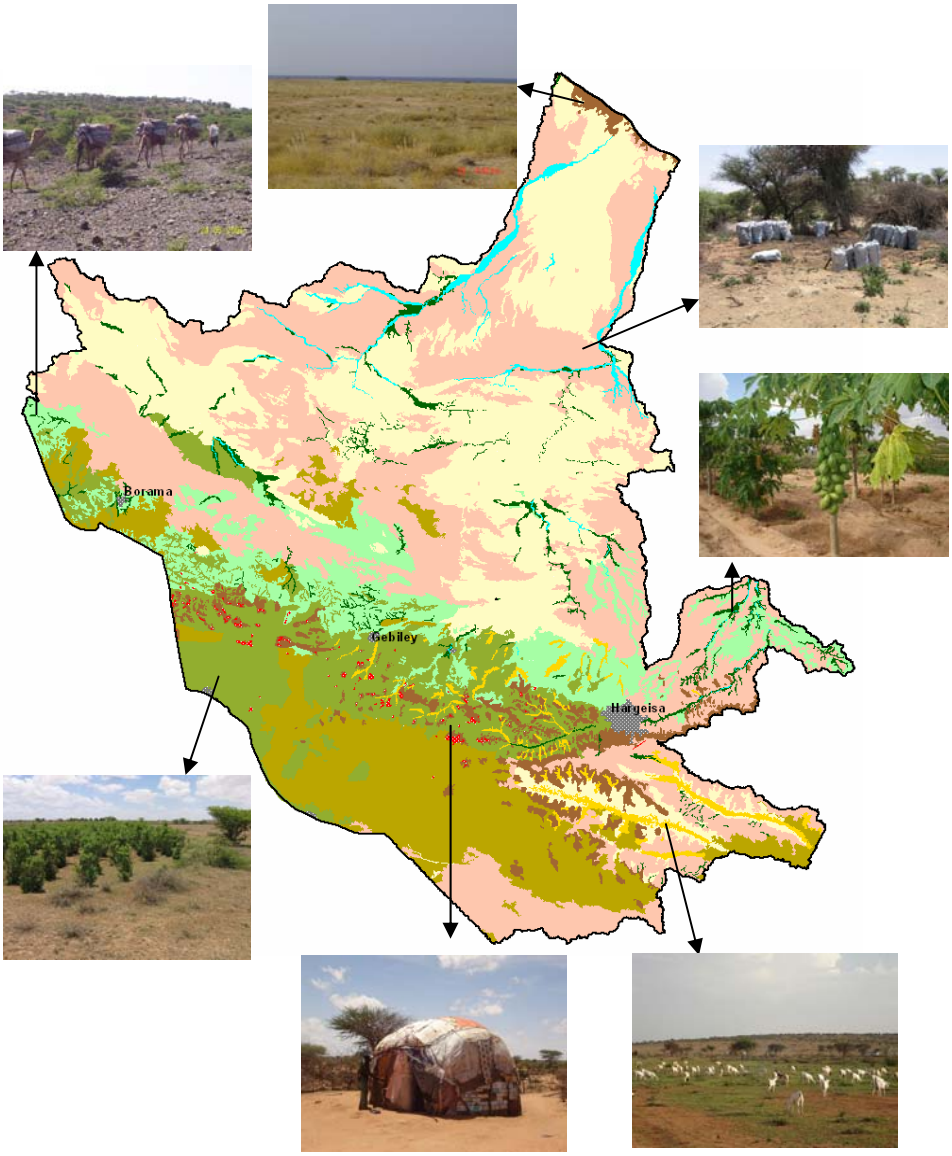
Land Use Characterisation of a Selected Study Area in Somaliland



Project Report No. L-04

Feb 2007

Somalia Water and Land Information Management
Ngecha Road, Lake View. P.O Box 30470-00100, Nairobi, Kenya.
Tel +254 020 4000300 - Fax +254 020 4000333,
Email: enquiries@faoswalim.org Website: http//www.faoswalim.org.

Funded by the European Union and implemented by the Food and Agriculture Organization of the United Nations

This document should be cited as follows:

Oduori, S., Vargas, R., Alim, M. 2007. Land Use Characterisation of a Selected Study Area in Somaliland. FAO-SWALIM. Project Report No. L-04. Nairobi, Kenya.

ACKNOWLEDGMENTS

The authors wish to acknowledge the considerable support given by the Project Task Force during the preparation of this report. Special thanks go to Dr. Hubert George for his overall contribution.

Many thanks to Abdullahi Hassan Magan and Mohamed Warsanie, the land use field surveyors who worked tirelessly collecting field data, and to our Somali drivers. All the Somali organisations contacted for information are also thanked, including the Somalia Mine Action Centre, the Ministry of Agriculture and the Cadastral Survey.

The contributions and support of all SWALIM technical, administrative and management staff are appreciated.

We also would like to thank the Food Security Analysis Unit (FSAU) of the United Nation's Food and Agriculture Organisation, for data and advice on land use issues.

Many thanks go to Mr. Jan Venema for the technical revision of this study report.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Plates

LIST OF ACRONYMS

EC	European Commission
FAO	Food and Agriculture Organization of the United Nations
FSAU	Food Security and Assessment Unit
GIS	Geographic Information Systems
GPS	Global Positioning System
LADA	Land Degradation Assessment in Drylands
SWALIM	Somalia Water and Land Information Management
UNDP	United Nations Development Programme

1 INTRODUCTION

Land use may be defined as the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it. This definition of land use establishes a direct link between land cover and the actions of people in their environment (Di Gregorio & Jansen, 2005). Land use surveys provide spatially defined information for land management, usually in the framework of rural development planning and decision making.

There is a growing concern over the degradation of natural and agro-ecosystems. In this case, land use studies form the basis for analysis of the causes leading to degradation of agro-ecosystem outputs, or deterioration of a natural ecosystem.

A prerequisite for improved land use is information on existing land use patterns and land use through time (Anderson *et al*, 1976). Such information is needed by legislators, planners, and state and local government officials to determine better land use policies, to project transportation and utility demands, to identify future development pressure points and areas, and to implement effective plans for regional development.

A land use policy is clearly of importance to many countries. It is important for nations and governments to know how much land and of what quality does a country and its provinces contain, which crops or other plants or trees can be grown on different kinds of land in different places, whether irrigated or rainfed, how potential yields vary from place to place and from season to season, and how many people can land support at different levels of production cost and with different management techniques.

This information can be used to assist in making wise choices about land use, determining where best to locate new settlements, cropping, drainage, irrigation, where and when to apply new technologies, to explain spatial and temporal variations in output, and to respond to many other questions about management, use and conservation of the natural environment (FAO, 1990).

Several techniques may be used to map land use. However, in the case of the present study areas the situation is complicated by a lengthy civil war, insecurity and landmines making field observations difficult. Available information for the study area is old and patchy, and the only available natural resource inventory is one that was carried out by SOGREAH in 1981.

The present study combines the scientific research techniques of GIS and remote sensing as mapping tools, accompanied by ground observations involving site-specific semi-structured interviews with local people familiar with the area and contact with local organizations. Interviews and discussions with local farmers and herdsmen were not only necessary for the collection of socioeconomic land use data, but were also very fruitful in the land use characterisation from technical and ecological perspectives.

A variety of land use characterisation methods suitable for various planning objectives were possible, although each scheme has its limits. Automatic inference of land use information from land cover is problematic given the complex area-specific relationship between land cover and land use. Satellite remote sensing, used alone, currently offers limited possibilities for routinely providing comprehensive agricultural land use information, including important land management aspects (George & Petri, 2006). Land management information is generally scarce and, when available, is usually aggregated over large geographic regions, thereby diminishing its suitability for land characterisation. George and Petri (2006) propose a framework that integrates remote sensing-derived data with other complimentary land use datasets. Characterisation elements can be grouped into three main categories: resources base, land use purpose

and management, and the socioeconomic setting. The current study follows this scheme, with some slight modifications.

The resource base-map was obtained through interpretation of satellite remote sensing data to produce a land cover map of the study area, which was then used as the basis for mapping land use. Sample polygons were selected and visited for land-use management and limited socioeconomic setting characterisation. The results included a land use map and a table (legend) with a description of the 13 land use types occurring in the area.

The land use classes, in their order of dominance, were as follows:

- Transhumance Pastoralism/Sedentary Pastoralism/Wood Collection
- Transhumance Pastoralism/Sedentary Pastoralism
- Transhumance Pastoralism/Rainfed Agriculture/Wood Collection
- Rainfed Agriculture/Sedentary Pastoralism
- Transhumance Pastoralism/Rainfed Agriculture
- Sedentary Pastoralism
- Transhumance Pastoralism/Irrigated Orchards
- Hay Production/Rainfed Agriculture
- Transhumance Pastoralism/Hay Production/Wood Collection/Rainfed Agriculture
- River Bed
- Urban Area
- Rural Settlement
- Airport

1.1 Objectives

The overall objective of the study was to characterise and map current land use in the Dur-Dur and Gebiley area of Somaliland, also referred to as the Northern Area of Interest (NAOI). Specific objectives were:

a. To assess, classify and map the present use of the land.
b. To analyse the causes and reasons underlying the present land use situation by means of technical assessment and the use of rural appraisal techniques.

2. STUDY AREA

2.1 Location and delineation

The study area of the Northwest Somalia is located between the latitudes 9^{o} 10’ 30.8” and 10^{o} 41’ 36.54” North and the longitudes 43° 0’ 52.3” and 44° 27’ 54.22” East (Figure 1) thus covering a total area of 12 915 km^{2}. It is bounded in the north by the Gulf of Aden and Lughaya District, in the east by Berbera District and the eastern parts of Hargeisa District, in the south by the Ethiopian border, and in the west by the Eastern part of Borama District.

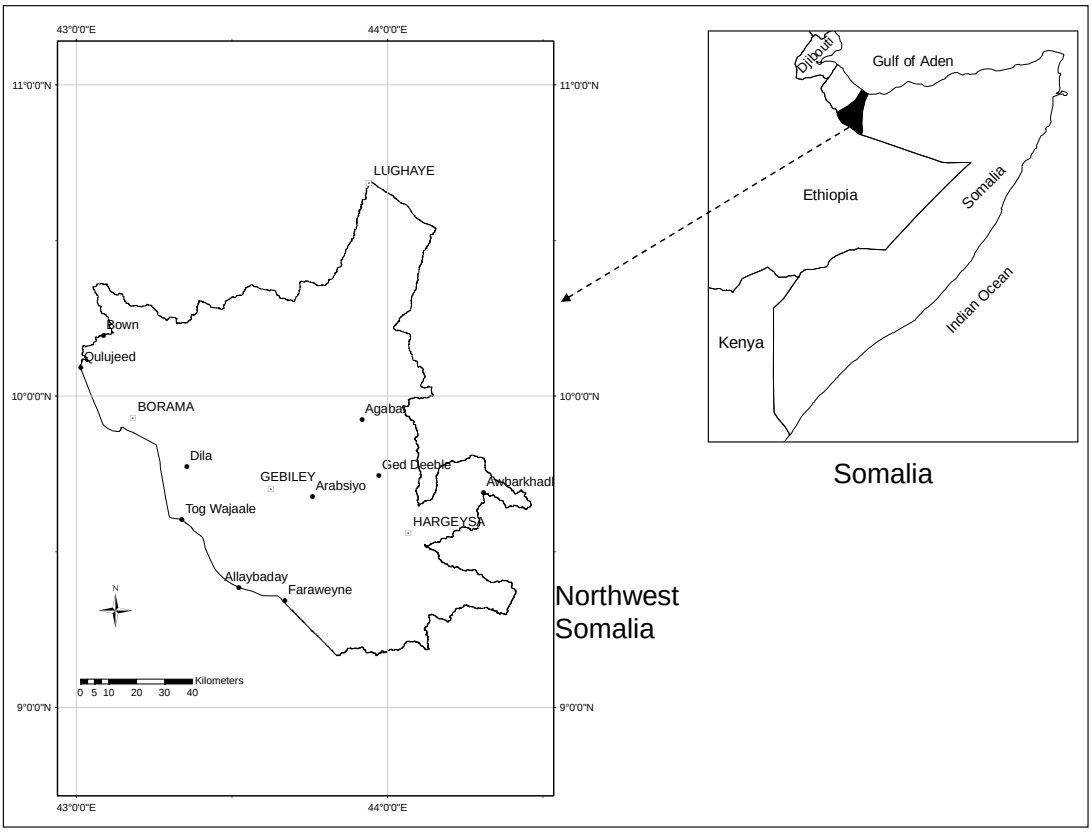


Figure 1: Study area

2.2 Climate

The region lies at the extremity of the sub-Saharan semi-arid zone commonly referred to as the Sahel, which traverses the continent from Senegal to Somalia.

