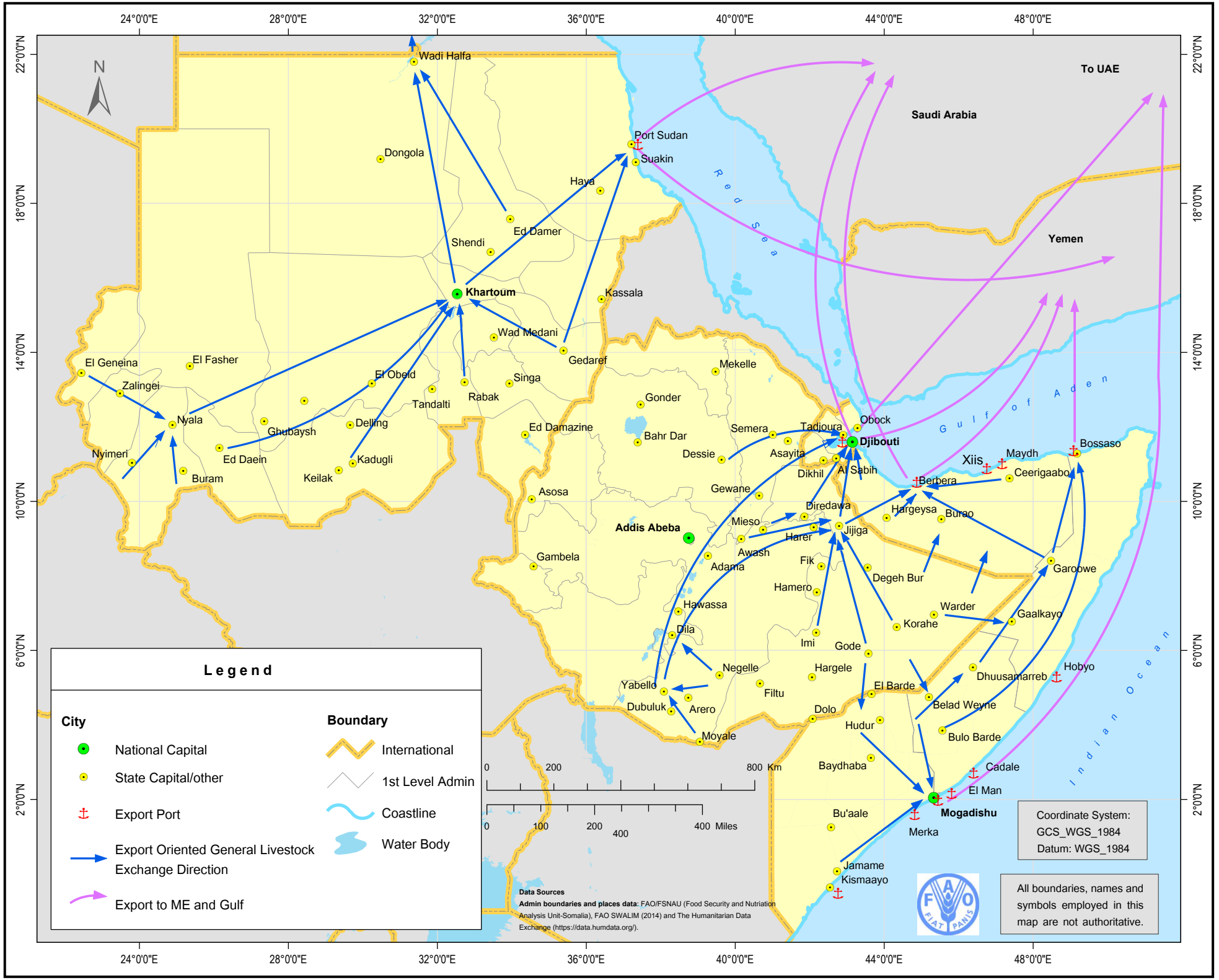
Main findings

Based on a detailed literature review and numerous interviews and focus group discussions, the major livestock trade routes in the four focus countries were mapped. The next page shows a simplified regional map with the major routes, while much more detailed country maps are included in the respective country sections. The study also identified six good practices on rangeland rehabilitation and fodder production & marketing with potential for replication and up-scaling. The good practices covered have demonstrated to increase rangeland productivity and maintain ecological resilience. Other aspects considered include economic viability / efficiency, acceptability (socially and culturally), proven effectiveness in adoption and uptake, as well as and environmental sustainability. The good practices covered include:

1. Management of invasive plants in rangelands
2. Use of perennial indigenous grasses to rehabilitate rangelands
3. Community grazing management to improve grazing capacity
4. Commercialization of fodder production
5. Innovative Satellite Assisted Pastoral Resource Management
6. Irrigated fodder production

Together with local stakeholders, priority interventions were identified in the four focus countries (Djibouti, Ethiopia, Somalia and the Sudan). However, considering the limited amount of funds available to implement activities, a further selection has to be made. The following criteria were used to recommend a final selection of priority interventions, which can be found on pages 11 and 12:

- Severity of water and fodder shortages along the different trade routes
- Expected amount of funds from the second instalment of GCP/RAF/490/ITA for the implementation of Output 2 activities
- Expected impact of the proposed interventions (number of animals and pastoralists benefitting, area covered, etc.)
- Geographical spread of the proposed interventions
- Extent to which GCP/RAF/490/ITA funds can complement or add value to existing FAO activities aimed at improving water and fodder availability along the livestock routes
- Complementarity of proposed activities with projects or interventions by other stakeholders, such as Ministries, NGOs and other development partners
- Proposed activities of the GCP/RAF/490/ITA project in other Outputs, in particular Output 1 (which focuses primarily on Djibouti and the Sudan)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El Geneina
El Fasher
Zalingei
El Obeid
Tandalti
Rabak
Singa
Nyala
Ghubaysh
Delling
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Ed Daein
Nyimeri
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Keilak
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Gonder
Ed Damazine
Bahr Dar
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Addis Abeba
Gambela
Semera
Tadjoura
Obock
Djibouti
Dessie
Asayita
Dikhil
Al Sabih
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Hobyo
Bulo Barde
Cadale
El Man
Mogadishu
Merka
To UAE
Saudi Arabia
Yemen
Red Sea
Gulf of Aden
Indian Ocean
Legend
City
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Export Port
Export Oriented General Livestock Exchange Direction
Export to ME and Gulf
Boundary
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Data Sources
Admin boundaries and places data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia), FAO SWALIM (2014) and The Humanitarian Data Exchange (https://data.humdata.org/).
Coordinate System:
GCS_WGS_1984
Datum: WGS_1984
All boundaries, names and symbols employed in this map are not authoritative.

Recommended priority activities for implementation during the second phase of GCP/RAF/490/ITA

The Republic of Djibouti

Since Djibouti is mainly a livestock transit country, it is suggested to use the little resources available towards improving the quality and quantity of fodder grown in-country. This will reduce the need to import expensive fodder from neighboring countries, and provides local farmers and agro-pastoralists with additional income while reducing degradation and erosion of rangelands. The following activities are proposed:

- Expand irrigated commercial fodder production at Haro River and Kourtimale, at an estimated cost of USD 15,000
- Conduct exchange visits and learning tours for farmers from other regions of Djibouti to successful farms in Dikhil, at an estimated cost of USD 5,000 (for 50 farmers).

The Federal Democratic Republic of Ethiopia

Given the fact that the livestock route from Ethiopia to Djibouti has much lower livestock numbers than the route to Somaliland, it is suggested to focus on the latter. The following activities are proposed:

- Establishment of a water point at Tog Wochale, for animals waiting to cross the border from Ethiopia to Somaliland (since they sometimes wait 2-3 weeks). The recommended water point is a shallow well, with an estimated cost of USD 23,000.
- A contract with PCI for the up-scaling of Satellite Assisted Pastoral Resource Management to four Woredas in the Somali region of Ethiopia. This will provide information about vegetation cover for a large area, and such information helps pastoralists more easily locate areas with good quality pastures in a short time.The cost of mapping and automation is USD 12,000 per Woreda, which brings the total cost for four Woredas to USD 60,000 when incorporating distribution costs.
- Support the improvement of Jigjiga customs facilities and infrastructure. This will enable customs processes to be undertaken during the night, resulting in significantly less loss of animal body weight, since stresses at night are much lower (estimated cost USD 25,000).

The Federal Republic of Somalia

The study revealed that fodder scarcity is a much bigger problem than water scarcity. It is therefore suggested to focus on improving feed availability in Somalia. Of all four focus countries, Somalia is the one that is most dependent on the livestock trade, and hence should ideally receive the bulk of GCP/RAF/490/ITA support. Northern Somalia suffer frequent fodder shortages, and this study therefore focused mainly on Somaliland and Puntland territories as these areas are the main places where vibrant export oriented livestock marketing takes place. In Northern Somalia water and fodder resources are limited and have the potential to ignite conflicts especially. Due to the fact that the baseline study team could not visit South Central Somalia and Puntland, this section focuses mainly on the water and fodder situation in Somaliland. The following interventions are prioritized for implementation:

- Support to FAO Somalia activities on introduction of locally adaptable fodder species (grasses, legumes, fodder tree/shrubs) in Togdheer region and training on informal seed production to avert continued importation of seeds. Estimated cost: USD 50,000
- Support to on-going FAO activity on physical processing to enhance feed intake by animals and reduce wastages. This includes the physical processing (grinding) of the pods/seeds from the invasive Prosopis tree into protein-rich feed. Estimated cost: USD 15,000
- Construction of fodder storage sheds in Beer & Odweyne areas already supported by FAO. Estimated cost: USD 40,000
- In collaboration with the IGAD Sheikh Technical Veterinary School:
    - Development and testing of a curriculum for ISTVS students on context-specific fodder production, prcessing and marketing. Estimated cost: USD 25,000
    - Technical and resource mobilization support to an ISTVS research programme on enhancing livestock productivity through improved animal feed production and sustainable use of natural resources. Estimated cost: USD 10,000 and in kind technical support

The Republic of the Sudan

Since the Sudan is expected to benefit significantly from GCP/RAF/490/ITA Output 1 activities, the study proposes to prioritize Output 2 activities for the other livestock export countries (Ethiopia, Somalia and Djibouti). However, it is suggested to pilot at least one activity in the Sudan, which can be an entry point for additional resource mobilization. The following activity is proposed:

- Pilot rehabilitation of one wateryards (to be selected out of 11 priority wateryards in close collaboration with the SLRC). Estimated cost: USD 50,000

1. Background & methodology

1.1 Introduction

This is the final report of the baseline and good practices study on water and fodder availability along the livestock trade routes in the Horn of Africa. For this study a collaboration was forged between the GCP/RAF/490/ITA field programme and the SFE Regular Programme - the latter as part of the Africa Regional Initiative 2 "*Sustainable Production Intensification & Value Chain Development in Africa*" (P/S 2010307). This regional study aims to consolidate findings from previous activities by FAO and other stakeholders, and identify good practices, existing infrastructure and the most appropriate areas for future interventions in rangeland productivity and water availability along the livestock routes used for export. This study identified the main livestock routes, appropriate sites for rehabilitation and development of strategic livestock water sources and sites for adaptation of good practices on fodder production and commercialization units as well as rehabilitation of natural rangelands.

This study was the starting point of one of the components of the Italian funded GCP/RAF/490/ITA project on "*Improving Supply of Safe and Quality Livestock and Meat Exported from the Horn of Africa to Middle East and Gulf Countries*". In this project, FAO is among others responsible for the following output: Water and pastures available to transported animals along the trade routes through creation/rehabilitation of water sources, promotion of good rangeland production practices and negotiation of access to resources.

This report covers Somalia, the Sudan, Ethiopia and Djibouti as they currently are the only countries in the region that export (or in case of Djibouti, act as a transit point for) livestock to the Middle East. The study results will be used for future FAO interventions in the HoA, including under the GCP/RAF/490/ITA project, in addition to advocacy, awareness and resource mobilization activities. This report provides suggestions on where interventions targeting the livestock export market could concentrate. This will help the GCP/RAF/490/ITA project and governments of respective countries, NGOs, development partners and other parties to more effectively select interventions aimed at improving livestock export and pastoralist livelihoods in the IGAD region. The report aims to assist the reader gain a better understanding on the prevailing livestock export system, where interventions should be implemented and what challenges pastoralists and stakeholders in the livestock trade are faced with.

1.2 Background

The predominant livelihood system in the Horn of Africa (HoA) is based on pastoral and agro-pastoral production. Livestock trading in the HoA to the Middle East is one of the oldest and most vibrant cross-border livestock trading system in the world, and provides a livelihood for millions of (agro-) pastoralists. However, this livelihood is constantly challenged by the scarcity of pasture and freshwater, with increasing human and social vulnerability to environmental hazards and economic shocks, which are aggravated by droughts and resource-based conflicts. Enhancing productivity and health of degraded rangelands to improve animal feed availability during all seasons, as well as availability of water resources along the livestock routes is therefore essential for millions of people.

Specific objectives of the study:

- To identify the main livestock routes used for export from the HoA to the Gulf and Middle-East countries;
- To identify the location and state of existing water points and the need for additional water infrastructure (natural or manmade) for livestock, including appropriate sites for creation of new water points or rehabilitation of existing ones with justification and budget;
- To assess pasture and fodder availability along the livestock trade routes (taking in account seasonal variations) including location of existing fodder banks. Based on this, identify appropriate sites for adaptation of good practices for fodder production and commercialization units as well as rehabilitation of degraded rangelands including justification and budget;
- Digitally map the information gathered during this study

Scope of Work

There are four major activities of the study:

- Development of a comprehensive study methodology;
- Desk review, analysis and consolidation of findings from previous studies, projects, maps, and other relevant documents;
- Conduct missions – including field visits to Kenya (for FAO Somalia), Ethiopia, the Sudan, Djibouti and Somaliland to validate desk review findings and obtain additional available information through interviews and Focus Group Discussions with stakeholders on:
    - Livestock trade routes used for export to the Gulf and Middle-East countries
    - Location and state of existing water points and the need for additional water infrastructure(both natural and man-made) for livestock, including appropriate sites for creation of new water points
    - Pasture and fodder availability along the livestock trade routes, including location of fodder banks and taking into account seasonal variations;
- Consolidate all findings into a final report, including recommendations per country (including rough budgets and justifications) on appropriate sites for:
    - creation of new water points and rehabilitation of existing ones
    - development of new fodder production & commercialization units
    - rehabilitation of natural rangelands.

1.3 Data collection methodology

The study adopted qualitative techniques to collect and analyze data. Data collection involved desk review of relevant documents/reports from FAO country offices and partners on their previous activities relating to livestock trade routes, maps and good practices on rangeland rehabilitation and fodder commercialization. The information obtained from desk review was validated through key informants (Annex 1) and Focus Group Discussions (FGDs) during country missions conducted from Nov 2015 - Apr 2016. A total of 59 KIs were interviewed, including:

- FAO country office staff,
- Government officials (mainly from ministries of Livestock/Agriculture/Trade),
- Community members,
- Relevant development partners staff, and
- Prominent livestock traders and farmers.

To collect the information on the ground missions, which included field visits, were conducted to:

- Kenya: 15-20 November 2015
- Ethiopia (Addis Ababa only): 6-11 December 2015
- The Sudan: 7-13 February 2016
- Djibouti: 7-10 March 2016
- Ethiopia (field mission only): 7-12 March 2016
- Somaliland[3]: 11-20 April 2016

Places visited during this study have been included in a regional map on page 18.

[3] A mission to Puntland was also envisaged as part of this study. However, in April 2016 flights to Garowe were suspended because of security concerns. Hence, this field mission had to be cancelled and the report therefore relies on secondary sources

1.4 GIS methodology

Maps that show existing livestock export routs from the Horn of Africa to Middle East and Gulf Countries, and livestock water points along the export routes were produced using Geographic Information System (GIS) software. The process involved collecting different relevant data and information, reviewing the data, organizing and analyzing it and converting the information into maps. Data was collected from various sources like government offices, FAO country offices, the internet, individuals, atlases, Google Earth and Open Street Map. The types of data and information obtained include published and unpublished documents, soft copy and hard copy maps, GIS shapefiles, satellite products, key informants and stakeholder interview responses, and field observations. The major software packages and applications used to analyze data and prepare the maps were ArcGIS for Desktop 10.4, Adobe Illustrator and Google Earth Pro.

Although steps followed to prepare the maps differ from country to country based on the type of the map prepared and pre-existing and available information and type of data – they can be grouped under two analysis levels. *In the first category*, pre-existing maps and information were reviewed, manipulated to fit the study purpose and displayed as a map with additional information. *In the second category*, different land resource data like land cover, topography, NDVI and rainfall were analyzed in a GIS environment to produce maps that show potential of pasture resource along the livestock export routes.

The maps can be grouped into three main classes[4]:

1. Maps that show livestock export routes to Middle East countries; one map for each target country and one regional map
2. Maps with functional livestock water points, and water point locations suggested for rehabilitation
3. Maps that show pasture resource potential for pastoralist areas of Ethiopia, Somalia and the Sudan.

Unfortunately, some challenges were encountered in the course of preparing the maps. The main challenge is associated to data unavailability. For most countries it has been difficult to access data in the required amount, format and scale. This restricted the depth of the analysis. Locating the right sources of data and information, accessing the data in the right time and incomplete/inconsistent data were part of the challenge.

The maps provide multitude of information regarding livestock export from Horn of Africa to Middle East and Gulf countries, and where interventions targeting the livestock export market should concentrate. They help governments of respective countries and other parties who are working to improve the livestock export from the region and the pastoralists' way of life through livestock marketing. Together with the report the maps assist the reader to have better understanding about the prevailing livestock export system, where interventions should be implemented and what challenges pastoralists and stakeholders in the livestock trade system are faced with. However, the maps have some ingrained drawbacks that arose due to scarcity of data, inconsistent information, limited field verification, changing nature of the themes mapped and limited budget and time to implement other methods of study. Some drawbacks include misplacing or generalized representation of export routes and livestock water points, unlikely representation and coarse scale of the maps. This should be considered when interpreting and using the maps.

[4] One additional map showing places that were visited during the study has also been included in this report

1.5 Challenges encountered

- Consultants and FAO staff were not able to visit and assess all of the proposed sites for water and fodder establishment. The study relied on interviews with key informants, thus the accuracy of the costs and locations entirely depended on the knowledge of the respondents about the actual need and extent of the problem.

- The study covered four countries but most of them lack official (published) data on livestock trade, specifically on the volumes and export values for livestock. To solve this, the study used data from various online resources whose authenticity entirely depends on the original data at that time.

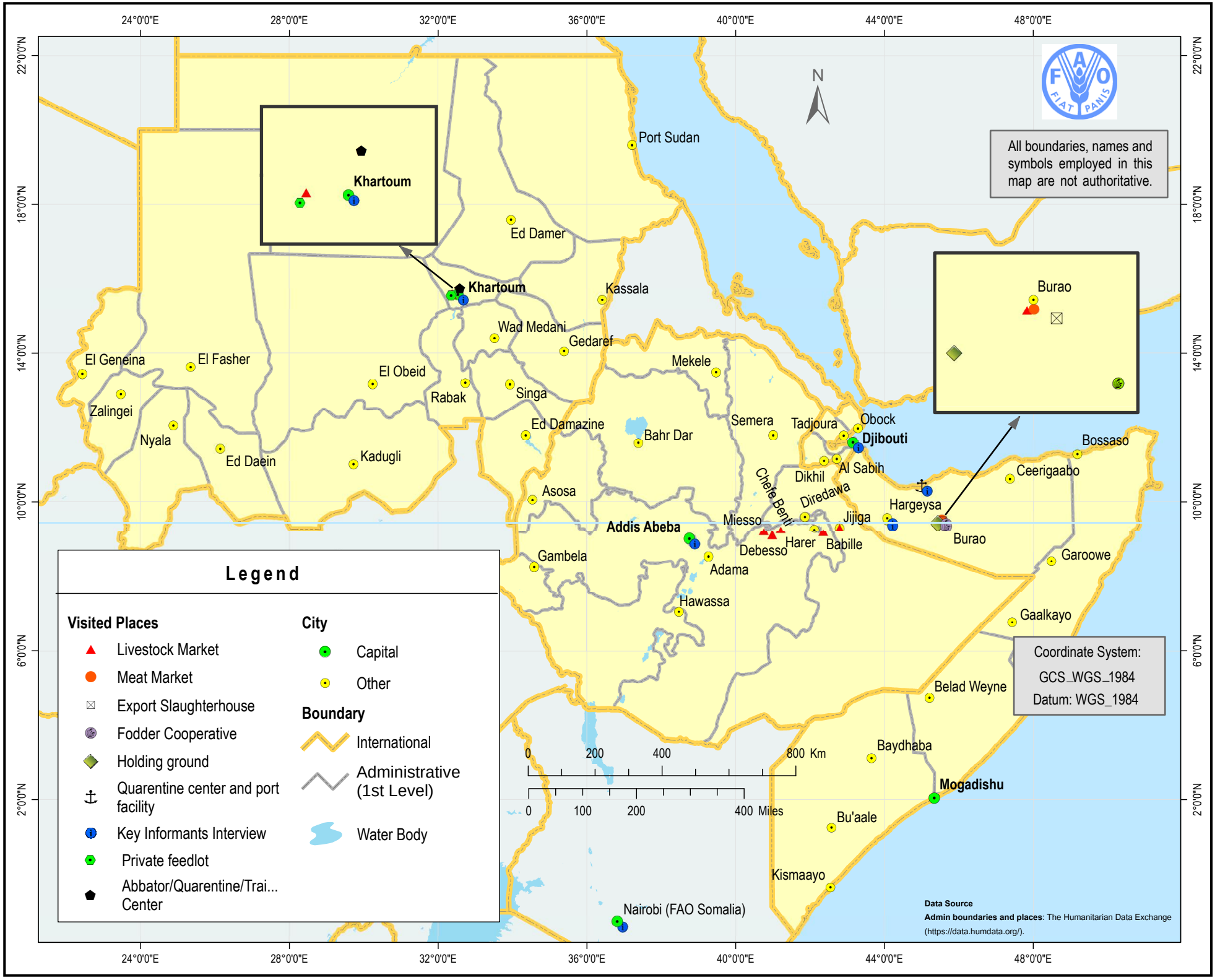
- Due to Sudan government regulations on international experts conducting field missions outside Khartoum, a planned field visit to El Obeid had to be cancelled. Instead, several visits were conducted to relevant infrastructure and areas around Khartoum city.

- In April 2016 – just as a mission to Somaliland and Puntland was being planned – flights to Garowe were suspended because of security concerns. Hence, the envisaged field mission to Puntland had to be cancelled and the report therefore relies on secondary sources.

- During the preparing of GIS maps the main challenge was associated with data unavailability. For most countries it has been difficult to access data in the required amount, format and scale. This restricted the depth of the analysis. Locating the right sources of data and information, accessing the data in the right time and incomplete/inconsistent data were part of the challenge.

- The maps in this report provide a multitude of information regarding livestock export from Horn of Africa to Middle East and Gulf countries, and where interventions targeting the livestock export market should concentrate. They help governments of respective countries and other parties who are working to improve the livestock export from the region and the pastoralists' way of life through livestock marketing. Together with the report the maps assist the reader to have better understanding about the prevailing livestock export system, where interventions should be implemented and what challenges pastoralists and stakeholders in the livestock trade system are faced with. However, the maps have some ingrained drawbacks that arose due to scarcity of data, inconsistent information, limited field verification, changing nature of the themes mapped and limited budget and time to implement other methods of study. Some drawbacks include misplacing or generalized representation of export routes and livestock water points, unlikely representation and coarse scale of the maps. This should be considered when interpreting and using the maps.

- In the four focus countries people speak among others Amharic, Arabic, Somali, Oromifa and Afari – some of them with their own alphabet. This means that several cities and towns have either different names, or are written in a variation of ways. This means that throughout the report and between maps, and between maps and text, place names can slightly differ from each other.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Data Source
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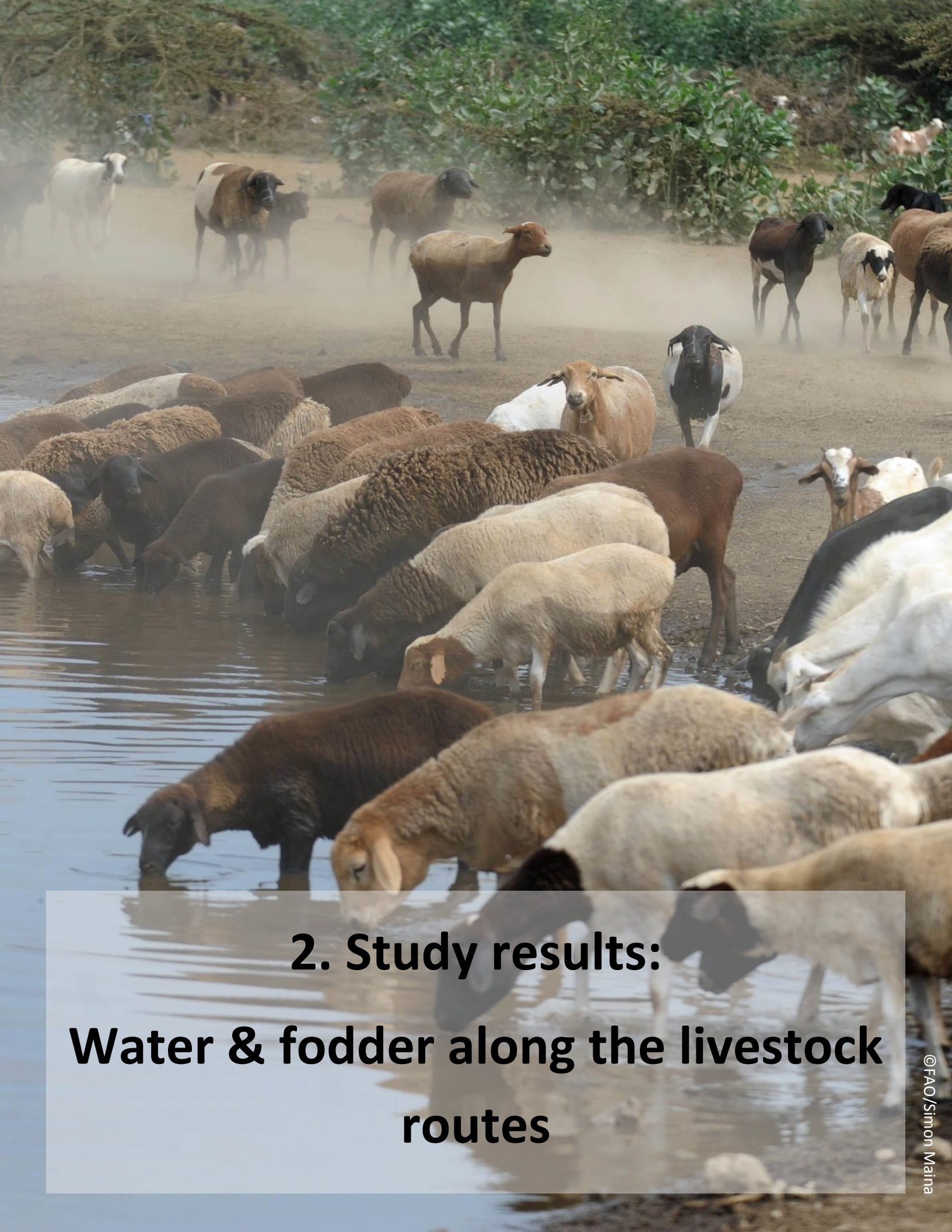


2. Study results:

Water & fodder along the livestock routes

The livestock export trade operation from the Horn of Africa is often considered to be one of the largest export movements in the world. The livestock trading through the Horn of Africa to the Middle East is also one of the oldest and vibrant cross-border livestock trading system in the world. The value of the cross-border trade is directly translated into an assortment of goods and services including food which are shipped from the Middle East back to the populations in the Horn of Africa.

IGAD member countries are home to approximately 336 million ruminants (cattle, small ruminants and camels). Ethiopia and the Sudan occupy the top most position in Africa in terms of livestock numbers. The economy of Somalia is almost entirely dependent on livestock-based production and trade. These countries have high livestock populations with diverse genotypes and a huge potential to export livestock and meat to the Middle East market that has a high demand for livestock and livestock products. Moreover, the importing Gulf countries have a particular preference for livestock from the Horn of Africa.