The climate of the study area is hot dry desert on the coastal plain (Lughaya and northern part of Baki districts), and arid in Borama and surroundings. Semi-arid conditions prevail at higher altitudes of the Al Mountains and south of Gebiley. Mean annual rainfall ranges from below 200 mm in the coastal areas of Lughaya, to 500–600 mm to the east of Borama and surroundings. The rest of the study area has a mean annual rainfall of 300-500 mm (see Figure 4).

The study area lies entirely between the two subtropical anticyclone belts, in which the main weather patterns are controlled by the passage of the seasonal monsoon winds. Rainfall in the area is thus bimodal (see Figure 2). The northeast monsoon brings the primary *Gu* rains between March to June. The *Gu* is followed by a hot, dry period called *Xagaa* (June-July). Short rains locally known as *Deyr* also occur between August and October followed by cool long dry *Jilaal* period between November-February.

Temperatures in the area are influenced by altitude and the strength and temperatures of the seasonal winds. Figure 3 illustrates how temperatures decrease with increasing altitude. In the higher altitudes of the Al Mountains and Plateau areas temperatures vary considerably seasonally, with mean annual temperatures between 20-24°C, while the coastal region has mean annual temperatures between 28-32°C.

Relative humidity of the highlands is mostly around 40%, except during rainy periods when it may reach 80%. High temperatures in the coastal areas combine with a high relative humidity of more than 70% to create an exceedingly hot, humid environment.

The major winds in the study area occur during the *Xagaa* dry season, particularly (June to July) and in *Jilaal* (December to February). Hot, calm weather occurs between the monsoons (part or whole of April and part or the whole of September). In the northwest the winds are strongest everywhere during the southwest monsoon. Average wind speed varies from 8-10 m/s, but during a large part of the year strong winds of up to 17 m/s occur, causing frequent dust-devils all over the coastal plains and plateaus.

The study area is subject to high potential evapotranspiration (PET), with an annual average of between 2000 and 3000 mm. Annual rainfall is far below potential evapotranspiration and a large water deficit exists during most of the year, throughout the region. Rainfall is not always sufficient for successful crop production (Figure 2).

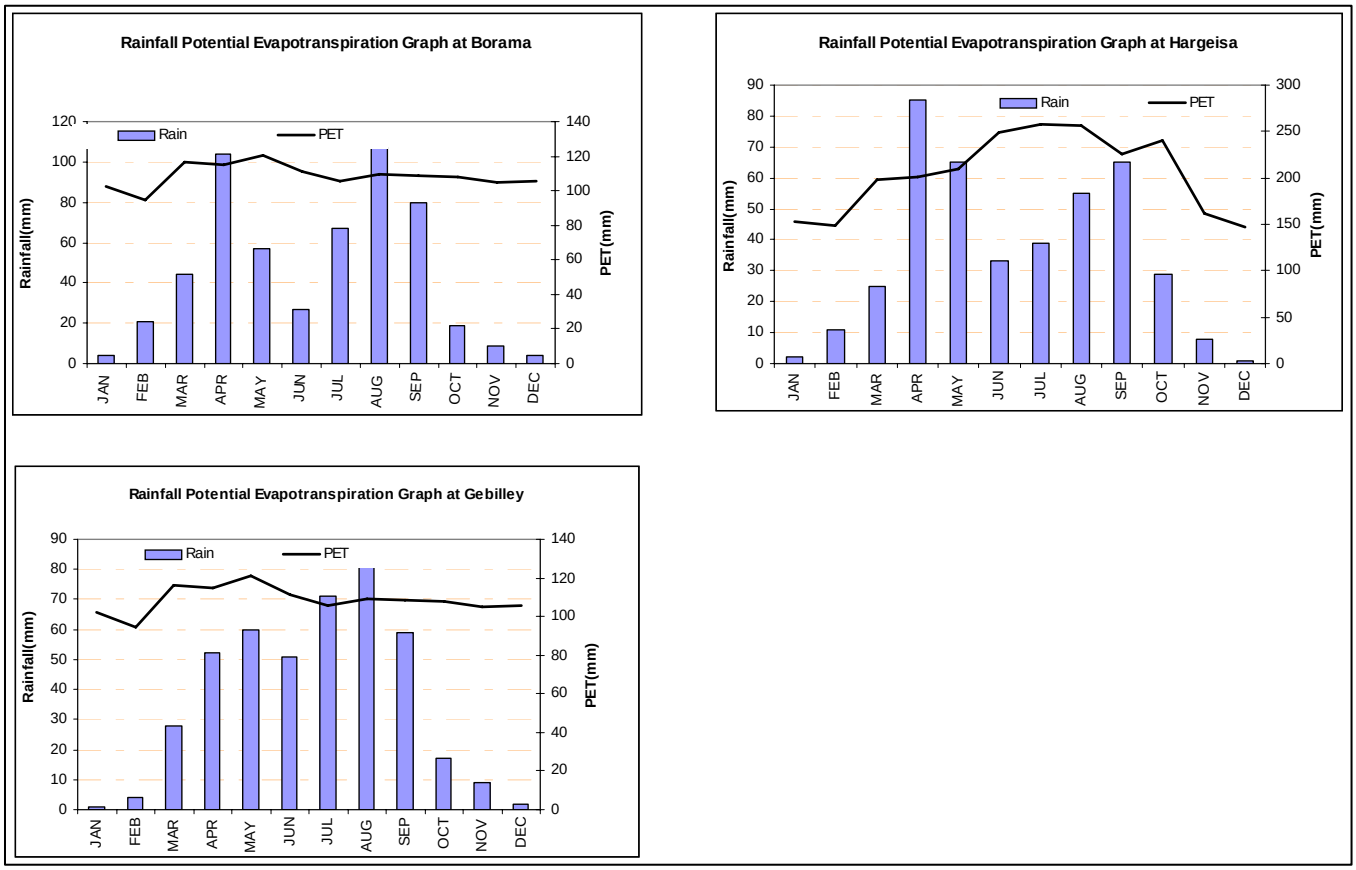


Figure 2: Rainfall and potential evapotranspiration

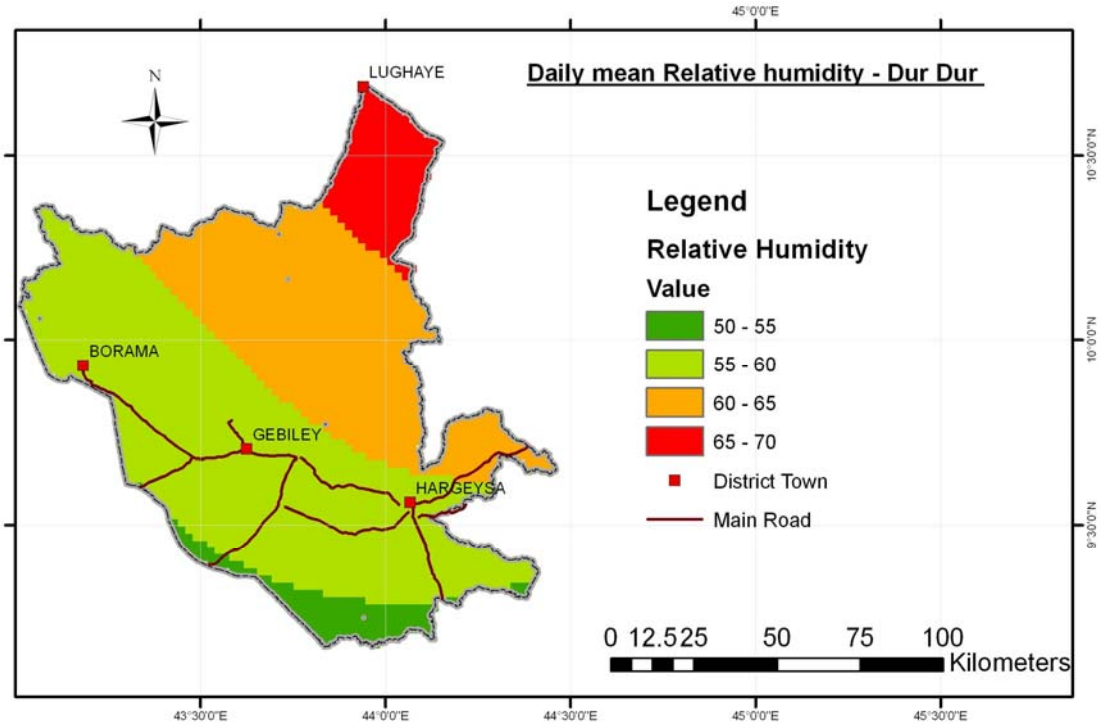


Figure 3: Relative humidity of the study area

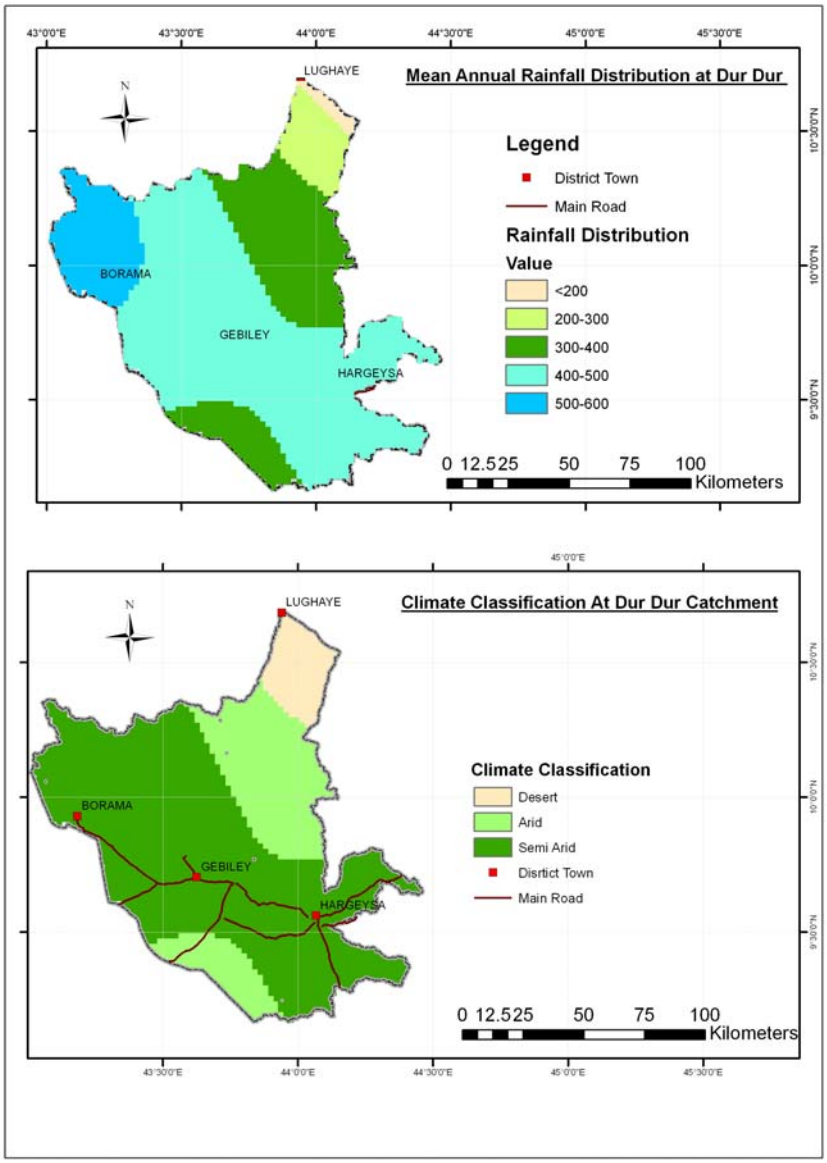


Figure 4: Rainfall distribution and climate classification of the study area

2.3 Geology / Lithology

The study area is covered by rocks dating from Pre-Cambrian to Recent, comprising sedimentary, igneous and metamorphic rocks. The tectonic arrangement of rock outcroppings in the region is complex and severely affected by many different systems of faults and fractures, oriented mainly parallel to the coast (WNW-ESE).

The basement complex covers extensive areas of the Al Mountains around Borama and Baki districts. In other parts of the region it is covered by Jurassic limestone and Miocene bio-limestone, Pleistocene basalts, and Recent alluvial and Aeolian deposits. Igneous rocks are mostly basalts and rhyolites, and metamorphic rocks include a wide range of schists, ortogneiss, quartzite, migmatites, marble, calcosilicate and paragneiss, intruded by granite, diorite and gabbro.

Pleistocene basalt outcrops and other volcanic outcrops occur dispersed along the northern escarpment and coastal plain.

2.4 Landform and Soils

From a geomorphological point of view, the study area can be divided into three landscapes: (1) Piedmonts and the Coastal Plain, (2) Mountainous and Hilland, and (3) Plateau (both dissected and normal). The middle mountain range and the southern plateau are locally known as *Oogo*. There are three main ephemeral river systems (Togga Durdur, Togga Biji and Togga Waheen) that drain from the plateau and traverse the mountain range in the direction of the Red Sea and from the southern side of the same mountain to the southern highlands, respectively.