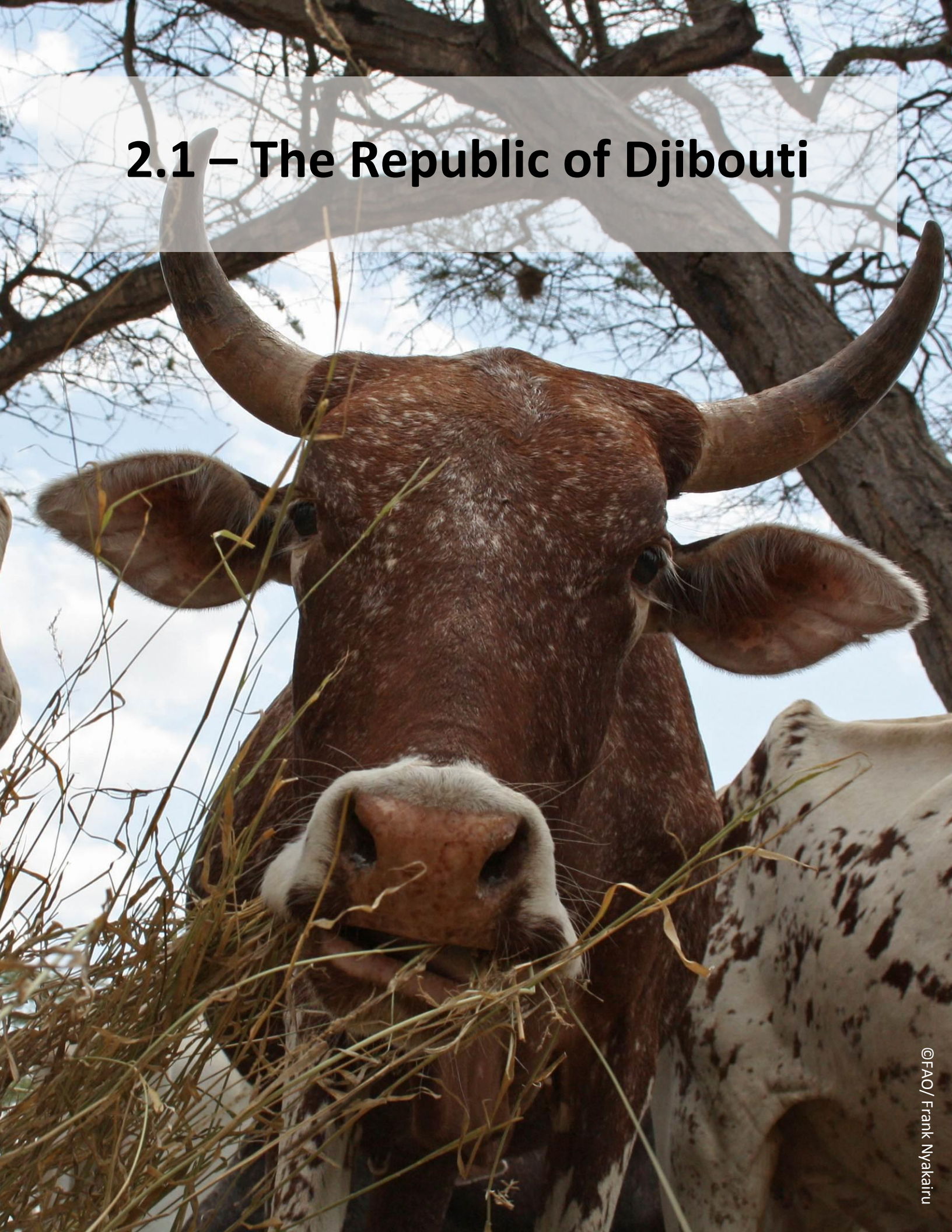
The regional livestock trade export 2014/2015 consists of 94% (14,757,922) small ruminants, 4% (590,783) cattle and 2% (360,588) camels (table 1). The highest peak of export is during Hajj when every able family offers an animal for sacrifice. This explains the far higher figures for small ruminants compared to the rest.

Table 1: Regional livestock export figures

Country	Small ruminants	Camels	Cattle	Total	Percentage
Djibouti	1,000,000	3,791	2,410	1,006,201	6.4%
Ethiopia	2,852,875	73,789	202,548	3,129,212	19.9%
Somalia	5,000,000	77,000	340,000	5,417,000	34.5%
Sudan	5,905,047	206,008	45,825	6,156,880	39.2%
Total	**14,757,922**	**360,588**	**590,783**	**15,709,293**	**100%**

This chapter presents in-depth analysis of data collected through desk review, key informant interviews, GIS analysis, field missions, and focus group discussions. It also covers the challenges and gaps relevant to the study and recommendations for priority activities for the second phase of the GCP/RAF/490/ITA project. It is organized in four sections – the four focus countries of this study.

2.1 – The Republic of Djibouti



2.1.1 Introduction

The Republic of Djibouti is a small country of 23,200 square kilometers strategically located in the Horn of Africa at the Southern entrance of the Red Sea. The country has a population of about 888,000 inhabitants in 2015 (World Bank, 2016)[5]. Almost 30 percent of the population lives in rural areas, some 12 percent in secondary cities and small towns, and the remaining 58 percent are living in the capital city of Djibouti and its immediate surroundings – which constitutes the center of the country's economic activity (World Bank, 2011)[6].

Source: http://bit.ly/2kK1mSp

Djibouti is poorly endowed with natural resources, thus the country's economy is dependent on income derived from its strategic location: revenues generated directly or indirectly from the activities of the international port and related business (including the trade traffic transiting to and from landlocked Ethiopia), the financial sector, rents from the several foreign military bases hosted in the country, and foreign aid. Although located in a conflict-prone region, Djibouti is in general politically stable with no major incidents for a decade, although it experienced a border conflict with Eritrea between 2008 and 2010 concerning Ras and Doumeira Islands. However, this has since been resolved through mediation by Qatar and borders have been demarcated.

The agricultural sector is underdeveloped in Djibouti because of climatic conditions very unfavourable for agricultural production on a large scale including the very arid character of the country. It contributes to 6.9% of the national GDP.

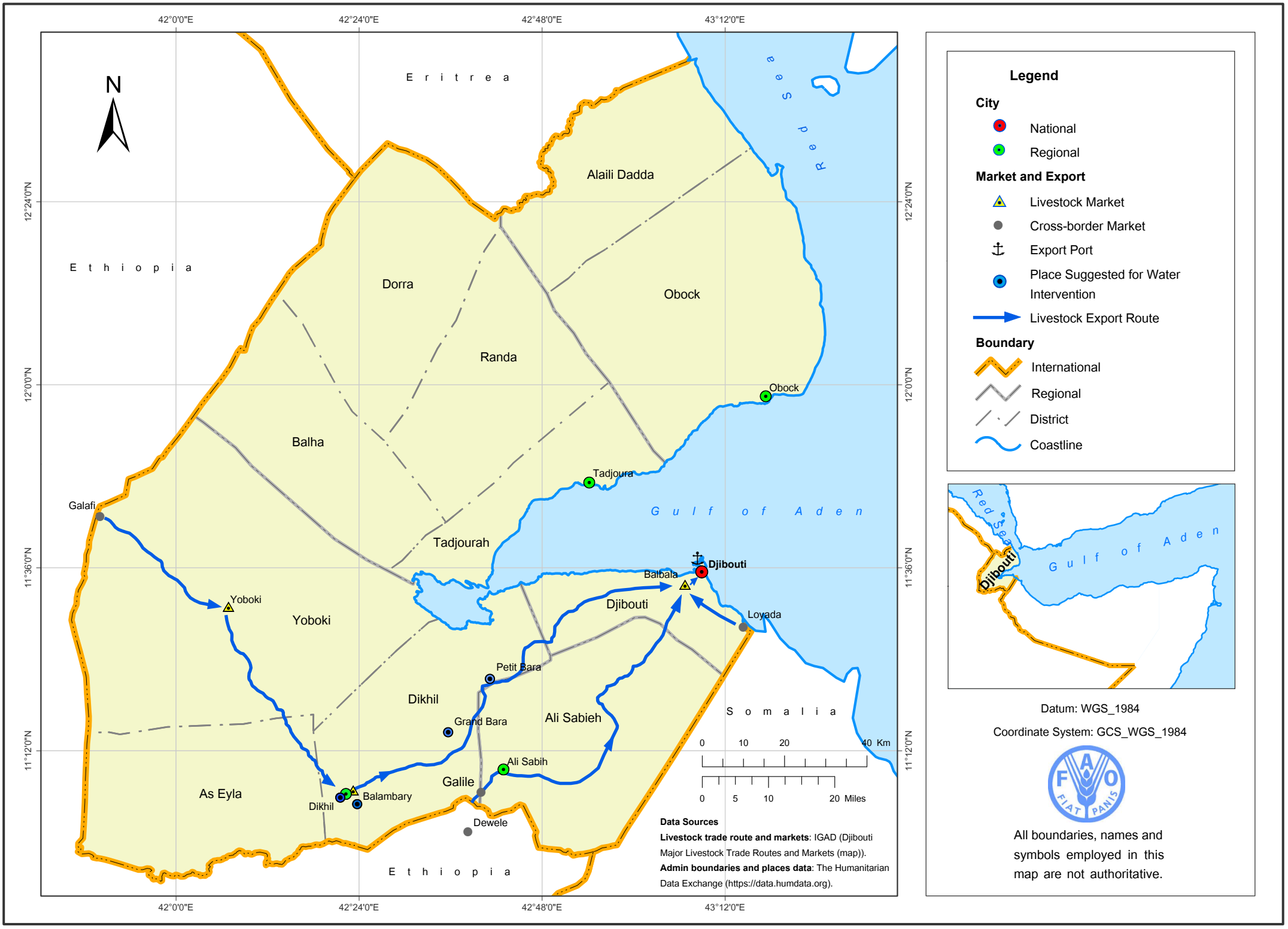
More than 80 percent of the rural population consists of nomadic and semi-nomadic herders who manage about 1 million heads of small ruminants (goats and sheep) as well as 50,000 heads of camels and 40,000 heads of cattle, equivalent to 0.5 Livestock Tropical Unit (LTU) per person. Livestock keeping represents the main source of subsistence for herding households (first 30 livelihood assets for 30% of the Djiboutian population) and contributes to 75 percent of the agricultural sector's contribution to GDP.

2.1.2 Djibouti livestock export trade routes

Djibouti's geostrategic location at the mouth of the Red Sea, the far northwest corner of the Somali sub-region, North-West of Ethiopia (source of livestock) and the recent re-development of the port including upgrading its livestock export facilities gives it exceptional advantage as a transit country for livestock export trade to the Middle East and Gulf states.

Based on the literature review, key informant interviews and focus group discussions, three livestock export routes were identified (and mapped) for Djibouti. Two are coming from Ethiopia (entry points at Galfi and Galile) and one from Somalia (entry point of Loyada). Galafi is linked to Balbala (main market) of Djibouti through Yoboki then Dikhil region by 200Km of road. Galile is also linked to Balbala through Ali-Sabieh region by rail, while Loyada is linked to Balbala by a 3 km road where animals are trekked. See next page for the detailed export trade route map for Djibouti.

[5] World Bank, 2016: http://data.worldbank.org/country/djibouti (accessed on 26 August 2016)
[6] World Bank, 2011: Djibouti rural community development and water mobilization project appraisal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Obock
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Yoboki
Dikhil
Ali Sabieh
As Eyla
Galile
Obock
Tadjoura
Galafi
Djibouti
Balbala
Loyada
Petit Bara
Grand Bara
Ali Sabih
Balambary
Dewele
0 10 20 40 Km
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Data Sources
Livestock trade route and markets: IGAD (Djibouti Major Livestock Trade Routes and Markets (map)).
Admin boundaries and places data: The Humanitarian Data Exchange (https://data.humdata.org).
Legend
City
National
Regional
Market and Export
Livestock Market
Cross-border Market
Export Port
Place Suggested for Water Intervention
Livestock Export Route
Boundary
International
Regional
District
Coastline
Datum: WGS_1984
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FAO
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All boundaries, names and symbols employed in this map are not authoritative.

2.1.3 Water and fodder in Djibouti

Djibouti, which is characterized by a warm climate with high temperatures averaging 30°C (+40°C from May to September), is extremely water-scarce, receiving on average 150 mm of rainfall per year and having no permanent surface freshwater flow. In addition, Djibouti is facing several years of recurrent drought (less than 80 percent of average rainfall since 2007). Due to the climate, less than five percent of total rainfall reaches the ground water table, with the remainder lost to either evapo-transpiration (with evaporation of 2000 mm per year) or flow to the sea especially during flash floods (World Bank, 2011). About 95 percent of total water use comes from groundwater aquifers, which are primarily recharged from rainwater runoff infiltration from seasonal streams (wadis or oueds).

The country's total annual water use is around 19 million cubic meters of which about 0.5 Mm^3 and approximately 3 percent is for livestock (FAO, 2005)[7]. However, the combined effect of higher temperature and reduced precipitation has increased water shortage along livestock export trade routes. This is exacerbated by a rise in sea level that has impacted groundwater quality through saltwater intrusion of coastal aquifers (http://adaptation-undp.org/explore/eastern-africa/djibouti). Thus the Ministry of Agriculture, Livestock and Fisheries prioritizes water resource development, given that with sufficient water, fodder production is possible.

According to the Ministry of Agriculture, Livestock and Fisheries, 40-48% of livestock deaths in Djibouti were due to lack of water with the highest death rate in Dikhil region which handles 80% of shoats and 20% cattle/camels for export. Dikhil, located 60Km from the Ethiopian border, was identified as a suitable location for water points because 3000-8000 animals often wait in this area in event of limited capacity of transportation (trucks or ships) or delays at the quarantine center.

The other proposed sites for water development / rehabilitation include:

- Balambary, which is about 6 km from Dikhil, because the area has fertile soils suitable for fodder production but lacks water.
- Grand Bara and Petit Bara, located along the livestock trade routes, have water points that have insufficient capacity and need expansion.

The decision of locating water facilities should consider the potential negative impact it will create in the area. For example, water resources tend to increase animal convergence towards the water point leading to excessive soil trampling and causing land degradation. Next to this, creating/rehabilitating water sources can increase potential for water resource based conflicts. This can be overcome by putting water points 7-10 Km apart. Having discussed the water situation, it is important to note that the Government is currently constructing a major water pipeline running parallel with the trade route from Ethiopia to Djibouti city. However, there are no signs that connections along the route will be provided.

According to FAO Djibouti, the recommended water infrastructure should be deep boreholes, shallow wells, excavation basins, and surface water harvesting infrastructure. Conducting viability assessments is vital for successful water resource establishment to take into consideration the high evaporation rates, reduced precipitation and high run-off. The cost estimates for establishing water resource points are included in table 2 while estimated cost for rehabilitation is USD 7,295.81 (details are in Annex 2).

[7] FAO, AQUASTAT, 2005: Estimates

Table 2: Cost estimates for establishing water resource points

Type of water infrastructure	Cost (US Dollars)
Deep borehole	200,000-300,000
Excavation basins	70,000-120,000
Shallow wells	6,000-9,000

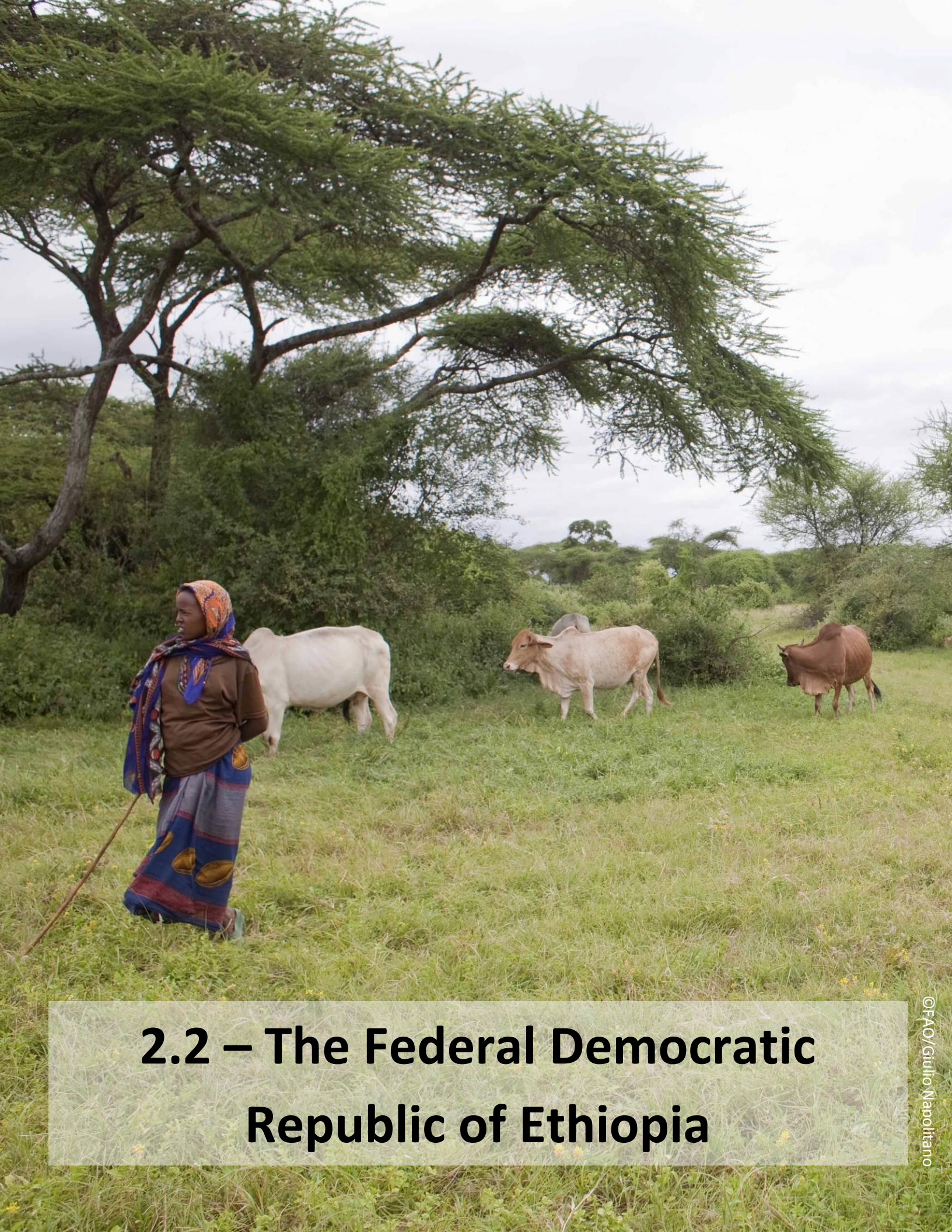
The study scrutinized the fodder situation and according to the World Bank, 2011 estimates, 63 percent of rangelands in Djibouti are already overgrazed or degraded, putting added pressure on livestock numbers due to severe and prolonged droughts. Underlining the extent of fodder shortage in Djibouti, the interview with livestock export traders revealed that animals received from Ethiopia are accompanied with fodder that lasts one week, and yet are quarantined for 2-3 weeks. Consequently, livestock traders import additional hay from Ethiopia at USD 6 per 14-15kg bale and when the situation worsens, hay is imported from Yemen, Jordan, Pakistan, and Saudi Arabia.

One observation made at Haro River in Dikhil region – where the terrain is bare, dry, and desolate with no surface water resources – helps to conclude that it is possible to establish fodder commercialization units along the livestock trade routes. The commercial fodder producer applying drip irrigation was able to produce a range of pastures and fodder which include; *Medicago sativa* (alfalfa), Pigeon peas (*Cajanus cajan*), *Leucaena leucocephala, sorghum, Panicum maxima, potato vines and Dolichos lablab.*

Improving fodder availability will require supporting small-scale irrigated fodder production units involving re-seeding, shrub planting and establishment of well-sized feed/forage or stocking facilities. The caution here is that water resource for animal and human use should not be used for irrigation, as it is likely to raise negative sentiments among communities because it is often perceived to be wasting water. Thus separate water points are required.

In consultation with relevant stakeholders, the following water and fodder interventions have been prioritized along the major livestock export trade routes in Djibouti (see also the map on page 23):

- Drilling a deep borehole at Dikhil market at an estimated cost USD 200,000
- Rehabilitate excavation basins at Kourtimale and Haro river each at an estimated cost USD 120,000
- Establish shallow wells at Balambaly at an estimated cost USD 9,000
- Expand irrigated commercial fodder production at Haro River and Kourtimale, estimated cost USD 15,000



2.2 – The Federal Democratic Republic of Ethiopia

2.2.1 Introduction

The Federal Democratic Republic of Ethiopia is the second-most populous country in Sub-Saharan Africa with an estimated population of 96.5 million, and a growth rate of 2.5% in 2014 (World Bank, 2015). The country's per capita income of USD 550 is substantially lower than the regional average. Ethiopia's economy is based mainly on agriculture (crop and livestock production). Although estimates vary widely, 80% of the rural population depends on livestock and the sector is thought to contribute 15–17% of Ethiopian gross domestic product (GDP) and constitutes 15% of export earnings. However, the Ethiopian economy, particularly livestock, is extremely vulnerable to external shocks such as recurrent and progressively severe droughts which are responsible for water and fodder shortages.

2.2.2 Ethiopia livestock export trade routes

Ethiopia's livestock exports consist of cattle, sheep, goats and camels, which are mainly sourced from pastoral areas. According to Future Agricultures[8], the main supply areas are Borana for cattle and Somali Region for live camels, sheep and goats. Other supply areas include the lowlands of Bale, Southern Nations Nationalities and Peoples (SNNPR) region, Afar regional state and the mid-altitude agro-pastoral zones of Oromia. Recent data by the National Bank of Ethiopia (NBE, 2012-2013) indicate that USD 150 million worth of export from live animals was realized in 2012-2013. Although it is a known fact that significant numbers of livestock from Ethiopia are exported, comprehensive statistics is not readily available. However, information obtained from Somaliland Chamber of Commerce recorded the following imports (note that the Somaliland export route is not the only export corridor):

Source: http://bit.ly/2kiQZV0

- Camels 73,789
- Cattle 202,548
- Shoats 2,852,875

65% of this volume is estimated to be of Ethiopian origin. According to Ameha (2011)[9], Black Head Somali and Afar sheep, as well as the Somali and Afar goat breeds are the most preferred Ethiopian sheep and goat breeds for export, especially to the Middle East market.

A report by Future agricultures in 2014[7] indicated that livestock export trade in Ethiopia has been boosted by a number of factors that include: obtainment of World Health Organization (WHO) certificate (May 2005) clearing Ethiopia of rinderpest, deregulation of domestic prices, liberalization of foreign trade, institutional support for the export sector and promulgation of liberal investment and labor laws. Others include construction of market yard facilities in pastoral areas, feedlot operations, and improvements in roads and mobile phone networks.

The livestock export trade routes consist of livestock market chains and trading routes that feed the Djibouti, Berbera and Bosaso corridors. Export trade involves operations over a long distance with many different types of actors such as farmers, traders, brokers and financiers. Within the chain are networks based on clan affiliation especially in informal export trade and these networks provide security for individual operators, debt recovery in

[8] Future Agricultures, (2014): Pastoral Livestock Trade and Growth in Ethiopia

[9] Ameha S (2011). Export requirements for meat and live small ruminants: How can Development agents assist producers to improve small ruminant export. Technical Bulletin No.47, Addis Ababa, Ethiopia.

case of non-payment, shields and issue security advisories in case of potential violent attacks, negotiate in case of confiscation and harassment (Desta et al., 2012).

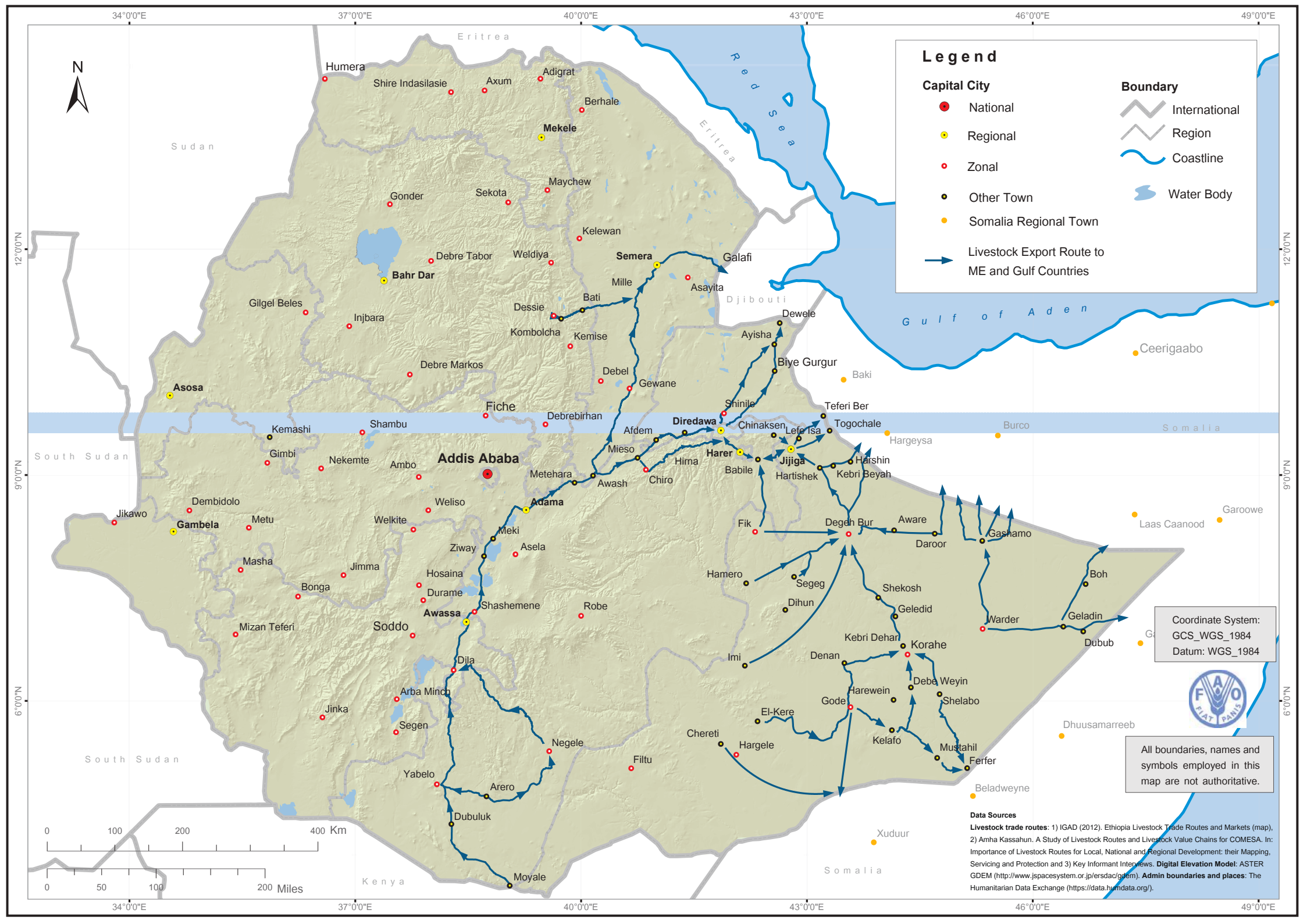
Literature suggests that clan-based networks are the kingpin for the cross-border livestock export trade that does not involve use of established quarantine facilities in Ethiopia (thanks to existence of alternate quarantine stations at Djibouti Port). The clan based transactions are not recorded by government, nor do they use convertible currencies and bank formalities. According to key informants well versed with livestock trade, transactions are often carried out through barter involving essential goods for poor pastoralists with much benefit accrued to women and children.

The second livestock export system, although less significant, is one that involves convertible currencies and bank procedures such as opening of letters of credit by an importing country and run by business firms with large capital and formal organizational set-ups that utilize the quarantine facilities (formal export trade).

To assert itself as livestock trade export oriented, Ethiopia has adopted specialization at market level within the different livestock producing regions of Ethiopia (Oromia, Harari and Somali). For example, the markets of Harar and Gursum are specialized suppliers of bulls fattened by small producers who buy one or two young bulls from pastoral areas and fatten in accordance with production practices that meet Gulf market requirements.

Other markets that demonstrate specialization include Hartishiek, which supplies shoats to Berbera corridor; Werder market is specialized in procuring shoats destined for Bosaso corridor and transported through Geladin Boh to Galkayo in Puntland. Harshin, Gashamo and Daror are part of the itinerary of Haud, which serves as transit markets for shoats before the animals cross the border. Babile market is becoming the leading center of trade in camels. Camels are brought to Babile market from distant areas in Imi Bale.

Connecting the markets, quarantine facilities and export ports are livestock export trade routes through which animals are either trucked or trekked on hoof. Based on the literature review, key informant interviews and focus group discussions, a livestock export route map for Ethiopia was developed (see next page).


Legend
Capital City
National
Regional
Zonal
Other Town
Somalia Regional Town
Livestock Export Route to ME and Gulf Countries
Boundary
International
Region
Coastline
Water Body
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Eritrea
Red Sea
Sudan
South Sudan
Kenya
Somalia
Djibouti
Gulf of Aden
Humera
Shire Indasilasie
Axum
Adigrat
Berhale
Mekele
Maychew
Gonder
Sekota
Kelewan
Debre Tabor
Weldiya
Semera
Galafi
Bahr Dar
Mille
Asayita
Gilgel Beles
Injbara
Dessie
Bati
Dewele
Kombolcha
Kemise
Ayisha
Biye Gurgur
Debre Markos
Debel
Gewane
Asosa
Fiche
Shinile
Teferi Ber
Debrebirhan
Diredawa
Chinaksen
Togochale
Kemashi
Shambu
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Lefe Isa
Gimbi
Nekemte
Ambo
Addis Ababa
Mieso
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Jijiga
Harshin
Metehara
Hirna
Babile
Hartishek
Kebri Beyah
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Adama
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Coordinate System:
GCS_WGS_1984
Datum: WGS_1984
All boundaries, names and symbols employed in this map are not authoritative.
Data Sources
Livestock trade routes: 1) IGAD (2012). Ethiopia Livestock Trade Routes and Markets (map), 2) Amha Kassahun. A Study of Livestock Routes and Livestock Value Chains for COMESA. In: Importance of Livestock Routes for Local, National and Regional Development: their Mapping, Servicing and Protection and 3) Key Informant Interviews. Digital Elevation Model: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). Admin boundaries and places: The Humanitarian Data Exchange (https://data.humdata.org/).

2.2.3 Water and fodder in Ethiopia

In general the Ethiopian lowlands are characterized by low availability of surface water and high variability of precipitation both in time and geographically from place to place. Availability of water is better in areas where there are traditional wells and where there have been water development projects. However, according to Daniel (2008)[10], along export trade routes and holding grounds availing feed and water is increasingly becoming a serious challenge to the beef cattle export trade. NEPAD-CAADP (2005)[11] indicates that the problem of feed and water is much more pronounced during drought, which is a recurrent phenomenon in pastoral ecosystems. Furthermore, *El Nino* significantly influenced weather patterns in pastoral areas in 2015/2016 resulting into floods and extended drought respectively affecting fodder availability among other negative impacts.

While assessing the fodder situation the study considered two main areas of focus:

1) Along transit routes especially for trekked animals, and
2) At quarantine stations.

As per the requirements by the importing countries in the Middle East, livestock is required to be held in the quarantine stations for a period of 3 weeks to undergo thorough routine checks against occurrence of any Transboundary Animal Diseases (TADs: foot and mouth disease, rift valley fever, Peste des petit ruminants) through observation and laboratory tests. During the quarantine period, the animals require fodder and this is supplied by fodder merchants. A vibrant fodder trade has developed over the years to sustain livestock during the long trek to Somaliland so that they fetch a good price.

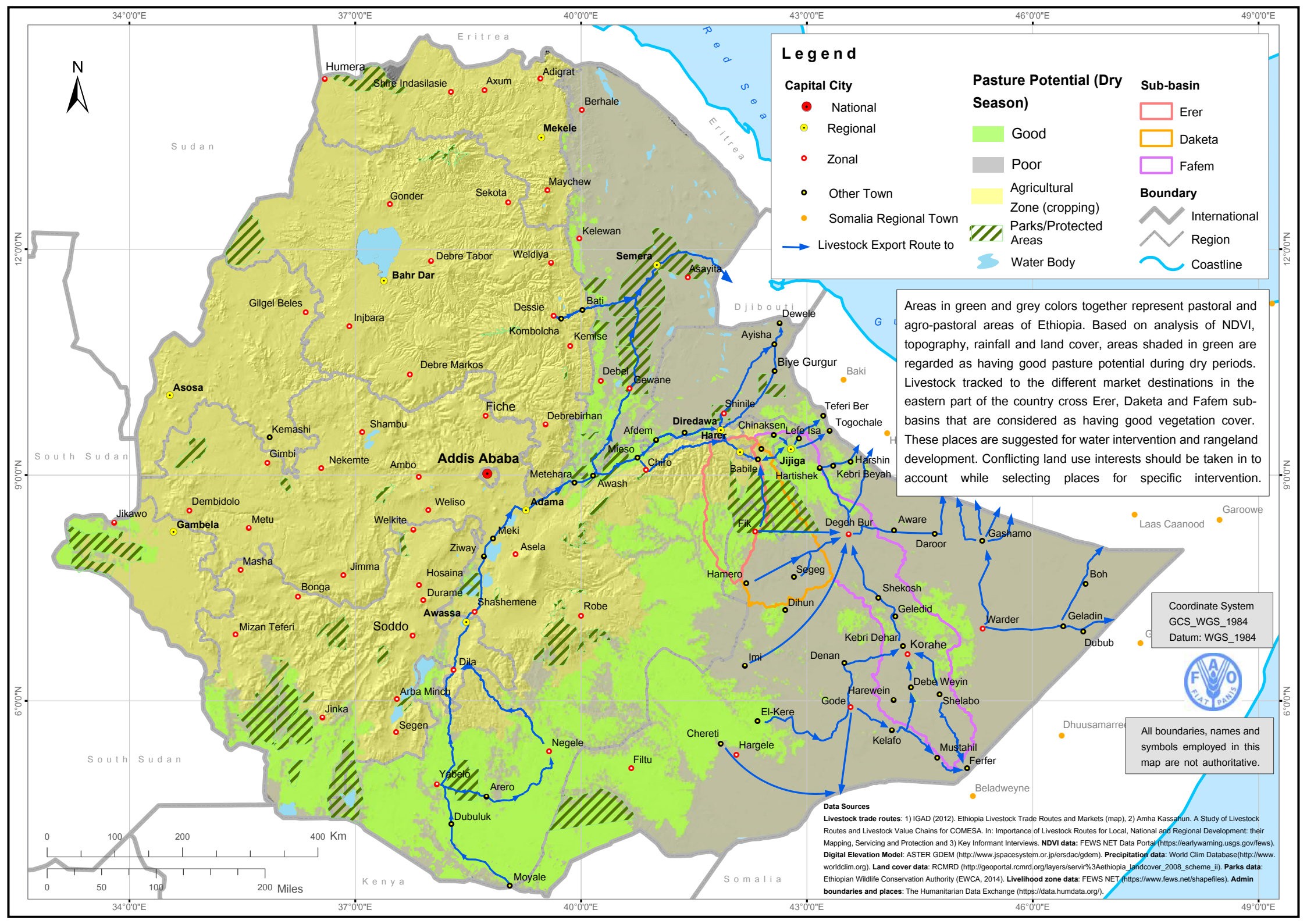
The Ministry of Trade acknowledges the fodder challenge along the export trade routes and recommended that fodder banks and commercial fodder units are established at Mile and Dire Dawa a quarantine station that experiences water shortage. Another location suggested was Galafi a border post where animals were kept for 1-3 weeks especially when the export documents were found to be incomplete.

These locations were confirmed by other Key informants, who underlined the fact that livestock for export is often kept at the feedlots for 2-3 months for finishing and regularly run out of fodder during this time. Stakeholders also supported the prioritizing of Mile quarantine station for establishing water and fodder resource due to the fact that animals are held for a long time awaiting finalizing documentation process.

As can be expected, there are large differences in fodder availability during the dry and wet seasons. To better understand pasture and rangeland production in different regions of Ethiopia, the study developed maps to help identify the (high) potential pasture and rangeland production areas. The maps on pages 31 and 32 show this for the dry and wet season, respectively. Based on analysis of Normalized Difference Vegetation Index (NDVI), topography, rainfall and land cover, areas regarded as having good pasture potential during those periods can be identified and interventions be well targeted.

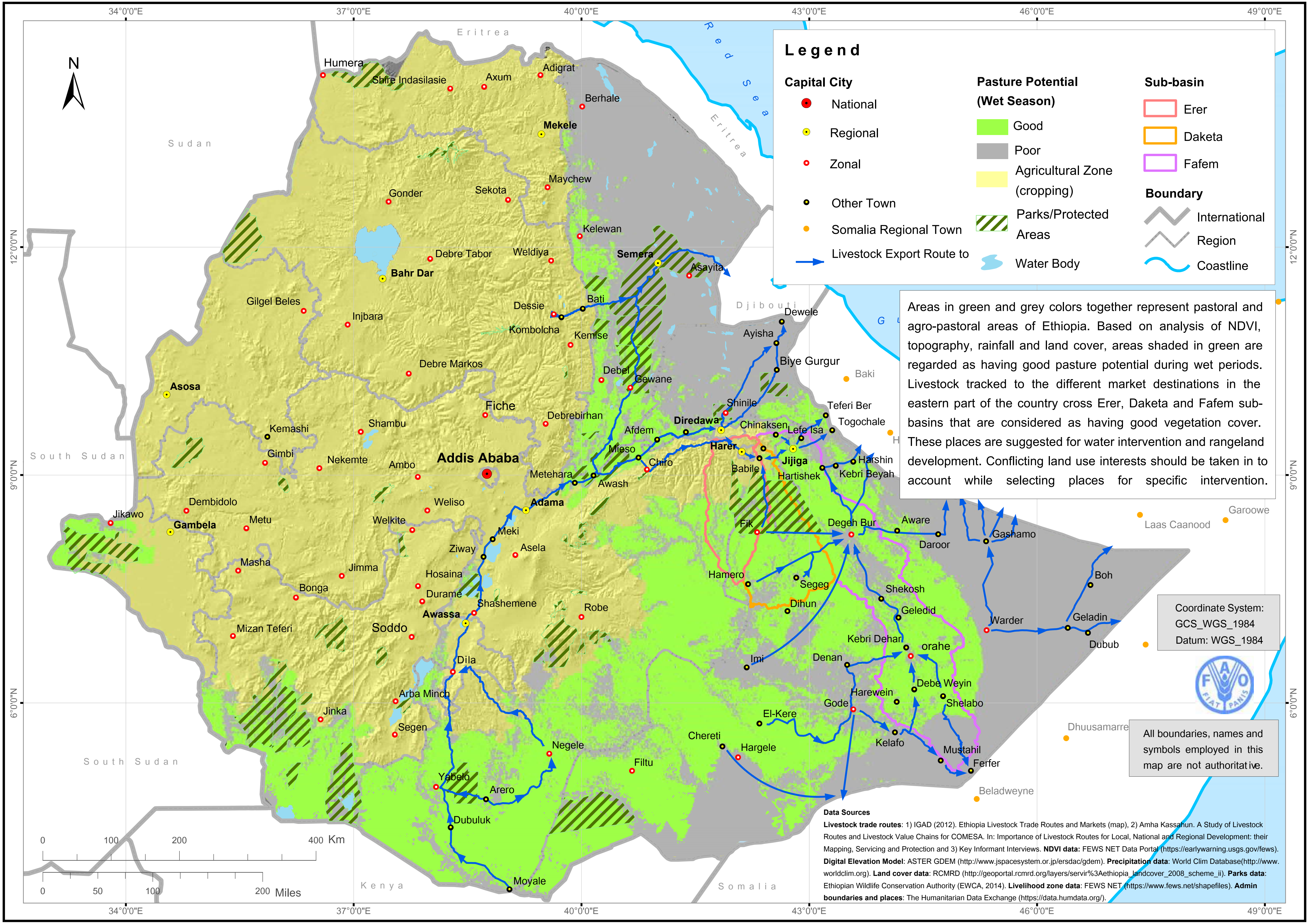
[10] Daniel T (2008). Beef Cattle Production System and Opportunities for Market Orientation in Borena Zone, Southern Ethiopia. A Thesis Submitted to the Department of Animal Science, School of Graduate Studies. Haramaya University, Ethiopia

[11] NEPAD–CAADP (New Partnership for Africa's Development – Comprehensive Africa Agriculture Development Programme) (2005). Ethiopia: Investment Project Profile "Live Animal and Meat Export" – Preliminary Options Outline. 3pp.



Data Sources

Livestock trade routes: 1) IGAD (2012). Ethiopia Livestock Trade Routes and Markets (map), 2) Amha Kassahun. A Study of Livestock Routes and Livestock Value Chains for COMESA. In: Importance of Livestock Routes for Local, National and Regional Development: their Mapping, Servicing and Protection and 3) Key Informant Interviews. **NDVI data:** FEWS NET Data Portal (https://earlywarning.usgs.gov/fews). **Digital Elevation Model**: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). **Precipitation data**: World Clim Database(http://www.worldclim.org). **Land cover data**: RCMRD (http://geoportal.rcmrd.org/layers/servir%3Aethiopia_landcover_2008_scheme_ii). **Parks data**: Ethiopian Wildlife Conservation Authority (EWCA, 2014). **Livelihood zone data**: FEWS NET (https://www.fews.net/shapefiles). **Admin boundaries and places**: The Humanitarian Data Exchange (https://data.humdata.org/).


Legend
Capital City
National
Regional
Zonal
Other Town
Somalia Regional Town
Livestock Export Route to
Pasture Potential (Wet Season)
Good
Poor
Agricultural Zone (cropping)
Parks/Protected Areas
Water Body
Sub-basin
Erer
Daketa
Fafem
Boundary
International
Region
Coastline
Areas in green and grey colors together represent pastoral and agro-pastoral areas of Ethiopia. Based on analysis of NDVI, topography, rainfall and land cover, areas shaded in green are regarded as having good pasture potential during wet periods. Livestock tracked to the different market destinations in the eastern part of the country cross Erer, Daketa and Fafem sub-basins that are considered as having good vegetation cover. These places are suggested for water intervention and rangeland development. Conflicting land use interests should be taken in to account while selecting places for specific intervention.
Coordinate System: GCS_WGS_1984
Datum: WGS_1984
All boundaries, names and symbols employed in this map are not authoritative.
Data Sources
Livestock trade routes: 1) IGAD (2012). Ethiopia Livestock Trade Routes and Markets (map), 2) Amha Kassahun. A Study of Livestock Routes and Livestock Value Chains for COMESA. In: Importance of Livestock Routes for Local, National and Regional Development: their Mapping, Servicing and Protection and 3) Key Informant Interviews. **NDVI data:** FEWS NET Data Portal (https://earlywarning.usgs.gov/fews). **Digital Elevation Model**: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). **Precipitation data**: World Clim Database(http://www.worldclim.org). **Land cover data**: RCMRD (http://geoportal.rcmrd.org/layers/servir%3Aethiopia_landcover_2008_scheme_ii). **Parks data**: Ethiopian Wildlife Conservation Authority (EWCA, 2014). **Livelihood zone data**: FEWS NET (https://www.fews.net/shapefiles). **Admin boundaries and places**: The Humanitarian Data Exchange (https://data.humdata.org/).
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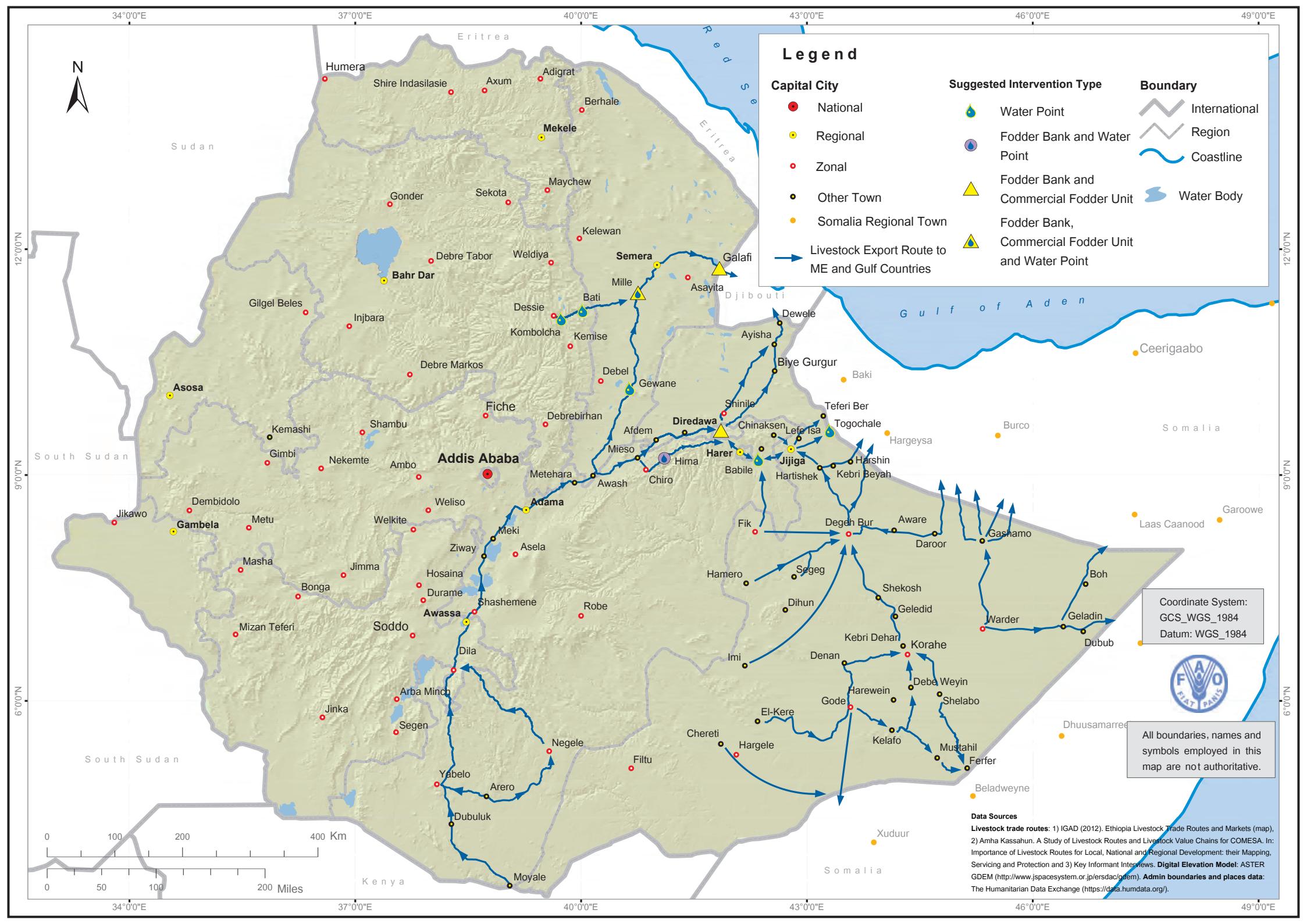
Eritrea
Sudan
South Sudan
Kenya
Somalia
Djibouti
Red Sea
Addis Ababa
Mekele
Bahr Dar
Asosa
Gambela
Semera
Diredawa
Harer
Jijiga
Adama
Awassa
Humera
Shire Indasilasie
Axum
Adigrat
Berhale
Maychew
Sekota
Gonder
Kelewan
Debre Tabor
Weldiya
Asayita
Gilgel Beles
Injbara
Dessie
Bati
Kombolcha
Kemise
Debre Markos
Debel
Gewane
Fiche
Debrebirhan
Shambu
Kemashi
Gimbi
Nekemte
Ambo
Metehara
Awash
Mieso
Afdem
Chifo
Shinile
Chinaksen
Lefe Isa
Babile
Hartishek
Dewele
Ayisha
Biye Gurgur
Teferi Ber
Togochale
Harshin
Kebri Beyah
Jikawo
Dembidolo
Metu
Weliso
Welkite
Meki
Ziway
Asela
Masha
Jimma
Hosaina
Durame
Bonga
Shashemene
Robe
Mizan Teferi
Soddo
Dila
Arba Minch
Jinka
Segen
Negele
Filtu
Yabelo
Arero
Dubuluk
Moyale
Fik
Degeh Bur
Aware
Daroor
Gashamo
Hamero
Segeg
Dihun
Shekosh
Geledid
Warder
Geladin
Dubub
Boh
Kebri Dehar
orahe
Denan
Imi
Debe Weyin
Shelabo
Harewein
Gode
El-Kere
Chereti
Hargele
Kelafo
Mustahil
Ferfer
Baki
Laas Caanood
Garoowe
Dhuusamarre
Beladweyne

In consultation with relevant stakeholders, the following water and fodder interventions have been prioritized along the major livestock export trade routes in Ethiopia (see also the map on page 34):

- Establishment of fodder bank and water point at Hirna, which is located between Awash and Dire Dawa along the livestock trade route to Somaliland and Djibouti. The cost of the commercial fodder unit is USD 29,000 while the recommended water point is a shallow well which is estimated to cost USD 20,000.
- Establishment of water point at Babile (located between Dire Dawa and Jigjiga) to support livestock to along the Jigjiga-Tog wochale route to Somaliland. The recommended water point is a shallow well, estimated to cost approximately USD 20,000.
- Establishment of a water point at Tog wochale, for animals waiting to cross the border from Ethiopia to Somaliland. The recommended water point is shallow well at USD 23,000.
- Establishment of water points at Kombolcha, Bati, Gawane and Mille located between Awash and Semera along the route to Galafi. Because this area has natural water catchments, spring wells are recommended at cost of USD 7,000 each (total USD 28,000).
- Support to improvement of Jigjiga customs facilities and infrastructure. This will enable customs processes to be undertaken during the night, resulting in significantly less loss of animal body weight, since stresses at night are much lower (estimated cost USD 25,000).


Legend
Capital City
National
Regional
Zonal
Other Town
Somalia Regional Town
Livestock Export Route to ME and Gulf Countries
Suggested Intervention Type
Water Point
Fodder Bank and Water Point
Fodder Bank and Commercial Fodder Unit
Fodder Bank, Commercial Fodder Unit and Water Point
Boundary
International
Region
Coastline
Water Body
N
Addis Ababa
Bahr Dar
Mekele
Semera
Diredawa
Harer
Jijiga
Awassa
Soddo
Adama
Fiche
Asosa
Gambela
Jimma
Dembidolo
Humera
Axum
Adigrat
Shire Indasilasie
Berhale
Maychew
Sekota
Gonder
Debre Tabor
Weldiya
Kelewan
Gilgel Beles
Injbara
Debre Markos
Kemashi
Shambu
Gimbi
Nekemte
Ambo
Weliso
Welkite
Metu
Jikawo
Masha
Bonga
Mizan Teferi
Ziway
Asela
Meki
Hosaina
Durame
Shashemene
Dila
Arba Minch
Jinka
Segen
Yabelo
Arero
Dubuluk
Moyale
Negele
Filtu
Robe
Metehara
Awash
Afdem
Mieso
Hirna
Chiro
Debrebirhan
Debel
Gewane
Kombolcha
Kemise
Dessie
Bati
Mille
Asayita
Galafi
Dewele
Ayisha
Biye Gurgur
Shinile
Chinaksen
Lefe Isa
Togochale
Teferi Ber
Babile
Hartishek
Kebri Beyah
Harshin
Fik
Degeh Bur
Aware
Daroor
Gashamo
Hamero
Segeg
Dihun
Shekosh
Geledid
Warder
Geladin
Boh
Dubub
Imi
Denan
Kebri Dehar
Korahe
Deba Weyin
Shelabo
Harewein
Gode
El-Kere
Kelafo
Mustahil
Ferfer
Chereti
Hargele
Ceerigaabo
Baki
Burco
Hargeysa
Laas Caanood
Garoowe
Dhuusamarreeb
Beladweyne
Xuduur
Sudan
South Sudan
Eritrea
Djibouti
Somalia
Kenya
Red Sea
Gulf of Aden
34°0'0"E
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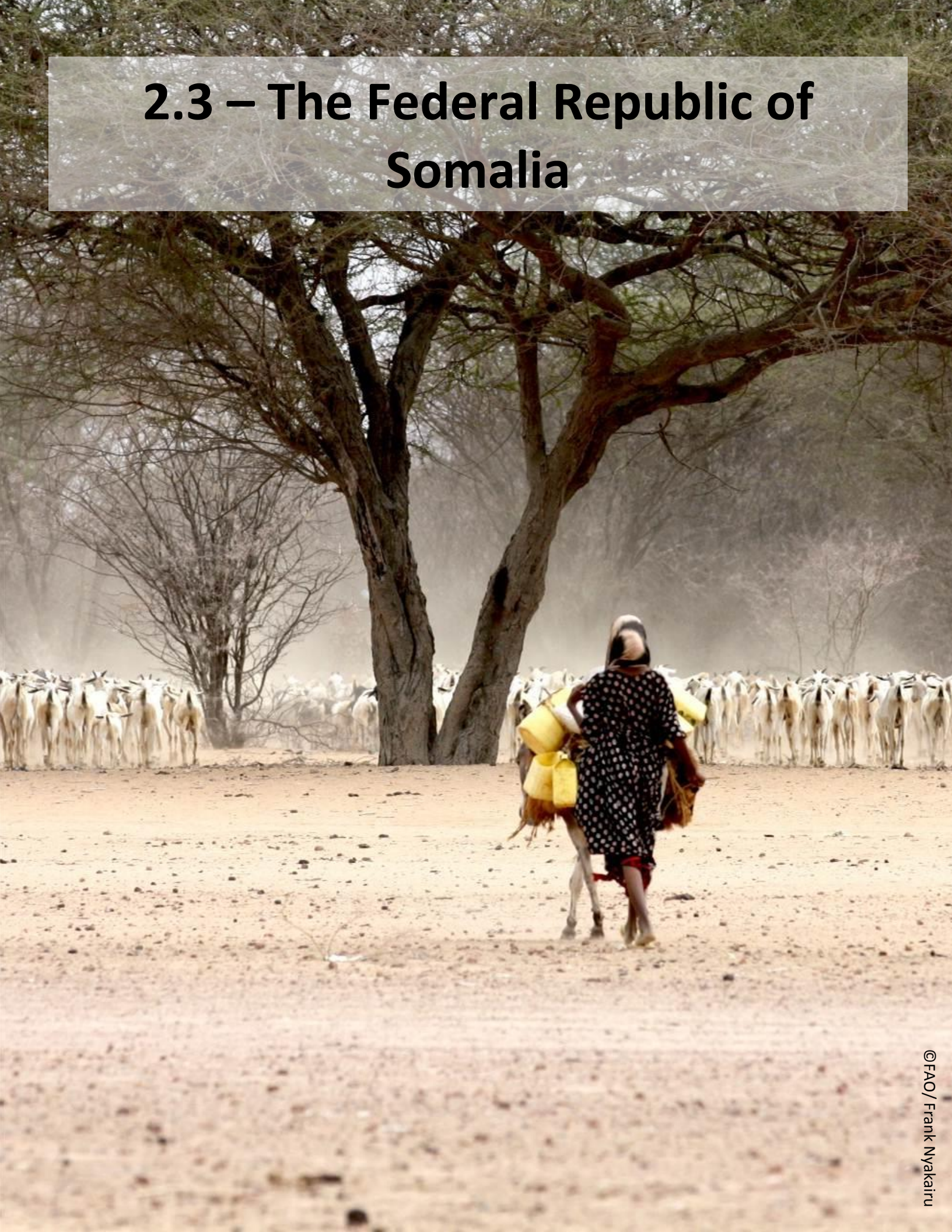
40°0'0"E
43°0'0"E
46°0'0"E
49°0'0"E
12°0'0"N
9°0'0"N
6°0'0"N
0 100 200 400 Km
0 50 100 200 Miles
Coordinate System: GCS_WGS_1984
Datum: WGS_1984
All boundaries, names and symbols employed in this map are not authoritative.
Data Sources
Livestock trade routes: 1) IGAD (2012). Ethiopia Livestock Trade Routes and Markets (map), 2) Amha Kassahun. A Study of Livestock Routes and Livestock Value Chains for COMESA. In: Importance of Livestock Routes for Local, National and Regional Development: their Mapping, Servicing and Protection and 3) Key Informant Interviews. Digital Elevation Model: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). Admin boundaries and places data: The Humanitarian Data Exchange (https://data.humdata.org/).