(1) Piedmonts and the Coastal Plain. A small northern section of the study area is coastal plain (locally called *Guban*) extending from the Red Sea over a gently sloping plain with elevations ranging from sea level to 600 m, southwards up to the foot of the mountains (See Map 1). It is characterised by debris and colluvia carried by several *togga* crossing the plain to the sea, the beds of which are very wide and subject to flash floods during the rainy season.

(2) Mountainous and Hilland. In the middle of the study area are the Al Mountains (Golis Mountains), oriented almost E-W parallel to the coast, with a very rugged topography rising to more than 1 500 m asl. Both sides of the mountains, towards the sea and southern hinterland, are drained by numerous streams of varying sizes.

(3) Plateau. The large, gently undulating and almost flat highlands and plateaus south of the Al Mountains have an altitude from 1 500-1 900 m asl and are cut by several streams (variously called *togga*, *tug* or *wadi*).

According to the Sogreah soil survey report [1], patterns of soil distribution closely follow regional geomorphology. On the high plateaus soils were mapped as predominantly deep and heavy textured Vertisols. Mountainous and Hilland areas were mapped as rocky or covered by shallow Entisols and some Aridisols. Soils in the Piedmont areas were classed as Entisols and Aridisols. A large part of the region is covered by Rocky soils that were mapped separately as a non-soil component.

2.5 Land cover

The land cover of the study area is comprised mostly of natural vegetation. Land cover classes include Open Shrubs, Open Trees and Open to Closed Herbaceous. Closed trees are not common. Other cover types include Urban and Associated Areas (Settlement/Towns and Airport), Bare Areas (Bare Soils and Sandy areas) and Natural Waterbodies.

The main woody species in the study area include *Acacia nubica, A. tortilis, A. bussei, A. senegal, Aloe* spp.*, Croton gilletti, Hypoestes hildebrandtii, Acalypha fruticosa, Grewia tenax* and *Balanites aegyptiaca.* Common herbaceous species are *Cenchrus ciliaris, Cynodon dactylon, Sporobolus marginatus, Tragus racemosus* and *Aristida adscensionis*. More details on land cover and the vegetation of the area can be found in FAO-SWALIM Technical Report No. L-03.

2.6 Land Use

The main land use in the study area is extensive grazing (pastoralism). Other land uses include rainfed agriculture, irrigated orchards along the alluvial plains, and wood collection.

Rainfed agriculture is found in what is considered as the “sorghum belt” of Somaliland. It is practiced in combination with pastoralism and wood collection. This land use class is the economic basis of households in the study area.

Cultivation of irrigated orchards is a cash-oriented activity in the area and involves the growing of fruit trees such as citrus, guava, papaya and mango. Supplementary water for irrigation is obtained from wells, dams and other water bodies.

Wood collection for charcoal production is rampant and occurs in all areas with abundant trees. Preferred tree species are *Acacia bussei, A. nilotica* and *A. etbaica.* Urgent interventions to help introduce sustainable sources of cooking energy are needed.

Most of the area is used for extensive grazing, or pastoralism. Goats and sheep are grazed mostly on sloping areas, whereas cattle and camels are grazed on flatter areas. Sedentary pastoralism around homesteads is a common practice. Hay harvesting from enclosures supports this land use, as the harvested hay can be used in the dry season. However, hay harvesting may be a source of conflict as enclosures are not generally welcomed. Hay production requires more research to establish its sustainability without being a cause of conflict in the study area.

Urban centres offer good markets for farm produce, but due to poor access are inaccessible to most farmers. Urban centres are also points of high demand for charcoal.

2.7 Population

The study area comprises the districts of Dila, Gebiley, Faraweyne and Allaybaday and parts of the districts of Hargeisa, Borama, Baki and Lughaya. The size of the study area is slightly more than one third of the total area of Awdal and Waqooyi Galbeed Regions.

According to Somalia UNDP (2005) (Table 1) the estimated urban and non-urban population for Hargeisa by mid-2005 was 560 028, making it the second-largest town in Somalia. Borama had a population of 215 616 and Gebiley 79 564 inhabitants. These three are the main towns in the study area.

Table 1: Regions, districts, and their populations (Somalia UNDP 2005, draft version)

		District	**Estimated population**		
Zone	**Region**	**(* Regional capital)**	**2005 (mid-year)**		
			Total	**Urban**	***Non-urban***
North-west			**1,828,739**	**819,989**	**1,008,750**
	Awdal		**305,455**	**110,942**	**194,513**
		Borama *	215,616	82,921	132,695
		Baki	25,500	8,577	16,923
		Lughaye	36,104	14,010	22,094
		Zeylac	28,235	5,434	22,801
	Woqooyi Galbeed		**700,345**	**490,432**	**209,913**
		Hargeisa *	560,028	422,515	137,513
		Berbera	60,753	42,070	18,683
		Gebiley	79,564	25,847	53,717

3 METHODS

3.1 Bibliographic research

This study involved an initial bibliographic research in order to obtain insights about land use in the study area. Research involved the Internet, grey literature and (importantly) visits to projects and institutions whose activities concentrated on Somaliland. Examples of such institutions are the Food Security Analysis Unit (FSAU) of the FAO, United Nations Development Programme (UNDP), European Community (EC), etc. Many libraries were visited from which numerous reports were collected. All documents were assessed for information regarding land resources and land use. Outlines of the different land use classes in the area, and their characterisation, were obtained from reports, following which a land use survey plan was established.

3.2 Field survey preparations

After obtaining a very general overview of land use characteristics in the study area, preparations were made for the implementation of the actual land use survey itself. The land use inventory is an intermediate product in the SWALIM framework, aimed at assessing physical land suitability and land vulnerability of the area. Before planning for field work, certain aspects had to be reviewed and considered; firstly, the technical aspects and then a review of the socio-political situation of the country which could limit carrying out a standard land use survey.

With these considerations in mind, a survey focused on two principal activities was designed: land use mapping and characterisation of the different land use classes.

Land use mapping required fieldwork in order to determine different spatial patterns of land use in the study area. The only way to characterise land use is through technical field assessment and participatory approaches. A land use form was designed to help map and characterise land use (see Annex 1). This form was designed to facilitate semi-structured interviews that were subsequently aimed at gathering both purely technical data by the surveyor, and indigenous knowledge from the different land users. Data to be collected using this form was semi-quantitative and mostly related to bio-physical components of each land use system. There was limited focus on collecting socioeconomic data, due to constraints already mentioned and SWALIM having different primary objectives to the above.

The preliminary land use classes generated in the bibliographic research were included in the form, grouped into three principal land use systems: agriculture, livestock production and wood collection.

A rigid sampling scheme was not used due to prevailing constraints, including lack of information regarding accessibility and landmines. It was also considered that the surveyors were Somali nationals, about to receive training for these purposes. Instead, the sampling scheme was based on the land cover survey and a sampling scheme using the box, or quadrat sampling concept. This involves a stratified random sampling of the different land cover classes produced in the preliminary land cover map. The planned boxes were distributed according to thematic aspects and accessibility. However, the visit to each point was not compulsory, as this was dictated by field realities. The size of the boxes varied with the size of the polygon being sampled; the general rule was that the bigger the polygon, the bigger the box. Details of this concept are outlined in FAO-SWALIM Report No L-03 on Land Cover Mapping (2006). The box concept was used for the land use survey due to the land cover map forming the basis of the land use map. Figure 5 shows the proposed sampling scheme for the land cover-land use survey.

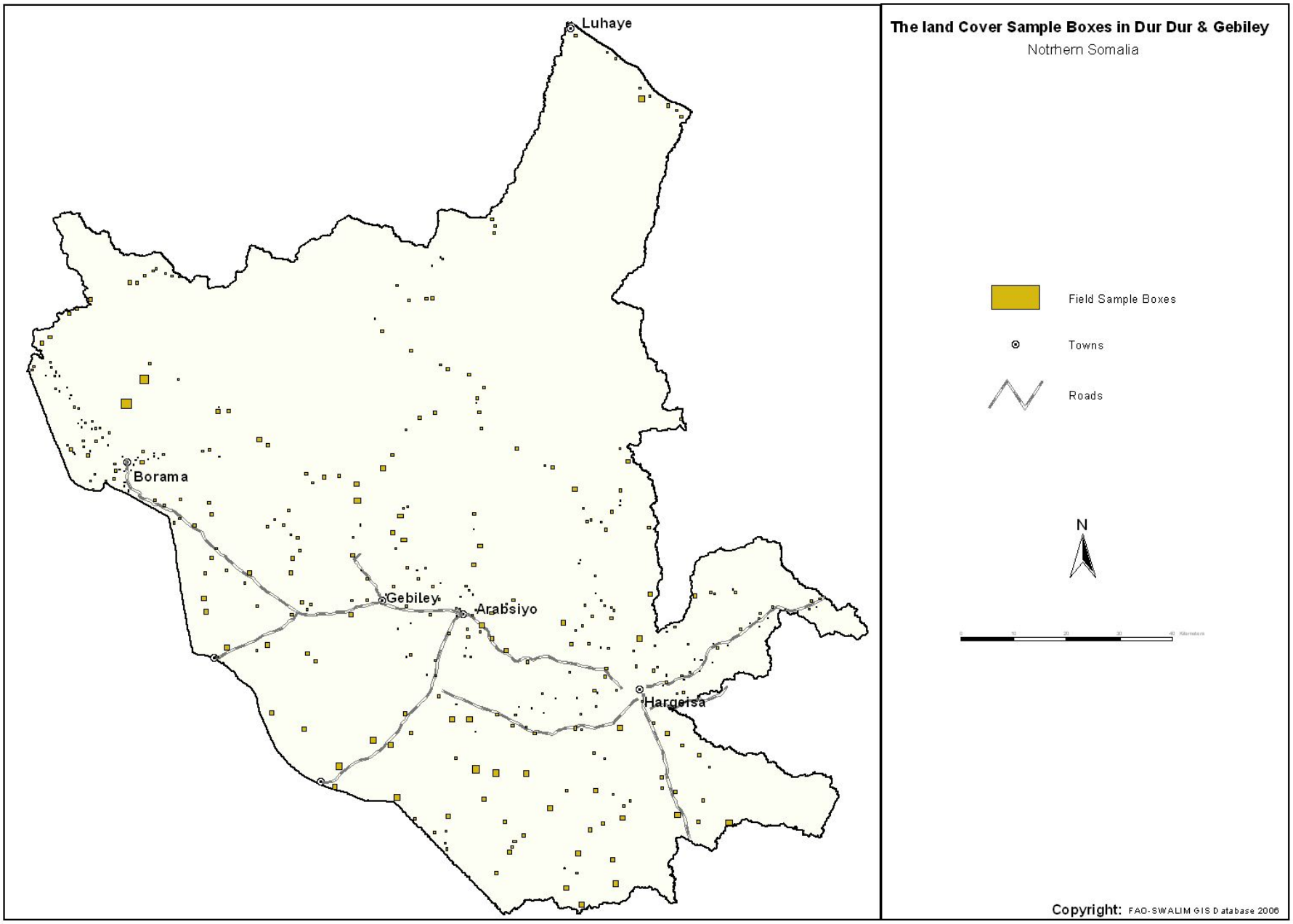


Figure 5: the sample boxes

3.3 Land use field survey

Given that international staff members of SWALIM were not allowed to conduct the field survey on their own due to security reasons, the language barrier and gaining the confidence of land users, the project decided to contract Somali experts to perform the field data collection.

A training stage for the Somali team was foreseen for the first week of the fieldwork stage. A field data collection manual (Field Work Manual for Resources Inventory, by FAO-SWALIM, 2006) was prepared with descriptions of how to obtain data for all land resources, including land use. This manual clearly explains how to work with the existing land use form in the field and how to elicit information from land users.

A two-month field data collection phase was planned to collect data from different data layers such as landform, land cover, land use, land degradation and soils. Two land use surveyors were contracted for the land use data layer. The SWALIM team moved to Hargeisa for a reconnaissance survey of the study area. The objective of this reconnaissance was to field test the different forms and to facilitate practical training for the Somali team. The land use surveyors were trained in the use of the field data collection manual for land use data collection, rapid rural appraisal techniques, use of a GPS, map reading and interpretation of the proposed box sampling scheme in order to guarantee proper collection of land use data.

3.4 Data input and analysis

While the field data collection was underway, batches of completed land use forms were sent to Nairobi. A Microsoft Excel worksheet was designed for data entry as a first assessment for form correctness and completeness. This was also useful in helping map interviews as point maps (i.e. with X, Y GPS coordinates) using ArcView 3.2 software to monitor areas covered and to better understand spatial land use patterns. A Microsoft Access database template was also created in which to enter the land use forms.

All data contained in each form were entered into the Excel spreadsheet. These were then grouped according to their preliminary land use classes and checked to see whether the land use surveyors had discovered new land use classes in the study area. Preliminary analysis was made on different land use classes described in the forms, their location on the satellite imagery and any specific productive variables of each system. Data was crosschecked against key data collected for different land use systems during the fieldwork reconnaissance period.

This process continued until the final batch of land use forms were delivered to Nairobi.

3.5 Land use characterisation

With data now in digital format and following preliminary analysis, final land use classes present in the study area were defined. The preliminary land use classes changed based on variables collected in the field, principally because the form was focused on individual land use classes, whereas fieldwork data showed that there were no single classes. However, for the land use characterisation semi-qualitative variables were analysed according to individual land use classes. This characterisation involved the utilisation of the land use point map to better understand distribution of the different land use classes. As an example, the system of rainfed agriculture does not have the same components and characteristics in Gebiley and Hargeisa. Using the point map and the interview data, groupings were made into different land use classes.

Finally, each interview was reclassified according to the final land use classes. This whole process offered tremendous support to the final stages of the actual land use mapping.

As the final classes were defined, they were characterised from a technical point of view that included agronomic aspects, constraints and opportunities. Positive and negative aspects of each system and ways of improving them from the perspective of the land user, were highlighted. Land user perspectives were crosschecked against technical aspects described by the surveyors.

3.6 Land use mapping

It will be recalled that the land use survey was guided by the preliminary land cover map produced by FAO-SWALIM (Monaci *et al*, 2006). This together with the land use point map formed the cartographic and thematic basis for land use mapping. Available Landsat and ASTER satellite images were further used to clarify specific patterns in complex areas.

The procedure involved reclassification of each land cover polygon according to its relation with the defined land use classes, supported by the land use point map and land use characteristics of each class. This was done on-screen, using ArcView 3.2 software.

An accuracy assessment was not conducted as this mapping exercise began without a preliminary land use map that could be validated in the field. However, validation was provided by Somali experts familiar with land use patterns in the study area.

4. RESULTS

4.1 Bibliographic research

The initial bibliographic research helped identify preliminary land use classes to be used in the land use form. The following land use classes were identified:

a. Communal rangelands (remote areas commonly used for grazing livestock by nomadic pastoralists and semi-sedentary agropastoralists).

b. Marginal free grazing communal land (highly degraded through overgrazing and cutting of trees) around villages and satellite settlements.

c. Private enclosed rangelands (used for harvesting grass either for sale or feeding to owners' livestock, firewood and charcoal, pastureland for owners' small stock).

d. Extensive Rainfed cultivation:
   - on level land with grain crops (sorghum, maize, barley) and legumes (cowpea and beans), and Qat.
   - in between soil bund structures (sorghum, maize, barley) and legumes (cowpea and beans).

e. Fallow land or shifting cultivation

f. Irrigated Cultivation:
   - irrigated farms of mostly less than 2 ha on low terraces, with water from shallow wells along valleys (seasonal rivers) growing cash crops of fruit and vegetables and rarely with maize.
   - irrigated farms with water from berkeds or ponds (*balliyo*) on the plateau away from seasonal rivers, growing Qat and vegetables.

g. Degraded lands (deeply eroded soils and barren rocky land)

h. Urban Centres and Settlements

i. Roads

j. Quarries

4.2 Land use survey

A complete land use field survey was performed. As a result, 185 land use forms were used to collect data in the field. Coordinates of those interviews were recorded and are mapped in Figure 6. Additionally, after a process that is explained further under land use characterisation, we defined the final land use classes. The next step was to match each land use form with its new land use class. A list of all land use forms with coordinates and land use classes can be found in Annex 2.

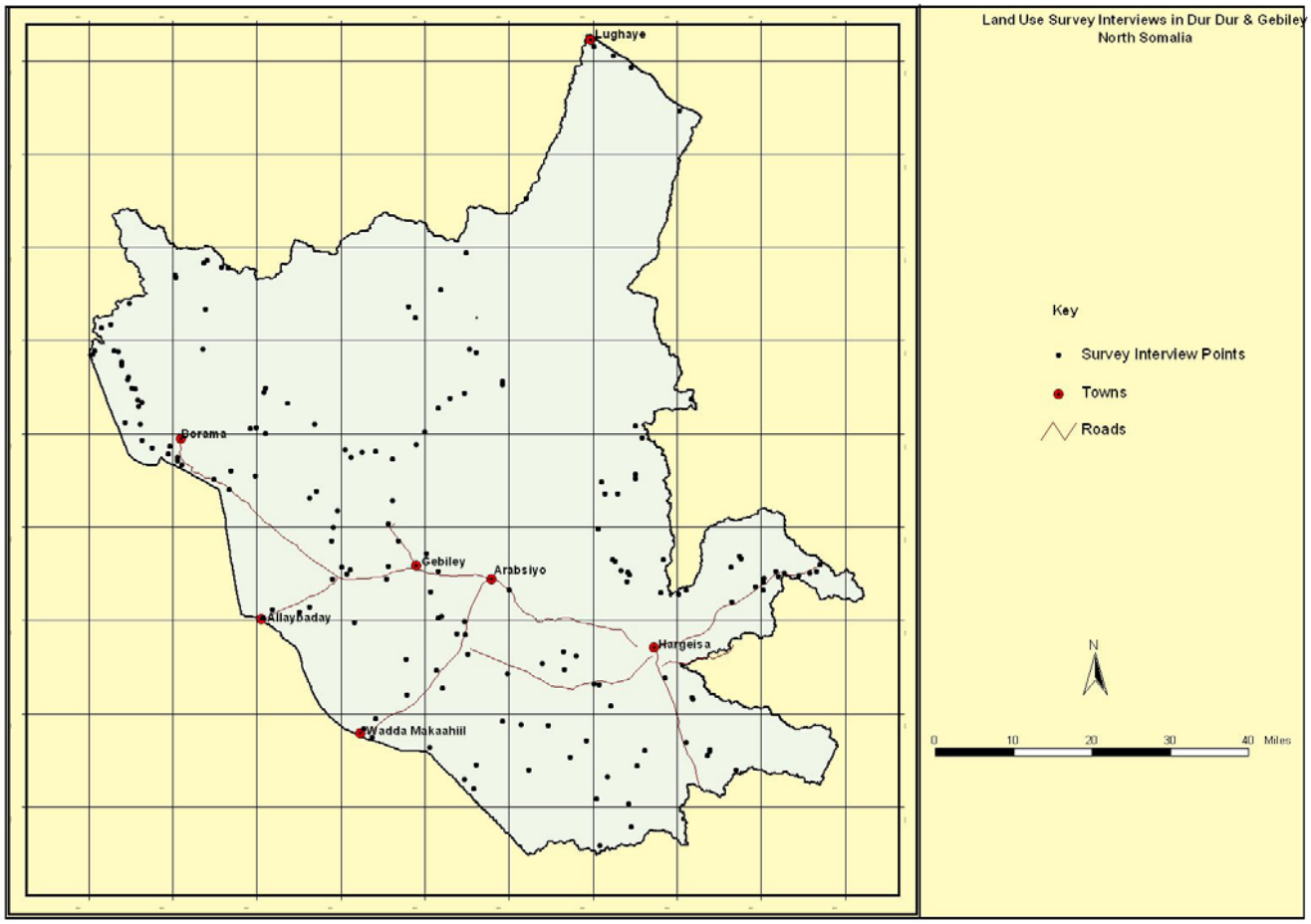


Figure 6: Land use survey samples

4.3 Land Use Classes

Data obtained from the 185 completed land use forms was entered in the prepared Excel spreadsheet, which allowed analysis of the data according to all the land use attributes collected in the field. After a detailed land use grouping process, the final list of land use classes produced was as follows:

- Rainfed Agriculture with Sedentary Pastoralism
- Transhumance Pastoralism with Irrigated Orchards
- Transhumance Pastoralism with Rainfed Agriculture
- Transhumance Pastoralism with Rainfed Agriculture and Wood Collection for Charcoal Burning.
- Transhumance Pastoralism with Hay Production and Wood Collection for Charcoal Burning and Rainfed Agriculture.
- Hay Production and Rainfed Agriculture
- Transhumance Pastoralism and Semi Sedentary Pastoralism and Wood Collection for Charcoal Burning.
- Transhumance Pastoralism and Semi Sedentary Pastoralism.
- Semi Sedentary Pastoralism
- Urban Areas
- Rural Settlement

- Airport
- River Water Extraction

After defining the final land use classes, they were characterised based on data contained in the field data forms. To do this, all land use attributes that defined the land use system itself, were used. Questionnaire results are detailed below.

4.3.1 Rainfed Agriculture

This land use involves rain-dependent crop production, and is practised around the southern parts of Gebiley, Borama and Hargeisa. Given that rainfall in the study area is low (average ±400 mm/annum), this land use class is characterised by water harvesting (through surface dams, soil bunding and berkeds) as improvement systems associated with it. However, water from berkeds and surface dams is particularly used for domestic and animal use. Crop production is based purely on rainfall or harvesting of rain water by soil bunds built around fields, without supplementary water being used. The most common crops grown in this category are maize and sorghum, as well as Qat (*miraa*), millet and cowpea. Table 2 shows crop calendars for various rainfed crops in the study area.

In the study area, Rainfed Agriculture can be classified into two categories: Low Input Rainfed Agriculture, and Medium Input Rainfed Agriculture. 'Input' here refers to material input such as seeds, fertilizer, pesticides, etc.

Low Input Rainfed Agriculture
Tractor use is not as extensive as in medium input rainfed agriculture. Intercropping of maize and sorghum is very common. Bunding is less extensive than in the medium input category. In both cases, the use of local seeds for planting is widely practiced.

Medium Input Rainfed Agriculture
Tractor use is more extensive, with all those interviewed acknowledging their use in the fields. Intercropping is not popular. Seed is mainly local in variety, but a few farmers have imported improved seeds from the Ministry of Agriculture. Fields are larger than 2 ha in average size. Soil bunding is more widespread. The use of fertilizer and manure is negligible in this category.

In view of the above, it is very difficult to spatially distinguish between low input and medium input categories of rainfed agriculture in the area. A general characterisation is therefore adopted for the purposes of this study.

The following is a general characterisation of rainfed agriculture in the area under observation:

- **Land Improvement** – consists of soil water harvesting (bunding, *berkeds*, check dams, diversion furrows). Water is a very limited resource in this area and therefore farmers always try to devise ways of conserving the little water that is available. Drought is a common phenomenon in the area.
- **Input levels** – input levels to agricultural production range from low to medium. However, inputs are limited in this land use class with local seed being widely used. The late maturing Elmi Jama sorghum variety is widely used, for example.
- **Mechanisation** – in most cases, tractor use is common. Oxen are also used to provide power for ploughing on the farm, but more rarely.
- **Farm Management** – the most common form of farm management is fencing around fields to protect crops against animals. Fences are cut from live trees, which together with charcoal burning causes an increase in deforestation. Other forms of farm management include soil bunding to control soil erosion by water.

- **Types of Crops** – crops grown are mainly maize and sorghum (see Plate 3), but also include cowpeas, millet, sesame and *Catha edulis* (*qat*, *khat*, or *miraa* in Kiswahili (see Plate 1)). Crops varieties planted are always local. The Ministry of Agriculture is contemplating introducing an early maturing sorghum variety, as the currently used variety of sorghum takes close to six months before harvesting.
- **Intercropping** – intercropping is common in the low input category of rainfed agriculture and includes maize and sorghum, maize and cowpea.
- **Purposes of Crop Production** – crops are produced for food, market and fodder for animals. In most cases, post-crop residues are cut and stored as animal feed (see Plate 2) and fed to animals during fodder scarcity in the dry season. Crops that have failed to mature due to moisture stress are also harvested and used as animal feed.
- **Crop Condition and Limitations to Agricultural Production** – performance of maize in this area is not as good as that of sorghum. There were more reported cases of maize crop failure than for sorghum. These cases of crop failure did not follow any pattern, but were spread across the study area. Drought, for example, is experienced across the area. Crop failures are attributed mostly to the harsh climatic conditions of low rainfall and very high evapotranspiration rates, in addition to pests, weeds and diseases, late planting due to lack of investment capital and poor farming techniques attributed to lack of training. The most notorious weed is called *kalinoole* in the Somali language, while pests includes maize stalk borer.
- **Agronomic Aspects** – yields fall far below potential levels, which may be as high as 2 700 kg/ha (FAO, 1968). For example, in some cases maize yield is only 55 kg/ha, which may be regarded as a crop failure. Low yields are attributed to low input levels that characterise this land use class. Other causes of low yields include moisture stress, poor farming techniques that are a consequence of limited farm training, pests and diseases and inappropriate seeds. An early maturing sorghum variety, for example, would be more reliable instead of the late-maturing Elmi Jama variety that takes six months to mature in areas that receive low rainfall and high rates of evapotranspiration.
- **Farm Training** – The majority of farmers have not received any farm training, resulting in the applied farming techniques not being of the required levels in most cases. Weeding, for example, is done at the wrong time or not at all. Inappropriate seed varieties are planted because of this fact and timing of planting is in most cases wrong. Soil bunding to conserve or harvest rainwater is poorly done, leaving bunds susceptible to rain erosion. A few farmers have received some training from NGOs, however.
- **Constraints to Agricultural Production** – constraints include lack of tillage capacity, soil erosion, pests, drought, poor seed varieties (e.g. of sorghum), lack of capital, lack of technical knowledge and lack of farm power. Lack of tillage capacity is due to lack of finance, which is in return attributed to lack of credit facilities. Soil erosion is due to deforestation through charcoal burning, fencing and vegetation clearing by overgrazing. Soil conservation activities are fairly limited. As a result, exposed and loosened soils are washed downstream, resulting in gulley formation and (occasionally) badlands.