2.3 – The Federal Republic of Somalia



2.3.1 Introduction

The Federal Republic of Somalia has undergone a prolonged period of conflict and insecurity over the last 30 years, with intense fighting, population displacement, food insecurity, humanitarian crisis and generalized lack of centralized governance structures (AFDB, 2015)[12]. Consequently, the country has been split into three de facto spatial and political entities: South Central Somalia where the official capital city (Mogadishu) is located, Puntland in the North-East and Somaliland in the North. The existence of de facto spatial and political entities results in complex political and economic realities which exacerbate the decision making process for work programming in Somalia as a whole.

Source: http://bit.ly/2kiOjXf

The common feature in the structure of the economy of the three sub-entities of Somalia is the predominance of livestock in the economy, accounting for about 65% of the GDP and employment of the workforce and roughly 80% of export earnings annually. The livestock sector is highly vulnerable to extreme weather conditions FAO (2012)[13]. See also the infographic developed by FAO Somalia on page 37.

2.3.2 Somalia livestock export trade routes

According to a report by the FAO-managed Food Security and Nutrition Analysis Unit (FSNAU, 2016)[14], Somalia livestock export hit a record high of 5.3 million (4.9 million sheep and goats, 294,000 cattle and 72,000 camels) in 2015. This was worth an estimated USD 380 million, the highest in the last 20 years, and is mostly exported through the ports of Berbera and Bossaso (see also the infographic on the next page). According to Holleman (2002)[15]; Oxfam-GB (2011) and Desta et al. (2011), 55-65% of the livestock exported to the Gulf States and Middle East originates from Ethiopia. Examining the drivers of livestock exports, FAO-Somalia (2014)[16] reveals that over 65% of the population is engaged in various ways in the livestock industry. Similarly, Abdullahi (1990)[17] observed that unlike other pastoral systems devoted to subsistence, the Somali system is traditionally oriented towards trade and export.

According to Terra Nuova and ILRI (2010)[18], livestock export consists of three routes, two of which supply the Arabian Peninsula with mostly small ruminants and cattle by sea, the third one is overland to Kenya. Interviews with FAO-Somalia staff confirmed the distinct routes but added that the North routes through Berbera and Bossaso are mainly for shoats while the South route to Kenya is mainly for cattle and camels (this route is not used for export to the Middle East and hence has been left out of the mapping exercise). Interviews with stakeholders revealed that the livestock routes in South Central Somalia connect either to the Galkayo-Bossaso route, to Kenya, or to Mogadishu. These routes have been included in the livestock route map. Although only a very small number of livestock and low quantities of meat are exported through Mogadishu port, the potential for using Mogadishu as an export outlet is high. It should furthermore be noted that these routes keep changing with respect to fodder and water availability, transaction costs, the security situation and clan dynamics.

[12] AFDB, 2015: Somalia country brief
[13] FAO, 2012: Protecting Somalia's leading livelihood assets. Somalia Livestock Issue No.1. FAO Somalia
[14] FSNAU, 2015: Long-term sector investment boosts country's trade with Gulf States
[15] Holleman, C. (2002), The Socio-economic Implications of the Livestock Ban(USAID/FEWSNET)
[16] FAO-Somalia (2014). http://www.faosomalia.org/livestock
[17] Abdulahi A.M, 1990: Pastoral production systems in Africa: a study of nomadic household economy and livestock marketing in central Somalia. Farming systems and resource economics in tropics, Vol. 8. Wissenschafstverlag Vauk, Kiel, Germany.
[18] Terra Nuova and ILRI, 2010: Mapping cattle trade routes in Southern Somalia: a method for mobile livestock keeping systems.

Somalia Livestock Exports 2015

infographics 2016

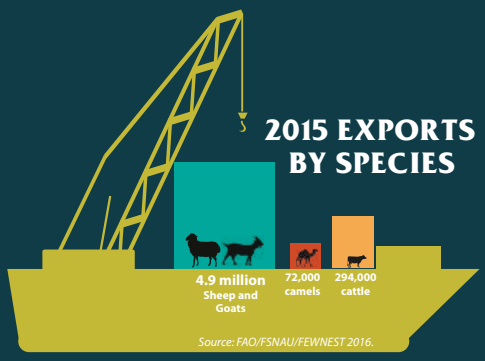
There are an estimated **40** million livestock in Somalia.

More than **5.3 million** livestock were exported from Somalia in 2015.

Source: FAOSTAT 2016.

This is highest number of live animals exported from Somalia in **20** years.

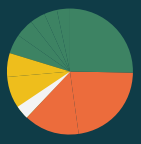
2015 EXPORTS BY SPECIES



Source: FAO/FSNAU/FEWNEST 2016.

GDP

Livestock contributes about **40%** to Somalia's Gross Domestic Product.

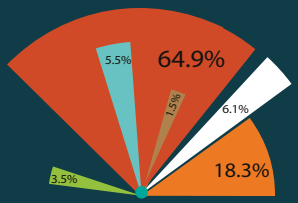


40% Livestock
20% Agriculture
33% Services
7% Industry

Source: US State Department 2015.

Demand for Somali livestock is boosted by **Eid al-Adha** festival when Muslims around the world traditionally sacrifice an animal.

IMPORTERS



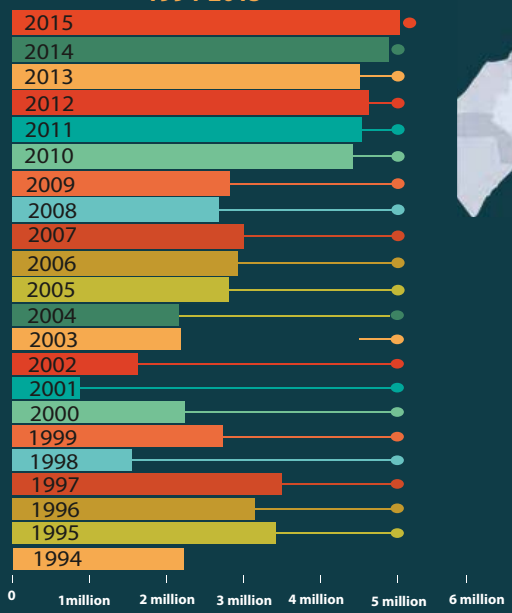
Source: USAID Somaliland Livestock 2013

THE SOMALI ECONOMY EARNED **$380 MILLION** FROM 2014 LIVESTOCK EXPORTS

HEADS OF LIVESTOCK EXPORTED IN 2014 BY PORT

Source: FAO/FSNAU/FEWNEST 2016

HEADS OF LIVESTOCK EXPORTED 1994-2015



Source: FAO/FSNAU/FEWNEST 2015.

Sheep

There are an estimated **13.9** million sheep in Somalia.

Camels

There are an estimated **7.1** million camels in Somalia.

Cattle

There are an estimated **5.3** million camels in Somalia.

Goats

There are an estimated **13.2** million camels in Somalia.

Source: FAOSTAT 2015.

fao.org/somalia

Food and Agriculture Organization of the United Nations

With the support of:

Previous studies further reveal that livestock is traded through a network of markets and participants at different level of the value chain. Similarly, the FAO CBIT (2012)[19] indicated that cross-border livestock trade involves producers, traders and brokers. The chain starts with primary markets located close to production areas where petty traders buy and sell animals to district markets. The secondary markets located close to regional capitals receive livestock from primary markets, trekked or trucked along trade routes, in which the key players are export traders. Such markets include Bossaso and Berbera which are terminal sea ports. Thus linking the markets are the livestock export trade routes.

Based on the literature review, key informant interviews and focus group discussions, the following livestock export routes were identified (and mapped) for Somalia:

Berbera corridor

- Boroma - Gebiley - Hargeisa - Berbera
- Erigabo - Burao - Berbera

Bosaso corridor

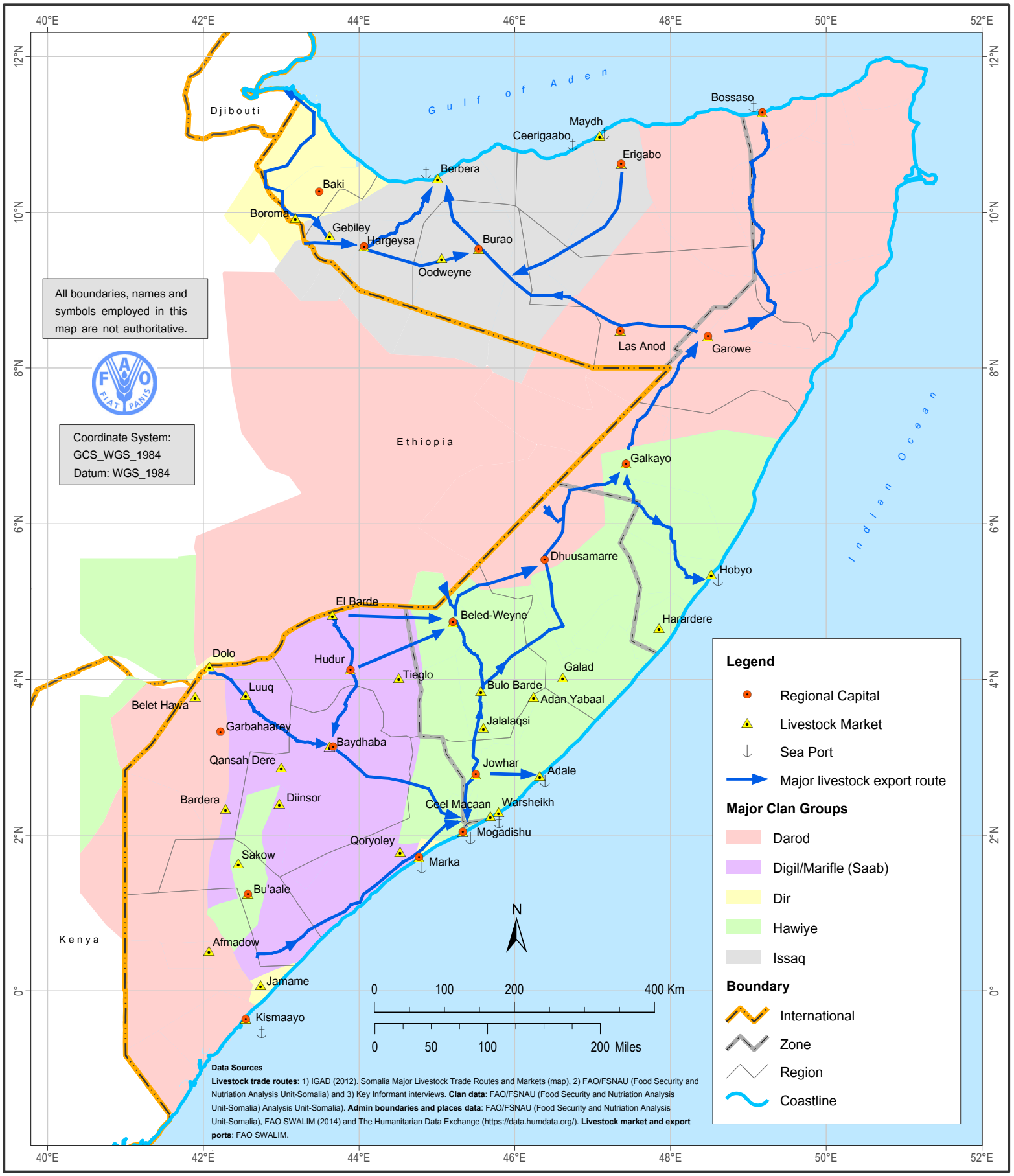
- Galkayo - Garowe - Bossaso

Mogadishu Corridor

- Dolo - Baydhaba - Mogadishu
- El Barde - Hudur - Baydhaba - Mogadishu

See the next page for the Somalia livestock export trade route map, which includes the major geographical distribution of the major clans.

[19] FAO CBIT, 2012: FAO Cross Border Informal Livestock Trade- Ethiopia-Somalia


Djibouti
Ethiopia
Kenya
Gulf of Aden
Indian Ocean
Bossaso
Maydh
Ceerigaabo
Erigabo
Berbera
Baki
Boroma
Gebiley
Hargeysa
Burao
Oodweyne
Las Anod
Garowe
Galkayo
Dhuusamarre
Hobyo
El Barde
Beled-Weyne
Harardere
Dolo
Hudur
Tieglo
Galad
Bulo Barde
Adan Yabaal
Luuq
Belet Hawa
Jalalaqsi
Garbahaarey
Baydhaba
Qansah Dere
Jowhar
Adale
Bardera
Diinsor
Ceel Macaan
Warsheikh
Mogadishu
Qoryoley
Marka
Sakow
Bu'aale
Afmadow
Jamame
Kismaayo
All boundaries, names and symbols employed in this map are not authoritative.
Coordinate System:
GCS_WGS_1984
Datum: WGS_1984
N
0 100 200 400 Km
0 50 100 200 Miles
Legend
Regional Capital
Livestock Market
Sea Port
Major livestock export route
Major Clan Groups
Darod
Digil/Marifle (Saab)
Dir
Hawiye
Issaq
Boundary
International
Zone
Region
Coastline
Data Sources
Livestock trade routes: 1) IGAD (2012). Somalia Major Livestock Trade Routes and Markets (map), 2) FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia) and 3) Key Informant interviews. Clan data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia) Analysis Unit-Somalia). Admin boundaries and places data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia), FAO SWALIM (2014) and The Humanitarian Data Exchange (https://data.humdata.org/). Livestock market and export ports: FAO SWALIM.

Box 1: The Enhancing Somali Livestock Trade (ESOLT) project

The Enhancing Somali Livestock Trade (ESOLT) project was launched softly during 2015, and officially (re-) launched in April 2016. Implementing partners of the ESOLT project are AU-IBAR and line ministries in charge of livestock and Chambers of commerce for Somaliland, Puntland and Federal Government of Somalia. FAO Somalia is also supporting ESOLT. The project is funded by the European Union for €3,000,000. ESOLT's objective is to improve the livelihoods and enhance resilience to shocks and disasters of livestock dependent households in Somalia, through enhancing the market access of Somali livestock and livestock products.

This will be achieved through three result areas:

- Competiveness of Somali livestock in international markets enhanced
- Compliance to market requirements for trade in livestock commodities improved
- Governance of Somali livestock value chains improved

Additionally, ESOLT also has a component on infrastructure development and rehabilitation. This includes the following activity: "Assessments of the status and usage of existing facilities and identification of priority structures and locations for rehabilitation". This will involve a detailed assessment of the existing livestock marketing and animal handling infrastructure facilities to determine their physical status, usage, appropriateness of their physical locations along the livestock marketing chains, modalities for their maintenance and management including payments for use of the facilities by value chain actors. The assessment will also entail the identification of gaps and priorities in infrastructure facilities along the marketing chains and the status of the public private partnerships established for their operations in Somaliland. Blue prints for the identified priority infrastructure facilities identified will be prepared.

Considering the similarity between this activity and the GCP/RAF/490/ITA Output 2 activities, it was agreed that both projects should work together and streamline activities, to avoid duplication and ensure optimal use of resources. A first step towards streamlining the activities of both projects was undertaken during the Somaliland field mission, by developing a common questionnaire for assessment of infrastructure facilities (including water and fodder infrastructure). The two projects divided tasks in assessing the infrastructure on the two trade routes in Somaliland.

Given the limited budget of both projects for infrastructure development/rehabilitation, it was agreed to liaise closely in prioritizing and implementing interventions – including with the Somaliland government (MoL). Any activities to be implemented by GCP/RAF/490/ITA during the second phase of the project will have to be aligned with ESOLT and Government of Somaliland activities. This will ensure optimal use of the limited project funds.

2.3.3. Water and fodder in Somalia

Reviews of various reports suggest that Northern Somalia (Somaliland and Puntland regions) suffer frequent fodder shortages. This was confirmed during meetings with FAO Somalia (FAO Somalia mission report, 2015). It was further decided that the baseline study should be focused on Somaliland and Puntland territories since these areas are the main places where vibrant export oriented livestock marketing takes place, and because in Northern Somalia there are no natural water sources available for livestock. It should be noted that water and fodder resources are limited and have the potential to ignite conflicts especially in Northern Somalia (Somaliland and Puntland). Stakeholders and livestock experts observed the need for conflict sensitive approaches, to be aware of potential political challenges and relationships among the federal government and the two self-governing territories of Somalia, as well as clan dynamics.

Due to the fact that the baseline study team could not visit South Central Somalia and Puntland, this section focuses mainly on the water and fodder situation in Somaliland. The map on page 43 shows the general grazing patterns overlaid with the export routes. This map clearly shows the differences between South Central Somalia and the rest of the country, where there are no permanent rivers and livestock traders and producers are dependent on rainfall and aquifers for water supply (and fodder production).

Fodder

Information obtained from the GCP/RAF/ 490/ITA inception workshop and Somaliland field visit shows that there are two holding/grazing grounds under construction in Somaliland: Qoolcaday (10 by 20 km) and Aroori. The sites are located along the export livestock route (Boroma-Berbera and Burao-Berbera). In Puntland there are grazing reserves in Harfo (10x10Km), Galgodob and Balambale, Mudug region and Qardho, Bari region. In South Central Somalia there are two reserves located at Warmahun (near Mogadishu) and Kisimayo. Unfortunately no GPS locations could be retrieved, and hence they have not been included in the maps.

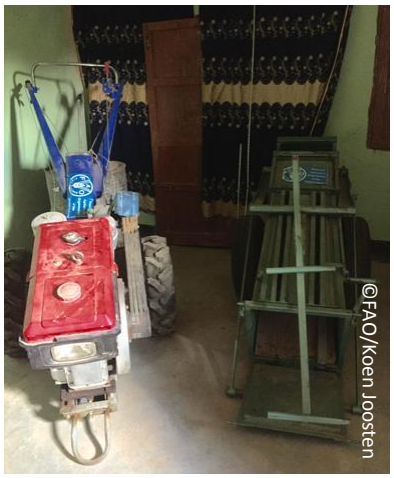
The field mission revealed that the availability of fodder is a key constraint for livestock trade in Somalia, more so than the availability of water. During the dry season, rangelands are often not able to sustain the large number of animals in Somalia, hence the need for (commercial) fodder production. This mainly happens in the areas round Beer and Oodweyne towns, east of Hargeisa. This area has indigenous fodder, supplemented by established fodder. The grass is produced using water from rains as well as from floods using temporary canals to divert the floodwater (spate irrigation). Most fodder is produced during the rainy season. Cooperatives sell their fodder mainly to traders in Burao, Berbera and Bosaso, as well as smaller quantities to individuals. From FAO observations/experiences, the fodder producers seem not well connected to the high-end markets (export market ports) – compared to traders. Market imperfections in terms of fodder prices exist that disfavor producers. A critical value chain analysis to bring all actors together is expected to provide a win-win situation among actors in the fodder marketing value-chain.

One truck of fodder (6 ton) sells for about 200-300 USD in the low/rainy season, when there is ample supply of fodder and rangeland conditions are good. During droughts and/or Hajj season, a truck of fodder can go up to USD 1000. Fodder is not bailed because traders prefer bulk loose fodder. The cooperative would prefer bailing, but in that case traders will buy their fodder elsewhere. Traders take advantage of producers; trucks carry lot less lighter loads when fodder is not baled – easing transportation. Consultative forums (including value chain analysis) that bring all actors together is necessary to overcome these and other challenges. As a starting point, FAO has introduced metallic manual balers (see below photo) to pilot commercial baling and engage actors in such discussions.

Fodder cooperatives experience several challenges and constraints in production and marketing, including:

- **Storage issues:** There is currently no storage capacity, and sometimes fodder gets wasted. Availability of storage will also make it possible to keep fodder when there is a surplus and then selling it during times when there is high demand (and high price)
- **Lack of production and marketing skills:** This includes training on harvesting, seeding and value addition.
- **Lack of knowledge on Proposis management:** Using prosopis pods for animal feed is seen as a potential value addition and source of income, but capacity to process pods is very limited.

FAO Somalia is undertaking efforts to improve fodder production and utilization in both Beer and Odweyne areas. These interventions include training and support for over-sowing rangelands with improved pasture seeds, hay stores for dry season storage, and utilization of invasive weeds for income and feed improvement. The fodder production cooperatives in Beer village in Burao District have been supported by FAO-Somalia under various projects in the last few years and focus on the production of fodder for livestock. Proposed priority interventions on fodder production and rangeland management for Somalia:



Some of the inputs previously provided by FAO: a tractor and bailer

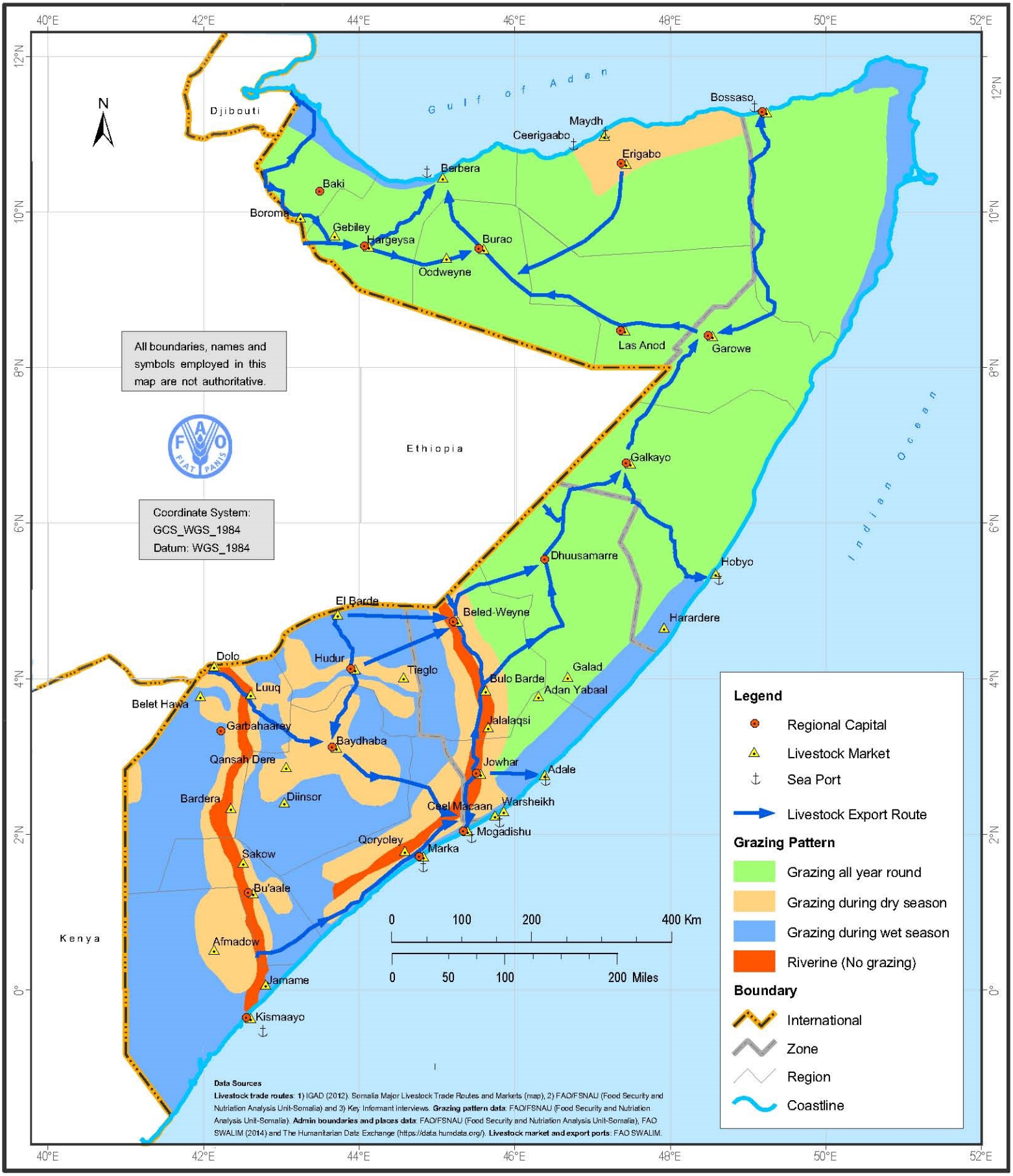
- Construction of two fodder storage sheds in Beer & Odweyne areas already supported by FAO. Estimated cost: USD 40,000
- Introduction of locally adaptable fodder species (grasses, legumes, fodder tree/shrubs) in Togdheer region (Beer, Odweyne) and training on informal seed production to avert continued importation of seeds. Estimated cost: USD 50,000
- Introduction of technologies that will improve the efficiency in the use of locally available feed resources, especially crop residues (that form bulk of the feed during the dry seasons after crop harvests) and natural browse tree species. Support to on-going FAO activity on physical processing to enhance feed intake by animals and reduce wastages. This includes the physical processing (grinding) of the pods/seeds from the invasive Prosopis juliflora tree (Garaanwa) into protein-rich feed. The tree is widespread in Somalia found encroaching into grazing areas and riverine areas thus reducing available pasture. Thus, the rate of invasion by the Prosopis is reduced by managing the seeds. Estimated cost: USD 15,000

Water

As indicated, stakeholders (including government officials) indicated that support to fodder activities is preferable over construction/rehabilitation of water infrastructure, as fodder availability is a bigger constraint than water availability. However, a few water-related priority interventions were identified in areas with water shortages.

1. This includes the connection of the Burao livestock market to the municipal water line. This will provide water for livestock and people. The price of water from the municipality is Sl.Sh 9,500 / m3. At the moment private parties are supplying water to the market, but after questioning the mission was assured that no conflicts are expected to arise if the market would be connected to the municipal water grid. Estimated cost is USD 50,000 – which includes a water tank, troughs, generator, overhead tank, etc.
2. The old marshaling yard at Berbera port is too small and lacks appropriate facilities, which means that animals are gathered in an open space before they are loaded onto the ship. This open space needs water facilities, which can be water throughs that will then be filled using water trucks provided by the traders themselves.

It should be noted that before implementing such activities, thorough conflict analyses should be undertaken as badly designed interventions can result in increased conflicts between clans or user groups.


40°E
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Djibouti
Gulf of Aden
Bossaso
Maydh
Ceerigaabo
Erigabo
Berbera
Baki
Boroma
Gebiley
Hargeysa
Burao
Oodweyne
Las Anod
Garowe
All boundaries, names and symbols employed in this map are not authoritative.
Ethiopia
Galkayo
Indian Ocean
Coordinate System:
GCS_WGS_1984
Datum: WGS_1984
Dhuusamarre
Hobyo
El Barde
Beled-Weyne
Harardere
Dolo
Hudur
Tieglo
Galad
Bulo Barde
Adan Yabaal
Luuq
Belet Hawa
Jalalaqsi
Garbahaarey
Baydhaba
Qansah Dere
Jowhar
Adale
Bardera
Diinsor
Warsheikh
Ceel Macaan
Mogadishu
Qoryoley
Marka
Sakow
Bu'aale
Kenya
Afmadow
Jamame
Kismaayo
0
100
200
400 Km
0
50
100
200 Miles
Legend
Regional Capital
Livestock Market
Sea Port
Livestock Export Route
Grazing Pattern
Grazing all year round
Grazing during dry season
Grazing during wet season
Riverine (No grazing)
Boundary
International
Zone
Region
Coastline
Data Sources
Livestock trade routes: 1) IGAD (2012). Somalia Major Livestock Trade Routes and Markets (map), 2) FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia) and 3) Key Informant interviews. Grazing pattern data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia). Admin boundaries and places data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia), FAO SWALIM (2014) and The Humanitarian Data Exchange (https://data.humdata.org/). Livestock market and export ports: FAO SWALIM.

ISTVS campus in Sheikh, Somaliland

Collaboration with the IGAD Sheikh Technical Veterinary School and Reference Centre

In addition to specific water and fodder interventions, another priority activity identified during the Somaliland field mission is a collaboration with the IGAD Sheikh Technical Veterinary School and Reference Centre (ISTVS). ISTVS is a regional institution located in Sheikh, in the highlands of the Sahil region (Somaliland). Its aim is to provide pastoralists in the Horn of Africa with better veterinary services. STVS began as a project in 2002 with international funding (European Union, Danish Government, Italian Cooperation), implemented by Terra Nuova and under the auspices of AU-IBAR. It has since then become a well-established tertiary education institution, also offering a curriculum in dryland agriculture. At the moment, ISTVS is owned by IGAD as one of its specialized regional institutions and managed/implemented by Terra Nuova. The Italian Government still supports ISTVS, by funding some of the staff salaries as well as sponsoring the programme with Mekele University (see below).