  Tractors and ox-ploughs are limited both in terms of numbers and accessibility, resulting in late planting in some cases. Stalk borer is a menace to maize production, and weeds have invaded farms. Pesticide use is hampered by unavailability and low purchasing power. Migration to better areas may not be possible, as most of the farmers have more or less adopted permanent settlement. In some cases, land has been demarcated and this also makes migration to better grounds difficult. Families with school-going children may be unwilling to move to places where there are no schools. Clan lineage may also not allow easy migration.

Opportunities – future opportunities for farmers include provision of farm power, soil and water conservation measures, training, migration to better areas, pest and weed control, provision of food relief, introduction of early-maturing sorghum varieties and improved water harvesting techniques.

Plate 1: Rainfed Qat (*Miraa* in Kiswahili) (*Catha edulis*). Notice soil bunding for water harvesting (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 2: Harvested maize stalks near Hargeisa, used as fodder for animals during dry periods *(Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 3: Rainfed maize and sorghum in early stages of growth (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.2 Irrigated Orchards

Irrigated orchards are found in river valleys and are characterised by the use of supplementary water from dams and shallow wells, the extensive use of farm manure and, in some cases, fertilizer. Crops grown are mostly fruit trees, intercropped with vegetables. Other characterisations include water harvesting (soil bunding, surface dams, shallow wells and *berkeds*) as associated improvement systems. Other improvements associated with irrigated orchards include diversion furrows which, in some cases, are cemented. The following is a detailed characterisation of irrigated agriculture in the area under observation:

- **Land Improvement** – consists of diversion furrows, wells and dams. All these are water harvesting techniques aimed at maintaining soil moisture. They require high initial investment costs, so most farmers have not been able to establish their own irrigation activities.
- **Inputs and their Levels of Application** – Seedlings are not of an improved variety, but are locally raised. Input levels for agricultural production are mostly medium in range, including manure, pesticides and in certain cases, fertilizer. However, application of these inputs is suboptimal due to lack of adequate funds.
- **Mechanization** – in most cases, tractors and oxen are used to provide farm power, mainly during the preparatory stages of ploughing and construction of irrigation infrastructure. However, due to high costs of machinery purchase and hire, most farmers cannot afford their use. The result is that only a few farmers have been able to invest in irrigated farming. Other machinery includes water pumps, used to pump water from the shallow wells and dams into fields.
- **Farm Management** – the most common form of farm management consists of fencing around fields, either with barbed wire or tree branches, to protect crops against animals. Other farm management activities include construction of river bank embankments to check flooding from rivers when in spate. On some farms, crops

have been separated by type, with citrus crops on one side of the field and papaya on the other.

- **Types of Crops** –crops are mostly fruits and vegetables grown for commercial purposes, i.e. citrus, guava, papaya, watermelon, tomato and vegetables (see Plates 4 and 5). Farmers rarely plant cereals such as maize and sorghum under irrigated conditions.
- **Intercropping** – intercropping is a common practice, with fields comprising a mixture of crops such as, for example, citrus and guava, papaya and custard apple, tomato and water melon.
- **Field Sizes** –Generally, irrigated farms require high investment costs and are mostly less than 2 ha in size. Field observation indicated that most of these fields are recently established.
- **Purposes of Crop Production** –crops are produced mostly for sale at market, but some produce is consumed at home. However, long distances to markets coupled with poor roads puts farmers in a difficult position when it comes to selling farm produce.
- **Crop Condition** – crop condition within irrigated fields is in most cases good. However, in some cases poor yields are attributed to incidences of pests and diseases, as was observed in most citrus trees. Shortage of water is also a limitation to crop production in some irrigated fields.
- **Agronomic Aspects** – yields were found to be much better than in rainfed fields. Use of fertilizer and pesticide is recorded in irrigated fields, as is use of improved seed varieties. Farm labour is drawn mainly from family members, but hired labour has been recorded in the irrigated orchards.
- **Farm Training** – some farmers have not received any training at all, whereas others have received some training from NGOs. Poor farmer training has resulted in some being unable to apply adequate, appropriate farming techniques. Water, for example has been used wastefully. Earth dams have been poorly lined in an attempt to retain water for longer periods. The fields are then flood-irrigated, another wasteful method of irrigation when rated against existing water scarcity and high rates of evapotranspiration.
- **Constraints to Agricultural Production** – constraints include low tillage capacity (labour shortage, limited acces to ox-ploughs, implements and tractors), market inaccessibility, flash flooding, water scarcity, loss of irrigation infrastructure, poor roads, pests, drought, lack of capital, lack of technical knowledge, and herbivore damage (e.g. monkeys and pigs). Damaged or lost irrigation infrastructure has to be reconstructed, which is expensive. When expenses are combined with the limited purchasing power of farmers, it is in some cases impossible to revive irrigation projects. Wild animals reduce yields further by feeding on produce while it is still in the fields. Market inaccessibility demoralises farmers, as they are unable to sell their produce.
- **Opportunities** – opportunities for farmers include exploitation of ground water for irrigation, borrowing cash from relatives, building soil and water conservation structures such as check dams, gabions and bunds, use of pesticides for pest control, improving soil fertility through use of animal manure, water trucking, training, upgrading of roads and reducing numbers of monkeys and pigs.

  However, farmers require assistance to be able to exploit ground water and construct water conservation structures such as check dams, gabions and bunds. Pesticides are also in most cases beyond farmers' financial means. A result is might be an orchard with fruits that are infected by disease, resulting in reduced returns. Table 3 shows the crop calendar for various irrigated crops in the study area.

Plate 4: Irrigated papaya near Hargeisa (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 5: Irrigated tomatoes in Xalimale (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.3 Transhumance Pastoralism

Transhumance Pastoralism is the most common type of grazing system in the area (see Plates 6 and 7), in which animals are moved in a regular pattern associated with water and forage availability. In terms of grazing patterns, goats are associated with steep hill slopes, while cattle and sheep are found in the valleys and plains where grazing is more practical. The following is a detailed characterisation of transhumance pastoralism in the area:

- **Animals Kept** – these are mostly sheep, goats, cattle, camels and poultry. Spatial distribution of these animals within the study area is in accordance with land cover distribution. Sheep and cattle are more abundant in areas with a greater abundance of grass, whereas camels and goats are found in areas where browse is dominant.
- **Livestock Products and Use** - products obtained from these animals include milk, meat, hides and ghee, for both domestic and commercial use. Products are sold in markets, which are not easily accessible due to poor access or long distances.
- **Livestock Health** –livestock health was found to be good in most of the surveyed area, although in some cases camels were found to be in bad health. Observed good health may be attributed to the availability of abundant feed at the time of the survey, during the wet season. In the dry season and with the onset of drought both fodder and water become scarce, leading to poor animal health and starvation.
- **Forage Condition** – condition of animal forage varies seasonally, favouring different livestock at different times of the year. The timing of the survey during the wet season may not have been the most suitable in which to assess forage condition, as forage worsens during the dry seasons. This was confirmed by the fact that migration to better grounds is a way of life in this area, undertaken during drought in search of pasture and water for livestock.
- **Presence of Enclosures** – the enclosures referred to here include fenced off grazing lands, the grass from which is sometimes harvested for sale and as dry season animal fodder. Enclosures were not found to be a common feature during the survey. They are illegal, established without blessings of the community as a whole. However, enclosures were encountered in valleys throughout the plateau area where grass is in most cases harvested for use locally, exported to towns like Hargeisa, or used for firewood and/or charcoal exploitation purposes. These enclosures are a source of conflict as most pastoralists feel they deny them grazing grounds for their animals. The fact that most enclosures are found on valley bottoms where soil moisture is retained for a longer time, means that pastoralists are indeed denied access to dry season grazing grounds.
- **Water Sources** - shallow wells are important sources of water for livestock, especially in the dry season. Other sources of water for livestock include springs, boreholes and dams. Most shallow wells and dams dry up during the dry season,. and animals have to be walked for long distances to access other water sources. Water sources are poorly constructed and their ability to retain water is minimal. Water is lost through ground seepage and evaporation, and harvested water is lost within a very short period. There is a need therefore to improve on the design of water reservoirs so that losses are minimised.
- **Constraints** - constraints associated with livestock production include disease, water shortage, poor quality pasture, ticks, pasture shortage, collapsing wells, invasion of cacti, ever-expanding numbers of enclosures, drought, soil erosion, low market prices for livestock products, intrusion by unpalatable plant species and land degradation due to charcoal burning. Many constraints are interrelated, and controlling one may reduce the manifestation of others. Charcoal burning, for example, leads to land degradation through water soil erosion, as water shortage leads to pasture shortage.
- **Opportunities** – according to interviewees, feasible opportunities for livestock production in the area include provision of veterinary services; ensuring ability to migrate to better pasture, particularly in dry periods; exploitation of ground water, access to food relief; eradication of invasive plants such as cactus; lining wells to reduce water seepage; soil and water conservation measures; controlled grazing; and re-vegetating degraded areas. All these opportunities that the

pastoralist may be exposed to, will require external support as all require heavy investment costs unavailable to the pastoralists.

Transhumance pastoralism may occur as a single land use class, or may occur as a mixed unit with Agriculture and Wood Collection for charcoal burning.

Plate 6: Pastoralism (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 7: Pastoralism (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.4 Wood Collection for Charcoal Burning

Charcoal burning is a common practice, occurring wherever there are trees, especially *Acacia bussei* and *A.etbaica* (Plates 8-11). Other tree species cut for charcoal burning include *Acacia nilotica*. Charcoal burning is practiced as an alternative livelihood, its negative environmental effects notwithstanding. The practice is illegal, conducted against the wishes of pastoralist communities and government. Charcoal burning sites are far from settlements, and those involved do all they can to avoid being controlled.

Charcoal burning has promoted a decline in range quality and an increase in land degradation, especially through water erosion. Live trees are cut and burned in kilns, mostly the mound type, more rarely the pit type. Trees cut for charcoal burning are thorny and their branches are left on the ground after cutting, making it difficult for animals to move freely and reducing available grazing grounds. Kilns are always covered by grass, which has the added effect of reducing grass cover in rangelands. Wood collection for charcoal burning always occurs as a mixed land use class, in which the land use class is always used as grazing grounds for animals.

Plate 8: Cut trees ready for firing in a charcoal kiln (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 9: Ready charcoal in sacks (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 10: Transporting charcoal in a truck (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

Plate 11: Transporting charcoal on camels (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.5 Sedentary-Pastoralism

Sedentary pastoralism (see Plate 12) occurs around homesteads and settlements, usually consisting of dairy animals, and weak, sick and young animals that cannot walk for long distances. The animals are taken out daily by herders from the village sheds to the communal rangeland. The practice exerts pressure on pasture around settlements. Sedentary pastoralism is practiced in the Lughaya area along the coast.

All other characteristics pertaining to Sedentary Pastoralism are similar to those of Transhumance Pastoralism.

Plate 12: Sedentary pastoralism. Note the village in the centre of the photograph
(*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.6 Hay Production and Grazing

Hay production is common along the alluvial plains, where moisture is retained for longer periods after rains. Hay is harvested and sold in the bigger towns, or consumed locally. Enclosures characterise these hay production centres. They are however illegal, and are a source of conflict within the community.

Harvested hay is poorly stored, as it is exposed to the sun and is easily attacked by termites, for example (see Plate 13). The exposed hay also loses moisture, becoming too dry to suffice as animal feed.

Hay Production as a land use class cannot be mapped on its own, but can be mapped as a mixed unit. These enclosures are scattered within general grazing zones and are difficult to map from satellite images. They were only observed on the ground during the field surveys.

Plate 13: Rural settlement and harvested hay for animal feed
(*Photo by Simon Mumuli Oduori – FAO SWALIM)*

4.3.7 Rural Settlement

Rural settlements are characterised by the presence of several houses together. Notable features include heaps of manure and harvested hay, artificial water bodies such as berkeds and wells, and animal sheds. Other features associated with rural settlements include overgrazed areas and general land degradation (Plate 12). Charcoal-burning sites occur close to rural settlements, wherever there are suitable trees.

4.3.8 Built-Up Areas - Urban Areas and Airport Services

Built-up Areas have a high concentration of buildings and people, forming towns or urban settlements. Notable features include shops, schools, hospitals, roads, offices and other social amenities (see Plate 14). They offer a ready market for charcoal and other farm produce, and trucks loaded with charcoal are a common sight. Towns offer consumer supplies to the rural settlements.

Plate 14: Women selling confectioneries in Borama town (*Photo by Simon Mumuli Oduori – FAO SWALIM)*

As part of the land use characterisation, crop calendars for the rainfed and irrigated agriculture were produced to give a general overview of the production system in relation to seasonality and productive activities. These calendars can be found in Table 2 and 3.

Table 2: Crop Calendar for Rainfed Fields

Crop Type	JILAL (Dry Season)			GU (Long Rains)			HAGAA (Short Rains)			DEYR (Short Rains)		
	January	February	March	April	May	June	July	August	September	October	November	December
Maize												
1st Maize												
2nd Maize												
Sorghum												
Sesame												
1st Sesame												
2nd Sesame												
Water Melon												
1st Cowpea												
2nd Cowpea												
Qat (Miraa in Kiswahili)												
Tomato												
Chilli												
Vegetables												
Vegetables												

The rainfed crops are grown in the long rains of *Gu* and a second crop may be planted immediately after to take advantage of the short rains of *Xagaa* (see Table 2). However, the long period maturing sorghum variety continues to grow into the *Xagaa* rains, maturing after approximately six months. A short period of water stress is experienced by the sorghum immediately after the end of the *Gu* rains but the crop recovers with the onset of the *Xagaa* rains and continues to grow into maturity. Table 2 above shows crop calendars for the different rainfed crops. Qat/miraa is a permanent crop and therefore remains standing in the fields throughout the year.

Table 3: Crop Calendar for Irrigated Fields

Crop Type	JILAL (Dry Season)			GU (Long Rains)			HAGAA (Short Rains)			DEYR (Short Rains)		
	January	February	March	April	May	June	July	August	September	October	November	December
Fruit Trees												
Tomato												
1st Maize												
2nd Maize												
3rd Maize												
Maize												
1st Maize												
2nd Maize												
Sorghum												
Cowpea												
Cowpea												
1st Vegetables												
2nd Vegetables												

Irrigated crops may be grown all year round so long as water is available, as shown in Table 3 above. Fruit trees, which are permanent crops, remain in the fields throughout the year with fruits being harvested whenever they mature.

4.4 Land use map

The resultant map comprised 13 land use classes. A land use map was produced, showing the spatial variability of human activities (Map 1). A summary of land use classes included on Map 1 can be found in Table 5:

Areas of the final land use classes are shown in Table 4 below.

Table 4: The Land Use classes and their hectarage

Land Use Code	Land Use Class	Cover in Hectares	% Cover
TSW	Transhumance Pastoralism/ Sedentary Pastoralism/ Wood Collection	425161	32.858
TS	Transhumance Pastoralism/ Sedentary Pastoralism	306417	23.681
TRW	Transhumance Pastoralism/Rainfed Agriculture /Wood Collection	172202	13.308
RS	Rainfed Agriculture/Sedentary Pastoralism	140225	10.837
TR	Transhumance Pastoralism/Rainfed Agriculture	113496	8.771
S	Sedentary Pastoralism	47519	3.673
TI	Transhumance Pastoralism/Irrigated Orchards	26571	2.054
HR	Hay Production/Rainfed Agriculture	19971	1.543
THWR	Transhumance Pastoralism/Hay Production/Wood Collection/Rainfed Agriculture	19894	1.537
W	River Bed	14583	1.127
U	Urban Area	4825	0.373
RST	Rural Settlement	3019	0.233
A	Airport	42	0.003
Total		**1 293 925**	**100**

Map 1: Land Use in the Study Area

Map 1: Land Use in the Study Area

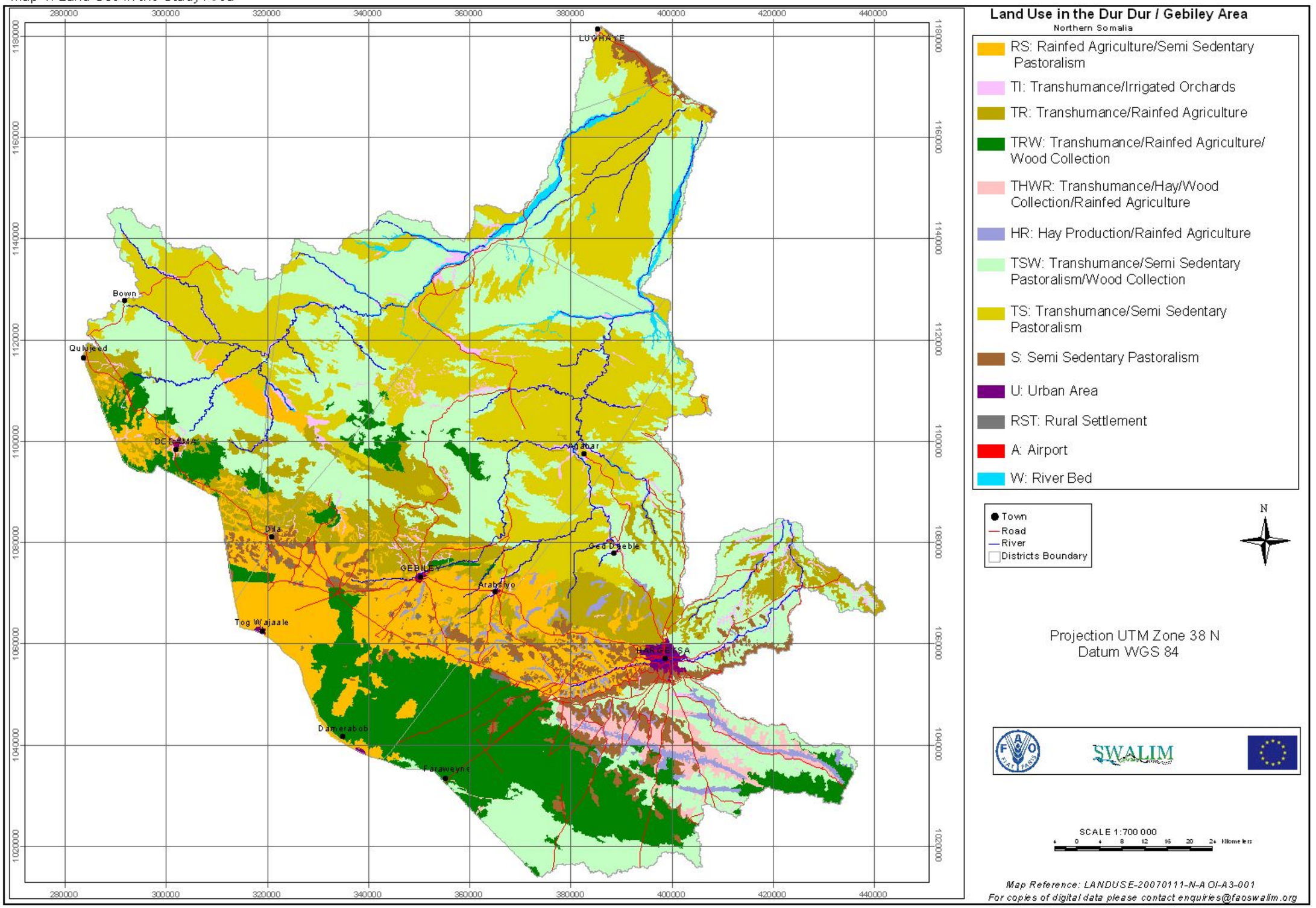


Table 5: Land Use Description Summary for Study Area

Map Unit	Land Use Code	Rainfall (mm)	Agrono. Inputs	Land Improvement	Crops	Mechanization	Cropping pattern	Crop condition	Agronomic aspects	Farm training	Constraints	Opportunities	Type of Animals	Livestock products	Use of livestock products	Livestock health	Forage condition	Enclo-sures	Water source	Charcoal burning Wood collection	Pre-ferred trees	Charcoal negative effects	Vegetative stage of tree cut
1.1	RS	400-500	Low-medium	Bunding Berkeds Check dams Diversion furrows	Maize Sorghum Cowpeas Millet Sesame Qat	Tractor Ox-Plough	Inter-cropping	Bad	Low Yields	Low	Limited cash Pests Soil erosion Drought Poor seed variety Limited farm training	Soil-Water conservation Farm training Migration Pesticides Relief food Water harvesting Improved seeds	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic Market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	-
1.2	TI	100-500	Low-medium	Diversion furrows Shallow wells Dams	Citrus Guava Mango Papaya Vegetables	Tractor Ox-Plough Water Pump	Inter-cropping	Average	Good	Low	Pests, Disease Water shortage Distant markets Poor Roads Infertile soils	Ground water exploitation Financial support Soil-Water conservation Pesticides Manure application Road grading	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic Market	Good in majority Bad in few	Deteriorating	Present	Rain Shallow wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	-
1.3	TR	400-500	Low-medium	Bunding Berkeds Check dams Diversion furrows	Maize Sorghum Cowpeas Millet Sesame Qat	Tractor Ox-Plough	Inter-cropping	Bad	Low Yields	Low	Limited cash Pests Soil erosion Drought Poor seed variety Limited farm training	Soil-Water conservation Farm training Migration Pesticides Relief food Water harvesting Improved seeds	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	-
2.1	TRW	400-500	Low-medium	Bunding Berkeds Check dams Diversion furrows	Maize Sorghum Cowpeas Millet Sesame Qat	Tractor Ox-Plough	Inter-cropping	Bad	Low Yields	Low	Limited cash Pests Soil erosion Drought Poor seed variety Limited farm training	Soil-Water conservation Farm training Migration Pesticides Relief food Water harvesting Improved seeds	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	Observed	Acacia bussei A. etbaica A. nilotica	Range quality decline Land degradation	Live
2.2	THWR	400-500	Low-medium	Bunding Berkeds Check dams Diversion furrows	Maize Sorghum Cowpeas Millet Sesame Qat	Tractor Ox-Plough	Inter-cropping	Bad	Low Yields	Low	Limited cash Pests Soil erosion Drought Poor seed variety Limited farm training	Soil-Water conservation Farm training Migration Pesticides Relief food Water harvesting Improved seeds	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Present	Rain Shallow wells Springs Boreholes Dams	Observed	Acacia bussei A. etbaica A. nilotica	Range quality decline Land degradation	Live
2.3	HR	400-500	Low-medium	Bunding Berkeds Check dams Diversion furrows	Maize Sorghum Cowpeas Millet Sesame Qat	Tractor Ox-Plough	Inter-cropping	Bad	Low Yields	Low	Limited cash Pests Soil erosion Drought Poor seed variety Limited farm training	Soil-Water conservation Farm training Migration Pesticides Relief food Water harvesting Improved seeds	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	
3.1	TSW	100-500	-	-	-	-	-		-	Low	Livestock diseases Water shortage Poor quality pasture Land degradation Drought Low prices Enclosures	Veterinary services Migration Ground water exploitation Soil-Water conservation Controlled grazing Improving well-dam structures	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	Observed	Acacia bussei A. etbaica A. nilotica	Range quality decline Land degradation	Live
3.2	TS	100-500	-	-	-	-	-		-	Low	Livestock diseases Water shortage Poor quality pasture Land degradation Drought Low prices Enclosures	Veterinary services Migration Ground water exploitation Soil-Water conservation Controlled grazing Improving well-dam structure	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	-
3.3	S	100-500	-	-	-	-	-		-	Low	Livestock diseases Water shortage Poor quality pasture Land degradation Drought Low prices Enclosures	Veterinary services Migration Ground water exploitation Soil-Water conservation Controlled grazing Improving well-dam structures	Camels Shoats Cattle Donkey	Milk Meat Skin Ghee	Domestic market	Good in majority Bad in few	Deteriorating	Absent	Rain Shallow Wells Springs Boreholes Dams	None	-	Range quality decline Land degradation	-
4.1	U	100-500	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	--
4.2	RST	100-500	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-
4.3	A	400-500	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-
5.1	W	100-500	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-

Details of the Land Use Codes

RS – Rainfed Agriculture mixed with Semi Sedentary Pastoralism, **TI –** Transhumance Pastoralism mixed with Irrigated Orchards, **TR -** Transhumance Pastoralism mixed with Rainfed Agriculture, **TRW -** Transhumance Pastoralism mixed with Rainfed Agriculture and Wood Collection for Charcoal & Firewood, **THWR -** Transhumance Pastoralism mixed with Hay Production, Wood Collection for Charcoal & Firewood and Rainfed Agriculture
HR - Hay Production mixed with Rainfed Agriculture, **TSW -** Transhumance Pastoralism mixed with Semi Sedentary Pastoralism and Wood Collection for Charcoal & Firewood, **TS -** Transhumance Pastoralism mixed with Semi Sedentary Pastoralism, **S -** Semi Sedentary Pastoralism, **U –** Urban Area, **RST –** Rural Settlement, **A –** Airport, **W –** River Bed

5 DETAILED ASSESSMENT OF LAND USE IN THE STUDY AREA

The following is a detailed assessment of land use in the study area. The classes are treated singly:

5.1 Rainfed Agriculture

Rainfed crop production in Somaliland is characterised by prolonged periods of moisture stress. To conserve the little moisture retained in the soil after rain, farmers employ water harvesting techniques. However, the water harvesting structures that characterise rainfed agriculture in the study area are poorly constructed. Soil bunds are badly designed and constructed, without stabilisation of soils - soil is just loosely heaped to form the bunds, which are unable to withstand rainfall and are washed away, ultimately forming gulleys which, if unchecked, result in badlands. Stabilisation of soil bunds may be accomplished by vegetating them with grass.