Since its establishment, the school has delivered 207 graduates, of which 36 were women. Approximately 60 students study at ISTVS every year, coming from all IGAD countries (although the bulk of them come from all regions of Somalia). Graduates end up at ministries, in the private sector, at NGOs, etc., many of them working in the livestock export sector. ISTVS is affiliated to Makerere University (Uganda) for its livestock programme, University of Nairobi for the Dry land Economics Agro-ecosystem Management curriculum, and Mekele University (Ethiopia). The last partnership is aimed at providing graduates of ISTVS the opportunity to get their degree or diploma in Ethiopia.

In general, the ISTVS facilities appear to be well managed and up to international standards. The school seems to be able to deliver high quality education that is much needed all over Somalia and the wider region. Working together with ISTVS in the area of fodder production and rangeland management can be a very effective means of increasing skills and capacity to sustainably manage Somalia's natural resources and sustain and grow the large livestock population (and trade with the Middle East). Implementation can be done using Letters of Agreement with ISTVS, through FAO Somalia.

Proposed interventions include:

- Somalia-specific workshop on good practices on sustainable rangeland management and natural resource management. Estimated cost: USD 20,000
- Development and testing/validation of a curriculum for ISTVS students on context-specific fodder production and marketing. Estimated cost: USD 25,000
- Technical and resource mobilization support to an ISTVS research programme on enhancing livestock productivity through improved animal feed production and sustainable use of natural resources. Estimated cost: USD 10,000 and technical support in kind. This research could include:
    - Identify and introduce high yielding fodder crop species/varieties suitable for dryland environments and production systems
    - Characterize and evaluate the nutritional quality of different fodder crops
    - Evaluate the performance of animals on different fodder crops

ISTVS is expected to be a good partner in building skills and capacity that is required to increase the livestock export from the Horn of Africa to the Middle East. Working with ISTVS on fodder and rangeland management

issues will not cover Somaliland only, but also Puntland and South Central Somalia – as they draw their graduates from the entire Somalia ecosystem and other IGAD countries. Trainings and workshops conducted at ISTVS can furthermore easily be attended by participants from all over Somalia.

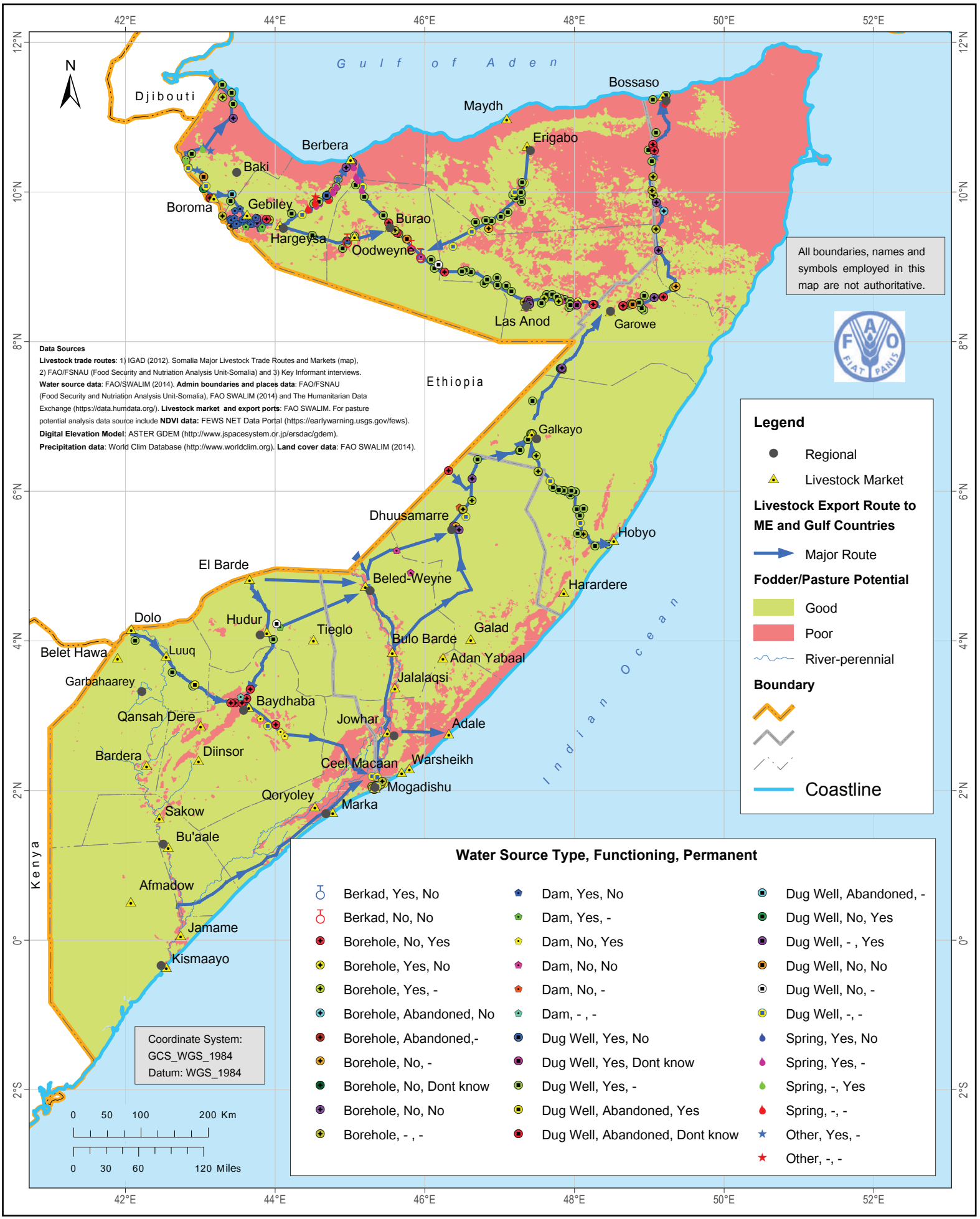
In consultation with relevant stakeholders, the following water and fodder interventions have been prioritized along the major livestock export trade routes in Somalia:

Related to **fodder availability** along the livestock routes:

- Construction of fodder banks in Beer & Odweyne areas already supported by FAO. Total cost: USD 40,000
- Introduction of locally adaptable fodder species (grasses, legumes, fodder tree/shrubs) in Togdheer region and training on informal seed production to avert continued importation of seeds. Estimated cost: USD 50,000
- Support to on-going FAO activity on physical processing to enhance feed intake by animals and reduce wastages. This includes the physical processing (grinding) of the pods/seeds from the invasive Prosopis tree into protein-rich feed. Estimated cost: USD 15,000
- Liaise with the ESOLT project team to contribute to relevant water and fodder activities identified during the assessment mission to Puntland, scheduled for after the finalization of this report. Estimated cost: USD 50,000
- In collaboration with ISTVS:
    - Somalia-specific workshop on good practices on sustainable rangeland management and natural resource management. Estimated cost: USD 20,000
    - Development and testing of a curriculum for ISTVS students on context-specific fodder production and marketing. Estimated cost: USD 25,000
    - Technical and resource mobilization support to an ISTVS research programme on enhancing livestock productivity through improved animal feed production and sustainable use of natural resources. Estimated cost: USD 10,000 and technical support in kind

Related to **water availability** along the livestock routes:

- Connecting the Burao livestock market to the municipal water line. Estimated cost: USD 50,000. This will provide water for livestock and people. The cost to connect the market to the municipal water line is estimated to be around USD 50,000, including water tank, troughs, generator, overhead tank, etc. However, it should be noted that before implementing this, a thorough conflict analysis should be done.
- Provision of water facilities for the Berbera port marshaling yard. Estimated cost: USD 10,000.
- See also the map on page 46 for the water sources that have been identified for rehabilitation using information from FAO SWALIM. It should be noted that these could not be verified on the ground. However, the map does provide suggestions for future water interventions along the livestock routes.


42°E
44°E
46°E
48°E
50°E
52°E
12°N
10°N
8°N
6°N
4°N
2°N
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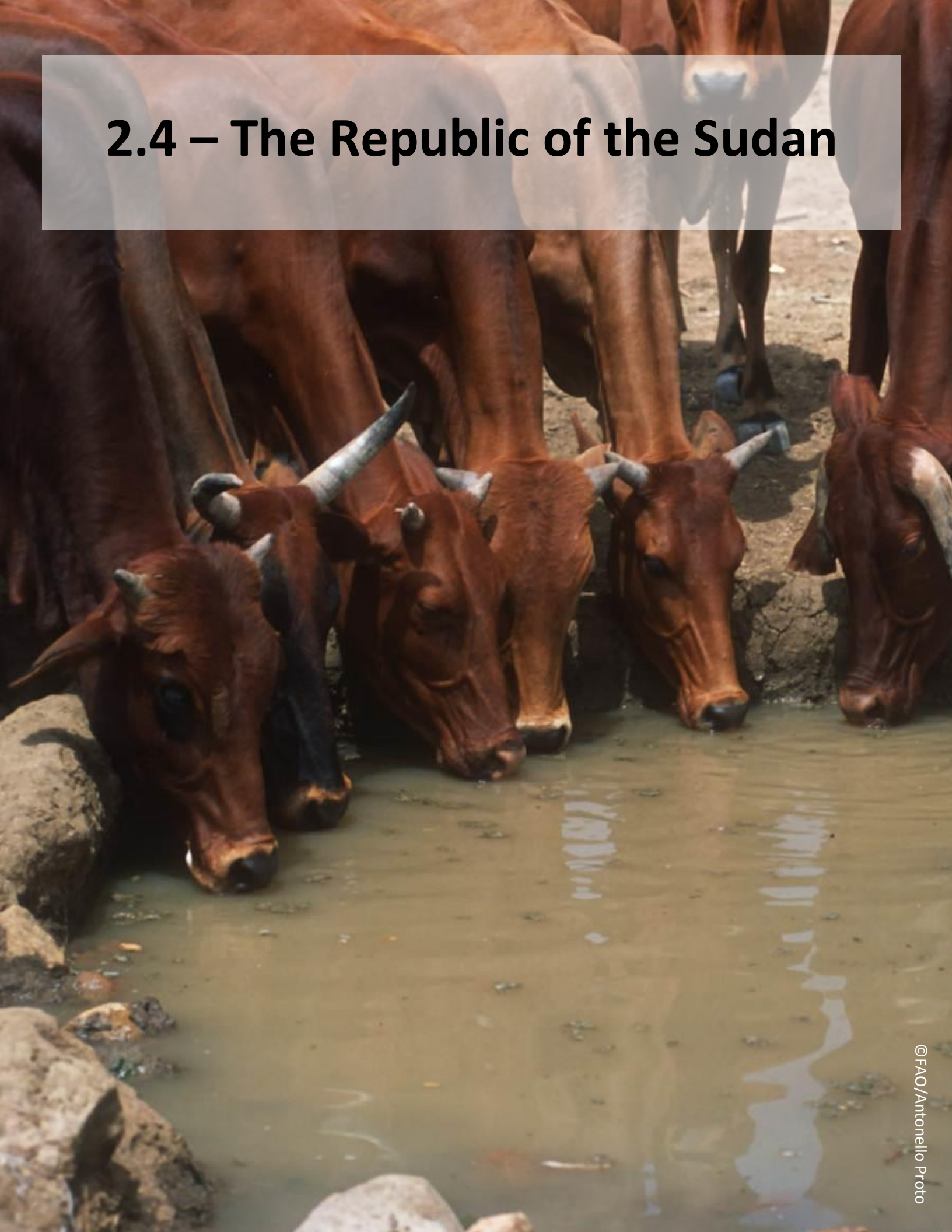
2°S
N
Gulf of Aden
Djibouti
Bossaso
Maydh
Erigabo
Berbera
Baki
Boroma
Gebiley
Hargeysa
Burao
Oodweyne
Las Anod
Garowe
Ethiopia
Galkayo
Dhuusamarre
Hobyo
El Barde
Beled-Weyne
Harardere
Dolo
Hudur
Tieglo
Galad
Bulo Barde
Belet Hawa
Luuq
Adan Yabaal
Garbahaarey
Jalalaqsi
Baydhaba
Qansah Dere
Jowhar
Adale
Bardera
Diinsor
Ceel Macaan
Warsheikh
Mogadishu
Qoryoley
Marka
Sakow
Bu'aale
Kenya
Afmadow
Jamame
Kismaayo
Indian Ocean
All boundaries, names and symbols employed in this map are not authoritative.
Data Sources
Livestock trade routes: 1) IGAD (2012). Somalia Major Livestock Trade Routes and Markets (map), 2) FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia) and 3) Key Informant interviews. Water source data: FAO/SWALIM (2014). Admin boundaries and places data: FAO/FSNAU (Food Security and Nutriation Analysis Unit-Somalia), FAO SWALIM (2014) and The Humanitarian Data Exchange (https://data.humdata.org/). Livestock market and export ports: FAO SWALIM. For pasture potential analysis data source include NDVI data: FEWS NET Data Portal (https://earlywarning.usgs.gov/fews). Digital Elevation Model: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). Precipitation data: World Clim Database (http://www.worldclim.org). Land cover data: FAO SWALIM (2014).
Legend
Regional
Livestock Market
Livestock Export Route to ME and Gulf Countries
Major Route
Fodder/Pasture Potential
Good
Poor
River-perennial
Boundary
Coastline
Water Source Type, Functioning, Permanent
Berkad, Yes, No
Berkad, No, No
Borehole, No, Yes
Borehole, Yes, No
Borehole, Yes, -
Borehole, Abandoned, No
Borehole, Abandoned,-
Borehole, No, -
Borehole, No, Dont know
Borehole, No, No
Borehole, - , -
Dam, Yes, No
Dam, Yes, -
Dam, No, Yes
Dam, No, No
Dam, No, -
Dam, - , -
Dug Well, Yes, No
Dug Well, Yes, Dont know
Dug Well, Yes, -
Dug Well, Abandoned, Yes
Dug Well, Abandoned, Dont know
Dug Well, Abandoned, -
Dug Well, No, Yes
Dug Well, - , Yes
Dug Well, No, No
Dug Well, No, -
Dug Well, -, -
Spring, Yes, No
Spring, Yes, -
Spring, -, Yes
Spring, -, -
Other, Yes, -
Other, -, -
Coordinate System:
GCS_WGS_1984
Datum: WGS_1984
0 50 100 200 Km
0 30 60 120 Miles

2.4 – The Republic of the Sudan



2.4.1 Introduction

The political landscape of the Sudan is complex and volatile, dominated by external and internal threats to sustainable peace, security and stability. The situation has remained fluid, shifting between conflict and post-conflict, with wide spatial variations (AFDB, 2014)[20]. The external threat to peace and security emanates essentially from pending post-secession issues with South Sudan, notably on oil, debt and arrears, security, border demarcation and the final status of Abyei.

The internal threats to peace and security tend to be localized regionally, in particular Blue Nile, South Kordofan, Darfur and to a lesser extent Eastern Sudan. The main triggers for conflict tend to be competition over scarce resources (water for instance) among other factors (AFDB, 2014). Despite this situation, 65% of the population depends on livestock. The Sudan is one of the world's largest producers of livestock. Livestock population in 2010 was estimated at around 141 million heads; comprising 51 million heads of sheep, 41.7 million heads of cattle, 43.4 million heads of goats and 4.6 million heads of camels (FAO, 2011)[21]. According to ICPALD, 2013[22], official GDP estimates about 68% as contribution from livestock sector and employing about 40% of the country's population.

Source: http://bit.ly/2kilXrq

The climate in the Sudan ranges from arid in the north to tropical wet-and-dry in the far southwest. Summer temperatures often exceed 43.3 degrees Celsius in the desert zones, and rainfall is negligible. Dust storms frequently occur in desert zone. High temperatures also occur in the south throughout the central plains region, but the humidity is generally low. In Khartoum the average annual temperature is about 26.7° Celsius; and annual rainfall, most of which occurs between mid-June and September, is about 254 mm.

2.4.2 Sudan livestock export trade routes

Export of livestock and livestock products is the country's second most important foreign exchange earner after oil (Yousif M.G*, et al,* 2015)[23]. Pastoralists in the Sudan are traditionally export orientated. The Sudan is one of the leading livestock exporting countries in the region, and most of these animals come from pastoral regions. The Middle East, especially Saudi Arabia, is the traditional export destination for most of Sudan's livestock. Export occurs throughout the year, but volumes peak during the two months prior to the annual Hajj festival. The table below shows the most recent livestock export numbers from the Sudan (2015).

Table 3 Sudan Livestock export figures, 2015

Livestock	Number of heads
Sheep	5,459,205
Goat	445,842
Cattle	45,825
Camel	206,008
Total	6,156,880

[20] AFDB, 2014: Sudan Country Brief – 2012-2014

[21] FAO, 2011. FAOSTAT. Food and Agriculture Organization of the United Nations, Geneva, Switzerland. http://faostat.fao.org/site/604/default.aspx#ancor

[22] ICPALD, 2013: Policy brief ICPALD 6/CLE/8/2013

[23] Yousif Mohammed Gesem Elberi et al.,: Mapping servicing, and protecting livestock routes in Sudan

Among the Horn of Africa countries, livestock export from the Sudan involves transporting live animals over long distances (5000km) from production areas to the major export ports. Despite the challenges, such as the extreme conditions through which livestock are transported, the Sudan is able to compete strongly in the Middle East countries. For example, a report by el Dirani OH, Jabbar MA and Babiker IB, 2009[24] claims that Sudanese livestock exports were accounting for about 70% of cattle imports in Gulf States, 31% of sheep, 49% of goats and 25% of camels.

Livestock moves 1000-5000km to the port mainly by truck (from Khartoum to Port Sudan and Wadi Halfa) and trekking on hoof (from the production areas in the East to Khartoum). Trekking is avoided in the dry season when due to potential for high mortality and weight loss. The road network is relatively well established throughout the country and well connected to export port outlets, with live animal handling facilities along the route. For example, the paved road from El Nihood through El Khowei to El Obeid is connected to Omdurman/Khartoum and Port Sudan (which is the main export outlet). However, the distances traversed result in high transportation costs, causing one of the major constraints facing the livestock export industry.

A characteristic feature of livestock movement in the Sudan is the longstanding system of stock routes which facilitates the movement of livestock through agricultural and forest areas in the central zone. Most of these routes were demarcated during the colonial period, although some in North Kordofan are said to be several hundred years old (UNDP 2004)[25]. Animals are trekked to terminal markets along these well-defined routes, which differ from the corridors that facilitate access to seasonal pasture. International funding from agencies such as the International Fund for Agricultural Development (IFAD) in the 1980s was directed towards improving these routes through the development of water yards and the rehabilitation of rangeland.

The study found that there are three main livestock export channels:

- Live sheep, goats and camels through Port Sudan
- Live camels and cattle cross-border to Egypt
- Live camels cross border to Libya

Based on the literature review, key informant interviews and focus group discussions, a livestock export route map for the Sudan was developed (see next page). It is clear that livestock movement in the Sudan is generally from West to East.

[24] el Dirani OH, Jabbar MA and Babiker IB. 2009. Constraints in the market chains for export of Sudanese sheep and sheep meat to the Middle East. Research Report 16. Department of Agricultural Economics, University of Khartoum, Khartoum, the Sudan, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 93 pp

[25] UNDP, 2004. 'Reduction of Resource Based Conflict Project: Project Document, 2004-07'. Khartoum: UNDP.


24°0'0"E
27°0'0"E
30°0'0"E
33°0'0"E
36°0'0"E
21°0'0"N
18°0'0"N
15°0'0"N
12°0'0"N
9°0'0"N
N
Egypt
Libya
Chad
Eritrea
Ethiopia
South Sudan
C. Africa Republic
Red Sea
Shalatin
Wadi Halifa
Dongola
Elimwahi
Port Sudan
(Port of export)
Ed Damer
Khartoum
Al Lafa
Kassala
Wad Medani
Shuwak
Humera
Gedaref
Kajarat
El Fasher
El Geneina
Zalingei
El Obeid
Rabak
Singa
Metema
Abu Hamra
Id Umm Bayt
Nyala
Umm Saata
El Shirfa
Um Dabeba
Almatord
Hilat
Abu Safifa
Jabal Ghanawa
Ed Damazine
Ed Daein
El Sim'ah
Babanusa
Kadugli
Kurmuk
0 100 200 400 Km
0 50 100 200 Miles
Data Sources
Livestock trade routes and markets: 1) IGAD (2012). Sudan Major Livestock Trade Routes and Markets (map) 2) Key Informant Interviews.
Water Centers: Sudan Livestock Route Company (SLRC). Admin boundaries and places data: The Humanitarian Data Exchange (https://data.humdata.org/).
Legend
SLRC Water Center
Rehabilitation priority site
Other
Market Place
Cross-border Market
Livestock Market
City
National Capital
State Capital
Livestock Export Route
Boundary
International
State
Coastline
Sudan
Red Sea
Gulf of Aden
Indian Ocean
Datum: WGS_1984
Coordinate System: GCS_WGS_1984
FAO
FIAT PANIS
All boundaries, names and symbols employed in this map are not authoritative.

Box 2: The livestock trade system in the Sudan

Examining how the livestock trade is conveyed, several studies on livestock export trade from the Sudan reveal that a number of players facilitate the movement of live animals from producers to the export market. According to reports (el Dirani OH, Jabbar MA and Babiker IB. 2009) livestock export trade in the Sudan involves Ghelaja (bush traders) who operate as agents and purchase animals directly from producers at grazing areas, villages and or primary markets then sell the animals to local brokers locally known as Sebbaba at primary markets.

Another category is the sheep suppliers locally known as Jellaba who purchase animals from remote production areas and bring them to the terminal markets for live sheep export. They may work in partnership with sheep exporters and wholesalers.

There are also guarantors (Damin), who provide a guarantee to the buyers that animals offered for sale are not stolen and that the seller is known by tribe. Each tribe has a guarantor. They are present in all livestock markets in the Sudan with high concentration in production areas. They also provide services for livestock owners, such as credit for managing and accommodating animals, and sometimes advice to producers as to whom they can sell on credit basis.

Agents (Wakil) act only as representatives of their clients; they do not own the animals they handle. They receive their income in the form of fees and commissions and provide services to buyers and sellers. Often, the main service they provide is market information and the linking of buyers and sellers.

Auctioneers (Dallallein) arrange for terms of sale of animals, receive payments, deduct their fees and transfer the balance to the owners. They influence the supply of sheep to Omdurman terminal market and the price determination. At secondary markets, they have the same function, but with relatively less influence.

With this streamlined roles, movement of animals from the production areas to the export ports over the years, has resulted in establishing livestock trade routes linking production and export ports (mainly Port Sudan).

2.4.3 Water and fodder in the Sudan

In terms of water resource, the Sudan is traversed by the Blue and White Nile rivers, which meet in the capital Khartoum to form the main Nile River that flows north to Egypt. In locations far off the river such as Darfur, water points along the routes are dependent on rainfall and/or groundwater. However, due to erratic rainfall and recurrent spells of drought, reliable sources of groundwater have become very important. According to an African Development Bank report (AFDB, 2010)[26], North Darfur and South Kordofan States (where a significant part of the livestock comes from) rely on groundwater supply (wells) and hafirs, but their capacity is limited which often results into acute water shortage.

According to reports by Yousif M.G*, et al,* 2015, the Government through the respective states has implemented some interventions. For example, major livestock trade routes with 1-4km width have been demarcated, regulated and maintained by the respective states. More importantly, the states facilitated the digging of reservoirs (hafirs) which harvest water from surrounding land during the rainy season which can then be used as a source of water for livestock in the dry season. However, it is thought that the number of hafirs is inadequate given the high number of animals and the long distances that they are transported along.

The Sudan's major livestock producing areas are located far from Khartoum and far from its main export markets. For a number of reasons including lack of infrastructure, most livestock trek on hoof to Khartoum. During the dry season, when water and fodder are scarce, this is an inefficient form of transportation that takes considerable time with negative consequences for health, quality of animals and quality of meat (Dirani et al., 2009)[27].

This was confirmed during a mission to the Sudan, which found out that livestock can trek up to 1.5 months to Khartoum, which often leads to poor body conditions, even though several water points have been established since the 1990s. Water and fodder availability is mainly an issue along the stock routes up to Khartoum (after Khartoum animals are mainly trucked or transported by train/plane). Animals coming from Darfur and North/South Kordofan sometimes trek up to 45 days to reach markets around Khartoum. This results in significant loss of body weight and affects animal health, hence the need for water/fodder interventions. Any water/fodder intervention will have to focus on the general livestock corridor from Nyala (in Darfur) to Khartoum.

The Sudan Livestock Route Company (SLRC), which is affiliated to the Animal Resources Bank, has the mandate to provide water facilities, fodder and veterinary services in 51 "centers" along the livestock route from Nyala to Khartoum/Omdurman, including some feeder routes outside that area. The SLRC was set up during an IFAD funded project in the late '80s (the "Stock Route Project"). This project aimed to renew and extend water supplies and veterinary services along livestock trade routes. The estimated financial benefits that would accrue to livestock raisers and traders included a reduction in livestock holding costs, a reduction in trekking weight losses and a reduction in livestock mortality during trekking. The Stock Route Project was implemented in an area running from the west of the country near Nyala, along a distance of about 1,000 km, and then up to Khartoum. It included a secondary southern route (a dry season route) and followed the railway line closely for the most part. The project activities were concentrated mainly in the states of Northern Kordofan and Southern Darfur.

At completion, 50 water yards along the livestock market route were operational. These water yards had 83 tube wells on two main routes over a distance of about 2,000 km. The water yards were equipped with water-storage

[26] African Development Bank, (AFDB, 2010): Regional Study on the Sustainable Livestock Development in the Greater Horn of Africa

[27] Dirani, O., M. Jabbar, and B. Babiker. 2009. "Constraints in the Market Chains for Export of Sudanese Sheep and Sheep Meat to the Middle East." ILRI Research Report 16. Ministry of Animal Resources and Fisheries, Sudan and ILRI, Nairobi.

tanks, selling facilities, staff housing, vehicles for delivery of supplies, and radio equipment. People who live close to the water yards would have access to them, as would the pastoralists on seasonal migration.

The distribution of the water yards was well planned and enabled the animals to obtain water, thereby reducing losses due to mortality and lower weights. The project also had a positive impact by diminishing the trek times along the route, cutting trekking and holding costs and boosting the marketable meat value and the incomes of pastoralists and livestock traders.

However, not all water yards are functioning anymore, and several need to be rehabilitated. Any work on water infrastructure and fodder/pasture improvement will have to be done through the SLRC, as they have the mandate to provide water, fodder and veterinary services along the livestock routes in the Sudan. Their water points have been established in the most important areas (basically from Nyala to Khartoum).

During the mission in the Sudan, 11 priority water points were identified that are in need of the most urgent rehabilitation, considering their location and needs from pastoralists. This data was included in the map on page 50.

The 11 centers are located in the following towns along the livestock routes[28]:

- Umsaata
- Umdabeba
- Abu Hamra
- Almatord
- Elsimlia
- Abusafifa
- Elshirea
- Babanosa
- Umbate
- Shag Elkharir
- Kajarat

The cost for creating new centers from scratch (that provide water, fodder and vet services) is approximately USD 200,000. The cost for rehabilitation of existing centers (focused on water provision) is approximately USD 30,000 – 60,000. If a decision will be made to rehabilitate (some of these) priority water yards, close consultation and collaboration will have to be ensured with both the SLRC – and the Sudanese government in general – as well as IFAD (who has been funding this kind of interventions over the past decades).

Fodder & rangeland management

Fodder availability along the livestock trade routes fluctuates and is often inadequate during dry seasons. For example, Omdurman livestock market, with an inflow of approximately 500,000 heads of cattle per year does not have adequate fodder.

To explain the fodder availability challenge, one needs to explore the ecological condition, soil type or chemical condition and water availability. The Sudan is divided into five distinct ecological zones: desert, semi-desert, woodland savannah, flood region and montane vegetation (Farida Mahgoub, 2014)[29]. The Sudan soil is geographically divided into four categories: sandy in the northern and west-central areas; clay in the central region; and laterite in the south; with alluvial soils as a fourth category but occurring less frequently (Farida Mahgoub, 2014). The poor rangeland productivity along the livestock trade routes is exacerbated by the climate which mainly ranges from hot and dry to arid desert.