The selection of crops grown by the farmers requires review. The sorghum variety utilised has a long growing period, and further research could develop quick-growing varieties, that mature within the short rainy periods. The current maize variety should also be one that is suited to dryland agriculture. Planting should be done at the right time of year, without delays. Field experience obtained during the surveys showed that some farmers are late in planting crops, making it harder for crops to mature in which case their only use is as animal fodder.

Animal manure is abundant around homesteads but is not put to proper use by farmers, for the that animal manure was formerly tried on fields, but resulted in weed invasions. The reality is that extension systems in this area of study are weak and do not reach farmers, who remain ignorant of proper farm management strategies. Some farmers indicated they have used fresh animal dung as manure.

The farmers require support in order to increase input levels to their farms. Currently, input levels are far below recommended values resulting in the actual yields being far below their potential. Farmers require credit facilities, to be able to purchase pesticides for example.

Last but not least, it is important that soil and water conservation measures be applied in the study area. Gulleys have been formed and, in some cases, rivers have been completely silted because of high levels of soil erosion. Topsoil is lost in this way and recovery may be difficult. Heavy investments will be required to arrest erosion in the area. Again, this is an area where farmers require support through soil and water conservation initiatives.

5.2 Irrigated Orchards

These are found mainly along the river valleys, differing from rainfed agriculture in terms of crops produced and management initiatives employed. Irrigated orchards involve the growing of fruit trees, with citrus, guava, papaya and mango being the most common crops grown. Supplementary water for crop irrigation is obtained from wells, dams and other water bodies. Crops are produced mostly for sale at the market, but some produce is consumed at home.

Long distances to markets coupled with poor state of roads puts farmers in a difficult position when it comes to selling farm produce. Rural access roads are in poor condition and need to be improved.

Seedlings are not of improved varieties, but are locally raised. Field observations indicate that these fruit trees are vulnerable to disease and yield and quality are also poor, resulting in low income for farmers.

Artificial water bodies that supply supplementary water for irrigation have been poorly constructed. Dams are poorly lined, leading to loss of water through seepage. *Berkeds* have a similar problem, many having been abandoned because of this.

Methods of water supply to crops are inefficient, and many farmers use inefficient flooding techniques. Improved techniques could include drip irrigation. In several instances, farmers were found to pump water from shallow wells into their fields by flooding, high temperatures and strong winds notwithstanding.

Most farmers have not received training in farming techniques, resulting in them relying on trial and error. Training on improved construction of water reservoirs and fertiliser application would help increase crop yields.

5.3 Transhumance Pastoralism

Transhumance pastoralism involves rearing of livestock, with animals being moved in a regular pattern associated with availability of water and forage. However, in Somaliland the movement of animals is not controlled. The result is that, unlike as in the times when there were controlled grazing patterns before the breakdown of governance there are no areas where fodder is available during the dry season.

Some pastoralists practice enclosures and are able to harvest and preserve fodder for the dry season, but at the peril of other land users. Whereas most of these fodder producing areas were used as dry season grazing in the past, following the introduction of enclosures there is insufficient fodder to sustain animals in the dry season. The enclosure system therefore requires more research to establish the most efficient approach to their utilisation. Enclosures also are found in areas which were used to produce crops.

Water sources for animals also include berkeds, dams and shallow wells, already discussed under Irrigated Orchards. In the dry season, animals have to walk for long distances to get to water points, which has the negative effect of weakening them and making them susceptible to diseases. The efficiency of artificial water bodies therefore requires improvement.

Poor livestock health leads to a decrease in yields of animal products, and it is important therefore to control all factors having a negative effect on animal health. Animal diseases, which are common in this area, require the provision of veterinary services.

Land degradation has been cited as one of the most destructive constraints to livestock production in the study area. Land degradation in this area involves soil erosion, resulting in loss of topsoil and consequent reduction in soil production capacity and carrying capacity. Since animal production is a primary source of livelihood in the study area, reduced production capacity as a result of land degradation renders communities vulnerable to food insecurity.

5.4 Wood Collection for Charcoal Production

Charcoal production as a source of livelihood in the study area is practiced against the wishes of many, and done secretly. There are several negative environmental effects associated with charcoal burning, such as reduction of vegetative cover and consequent vulnerability to erosion by water. Exposed soil is trampled on, loosening its structure and forming gulleys when it rains. If not checked, gulleys give rise to unproductive badlands. Loss of topsoil reduces soil fertility, and consequently the vegetative potential of the land. Exposed, loose soil is also very vulnerable to wind erosion.

The burning of charcoal in this area involves selective tree cutting, with *Acacia bussei* being the preferred tree species. In some areas it has been wiped out, while in others it remains threatened. Other tree species threatened due to charcoal burning include *Acacia nilotica* and *Acacia etbaica*. The pruned thorny branches of these cut trees are left lying on the ground after cutting, making it difficult for animals to move freely to find grazing as well as reducing the extent of grazing areas.

5.5 Sedentary Pastoralism

Animals are taken out daily by herders from the village sheds to the communal rangelands, resulting in this land use exerting pressure on the vegetation of this fragile ecosystem. Observations showed that these areas are bare, with sparse vegetation. This has the ultimate effect of exposing the soil, rendering it vulnerable to water and wind erosion.

5.6 Hay Production and Grazing

Some pastoralists practice enclosures and are able to harvest and preserve fodder for the dry season, at the peril of other land users. The result is that, whereas most of these fodder producing grounds were used as dry season grazing in the past, today they do not allow access to fodder to sustain animals during the dry season. Harvested hay is poorly stored, being exposed to the sun and easily attacked by termites. It also loses moisture and becomes too dry for animals to eat. Further training is required on the most suitable hay production techniques, if the activity is to continue. The fact that some of the hay is exported to big towns like Hargeisa begs the question of whether sufficient is left behind to feed livestock in the study area.

5.7 Rural Settlement

Rural Settlements are areas of increased density of human shelter. They include villages and satellite settlements, with either immobile or mobile housing structures. Most rural settlements are not provided with access roads in good condition, and as a result farm produce cannot easily leave these rural settlements, where no proper markets are found, and livestock and crop products cannot easily be sold. Improving accessibility to these rural settlements will enhance trade and ultimately the economy of the communities of the study area.

5.8 Built-Up Areas - Urban Area and Airport Services

Built-up areas consist of towns, urban settlements and associated airports. They are areas of increased human settlement, with an increasing human population constantly demanding products such as charcoal. These urban centres offer ready markets for charcoal and other farm produce such as milk, fruits, vegetables, ghee and grains. Demand for cooking charcoal is always increasing, and alternative cooking techniques could be a solution to this. Interventions such as solar cooking stoves need to be introduced in these urban centres if pressure on live trees for charcoal burning is to be eased. The airport not only promotes national interactions but also international interactions within the urban settlements. Qat/miraa is flown in from Kenya for example, and traders fly in and out of Hargeisa through Hargeisa Airport.

5.9 River Bed

Activities in river beds include small-scale sand harvesting, and shallow wells for water for irrigation, animals and domestic use. Water from shallow wells is sometimes pumped by diesel or petrol pumps.

6. CONCLUSIONS

From Table 4 it can be established that about 60% of the study area is used purely for grazing, and about 40% for crop production. It must be noted that rainfed agriculture is practiced in combination with pastoralism and wood collection. Goats and sheep are grazed mainly on sloping areas, whereas cattle and camels are grazed on flatter areas. This land use class is the economic basis of households in the study area.

Sedentary pastoralism around homesteads is a common practice. Hay harvesting supports this land use, as harvested hay can be used during the dry season. However, hay harvesting may be a source of conflict as enclosures are not welcomed by many. Hay production requires further research to establish its levels of sustainability without being a cause of conflict in the study area.

Rainfed agriculture lies in what is considered as the “sorghum belt” in Somaliland. The activity incorporates many different water harvesting techniques which provide good support for water retention. However, the manner in which water harvesting structures are constructed is inadequate, and results subsequently in severe gully erosion. Several severely eroded areas were located during field visits.

Irrigated orchards are a cash-oriented activity in the area, involving the growing of fruit trees with citrus, guava, papaya and mango being the most common crops grown. Supplementary water for irrigating the crops is obtained from wells, dams and other water bodies. These supplementary water sources are poorly constructed and require interventions to help solve inefficiencies associated with their poor construction. However, the activity requires technical support. Farmers need to be trained in construction techniques of supplementary water sources, for example. More efficient methods of irrigation also need to be introduced. Current irrigation methods are wasteful, and many suitable and promising areas are not irrigated.

Urban centres offer good markets for farm produce, but due to poor access are inaccessible to most farmers. Urban centres are also points of high demand for charcoal. The population in these urban centres exerts pressure on trees, particularly preferred tree species such as *Acacia bussei, A. nilotica* and *A. etbaica.* Interventions to help introduce sustainable sources of cooking energy are important and urgent.

Uncontrolled grazing has led to degradation of vegetation in some cases, with animals trampling and loosening the soil, and leaving the ground devoid of vegetation. This has left the soil vulnerable to various forms of water and wind erosion and has also reduced carrying capacity in the study area. Excessive gullying in many areas is testimony to the problem of land degradation. Controlled grazing is necessary to halt the loss of grazing resources.

Rural settlements have poor access roads, making it difficult for rural folk to access markets to sell their farm and livestock products. It is important to develop relevant infrastructure, which would in turn trigger a progressive rural economy.

A semi-structured questionnaire was used to obtain information about land use in the area under investigation. However, due to time constraints, information obtained by this means was qualitative, and quantitative analysis is desirable. In addition, socioeconomic dimensions were not emphasised in the interviews. Given that a comprehensive land evaluation involves physical and socioeconomic investigations, it is important the socioeconomic aspects of land use should be addressed in future.

In view of the fact that national and regional development objectives and the present land use situation in the area mostly determine which alternative forms of rural land use

are relevant for the land evaluation, information in this report is an important input to planned land evaluation exercises in the areas of interest.

7. BIBLIOGRAPHY

Anderson, J R., Hardy, E.E., Roach, J.T. & Witmer, R.E. 1976. *A Land Use and Land Cover Classification System for use with Remote Sensor Data*. Geological Survey Professional Paper **964**. United States Government Printing Office, Washington.

Besteman, C.. and Cassanelli, L.V. 2000. *The Struggle for Land in Southern Somalia. The War Behind the War*. HAAN, P O Box 607, London SW16 1EB.

Bronsveld, K., van Gils, H., Groten, S., Huizing, H. & van Wijngaarden, W. 1992. *Land Ecology and Land Use Survey*. ITC Lecture Series LS. ITC Enschede, The Netherlands.

Dixon J, Gulliver A and Gibbon D. 2001. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World*. FAO & World Bank, Rome & Washington DC.

Di Gregorio A and Jansen L J M. 2005. *Land Cover Classification System. Classification Concepts and User Manual. Software Version 2*. FAO Rome.

Dent D and Young A. 1980. *Soil Survey and Land Evaluation*. Cambridge University Press.

de Leeuw P N. 1984. Pastoral Production Systems and Land Utilization Types. In: Siderius, W. (ed). *Proceedings on Land Evaluation for Extensive Grazing*. ILRI. Wageningen. 113-119.

European Commission. 2003. *Banana Sector Study for Somalia Strategy for Agricultural Development and Diversification in Lower Shabelle. 2002/34474 Version 1*. European Union Rural and Agriculture Temporary Association.

FAO 1968. *Agricultural and Water Surveys. Somalia Final Report Volume IV, Livestock and Crop Production*. Food and Agriculture Organization of the United Nations, Rome.

FAO. 1983. Guidelines: Land Evaluation for Rainfed Agriculture. *FAO Soils Bulletin **52***. Food and Agriculture Organization of the United Nations, Rome.