[28] Note that these names have been translated from Arabic, and therefore slight discrepancies might occur in spelling/pronunciation

[29] Farida Mahgoub, 2014: Current Status of Agriculture and Future Challenges in Sudan

Rangelands traversed by livestock export trade routes form an immense source of fodder in the Sudan with potential to benefit livestock trekkers through grazing. According to Harrison and Jackson (1958)[30], Desert Zone grazing lands consist of ephemeral herbs and grasses confined to water courses and flat low lying areas that receive runoff. The valuable 'Gizzu' grazing (succulent plants) is part of this zone and supports sheep and camels and can support animals for 4-5 months without the need for water. However, there have never been efforts to commercialize it along the export trade routes.

Livestock export trade routes in the Sudan also traverse semi-desert zones with grazing lands. The range vegetation in the semi-deserts that constitutes fodder, supported by sandy soils west of the White Nile (northern Kordofan and Darfur) while range vegetation supported by clay soils are mainly in the Butana area.

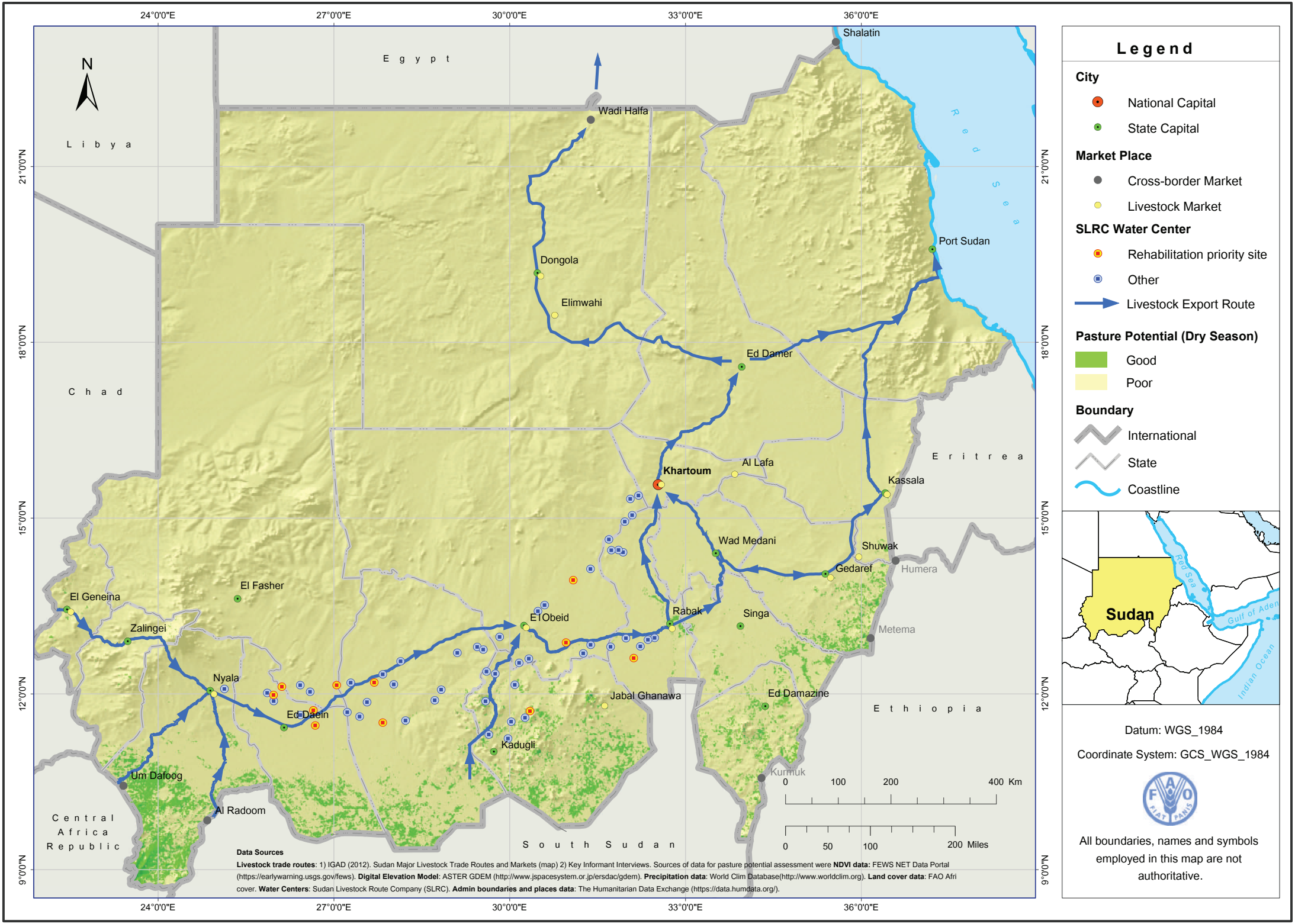
To ensure fodder availability along the livestock export trade routes within the semi-desert of the Sudan this study suggests that, attention be put on trees and shrubs to provide livestock feed in the form of leaves, twigs and pods. Important among these **woody species that may be established in semi-desert zone** include *Acacia ehrenbergiana, A. tortilis* sub-species *tortilis* and sub-species *raddiana*, *Capparis decidua*, *Maerua crassifolia*, *Salvadora persica* and *Ziziphus spina-christi*. **Grasses that may be established in Semi-desert Zone** to provide fodder along the trade routes in the Sudan include *Aristida* spp, *Schoenefeldia gracilis*, *Eragrostis* spp., *Cenchrus setigerus*, *Cymbopogon proximus* and *Panicum turgidum*.

At some point, the livestock export trade routes traverse the low rainfall savanna grazing lands found in the undulating sandy soils of western Sudan and the dark cracking clays of central and eastern Sudan, for which the following **shrubs and grass species** are recommended:

- Woody species: *Acacia mellifera*, *A. senegal*, *A. seyal*, *Balanites aegyptiaca*, *Cadaba rotundifolia*, *Combretum*. Among the important herbs are *Blepharis* spp, *Crotalaria* spp and *Zornia diphylla*.
- Grass species: *Aristida* species, *Brachiaria obtusiflora*, *Cenchrus biflorus*, *C. ciliaris*, *Cymbopogon nervatus*, *Eragrostis, Schoenefeldia gracilis*, *Pennisetum pedicellatum*, *Setaria pallide-fusca Chloris pilosa* and *Andropogon gayanus*.

As can be expected, there are large differences in fodder availability during the dry and wet seasons. To better understand pasture and rangeland production in the Sudan, the study developed maps to help identify the (high) potential pasture and rangeland production areas. The maps on pages 55 and 56 show this for the dry and wet season, respectively. Based on analysis of Normalized Difference Vegetation Index (NDVI), topography, rainfall and land cover, areas regarded as having good pasture potential during those periods can be identified and interventions be well targeted. It is clear that fodder production and/or rangeland management interventions should be focused on the areas bordering Ethiopia and South Sudan, as the rest of the country is too dry.

[30] Harrison, M. N. and J. K. Jackson (1958). Ecological Classification of the Vegetation of the Sudan. Khartoum, Agriculture Publications Committee.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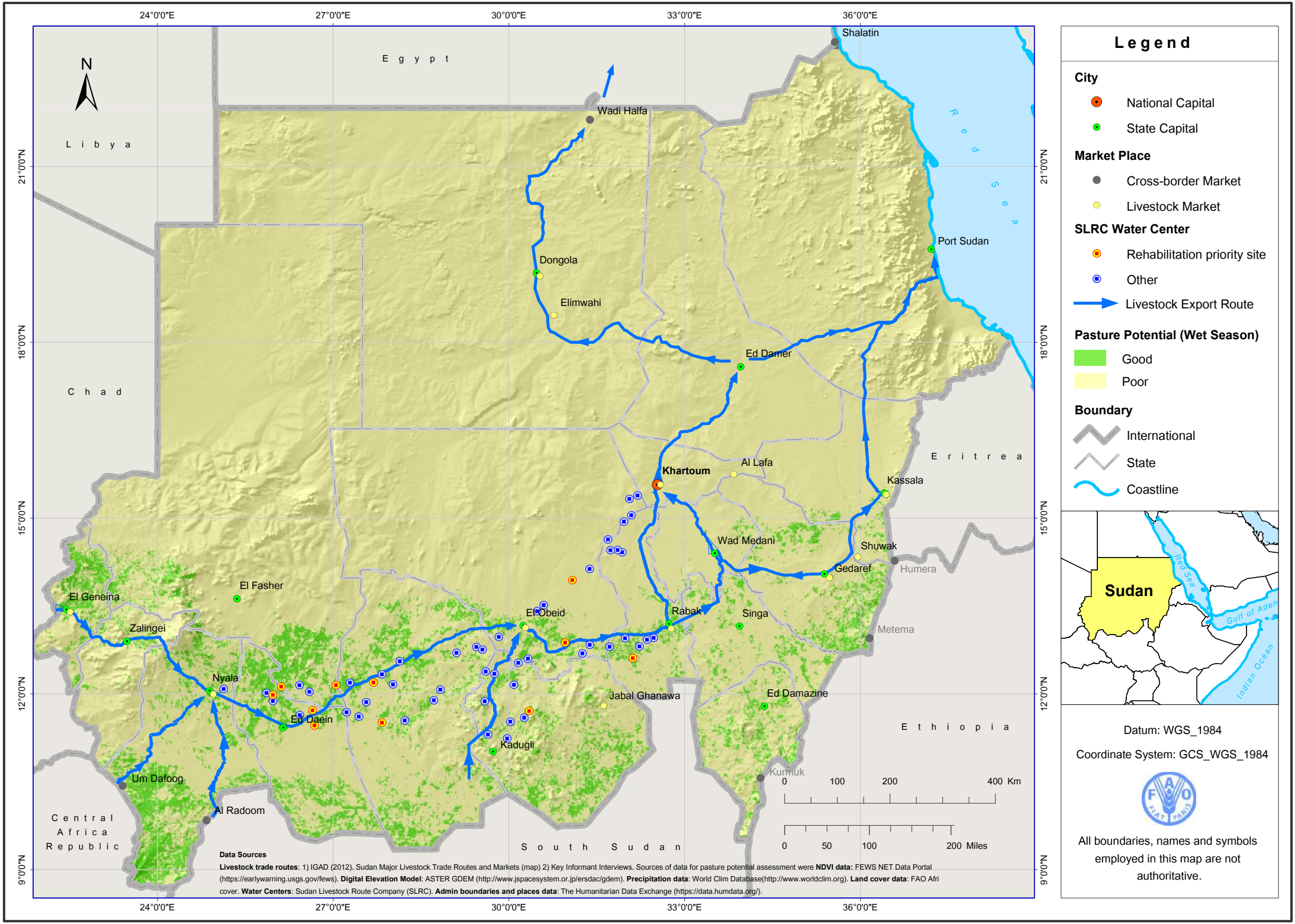
Eritrea
Ethiopia
South Sudan
Central Africa Republic
Shalatin
Wadi Halfa
Dongola
Elimwahi
Port Sudan
Ed Damer
Khartoum
Al Lafa
Kassala
Wad Medani
Shuwak
Gedaref
Humera
El Fasher
El Geneina
Zalingei
El Obeid
Rabak
Singa
Metema
Nyala
Ed Daein
Jabal Ghanawa
Ed Damazine
Kadugli
Kurmuk
Um Dafoog
Al Radoom
0 100 200 400 Km
0 50 100 200 Miles
Legend
City
National Capital
State Capital
Market Place
Cross-border Market
Livestock Market
SLRC Water Center
Rehabilitation priority site
Other
Livestock Export Route
Pasture Potential (Dry Season)
Good
Poor
Boundary
International
State
Coastline
Red Sea
Sudan
Gulf of Aden
Indian Ocean
Datum: WGS_1984
Coordinate System: GCS_WGS_1984
All boundaries, names and symbols employed in this map are not authoritative.
Data Sources
Livestock trade routes: 1) IGAD (2012). Sudan Major Livestock Trade Routes and Markets (map) 2) Key Informant Interviews. Sources of data for pasture potential assessment were NDVI data: FEWS NET Data Portal (https://earlywarning.usgs.gov/fews). Digital Elevation Model: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). Precipitation data: World Clim Database(http://www.worldclim.org). Land cover data: FAO Afri cover. Water Centers: Sudan Livestock Route Company (SLRC). Admin boundaries and places data: The Humanitarian Data Exchange (https://data.humdata.org/).



Data Sources

Livestock trade routes: 1) IGAD (2012). Sudan Major Livestock Trade Routes and Markets (map) 2) Key Informant Interviews. Sources of data for pasture potential assessment were **NDVI data:** FEWS NET Data Portal (https://earlywarning.usgs.gov/fews). **Digital Elevation Model**: ASTER GDEM (http://www.jspacesystem.or.jp/ersdac/gdem). **Precipitation data**: World Clim Database(http://www.worldclim.org). **Land cover data**: FAO Afri cover. **Water Centers**: Sudan Livestock Route Company (SLRC). **Admin boundaries and places data**: The Humanitarian Data Exchange (https://data.humdata.org/).

In consultation with relevant stakeholders, the following water and fodder interventions have been prioritized along the major livestock export trade routes in the Sudan (see also the map on page 50):

- Rehabilitation of priority wateryards (in collaboration with the SLRC). The cost for rehabilitating water infrastructure is approximately USD 30,000-60,000 per center
- In view of the available literature the areas identified for rangeland rehabilitation by re-seeding to ensure fodder availability through production and commercialization along livestock trade export routes in the Semi-desert and Low Rainfall Savanna zones using native forage seeds. The suggested grass species include:
    - Sodari area of Northern Kordofan may be re-seeded using; Cenchrus biflorus, Echinocloa colonum, and Dactyloctenium aegyptium;
    - Butana area may be re-seeded with C. ciliaris, Stylosanthes spp, Aristida mutabilis, C. biflorus, Dactyloctenium aegyptium and Rhynchosia memnonia

3. Study results:

Good practices on rangeland rehabilitation & fodder commercialization

Part of the GCP/RAF/490/ITA project is the implementation of Output 2: "*Water and pastures available to transported animals along the trade routes through creation/rehabilitation of water sources, promotion of good rangeland production practices and negotiation of access to resources*". It aims to identify good practices for enhancing productivity and health of degraded rangelands to strengthen animal feed availability during all seasons in different areas, particularly targeted to livestock trade routes. The project will aim to build capacity on these good practices, and as much as financial resources allow, replicate or up-scale some of the examples identified.

This chapter therefore covers case studies of good practices for rehabilitation of degraded rangelands and fodder production and commercialization. The study identified six good practices on rangeland rehabilitation and fodder production & marketing with potential for replication and up-scaling.

TerrAfrica (2009)[31] and FAO, (2012)[32] defined good practice in the context of rangeland rehabilitation and fodder production as one that has potential for replication in other degraded rangelands with similar social-ecological conditions, increases rangeland productivity and maintains ecological resilience, economically viable/efficient, easy to learn, socially and culturally acceptable, and environmentally sustainable.

The good practices covered in this chapter have demonstrated to increase rangeland productivity and maintain ecological resilience. Other aspects considered include economic viability/efficiency, acceptability (socially and culturally), proven effectiveness in adoption and uptake, as well as and environmental sustainability.

The good practices covered under this section include:

1. Management of invasive plants in rangelands,
2. Use of perennial indigenous grasses to rehabilitate rangelands,
3. Community grazing management to improve grazing capacity
4. Commercialization of fodder production
5. Innovative Satellite Assisted Pastoral Resource Management (SAPARM) project Ethiopia
6. Irrigated fodder production case of Haro River, Dikhil region of Djibouti

[31] TerrAfrica. 2009. SLM in Practice: Promoting Knowledge on Sustainable Land Management for Action in Sub-Saharan Africa. Guidelines and Case Studies (Draft, September 13, 2009). Prepared by WOCAT in collaboration with the FAO

[32] FAO 2012: Agri-Knowledge Share Fair 23-25th October 2012, ADDIS ABABA, ETHIOPIA

3.1 Management of invasive plants through linkage to economic benefits: Afar Region of Ethiopia

3.1.1 Context

The Afar Region of the northern part of Ethiopia lies between 8° 51′ and 14° 34′ latitudes, and 39° 47′ and 42° 24′ longitudes with elevations ranging from 125 m below sea level to 2,870 m above sea level. The mean annual rainfall ranges from 215-580mm, with mean annual temperature from 26.6°C to 30.1°C. The Afar region has an estimated population of 1,650,000, with 80% being pastoralists, while 10% are agro-pastoralists. The livelihoods of Afar pastoralists are threatened by *Prosopis juliflora*. The plant causes loss of pasture, displaces native plants that have high livestock grazing and forage uses and degrades rangelands. *Prosopis juliflora* seeds are mainly dispersed by animals and floodwater. Birds, bats, reptiles and ants that feed on the sugary Prosopis pods also contribute to dispersal of the seeds. A recent study by Wakie *et,al*. 2014[33] indicated that *P. juliflora* covers 3,605 km^2 in the Afar region and the biomass assessment showed that the *P. juliflora* stock density in Afar is 3000 stems/ha which is beyond the critical density and is said to be in state of invasion.

According to a report by Farm Africa, 2008[34] *Prosopis juliflora* invades rapidly due to its rooting and coppicing abilities, its ability to stay dormant for a long time and germinate when conditions favour and its high seed production. These characteristics make *P. juliflora* a very invasive plant that disrupts water flows, causes severe constipation in livestock, forms impenetrable thickets, encroaches and degrades rangelands including eroding genetic biodiversity. Although most literature suggests that there have been several efforts to manage *P. juliflora* by mechanical removal, use of herbicides, and biological (insects) interventions, these have proved to be expensive and ineffective (Geesing *et al.,* 2004)[35]. However, the integration of economic incentives in the management of *Prosopis juliflora* is reported to have been effective. This section, therefore, describes the good practices for *Prosopis juliflora* management through linkage to economic benefits derived from utilization of *Prosopis juliflora*.

3.1.2 Approach

The approach to *P. juliflora* management includes utilizing *P. juliflora* pods in processing commercial animal feeds, commercial charcoal burning followed by clearing the stumps. This incentive mechanism facilitated smooth progress for a wider acceptance by pastoralist community members (Farm Africa, 2008).

[33] Wakie TT, Evangelista PH, Jarnevich CS, Laituri M (2014) Mapping Current and Potential Distribution of Non-Native *Prosopis juliflora* in the Afar Region of Ethiopia

[34] Farm Africa, 2008: Experience on prosopis management , case of Afar Region

[35] Geesing, M., Khawlani and Abba, M.L. 2004 Management of introduced Prosopisspecies:
Can economic exploitation control an invasive species. Unasylva, 217, Vol.55, 36-44.

Utilization of Prosopis pods in commercial animal feeds

P. juliflora trees set pods twice a year and according to Farm Africa, 2008, a mature *P. juliflora* tree can set seeds that can fill up four sacks (approx. 120 kg) within two months. Results from a study by Wahome RG, 2009[36] on suitability of *P. juliflora* pods flour as a feed ingredient in manufacture of animal feeds concluded that the flour forms a valuable addition to the feed ingredient base. According to some literature, P*. juliflora* pods offer high nutritional value, high digestibility and excellent palatability for livestock. The pulp is high in sucrose content, calcium, phosphorus, iron, vitamin B1 and vitamin B6. It is approximately 13% crude protein (163g/kgDM).

Processing pods

Afar Pastoralist community members collect pods from *P. juliflora* trees at three levels; green but mature pods still attached to the twigs, yellow (dry) pods still attached to the tree and yellow (dry) pods that had dropped onto the ground from the *P. juliflora* tree. The inputs included locally made hooked knife mounted on 10-12ft rod, tarpaulin and sacks. Pods picked from the ground were inspected against decay or insect damage. The dried pods were purchased by cooperatives from members and non-members before crushing using locally manufactured diesel operated hammer mills (25HP, crushing 400Kg/hr) before packaging in 50kg bags. The immediate buyers for the processed pods were commercial animal feed processors. Pastoralists that supplement goat feeds with mixture (50:50) 200gm crushed Prosopis pod and 200gm concentrate/head/day often obtained highest mean live body weight gain (5.64kg/head).

Utilization of Prosopis tree for charcoal production

The drum of mature *P. juliflora* trees can attain a circumference of 30-70cm, and with tree stock density in Afar being 3000 stems/ha, the average charcoal yield is 475bags/ha. The communities preferred using traditional earth mound kiln because it could produce 150bags in one round compared to 10bags that were obtained from metal kilns. Although the use of traditional earth mound kiln accelerated the clearance of *P. juliflora,* by local communities, it is still a subject of environmental conservation concern particularly for indigenous trees that can be rapidly cut down for charcoal.

The process

Community members under their cooperatives reached an agreement with the regional government on the controlled process of managing *P. juliflora*. The licensed cooperatives were required to comply with some provisions of the regulations particularly,cutting *P. juliflora* wood for charcoal and restoring the cleared land. To ensure that this was done, the cooperatives updated their by-laws to include specifications of cutting trees, boundaries of the areas of operation, protection of indigenous trees species and restoring cleared land.

The inputs required were hoes, pangas (machetes), axes, pick axes and charcoal bags. Charcoal production was done by households using traditional earth mound kilns and sold charcoal to cooperatives for bulking and marketing to major cities. The practice involved cutting *P. juliflora* young trees 10cm below the ground level and up to 40 cm for the matured Prosopis trees – this was sufficient to prevent coppicing.

To enforce the clearing of stumps, 17% of the cost price was retained by cooperatives and only redeemable after satisfactory removal of stumps. Utilization of *P. juliflora* trees for charcoal production and clearing the stumps prevented further spread of *P. juliflora* and helped restore rangelands.

[36] Wahome RG; Choge S; Wamwere N; Mnene J; Wang'ombe; Matere J, Matere J.; 2009: Nutritional evaluation of the suitability of prosopis pods for livestock feed

3.1.3 Impact

Pastoral communities in Afar Region of Ethiopia changed their perceptions about the value of *P. juliflora* from being a cause of livelihood loss to a source of employment, income and animal feed. For example, a demand for 36,000/t/yr of *P. juliflora pods* for animal feeds, put USD 120,000 into some of the most marginal pastoral communities in Ethiopia every year, and removed at least 70 billion seeds which is a relief to pastoral community livelihoods. The success in Ethiopia has resulted into knowledge sharing with other regional countries now using the approach in the control of *P. juliflora; for* example FAO project in Baringo County, Kenya went ahead to partner with Manyana Primary School, where children supplied *P. juliflora pods* in exchange of scholastic materials. This innovation improved school attendance but also created awareness about utilizing *P. juliflora* pods.

Recently, Kenya secured an export order to South Africa (as a dietary supplement) while an animal feed industry in Nairobi secured a contract with the farmers to supply 200 tonnes per month, at Kshs. 3 per kilo (Philip Kisoyan, 2013). In Kenya, the removal and milling of each tonne of pods destroys around two million seeds, with a corresponding effect on controlling the spread of *P. juliflora* in rangeland per year, and in addition pastoral communities in Kenya have since innovatively used the seed flour to make human food and stems used to make high value crafts (curios).

3.1.4 Recommendation for up-scaling

The good practice has been piloted in Afar region, Ethiopia and was already replicated in Baringo County of Kenya and now efforts should geared to up-scaling in ecologically similar areas. It is suggested to replicate this good practice to the area around Jigjiga, which is located in the Somali region of Ethiopia, and strategically located along the Dire Dawa - Tog Wochale livestock export trade route to Berbera in Somaliland. Jigjiga is also an important grazing area, but the rangelands have been invaded and degraded by *Prosopis juliflora*. Another potential replication can be undertaken in Djibouti, which has roughly 60 km^2 of rangelands invaded by propsopis (in the Dikhil region more than three quarters of the land is covered).

The study recommends adoption of the integrated management of *P. juliflora* in Djibouti and Jigjiga areas, through ensuring economic benefits of clearing. These include utilizing *P. juliflora* pods in commercial animal feeds, commercial charcoal making, clearing stumps, re-seeding with *Cenchrus ciliaris* (buffel grass) and *Eragrostis superb* (Maasai love grass) and then irrigate. The estimated cost is USD 20,000 for Ethiopia (see Annex 1) and USD 24,000 for Djibouti (Annex 2).

3.2 Use of indigenous grass to rehabilitate rangelands: Case of Makueni County, Kenya

3.2.1 Context

Makueni County is located in the southern part of Eastern Kenya and borders Kitui to the East, Taita Taveta to the South, Kajiado to the West and Machakos to the North. The county covers an area of 8000 km^2. Temperatures in the county range from a minimum of 12^{o}C to a maximum of 28^{o}C and rainfall ranges from 150 mm to 650 mm per annum. There are two rainfall seasons known as the short and long rains, which occur during October-December and March-May respectively. The county has a population density of 100.4 people per km^2. 67% of the rural population lives below the poverty line and the main livelihood activity is livestock keeping. Poverty is both an effect and cause of environmental degradation – an effect of degradation as a degraded ecosystem provides fewer goods and services, and a cause of degradation as people strive to eke out a living from a diminishing and variable resource base.

Source: http://bit.ly/2jNhnmq

The natural pasture lands in Makueni County were severely degraded due to continuous heavy grazing, inappropriate land use, clearing of vegetation, soil erosion and severe drought. The effect of rangeland degradation has had much impact on livestock production, reduced carrying capacity, and increased livestock mortality. According to on-farm survey reports by Njarui *et al*. (2011)[37] and Ndathi *et al* (2012)[38], the most important constraint to livestock productivity in the Arid and Semi-Arid Lands (ASALs, of which Makueni County is part) is drought induced feed shortage, where by 90% of smallholder farmers / pastoralists experience regular feed shortages.

There were efforts to re-seed using improved pasture/fodder seeds, but the market had the type that does well in the humid and sub-humid areas such as the *Chloris gayana and Lucern*. Kenya Seed Company (KSC) is the market leader in seed production for cereals, pastures and fodder. The target for KSC is the high rainfall areas where agriculture and livestock production systems are commercialized. Less effort has been put in producing seeds for the marginal ASAL areas (Philip Kisoyan, 2013), thus farmers reseed using indigenous seeds. This section therefore, covers a case study around good practices for re-seeding degraded rangeland lands using indigenous species in Makueni County.

[37] Njarui *et al*. (2011): Njarui D. M. G., Gatheru M., Wambua J. M., Nguluu S. N., Mwangi D. M. and Keya, G. A. (2011). Feeding management for dairy cattle in smallholder farming systems of semi-arid tropical Kenya. Livestock Research for Rural Development. Volume 23, Article 111. Retrieved May 11, 2011, from http://www.lrrd.org/lrrd23/5/ njar 23111 .htm

[38] Ndathi, A. J. N., Nyangito, M.M., Musimba, N.K.R. Mitaru, B. N. 2012b Smallholder farmers' feed material conservation strategies in the tropical dry-lands of South-eastern Kenya. Livestock Research for Rural Development 24 (6) 2012.

3.2.2 Approach

According Njarui (2013)[39], four indigenous range grasses are grown in Makueni. These include *Cenchrus ciliaris* (buffel grass), *Eragrostis superb* (maasai love grass), *Chloris roxburghiana* (horse tail grass) and *Enteropogon macrostachyus* (wild rye grass). These grasses have been used to rehabilitate degraded land with remarkable success. The grasses are preferred over other plants because they are easy to establish, respond quickly to low rainfall, adaptable to heavy grazing, are deep rooted (2m), drought tolerant and resistant to grazing. Their major limitation is the low germination rate (<20%) (Keya and Hornetz, 1999)[40]. The process for reseeding involves three stages: site selection, land preparation, planting and weeding.

1. Site selection

The process for establishing perennial grass starts with site selection for fodder production with a main focus on ensuring the right soil type and soil quality. For example, *Eragrostis superb* (Masai love grass) will grow well in sandy-clay soils and clay soils; *Cenchrus ciliaris* (buffel grass) is less tolerant to salt and requires lighter textured soils (high phosphorus status are best) but thrives well on the clay loams.

2. Land preparation

The timing of land preparation is very important to the success or failure of the pasture establishment. Since pasture establishment is dependent on rainfall, land preparation in Makueni County starts just before the beginning of October to take advantage of short rains which are more reliable. During the second production cycle (under the long rains), preparation of the land starts in late February and ends by mid of March. The inputs for land preparation include tools (ox ploughs, hand hoes), labour and financial resources. Seed treatment is then done before planting which involves cleaning and separating different types of seeds.

3. Planting

Two planting methods have been widely adopted in Makueni County: sowing in pits and sowing in furrows. Broadcasting the seed is not common because ants carry away planted seeds to their nest.

Sowing in pits:

Sowing in pits is used where the ground is slopping and according to Gichangi *et al.* (1992)[41] the pits are circular or semi-circular loops, where soil is excavated to a shallow depth (up to 30 cm) creating a semi-circular bank of 15-30 cm high on lower side of pit using soil removed from the trench immediately above it forming terrace commonly known as "*fanya chini*". The pits are interlocked with each other to trap water in the pit immediately below it but also prevent seeds from being washed off by torrential rains experienced during the first days of the rainy season. Although sowing in pits has shown to be extremely effective in rehabilitating the denuded land the cost of digging is significant (Njarui, 2013).

[40] Keya, G.A. and Hornetz, B. 1999. Studies on rangeland production potential and its limitation in the semi-arid and arid lands of Northern Kenya. In M/S Agronam services Ltd. (Eds). Agricultural research and Development for sustainable resource management and increased production proceeding of the 6th KARI Scientific Conference, 9-13 November 1998. KARI headquarters, Kaptagat road, Loresho, Nairobi, Kenya. pp 466-475.

[41] Gichangi, E.M., Jones, R.K., Njarui, D.M., Simpson, J.R., Mututho, J.M.N. and Kitheka, S.K. 1992. Pitting practices for rehabilitating eroded grazing lands in the semi-arid tropics of Eastern Kenya: a progress report. In: Hurni, H. and Tato, K. (Eds). *Erosion, Conservation and small-scale farming*. Proceeding of the 6th International Soil Conservation Conference of the International Soil Conservation Organisation (ISCO) held in Ethiopia and Kenya 6-18 November 1989. Missouri, pp 313-327

Furrow sowing:
The furrows are made using a pair of oxen and plough, then drilling pasture seeds by hand and covering by lightly pulling tree branches along the furrows, which makes this method cheaper than sowing in pits. The seeding rate for C*enchrus ciliaris* (Buffel grass) is 0.5-4 kg/ha depending on seed supplies, soil quality and expected rate of full ground cover. For good establishment *Cenchrus ciliaris* seed needs to be moist for about five days and a minimum of 30 mm of rainfall is needed. To ensure better results at germination, farmers have carried out seed treatment before planting and this is said to prevent attacks by seed-harvesting ants. The production of *Cenchrus ciliaris* grass does not often involve use of fertilizers.

3.2.3 Productivity and utilization

Buffel grass makes reasonable quality hay when cut in the early flowering stage, yielding up to 2.5t/ha, although the potential yield under good management is over 6 t/ha. Farmers in Makuenei County cut grass and bale using the handmade hay boxes, for feeding their livestock during the dry season (Njarui, 2013). Different forms of storage methods are used including hay barns, granaries and on tree canopies. The most effective method of storage is granary (Ndathi *et al.*, 2012b). Where the grass is left as standing hay in the field, the quality is poor and is susceptible to weather and termite destruction. Njarui, 2013 further indicated that old grass after seed has been harvested can give low-quality roughage for drought feeding.

Farmers normally preserve some of their pastures for seed, either to use for planting in subsequent seasons or for sale. Seed harvesting is the prerogative of both genders. However, women and children are key players particularly at harvesting, cleaning and sorting of the seeds. Generally the seed yields are low because of uneven establishment, low rainfall and inefficient methods of seed harvesting and timing. Estimates of 112, 72 and 66 kg/ha from buffel grass, maasai love grass and wild rye grass, respectively have been reported in literature (Manyeki et al., 2011)[42].

Seed is harvested manually and the process is slow and time consuming. Research recommends that during harvest the grass culms should be cut at least 30 cm below the inflorescence and then tied in bundles and stacked in order to dry slowly to avoid shock before the seeds are threshed. Some farmers feel that this is labour intensive and prefer stripping the seed directly from the inflorescence. For the false rye grass, the seeds have awns which prick the hand and some farmers tend to avoid planting this grass.

3.2.4 Marketing

A report by Njarui (2013) stated that farmers have groups for collective marketing in order to leverage better price for their seeds. Within each farmer group, there is a lead person who is trained to source for market outlets, but what is important to note here is the level of enthusiasm from Local Government (district livestock office in Makueni County) and the research station (KARI Kiboko) in linking farmers to buyers - especially Non-Government Organizations (NGOs). The key concern is that their seeds are not certified by Kenya Plant Health Inspectorate Services (KEPHIS) since these grasses are not registered varieties.

3.2.5 Impact

The main impact is that farmers have developed the capacity to reseed the degraded rangeland using local seeds, from which they are able to produce hay for own use as well as selling them for additional income (Kshs 250-300

[42] Manyeki, J.K., Mnene, W.N., Kimitei, R., Mosu, A and Ngetich, R. 2011. Social economic survey on range grass seed production, reseeding and marketing in the rangelands of Kenya. Proceeding of KASAL end of Programme Conference and Exhibition, 9-11th August 2011, KARI Headquarters, Nairobi, Kenya. pp 185-193

for a bale of 14-18 kg, depending on the level of feed scarcity). Most of the hay is sold locally, within the region and around Wote town.

The price of seed varies between seasons and is high preceding drought. In 2011, the price ranged from Kshs 800-1000 per kg of buffel grass and Kshs 600-800 per kg of maasai love grass for external markets. The difference in price between grass species is based on the amount of seed per kg with buffel grass having more seeds per kg than maasai love grass. However, the price at local market is the same for all species (Kshs 100-300 per kg).

The success in Makueni County has encouraged other counties with related ecological conditions to adopt the use of indigenous grasses to re-seed degraded rangelands.

3.2.5 Recommendation for up-scaling this good practice

The good practice involving the use of indigenous grass to rehabilitate rangelands has successfully been piloted in Makueni County, Kenya and can be up-scaled in other areas with severely degraded rangelands.

Two sites are recommended for up-scaling the good practice involving use of indigenous grass to rehabilitate degraded rangelands. The sites include Awash of Ethiopia, and the Toghdeer region of Somaliland. These are important sites strategically located along the major livestock export trade routes. Just like Makueni County, these areas are ASALs and their rangelands have been severely degraded due to continuous heavy grazing, soil erosion and severe and recurring droughts. Fodder shortage is exacerbated by the lack of local pasture seeds in these areas.

To ensure availability of fodder along the livestock export trade routes, the study further recommends up-scaling the reseeding of degraded rangelands using indigenous seeds using *Cenchrus ciliaris* (buffel grass), *Eragrostis superb* (maasai love grass), *Chloris roxburghiana* (horse tail grass) and *Enteropogon macrostachyus* (wild rye grass) and some fodder tree which can be produced under irrigation. The estimated cost for up-scaling in Awash is USD 16,000 (Annex 3) while in Toghdeer (Somaliland) is USD 27,000 per centre (Annex 4).

3.3 Grazing management: The case of Karamoja region (Uganda)

3.3.1 Context

Karamoja is located to the North Eastern region of Uganda with a total area 27,000 Km^2. This region belongs to the greater Karimojong cluster ecosystem, which also extends into South-Eastern South Sudan, North-Western Kenya, and South-Western Ethiopia and can be classified as ASAL. The major socio-economic and cultural system for Karamoja is agro-pastoralism based on extensive grazing on the rangelands, characterized by high mobility in search of water, pasture and mineral licks.

The region is generally characterized by poor rainfall distribution and reliability, averaging 700mm per annum, manifested through prolonged dry spells and also occasional flash floods leading to repeated water and pasture scarcity. The connection between land degradation and livestock management in Karamoja region is a known problem, calling for improvements in livestock management strategies. This section describes case studies on good practices for grazing management adopted by pastoralists in Karamoja region, Uganda.

3.3.2 Approach

Seasonal patterns of grazing are a key element in the flexible response of Karimojong agro-pastoralists to uncertain resources (Okori, 2012)[43]. Herders move livestock frequently in order to achieve optimum exploitation of available pasture and water. This mobile exploitation of communally held grazing has proved to be the most optimal use of the ASALs of Karamoja.

Karimojong agro-pastoralists have developed patterns whereby the best watered and lush pastures are left for grazing in the dry season while the herds roamed far and wide to feed on short term grass available only at the beginning of the wet season. To achieve this, the pastoralists use protected kraals system to ensure rotational and deferred grazing as a grazing management strategy. Protected kraal consists of several herds of animals (goats, sheep, camels and cattle) from several closely related communities, kept in one place under the protection of the army (Edward Okori, 2012). The presence of the army is intended to protect herds of a given community from raids by other ethnic communities. Structurally, a protected kraal consists of a strong enclosure/fence made from locally available woody species particularly from Acacia species. Internally, the kraal is sub-divided into several partitions to represent the different herds within the kraal.

Each partition is further sub-divided in sub-partitions to separate cattle, goats and sheep. The animals in the kraal are collected by the owners every morning, taken for grazing in the surrounding areas and returned to the kraal in the evening. When the surrounding grazing resources are exhausted or when water is inadequate, the kraal shifts to a new location in search of pasture and water, still under the protection of the army. The rotational and deferred grazing plans are often worked out separately for each grazing territory based on the vegetation and hydrological systems, whereby for every 2-4 weeks (in wet season) and 4-8 weeks (dry season), protected kraals shift to other areas, leaving the overgrazed areas to rejuvenate.

The success of the kraal system is facilitated by the variation in the distribution of *Sporobolus ioclados* commonly referred to as “salty grass” and locally known as *Eleti*. The grass has a high salt concentration making it very palatable to animals and hence one of the major determinants of animal distribution. Herders thus deliberately

[43] Edward Okori, 2012: Paper presented at the rangeland management best practices sharing workshop, EARI and FAO, 3-6 December 2012, Addis Ababa, Ethiopia

search for sites dominated by the grass in far off locations, lowering grazing pressure through controlled grazing in some areas close to the kraal - allowing for rejuvenation and rehabilitation of rangelands.

3.3.3 Impact

With regards regard to rehabilitation of the degraded rangelands along the dry season mobility belts and mainstreaming indigenous practices in this process, there is uptake of these practices although still on a small scale. The good practices have been an attraction and potential for replication across borders especially among the Pokot and Kenyan Turkana that have benefited from the know-how as they spend most of their grazing seasons in Uganda utilizing the salt grass – believing strongly that animals who feed on this salt grass develop strong bones.

The agricultural ecological zones on the western part of the region are mainly dry season grazing areas and are largely grazed during the dry season and constitute the dry season migratory routes for pastoral communities. The areas are dominated by *Hyparrhenia* spp and *Setaria sphacelata* while *Panicum* species and *chloris gayana* are largely found in protected areas such as under dense tree/shrub canopies that are hardly grazed by animals. Because these zones are grazed during the dry season, the pasture in these grazing areas are left to establish, grow and accumulate during the wet season forming what is normally referred to as “standing hay”. The impact of vegetation maintenance through alternating periods of grazing as a practice used by Karimojong agro-pastoralists has contributed to improved fodder availability throughout the year.

3.3.4 Recommendation for up-scaling the “Karamoja” grazing management

Grazing management as an approach to degraded rangeland rehabilitation has been successfully piloted in Karamoja, Uganda. The practice differs from the seasonal movement of livestock in search for pastures which is typical of pastoralists. To achieve this, the pastoralists use protected kraals system to ensure rotational and deferred grazing as a grazing management strategy. The success of the kraal system is facilitated by the variation in the distribution of *Sporobolus ioclados* commonly referred to as “salty grass” and locally known as *Eleti*. Pastoralists plant this grass to ensure controlled grazing through animal distribution, thus lowering grazing pressure on degraded areas and allowing for rejuvenation and rehabilitation of degraded rangelands.

The recommended areas along the livestock export trade routes where rangeland rehabilitation can effectively be achieved by up-scaling the practice of grazing management using *Sporobolus ioclados* are Degehabur and Tog Wochale in the Somali region of Ethiopia, and Galkayo in Puntland. These locations are major transhumance areas crossed by major livestock trade routes. For example, during the rainy season (April-June) livestock moves into Somali region of Ethiopia, then moves towards Somalia in the dry season (December-March). The “salty grass” can be distributed 50-70 metres apart in the pasture lands to ensure sufficient animal dispersal during grazing.

The cost of establishing *Sporobolus ioclados* and developing the controlled movement pattern is USD 6000 in Ethiopia and USD 10,000 in Somalia (see table X).

Table 4: Budget estimates for community grazing management up scaling in Ethiopia

Item	Degehabur (Somali region)	Tog Wochale & Galkayo
Sporobolus ioclados	4000	6000
Hand tools	2000	2000
Total (in USD)	6000	10000

3.4 Commercialization of fodder production: A case Paradise fodder group in Wajir County, Kenya

3.4.1 Context

Wajir County is located in North Eastern part of Kenya, characterised by dry and hot conditions (mean annual temperature of 28°C and annual rainfall of 250-700 mm) and frequent droughts. Over 70% of Wajir's 661,941 inhabitants are pastoralists and depend on livestock resource for food and income.

Source: http://bit.ly/2k8oxCF

As far back as 2008, the "*Paradise*" fodder group has been growing fodder on a small scale to mitigate drought induced feed shortage responsible for livestock losses. Since November 2012, SNV Netherlands Development Organisation partnered with ILRI and the Kenya Livestock Marketing Council (KLMC) under the Kenya Rural Development Program (KRDP1) to enhance community resilience to drought through innovative market based systems. This specifically aimed at improving availability of fodder during these times of scarcity in Kenya's Arid and Semi-arid Lands (ASALs).

3.4.2 Approach

The Paradise fodder group benefited from technical trainings on fodder production and marketing, and received fodder seeds, bailing boxes as well as support to till and plough the expanded farmland. The Paradise group is a member of the Wajir County farmers association, which is an umbrella association that safeguards the interest and promotes the agenda of all farmers in Wajir County. The association helps in marketing of both fodder and the seeds by bulking the products in different County stores (Dahir and Mohammed, 2015)[44].

The project worked with this association in identification and engagement of farmer groups through the association as a platform for the project. The initial mobilization activity was undertaken through the association, therefore, gaining trust and support from all the farmer groups. The association was also responsible for group fodder and seed marketing. The County stores built by the project are managed by the association and therefore all the members had access to the store. The project bought fodder seeds (Cenchrus Cilliaris) from the association and the Paradise group was one of the beneficiaries from the seed purchase.

3.4.3 Impact

The Wajir farmers association produces fodder by groundwater irrigation despite challenges such as sandy soils, high costs to operate diesel pumps, bad water quality (salty/hard water) from the wells, and intrusion of wildlife.

Producing and marketing fodder contributed to improved community income. To demonstrate this, Paradise fodder group harvested a total of 163 bales of fodder and 45 kg of seeds, most of which was sold to individuals, but utilised part of the harvested fodder to fatten their own goats in order to sell them at a premium price. Initially the group started with 10 weak goats and after fattening earned an income of KES 20,000 (USD 200). The group sold the 163 bales at a price of KES 500 (USD 5) per bale realising an income of KES 81,500 (USD 815) and sold the 45 kg of the seeds at a price of KES 800 (USD 8) per kg thus realising an income of KES 36000 (USD 360).

[44] Issack Dahir and Abdikadir Mohammed, 2015: Commercialization of fodder production; Paradise fodder group in Wajir County, Kenya

The approach also contributed to improved resilience when the group was able to sell fodder to the County government of Wajir. This was as a result of lobbying of the Wajir County farmers association and County Livestock Marketing Council (CLMC). The County government re-distributed fodder as relief to pastoralist during severe drought. As a sustainable way of promoting and encouraging the fodder farmers, the County government of Wajir constructed 13 hay stores with a capacity of 15,000 bales. They also set aside funds to purchase fodder from the farmers and store it, so that pastoralists can access fodder during times of droughts.

3.4.4 Recommendation for up-scaling fodder production commercialization

Fodder production commercialization has been successfully piloted in Wajir County through a farmers' association, where rather large volumes of fodder and pasture seeds were produced and marketed. It is important to note that while communities produced the fodder and seeds, the success was guaranteed by local government and its partners through setting up marketing infrastructure and buying off the surplus which was distributed as relief.

The Djibouti livestock trade has been reported to experience fodder shortages and surprisingly, and expensive hay and Alfalfa was reported to be imported from the Gulf countries to supplement imports from Ethiopia. This shows the enormous commercialization potential for fodder and seed if produced within the country. The study recommends this practice for up-scaling at Balambary, in Dikhil region, Grand Bara and Petit Bara of Djibouti for irrigated fodder production commercialization, which are located along the livestock trade routes. The estimated cost for fodder production commercialization is USD 25,000 per site (see Annex 2).

3.5 Satellite Assisted Pastoral Resource Management (SAPARM)

3.5.1 Context

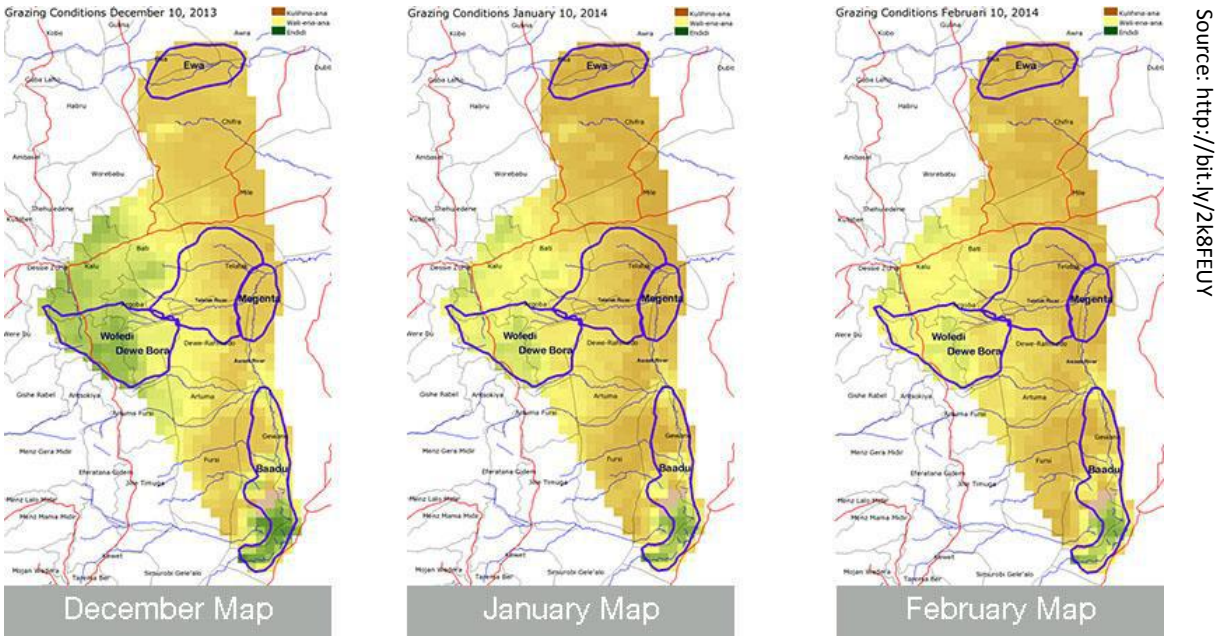
There are 6 million herders or pastoralists in Ethiopia. They rely on word-of-mouth or local knowledge to tell them where there might be grazing lands. They take the gamble and hope that they will encounter green pastures. Sometimes, their luck, like the land around them, runs dry.

After long treks with little to no water or food, livestock will die. For the families that depend on their livestock, this is devastating. If their livestock dies, they will experience a serious loss in income and food. To reduce the mortality rates of the livestock – the livelihood of many Ethiopian families – PCI[45] started a ground-breaking project called "Satellite Assisted Pastoral Resource Management" (SAPARM), funded by the USAID Development Innovation Ventures. SAPARM aimed to provide pastoralists more reliable sources of information on where to take their herds.

3.5.2 Approach

These valuable sources of information are detailed satellite maps. Using existing networks of global satellites, PCI and its partners in the project (the Government of Ethiopia and the World Food Program) created maps for the pastoralists to use. Instead of a normal satellite map, PCI calculates how much green grass is in the area. On the map, greener areas meant more green grasses, brush, or trees. Pastoralists would then know that they should go to greener areas of the map and should avoid the more brown areas. Because the weather changes from month to month, the area with the greenest grasses would also change.

Sample SAPARM Maps



Source: http://bit.ly/2k8FEUY

[45] Project Concern International (PCI), founded in 1961, is an international non-profit development organization that helps families and communities lift themselves out of poverty and create opportunities to build better lives for generations to come.

SAPARM had multiple steps that support the project's success:

- Meet with the local communities to map the areas they typically sent their livestock to graze in
- Use imagery from a satellite positioned 22 thousand miles above Ethiopia
- Analyzed the satellite imagery to display the amount of vegetation or grasses in the area
- Created maps for local communities, keeping in mind their traditional grazing lands
- Send maps to the communities every 10 days

The digitized maps were auto-generated and distributed every ten days through local government and community networks at the Woreda, then to villages and individuals to ensure that local customs of communication were embedded. The cost of mapping and automation is USD 12,000 per Woreda.

3.5.3 Impact

According to PCI, 78% of Pastoralists have adopted the use of maps and perceive them as being more reliable and valuable as a source of information on grazing lands than the traditional word of mouth. Thus, mortality rate of livestock reduced by 47% through improved certainty of finding fodder. Other impact figures include:

- Every person who used a pasture map, found it to be accurate
- 80% of herders or pastoralists reported that they relied on the maps
- 99% of pastoralists believed SAPARM maps could help reduce future livestock death

3.5.4 Challenges

- The maps are produced in every 10 days and need to reach the users, thus funds are needed to support the continuous distribution of the maps from the Woreda to the communities in the Kebele.
- Given that water points are small in size, and that the satellite needs to be positioned to be able to cover a wider area, the system was not able to show water sources on the maps.
- The majority of pastoralists had not had formal education, thus not all persons were able to read and interpret the features provided on the maps.

3.5.5 Recommendation for up-scaling

SAPARM has been successfully piloted in the Afar and Oromo regions of Ethiopia. The study recommends up-scaling in Somali region of Ethiopia, being a major source of livestock for export but also a region traversed by the livestock export trade routes leading to Somalia. The same can be replicated through a Letter of Agreement (LoA) with PCI in Central Somalia bordering with Ethiopia where seasonal movement in search of pastures and water is frequently done by pastoralists.

3.6 Irrigated fodder production and innovative land preparation: The case of Haro River, Dikhil Region (The Republic of Djibouti)

3.6.1 Context

Dikhil region is a livestock hub for Djibouti. However, its rangelands are overgrazed and degraded because of the pressure of large numbers of livestock due to the large export and local market. When it rains, there is heavy runoff eroding the soil and thereby reducing the potential for plant growth (due to a lack of nutrients). Because of this erosion and the high evaporation rates in Djibouti, within a short time after rainfall the soil loses its moisture. The combination of bare land that can no longer support any form of plant to grow and lack of moisture to support plant growth leads to a situation in which it is very difficult to grow fodder.

Source: http://bit.ly/2kiOmsD

Extent of degradation of rangelands

3.6.2 Approach

Pastoralists and farmers in Dikhil have come up with innovative ways of restoring the degraded land by separating and heaping small stones in rows eventually forming furrow-like patterns using simple tools such as hand hoes and shovels. The heaping of stones is practiced to provide a cool micro-environment beneath and preventing excessive evaporation. Possibly this is the reason why, unlike typical farmers that tend to remove the stones from their fields, the Dikhil farmers instead bring more stones to the fields if they are to succeed in pasture production.

The practice is meticulously done, with the smaller stones at the bottom and the larger ones progressively on the upper side. This is because the large stones tend to absorb more heat from the environment without a significant raise in temperature due to a lower surface area to volume ratio, and thus they provide an effective cover. Further to stone formation, the garden is left for 2-3 months to rest, a process which enables the stones settle firmly and establish a consistent micro-environment.

After the garden is established, farmers plant grasses/fodder and continue to irrigate using water obtained from a shallow well. The typical volume of water used by successful farmers was 100m^3 per/2.5acres/year but the benefit outweighed the costs because the farmer is able to produce various types of fodder throughout the year at a good price.

Typical stone formation in a pasture garden

Section of fodder produced at Haro River

3.6.3 Impact

Several farmers have taken up this practice, and thereby have rehabilitated (part of) the degraded rangelands and produce fodder for livestock throughout the year. This generates much needed income for pastoralists and provides a buffer for times of drought. More innovations in the Haro River area of Dikhil have been observed as farmers have started keeping small ruminants within the farms and using the droppings to make animal composite manure which was then used to improve the soil fertility of the farms. Farmers have also diversified to fruit and vegetable production and are using the crop residues animal feeds. These farms have become centers of excellence where learning tours are conducted for other farmers, thus helping in the spread of the practice to other parts of the country.

3.6.4 Recommendation for up-scaling irrigated fodder production

The practice of using innovative ways of harnessing the degraded land by separating and heaping small stones in rows eventually forming furrow-like patterns and irrigating to produce fodder has been successfully applied in Dikhil, Haro river. The practice was found to be effective at rehabilitating overgrazed and degraded rangelands and has been used as centre of excellence for farmer learning visits.

The recommended sites for up-scaling the practice within Djibouti include Balambary in Dikhil region to expand to other farms, and Grand Bara and Petit Bara of Djibouti. The estimated cost for establishing a farm is USD 25,000 at each site. Furthermore, exchange visits and learning tours to successful farms in Dikhil from other regions of Djibouti can be conducted, at an estimated cost of USD 5,000 (for 50 farmers).

3.7 Recommendations for up-scaling of good practices

Six good practices on fodder production & commercialization as well as sustainable rangeland management throughout the IGAD region have been identified during this baseline and good practices study. The good practices have demonstrated to increase rangeland productivity and maintain ecological resilience. Other aspects considered include economic viability/efficiency, acceptability (socially and culturally), proven effectiveness in adoption and uptake, as well as and environmental sustainability.

This chapter summarizes the recommendations related to up-scaling or replicating these practices in other regions. This is based on an extensive literature review and expert consultations. However, due to the imited time and resources available to conduct this study, it was impossible to fully investigate and visit all of the areas where the good practices have been implemented. Furthermore, the costing of up-scaling these practices is based on estimates and the assumption that the actual up-scaling will be implemented by local service providers through LoAs. This will ensure the most effective and cost-efficient implementation. It should be noted that – except for the SAPARM good practice – no potential service providers have been identified during this study.

In the Sudan and Ethiopia sections, maps on fodder / rangeland rehabilitation suitability can be found, which are the result of a mapping exercise undertaken during this study. Different land resource data like land cover, topography, NDVI and rainfall were analyzed in a GIS environment to produce maps that show potential of pasture resource along the livestock export routes. They provide a good overview of where fodder and rangeland management interventions could be successful.

Management of invasive plants through linkage to economic benefits

The study recommends the up-scaling of rangeland rehabilitation through utilization of invasive plants (*prosopis juliflora)* for animal feed production, charcoal and ornaments as the case of Afar region, Ethiopia. The practice reclaims land from the invasive plants which can be used for fodder production throughout the year. The actions required to rehabilitate the rangelands include promoting the economic utilization of the invasive plant, recovery of land, and partnering with local pastoralist groups for capacity building and awareness creation.

The recommended sites for upscaling this practice are:

- Jigjiga in the Somali region of Ethiopia, a major pastoral livestock production, located along the livestock export trade route to Somaliland. The estimated cost is USD 20,000
- Dikhil region in Djibouti, a major livestock production area and holding ground located along the livestock export trade route in Djibouti. The estimated cost is USD 24,000

Use of indigenous grasses to rehabilitate rangelands

The lack of pasture seeds has constrained efforts for rangeland rehabilitation in Ethiopia and Somalia. The study recommends up-scaling the use of indigenous grasses to rehabilitate rangelands.

The recommended sites for upscaling are:

- Awash (Ethiopia), a major livestock source but also strategically located along the livestock export trade route, often experiencing fodder shortages. The estimated cost of for this site is USD 16,000
- Qoolcaday and Aroori (Somaliland), where the estimated cost is USD 27,000 per centre

Grazing management

Community grazing management to improve grazing capacity has been used successfully to rehabilitate degraded rangeland in Karamoja region, Uganda. The good practice has been used by agro-pastoralist to effectively disperse grazing animals in the rangelands. By widely distributing *Sporobolus ioclados* commonly referred to as "salty grass" in the fields dominated by *Hyparrhenia* spp, *chloris gayana, Panicum* spp and *Setaria sphacelata,* overgrazing was effectively reduced. The activities that are part of this practice are seed multiplication, capacity building and involving clan leaders in the community grazing management plans.

It is recommended to up-scale this practice to:

- Degehabur in the Somali region of Ethiopia, at an estimated cost of USD 6,000
- Tog Wochale (Somaliland) and Galkayo (on the border between Puntland and South Central Somalia), at an estimated cost of USD 10,000

Commercialization of fodder production

Commercialization of fodder production to improve its availability throughout the year has been successfully piloted in Wajir County, Kenya. Large volumes of fodder are produced and jointly (through a cooperative) marketed. Implementing this practice to produce *Cenchrus ciliaries* (buffel grass), *Panicum maximum* (Guinea grass), *Chloris gayana* (Rhodes grass) and Sudan grass would significantly reduce animal mortality but also increase incomes and resilience to drought. Activities include market stimulation through local government/development partners' involvement in purchasing surplus fodder and seed for possible re-distribution, setting up of marketing infrastructure and business skills development for fodder cooperatives.

This practice has the potential to be up-scaled in Balambary (Dikhil region) and Grand Bara and Petit Bara, both in Djibouti. These are important locations along the livestock export trade routes. The estimated cost for fodder production commercialization is USD 25,000 per site.

Using remote sensing to provide pastoralists more reliable sources of information on pasture quality

The SAPARM project Ethiopia has been piloted in Afar and Oromo regions of Ethiopia. The practice provides information about the vegetation cover over a large area, and such information helps pastoralists locate areas with pastures in a short time. SAPARM is recommended for up-scaling to four Woredas in the Somali region of Ethiopia where transhumance is most practiced, and where pastoralists are very mobile across large areas of rangelands in search for water and pasture. The cost of mapping and automation is USD 12,000 per Woreda, which brings the total cost for four Woredas to USD 60,000 – when distribution costs are included. For effectiveness and efficiency reasons, it is recommended to have the implementation carried out by PCI.

Irrigated fodder production and innovative land preparation

Djibouti, as earlier mentioned, is a major transit for livestock export trade. At the same time, it has major challenges to provide water and fodder to livestock, while its rangelands are extensively degraded and eroded. Up-scaling the good practice on irrigated fodder production and innovative land preparation – as the case for Haro River, Dikhil region – would increase fodder availability.

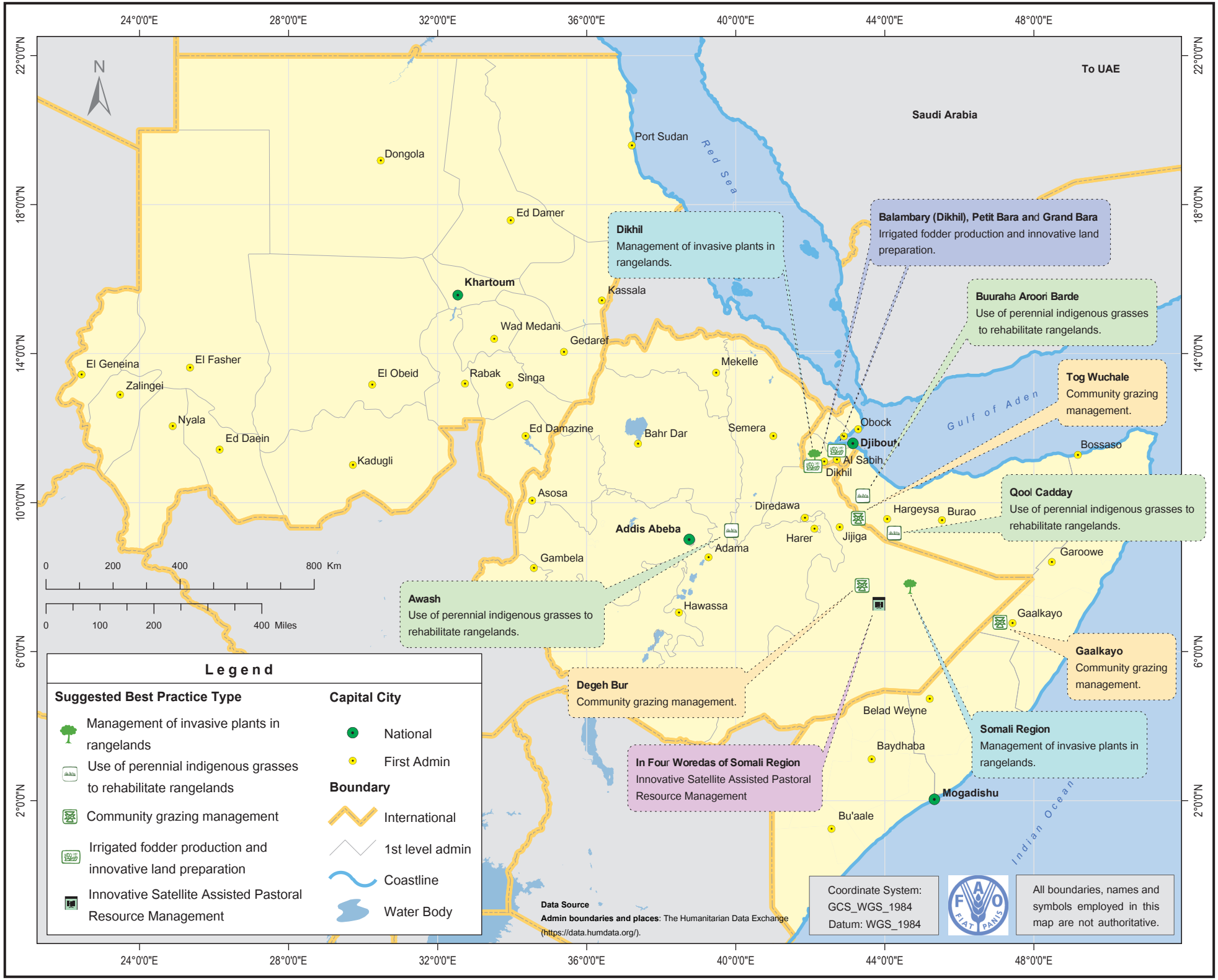
The recommended sites include:

- Balambary, Grand Bara and Petit Bara in Djibouti. The estimated cost of up-scaling per site is USD 25,000. The actions required to rehabilitate the rangelands include promoting the recovery of soil and vegetation, establishment of local groups to receive training and ensure local support and engagement.
- Exchange visits and learning tours for farmers from other regions of Djibouti to successful farms in Dikhil can be conducted, at an estimated cost of USD 5,000 (for 50 farmers).

Table 5: Summary of estimated cost and potential locations of good practice replication/up-scaling

Good practice	Location and cost for up scaling
Management of invasive plants in rangelands	• Jigjiga (Ethiopia), at USD 20,000 • Dikhil region (Djibouti), at USD 24,000
Use of perennial indigenous grasses to rehabilitate rangelands	• Awash (Ethiopia), at USD 16,000 • Qoolcaday and Aroori (Somalia), at USD 27,000 per centre
Community grazing management to improve grazing capacity	• Degeh Bur (Ethiopia), at USD 6000 • Tog Wochale and Galkayo (Somalia), at USD 10,000
Commercialization of fodder production	• Up-scaling at Balambary (Djibouti), at USD 25,000 • Grand Bara and Petit Bara (Djibouti), at USD 25,000
Innovative Satellite Assisted Pastoral Resource Management in Ethiopia	• Up-scaling in Somali region of Ethiopia, at USD 60,000
Irrigated fodder production and innovative land preparation	• Up-scaling in Balambary in Dikhil (Djibouti), at USD 25,000 • Grand Bara & Petit Bara (Djibouti),USD 25,000 • Exchange visits and learning tours to successful fodder farms, at USD 5,000

The map on the next page shows the location of where the above good practices could be up-scaled/replicated.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2°0'0"N
N
To UAE
Saudi Arabia
Port Sudan
Red Sea
Dongola
Ed Damer
Khartoum
Kassala
Wad Medani
Gedaref
El Geneina
El Fasher
Zalingei
El Obeid
Rabak
Singa
Mekelle
Nyala
Ed Daein
Ed Damazine
Bahr Dar
Semera
Kadugli
Obock
Djibouti
Al Sabih
Dikhil
Bossaso
Asosa
Diredawa
Hargeysa
Burao
Addis Abeba
Adama
Harer
Jijiga
Gambela
Garoowe
Hawassa
Gaalkayo
Belad Weyne
Baydhaba
Mogadishu
Bu'aale
Gulf of Aden
Indian Ocean
0 200 400 800 Km
0 100 200 400 Miles
Dikhil
Management of invasive plants in rangelands.
Balambary (Dikhil), Petit Bara and Grand Bara
Irrigated fodder production and innovative land preparation.
Buuraha Aroori Barde
Use of perennial indigenous grasses to rehabilitate rangelands.
Tog Wuchale
Community grazing management.
Qool Cadday
Use of perennial indigenous grasses to rehabilitate rangelands.
Awash
Use of perennial indigenous grasses to rehabilitate rangelands.
Degeh Bur
Community grazing management.
Gaalkayo
Community grazing management.
Somali Region
Management of invasive plants in rangelands.
In Four Woredas of Somali Region
Innovative Satellite Assisted Pastoral Resource Management
Legend
Suggested Best Practice Type
Management of invasive plants in rangelands
Use of perennial indigenous grasses to rehabilitate rangelands
Community grazing management
Irrigated fodder production and innovative land preparation
Innovative Satellite Assisted Pastoral Resource Management
Capital City
National
First Admin
Boundary
International
1st level admin
Coastline
Water Body
Data Source
Admin boundaries and places: The Humanitarian Data Exchange (https://data.humdata.org/).
Coordinate System: GCS_WGS_1984
Datum: WGS_1984
FAO FIAT PANIS
All boundaries, names and symbols employed in this map are not authoritative.

4. The next Step:

Recommendations for implementation of priority activities for the second phase of GCP/RAF/490/ITA

4.1 Criteria to establish a shortlist of recommended priority interventions

One of the Outputs of the GCP/RAF/490/ITA project is: "*Water and pastures available to transported animals along the trade routes through creation/rehabilitation of water sources, promotion of good rangeland production practices and negotiation of access to resources*". This entails that targeted efforts have to create/rehabilitate water sources, and to promote of good rangeland production practices and fodder production/commercialization. This is expected to enhance livestock and rangeland production along the trade routes to sustain and grow livestock trade activities.

Together with local stakeholders, priority activities were identified in the four focus countries (Djibouti, Ethiopia, Somalia and the Sudan). However, considering the limited amount of funds available to implement activities, a further selection has to be made. This includes activities on water and fodder, as well as up-scaling good practices on rangeland management and fodder production & marketing. The following criteria were used to recommend a final selection of priority interventions:

- Severity of water and fodder shortages along the different trade routes
- Expected amount of funds from the second installment of GCP/RAF/490/ITA for the implementation of Output 2 activities
- Expected impact of the proposed interventions (number of animals and pastoralists benefitting, area covered, etc.)
- Geographical spread of the proposed interventions
- Extent to which GCP/RAF/490/ITA funds can complement or add value to existing FAO activities aimed at improving water and fodder availability along the livestock routes
- Complementarity of proposed GCP/RAF/490/ITA activities with projects or interventions by other stakeholders, such as Ministries, NGOs and other development partners
- Proposed activities of the GCP/RAF/490/ITA project in other Outputs, in particular Output 1 (which focuses primarily on Djibouti and the Sudan)

4.2 Final shortlist of recommended priority interventions for implementation during the second phase of GCP/RAF/490/ITA

The Republic of Djibouti

Since Djibouti is mainly a livestock transit country, it is suggested to use the little resources available towards improving the quality and quantity of fodder grown in-country. This will reduce the need to import expensive fodder from neighboring countries, and provides local farmers and agro-pastoralists with additional income while reducing degradation and erosion of rangelands. The following activities are proposed:

- Expand irrigated commercial fodder production at Haro River and Kourtimale, at an estimated cost of USD 15,000
- Conduct exchange visits and learning tours for farmers from other regions of Djibouti to successful farms in Dikhil, at an estimated cost of USD 5,000 (for 50 farmers).

The Federal Democratic Republic of Ethiopia

Given the fact that the livestock route from Ethiopia to Djibouti has much lower livestock numbers than the route to Somaliland, it is suggested to focus on the latter. The following activities are proposed:

- Establishment of a water point at Tog Wochale, for animals waiting to cross the border from Ethiopia to Somaliland (since they sometimes wait 2-3 weeks). The recommended water point is a shallow well, with an estimated cost of USD 23,000.
- A contract with PCI for the up-scaling of Satellite Assisted Pastoral Resource Management to four Woredas in the Somali region of Ethiopia. This will provide information about vegetation cover for a large area, and such information helps pastoralists more easily locate areas with good quality pastures in a short time.The cost of mapping and automation is USD 12,000 per Woreda, which brings the total cost for four Woredas to USD 60,000 when incorporation distribution costs.
- Support to improvement of Jigjiga customs facilities and infrastructure. This will enable customs processes to be undertaken during the night, resulting in significantly less loss of animal body weight, since stresses at night are much lower (estimated cost USD 25,000).

The Federal Republic of Somalia

The study revealed that fodder scarcity is a much bigger problem than water scarcity. It is therefore suggested to focus on improving feed availability in Somalia. The following interventions are prioritized for implementation:

- Construction of fodder banks in Beer and Odweyne areas already supported by FAO. Estimated total cost: USD 40,000
- Support to FAO Somalia activities on introduction of locally adaptable fodder species (grasses, legumes, fodder tree/shrubs) in Togdheer region and training on informal seed production to avert continued importation of seeds. Estimated cost: USD 50,000
- Support to on-going FAO activity on physical processing to enhance feed intake by animals and reduce wastages. This includes the physical processing (grinding) of the pods/seeds from the invasive Prosopis tree into protein-rich feed. Estimated cost: USD 15,000
- In collaboration with the IGAD Sheikh Technical Veterinary School:
    - Development and testing of a curriculum for ISTVS students on context-specific fodder production and marketing. Estimated cost: USD 25,000
    - Technical and resource mobilization support to an ISTVS research programme on enhancing livestock productivity through improved animal feed production and sustainable use of natural resources. Estimated cost: USD 10,000 and technical support in kind

The Republic of the Sudan

Since the Sudan is expected to benefit significantly from GCP/RAF/490/ITA Output 1 activities, the study proposes to prioritize Output 2 activities for the other livestock export countries (Ethiopia, Somalia and Djibouti). However, it is suggested to pilot at least one activity in the Sudan, which can be an entry point for additional resource mobilization. The following activity is proposed:

- Pilot rehabilitation of one wateryards (to be selected out of 11 priority wateryards in close collaboration with the SLRC). Estimated cost: USD 50,000

Annexes

Annex 1: Persons interviewed

Kenya

- Mr. Martin Okonji Mukwana (Senior Assistant Director Livestock Production) – Ministry of Livestock Development
- Mr. Ahameed Sherif - Ministry of Livestock Development
- Mr. Tom Otieno (GIS expert) – Formerly with ILRI
- Ms. Eva Nyaga (GIS Expert) – ICPALD
- Dr. Martin Nyamweya (Senior Development Advisor Extensive livestock Sector) – SNV Netherlands Development Organisation
- Mr. Paul Isacko (Business Development Advisor) – SNV Netherlands Development Organisation
- Mr. Adan Abdi (Livestock Advisor) – SNV Netherlands Development Organisation
- Mr. Issack Ahmed Dahir – Kenya Livestock Marketing Council

Ethiopia

- Dr. Beqiwt Sire (Director Veterinary Services) – Ministry of Livestock & Fisheries
- Mr. Meseret Adugnaw (General Manager) – Live Animal Export Association
- Mr. Abebaw Mekonen (Manager) – Ethiopia Meat Producers and Exporters Association
- Mr. Kelifa Hussien (Head of livestock trade) – Ministry of Trade
- Mr. Andrew Malinga (GIS Expert) – Conflict Early Warning and Response Mechanism

The Sudan

- Dr. Kamal Tagelsir Elsheikh (Undersecretary) – Ministry of Livestock
- Dr. Ahmed Mahmoud Sheikheldeen (Director General Quarantine and Meat Hygiene) – Ministry of Livestock
- Eiman Ahmed Osman (Manager Abbatoirs and Meat Hygiene & Focal Point for GCP/RAF/490/ITA) – Ministry of Livestock
- Dr. Omer Hassan El Dirani (Freelance consultant livestock marketing) – Private sector
- Dr. Awatif Abdalla (Project Manager) – Integrated Livestock Production and Marketing Project
- Mr. Ahmed Meena (Animal production expert) – Integrated Livestock Production and Marketing Project
- Mr. Ahmed Abdelhamid (Director) – Stock Route Company - Animal Resources Bank
- Mr. Mohamed Ahmed Shenni (Deputy director) – Stock Route Company - Animal Resources Bank
- Mr. Abdalla El Dokko (Cattle exporter) – Private sector

Djibouti

- Mr. Moussa Ibrahim Cheik (Director) – Livestock and veterinary services
- Dr. Abdi Mohamould Elmi, in-charge of field operations,
- Dr. Hassan Mohammad (Deputy Manager) – Pima International Co, Djibouti regional livestock quarantine
- Mr. Ali Walou (Veterinary Technician and Director of Livestock and Veterinary Services Dikhil Region) – MoAF
- Mr. Djama Guiedi Dideh (Model Farmer) – Haro River, Dikhil Region

Somaliland

- Mr. Abdirashid (State Minister) – Ministry of Livestock

- Mr. Khadar Mohammed Fahriye (Director General) – Ministry of Livestock
- Mr. Farhan Ahmed Yusuf (Director for Planning) – Ministry of Livestock
- Mr. Harun Saeed (Director for Animal Production) – Ministry of Livestock
- Mr. Abdirashid Omar (Technical Advisor for SDF) - Ministry of Agriculture
- Mr. Ibrahim Omar (Director) – Ministry of Agriculture
- Mr. Abdi Hindi Muse (Regional Veterinary Coordinator) – Ministry of Livestock, Togdheer
- Mr. Ibrahim Warsame (Technical Advisor) – Ministry of Livestock
- Mr. Dahir Muse Hussein (District Veterinary Officer) – Ministry of Livestock, Borama
- Mr. Haji Abdi (District Veterinary Officer) – Ministry of Livestock, Togwajale
- Mr. Fred Wesonga (Principal) – IGAD Sheikh Veterinary School
- Mr. Abdulahi Sheikh (Dean of Studies) – IGAD Sheikh Veterinary School
- Mr. Haile Selassie Mariam (Head of Dry land Economics Agro-ecosystem Management) - IGAD Sheikh Veterinary School
- Mr. Michiel Bourgondien (Project Director SDF) – BMB Mott MacDonald

FAO

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Annex 2: Budget estimates for rehabilitating watering points

ITEM	DESCRIPTION	UNIT	QUANTITY	USD
1	63 mm dia. HDPE pipe, 10 Bar	M	150	525
2	50 mm dia. G.I pipe C/B	No.	1	75
3	P.E adaptors 63 mm dia.	No	2	65
4	40 mm dia. G.I pipe C/B	No.	2	110
5	P.E adaptor 32mm dia.	No	6	24
6	Gate Valve (pegler) 25 mm dia.	No	3	55
7	Gate Valve (Pegler) 40 mm dia.	No.	1	45
8	32 mm dia P.E roll, 8 Bar	M.	150	188
9	25 mm dia. G.I pipes C/B	No.	3	105
8	32 mm dia P.E connectors	No	4	30
9	Reducing bush G.I. 40 mm x 25 mm	N0	3	4
10	Elbows 50mmx90° dia.	No	2	4
11	40 mm x 90° elbows	No	2	3
12	25 mm x 90°	No	6	6
12	Hexagonal nipples 25 mm diameter	No	3	2
13	Equal Tee 40 mm diameter	No.	2	13
14	5,000 litre Plastic tank	No.	1	450
15	Standard cattle trough (1M by 10M)	No.	3	1 800
16	Water tower steel structure	No.	1	1 500
17	A portable pump set capable of discharging 5 m^3/hr against a total pumping head of 30 metres. The pump set be duly derated to work at 1000 M.A.S.L.	No.	1	400
	Sub-Total			5 404
	Add 35% for labour and transport			1 891
	Total- USD			7 295

Annex 3: Budget estimates for establishing a fodder unit in Ethiopia

Material	Unit	Total Qty	Unity price	Total price (ETB)	Total price (USD)
Two finger hoe	PCs	100	190	19 000	863
Three finger hoe	PCs	100	190	19 000	863
Grape hoe	PCs	100	190	19 000	863
Cultivating hoe	PCs	100	87	8 700	395
Pick mattock (Axe)	PCs	100	130	13 000	590
Forks	PCs	100	49	4 900	222
Rake	PCs	300	40	12 000	545
Spade /shovels	PCs	300	100	30 000	1 363
Trowel	PCs	360	100	36 000	1 636
Sickles	PCs	400	110	44 000	2 000
Watering can (10ltres)	PCs	200	50	10 000	454
Axe (small)	PCs	300	130	39 000	1 772
Hammers-Carpenter	PCs	8	100	800	36
Water pumps	PCs	8	18 000	144 000	6 545
Fodder trees					
Leucaena leucoephala	kg	40	80	3 200	145
Gliricidia sepium	kg	40	150	6 000	272
Sesbania sesban	kg	40	100	4 000	181
Grass					
Cenchrus ciliaris	kg	100	670	67 000	3 045
Panicum Antidotal	kg	100	400	40 000	1 818
Chloris gayana	kg	100	370	37 000	1 681
Sudan grass	kg	100	200	20 000	909
Napier grass cuttings	cuttings	400	5	2 000	90
Legumes					
Medicago Sativa (alfalfa)	kg	60	560	33 600	1 527
Macroptilium spp. (siratro)	kg	60	150	9 000	409
Lablab (dolichos)	kg	60	90	5 400	245
Pigeon peas	kg	60	200	12 000	545
Cow pea	kg	60	150	9 000	409
Total				**879 890**	**29 436**

Annex 4: Estimates for drilling a shallow well (Estimated Depth: 96 m) drilling method: Mud

S/N	Description	Unit	Qty	Unit price	Total Birr
1	**General**				
1.1	Mobilization of equipment and construction from A.A	Ls	1	80 000	80 000
1.2	Site Preparation including rig up & rig down	Ls	1	65 000	65 000
1.3	Inter site mobilization	Ls	1	20 000	20 000
1.4	Demobilization of equipment and construction	Ls	1	60 000	60 000
2	**Well Drilling in any formation**				
2.1	Air rotary with mud system	M	96	2 500	24 000
2.2	Cable tool	M	96	800	76 800
3	**Well logging**				
3.1	Litho logical logging	Ls	1	6 000	6 000
4	**Supply and Installation of Materials**				
4.1	Retrievable Surface casing 12 inch	M	9	4 500	40 500
4.2	Upvc Blind casing 6 inch	M	65	429	27 970
4.3	Upvc Screen casing 6 inch	M	30	483	14 876
4	**Well Completion Works**				
4.1	Supply & Packing Well sorted river gravel 4mm	M3	5	2 200	11 000
4.2	Well Cleaning and Development	Hr	8	800	6 400
4.3	Grouting with mass concrete up to 5meter	Ls	1	8 200	8 200
4.4	Well Head and Cattle Trough Construction as per design	Ls	1	15 000	15 000
5	**Pumping Test**				
5.1	Preliminary Test	Hr	2	500	1 000
5.2	Test drawdown Test	He	6	500	3 000
5.3	Constant Test	Hr	12	500	6 000
5.4	Recovery Test	Hr	3	500	1 500
6	**Pump cost**				
6.1	Supply and Installation of hand pump Indian Mark II	Ls	1	21 000	21 000
6.2	Supply and Installation of hand pump extra-deep Indian Mark II		1	22 000	22 000
7	**Completion report**	No	1	8 000	8 000
8	**Water Quality test**	No	1	5 000	5 000
	Total				**523 246**

Annex 5: Budget estimate – Management of invasive plants and rangeland rehabilitation in Ethiopia

Machinery and Material	Unit	Total Qty	Total price (USD)
Water pumps	PCs	3	2 454[46]
Motorized saw (Small)	PCs	4	1 363
Two finger hoe	PCs	100	863
Three finger hoe	PCs	100	863
Grape hoe	PCs	100	863
Cultivating hoe	PCs	100	395
Pick mattock (Axe)	PCs	100	590
Forks	PCs	100	222
Rake	PCs	300	545
Spade /shovels	PCs	300	1 363
Sickles	PCs	200	1 000
Watering can (10L) plastic	PCs	200	454
Axe (small)	PCs	300	1 772
Charcoal Sacks	PCs	400	363
Seeds or seedlings planting material			
Fodder trees			
Leucaena leucocephala	kg	40	145
Gliricidia sepium	kg	40	272
Sesbania sesban	kg	40	181
Grass			
Cenchrus ciliaris (buffel grass)	kg	100	3 045
Panicum maximum	kg	100	1 818
Chloris gayana (Rhodes grass)	kg	100	1 681
Total (USD)			**20 263**

[46] Costs for establishing water source not included because it varies with type and location

Annex 6: Budget estimate – Management of invasive plants and rangeland rehabilitation in Dikhil Region

Machinery and material	Unit	Total Qty	Total price (USD)
Water pumps	PCs	3	2 945
Motorized saw (Small)	PCs	4	1 636
Two finger hoe	PCs	100	1 036
Three finger hoe	PCs	100	1 036
Grape hoe	PCs	100	1 036
Cultivating hoe	PCs	100	474
Pick mattock (Axe)	PCs	100	709
Forks	PCs	100	267
Rake	PCs	300	654
Spade /shovels	PCs	300	1 636
Cutlass	PCs	400	0
Sickles	PCs	200	1 200
Watering can (10ltres)plastic	PCs	200	545
Axe (small)	PCs	300	2 127
Charcoal Sacks	PCs	400	436
Seeds or seedlings planting material			
Fodder trees			
Leucaena leucocephala	kg	40	189
Gliricidia sepium	kg	40	354
Sesbania sesban	kg	40	236
Grasses			
Cenchrus ciliaris (buffel grass)	kg	100	3 959
Panicum maximum	kg	100	2 363
Eragrostis superb	kg	100	2 186
Total (USD)			**24 030**

Annex 7: Budget estimate – Establishment of indigenous grass to rehabilitate rangelands in Awash (Ethiopia)

Material	Unit	Total Qty	Total price (USD)
Water pumps	PCs	3	2 454
Two finger hoe	PCs	100	863
Three finger hoe	PCs	100	863
Cultivating hoe	PCs	110	435
Forks	PCs	110	245
Rake	PCs	300	654
Sickles	PCs	200	1 200
Watering can (10ltres) plastic	PCs	195	531
Seeds or seedlings planting material			
Fodder trees			
Leucaena leucocephala	kg	40	145
Gliricidia sepium	kg	40	272
Grasses			
Enteropogon macrostachyus	kg	100	1 818
Cenchrus ciliaris (buffel grass)	kg	100	3 045
Eragrostis superba (maasai love grass)	kg	100	1 818
Chloris roxburghiana	kg	100	1 681
Total cost USD			**16 030**

Annex 8: Budget estimate – Establishment of indigenous grass to rehabilitate rangeland in Qoolcaday and Aroori, Somalia

Material	Unit	Total Qty	Total price (USD)
Water pumps	PCs	3	4 172
Two finger hoe	PCs	100	1 468
Three finger hoe	PCs	100	1 295
Cultivating hoe	PCs	110	870
Forks	PCs	110	490
Rake	PCs	300	1 090
Sickles	PCs	200	1 500
Watering can (10ltres) plastic	PCs	195	664
Seeds or seedlings planting material			
Fodder trees			
Leucaena leucocephala	kg	40	290
Gliricidia sepium	kg	40	545
Grasses			
Enteropogon macrostachyus	kg	100	3 636
Cenchrus cilaries (buffle grass)	kg	100	6 090
Eragrostis superb (maasai love grass),	kg	100	2 727
Chloris roxburghiana	kg	100	2 522
Total cost (USD)			**27 365**

This regional baseline and good practices study on livestock routes, water and fodder availability was produced by the FAO and funded by the Italian Agency for Development Cooperation. It was implemented with technical support from the IGAD Centre for Pastoral Areas and Livestock Development (ICPALD). Together the relevant government authorities and with local stakeholders, the location and direction as well as priority water and fodder interventions were identified. The study also documented good practices on rangeland rehabilitation and fodder production & marketing with potential for replication and up-scaling.

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