FAO. 1985. Guidelines: Land Evaluation for Irrigated Agriculture. *FAO Soils Bulletin* **55**. Food and Agriculture Organization of the United Nations, Rome.

FAO. 1990. *Remote Sensing Applications to Land Resources*. Report of the 14th UN/FAO International Training Course in Cooperation with the Government of Italy. Rome, Italy.

FAO. 1991. Guidelines: Land Evaluation for Extensive Grazing. *FAO Soils Bulletin* **58**. Food and Agriculture Organization of the United Nations, Rome.

GTZ. 1990. *Masterplan for Juba Valley Developmen: Main Report*. Somali Democratic Republic.

Hack, H., McKilligan, F.D. & Ouko. 2002. *Banana Sector Study for Somalia Strategy for Agricultural Development and Diversification in Lower Shabelle*. European Commission

Huizing, H. 1992. *Land Evaluation*. Lecture Notes for the LE Specialization, ITC Enschede, Netherlands.

Kannegieter, Ir. A. 1987. *Land Ecology and Land Use Survey*. ITC Lecture Series N9. Part A. Remote Sensing for Land Ecology and land Use Survey. ITC Enschede, Netherlands.

Ministry of Agriculture. 1983. *North-West Region Agricultural Development Project. Feasibility Study and Technical Assistance. Agricultural Development Programme B-Irrigated Agriculture. Main Report and Annexes*. SOGREAH Consulting Engineers, Grenoble, France.

Mott MacDonald. 1996. *Middle Shabelle Flood Control Study*. Mott MacDonald Group, Cambridge, England.

Shaie, A M. 1997. *Inventory Report Somalia*. FAO Report, Rome Italy.

George, H. & Petri. M. *The Rapid Characterisation and Mapping of Agricultural Land Use: A Methodological Framework Approach for LADA Project*.. FAO Report, Rome Italy.

ANNEXES

Annex 1: Land use data collection form

Annex 2: Interview form coordinates and the deduced Land Use

Annex 1: Land Use data collection form

LAND USE FORM

1. Date……..

2. GPS coordinates:
N……..E……

3. Name of the observer……

4. Local name of the village or any location……..

5. Select the Actual Land Use:

Check	Type of land Use
	Irrigated Agriculture
	Rainfed Agriculture
	Rainfed Fallow Agriculture
	Nomadic Pastoralism
	Transhumance Pastoralism
	Agropastoralism (semi-sedentary grazing)
	Grazing and Wood collection for charcoal and firewood
	Urban area
	Sedentary Pastoralism
	Currently without use

Farming System

1. Land improvement systems, please check the ones present in the unit

Check	Land Improvement
	Drainage
	Berkade
	Borehole
	Wells
	Terracing
	Soil bunding
	Water harvesting
	Other…

2. Can you determine the level of input in the present land use system?

	Input Level
	Low input
	Medium input
	High input

3. Mechanization: ( ) Yes ( ) No

Type……
……

4. Is there any form of Farm management and/or protection observed?

Yes ( ) No ( )

If Yes, give the type:……

Crops

1. Can you indicate the Current crop/s? (you can select and describe more than one)

	Crop Type
	Maize
	Sorghum
	Sesame
	Cowpeas
	Barley
	Vegetables
	Fruits
	Other

2. Is there any intercropping activity? Yes ( ) No ( )

If yes, which crops? ……, ……, …… ……..

3. Can you indicate an average of the Field size corresponding to this unit?

	Average Farm Size
	<2 ha
	2-5 ha
	>5 ha

4. Which is the Purpose of the crop production?

Crop Type	**Crop Use**			
	market	consumption	fodder	Other
Maize				
Sorghum				
Sesame				
Cowpeas				
Barley				
Vegetables				
Fruits				
Other				

5. Can you indicate the actual Phenological stage of the crop?

Crop Type	Crop Phenological Stage				
	start	growing	flowering	fruiting	fallow
Maize					
Sorghum					
Sesame					
Cowpeas					
Barley					
Other					

6. What is the general crop condition at this time?

Crop Type	Crop Condition		
	Crop Failure	Poor Crop	Good Crop
Maize			
Sorghum			
Sesame			
Cowpeas			
Barley			
Other			

7. In case of crop failure or poor crop, which is the principal limitation?

Climate conditions……
……
……
……

Water availability……..
……
……

Soil related factors……...
……
……

Agronomic cultural aspects……
……
……
……....
Other……
……
……

8. Can you explain some principal agronomic aspects?

Actual crop	Hectarage Under Crop	Type of seed	Type of cropping	Use of fertilizers	Manure	Use of pesticides	Labour	Machinery	Aprox.Yield per ha
Maize									
Sorghum									
Sesame									
Cowpeas									
Barley									
Vegetable									
Fruits									
Other									

9. Can you make a general Crop Calendar for this land use system? Give a complete yearly Crop Calendar.

CROP	JILAL			GU			HAGAA			DEYR		
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Maize												
Sorghum												
Sesame												
Cowpeas												
Barley												
Vegetables												
Fruits												
Other												

1	Land preparation
2	Planting
3	Mid-season
4	Harvesting

10. Have you received any Farm Training in the last 5 years? Are there any rural extension services?

11. What are the Major constraints and opportunities from a farmer's perspective (semi structured interview? Analyse the crop history by trying to get information from the land users regarding a historical perspective of the lands in terms of production. How is the current situation and what future improvements are possible). What according to you is the best alternative land use in this area?

Constraints	Opportunities

12. Major constraints and opportunities from a technical point of view (your opinion as technician regarding the negative issues regarding all the aspects and also some feasible solutions).

Constraints	Opportunities

Livestock

1. Which is the type of grazing?

	Type of Grazing
	Nomadic Pastoralism Transhumance Pastoralism Semi-sedentary (Agropastoralism) Other……

2. Which are the species present in the system?

	Type of animal
	Camel Goat Sheep Cattle

3. Can you estimate the number of animals per species?

Species	Aprox. Number
Camel	
Goat	
Sheep	
Cattle	
Other	

4. Can you List the Livestock Products and their use?

Livestock Product	Camel	Goat	Sheep	Cattle	Other	Use for Livestock Product
Meat						
Milk						
Skin						
Ghee						
Cheese						
Other						

5. Can you indicate the general health condition from a physical appearance?

Species	Condition		
	bad	average	good
Camel			
Goat			
Sheep			
Cattle			
Other			

6. If the general condition is down from average to bad, can you explain the principal reasons for it?

7 What, in your opinion, is the quality of the forage for the various animals as listed below? (Tick)

Animal Type	Forage Quality		
	Good	moderate	bad
Camel			
Goat			
Sheep			
Cattle			
Other			

8. Enclosures in the rangeland area.

Presence of enclosures	Purpose of Enclosures (list)	Destination of Produce from enclosures (list)	Do they cause problems? (yes or no) list problems

9. Which is the water source for the livestock?

	Water Source	Season
	Rivers	
	Boreholes	
	Shallow well	
	Other:	

10. What is the distance to the nearest watering point for the animals (in kilometres)?

- In the rainy season?.....
- In the dry season?.....

11. What are the Major constraints and opportunities from a pastoralist's perspective (semi structured interview? Analyse the grazing history by trying to get information from the land users regarding a historical perspective of the lands in terms of livestock production. How is the current situation and what future improvements are possible). What according to you is the best alternative land use in this area?

Constraints	Opportunities

12. Major constraints and opportunities from a technical point of view in regard to livestock production (your opinion as technician regarding the negative issues regarding all the aspects and also some feasible solutions).

Constraints	Opportunities

Wood Collection (firewood and charcoal production)

1. Is the charcoal production a common activity in the area?

Yes……
No……..

2. Is charcoal production leading to rangeland degradation in this area? List the environmental problems associated with charcoal production

a)……..

b)……..

c)……..

3. Is the charcoal production activity selective in species?

Yes / No

If yes, list preferred tree species, starting with most preferred tree species

4. Which type of production method they use?

	Type of Kiln
	Pit/trench kiln
	Mound kiln
	Other

5. **Do they use live or dead trees? (tick)**

Yes / No

6. Can you explain the current situation in terms of land use? (This is a related to a general overview of the influences of this land use in the landscape. Specifically if the charcoal is only in some part of the area or is in the all surroundings. (Stimulate the pastoralists to sketch the extent of the charcoal burning activity)

Annex 2: Interview form coordinates and deduced Land Uses

Id	Date	X	Y	Land Use
1	15.05.2006	345638	1077948	Rainfed Agriculture, Agropastoralism
2	16.05.2006	423372	1070500	Irrigated Agriculture
3	16.05.2006	424604	1071286	Irrigated Agriculture
4	18.05.2006	399351	1067359	Grazing & Wood Collection, Transhumance Pastoralism
5	19.05.2006	409412	1035096	Hay Production and Grazing
6	20.05.2006	409418	1034618	Agropastoralism
7	20.05.2006	408889	1033770	Grazing & Wood Collection, Lime Production
8	21.05.2006	405823	1045415	Hay Production and Grazing/Transhumance
9	21.05.2006	405760	1045743	Rainfed Agriculture
10	23.05.2006	403162	1166137	None
11	23.05.2006	397886	116946	Nomadic Pastoralism/Sedentary pastoralism
12	23.05.2006	295123	1096978	Rainfed Agriculture/Agropastoralism
13	23.05.2006	292980	1098489	Agropastoralism
14	24.05.2006	389611	1177387	Sedentary Pastoralism
15	24.05.2006	288949	1114616	Agropastoralism
16	24.05.2006	299883	1132030	Transhumance Pastoralism
17	24.05.2006	299862	1132461	Irrigated Agriculture
18	24.05.2006	385668	1179306	Transhumance Pastoralism, Sedentary Pastoralism
19	24.05.2006	393211	1175039	Transhumance Pastoralism, Sedentary Pastoralism
20	29.05.2006	371735	1148073	Transhumance Pastoralism
21	30.05.2006	354166	1129322	Nomadic Pastoralism
22	30.05.2006	359357	1137047	Irrigated Agriculture, Transhumance Pastoralism, Urban
23	31.05.2006	349046	1123611	Nomadic Pastoralism, Transhumance Pastoralism
24	31.05.2006	361443	1116472	Nomadic Pastoralism, Transhumance Pastoralism
25	31.05.2006	347733	1125888	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
26	31.05.2006	360196	1117204	Nomadic Pastoralism, Transhumance Pastoralism
27	01.06.2006	351024	1100200	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
28	01.06.2006	349220	1097692	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
29	01.06.2006	356136	1107172	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
30	01.06.2006	359107	1108233	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
31	01.06.2006	353642	1105004	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
32	01.06.2006	366855	1110624	Irrigated Agriculture
33	01.06.2006	366855	1110024	Nomadic Pastoralism, Transhumance Pastoralism
34	04.06.2006	309327	1133992	Nomadic Pastoralism
35	04.06.2006	310743	1133799	Nomadic Pastoralism
36	04.06.2006	306412	1135355	Nomadic Pastoralism, Transhumance Pastoralism
37	04.06.2006	305757	1134928	Nomadic Pastoralism, Transhumance Pastoralism
38	05.06.2006	288138	1116710	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
39	05.06.2006	287339	1116938	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
40	05.06.2006	290260	1111555	Nomadic Pastoralism
41	05.06.2006	288824	1113891	Rainfed Agriculture
42	05.06.2006	284710	1121613	X
43	05.06.2006	282900	1116209	Nomadic Pastoralism, Transhumance Pastoralism
44	05.06.2006	283245	1116868	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
45	05.06.2006	286613	1122320	Nomadic Pastoralism, Transhumance Pastoralism
46	05.06.2006	290382	1126641	Nomadic Pastoralism, Transhumance Pastoralism
47	06.06.2006			Rainfed Agriculture/Agropastoralism
48	06.06.2006	X	X	X
49	06.06.2006	289608	1102140	Agropastoralism
50	06.06.2006	293361	1199877	Agropastoralism
51	06.06.2006	X	X	Nomadic Pastoralism
52	06.06.2006	X	X	Nomadic Pastoralism
53	06.06.2006	292978	1106281	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
54	06.06.2006	292254	1105517	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
55	06.06.2006	292214	1106827	Rainfed Agriculture/Agropastoralism, Transhumance Pastoralism
56	06.06.2006	291652	1109050	Nomadic Pastoralism/Sedentary pastoralism, Wood Collection
57	06.06.2006	290081	1110905	Rainfed Agriculture

58	06.06.2006	290884	1109229	Nomadic Pastoralism/Sedentary pastoralism, Wood Collection
59	07.06.2006	298693	1097223	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
60	07.06.2006	300390	1095066	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
61	07.06.2006	300346	1094321	Rainfed Fallow, Nomadic Pastoralism, Transhumance, Wood Collection
62	07.06.2006	301162	1093423	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
63	07.06.2006	298452	1095668	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
64	07.06.2006	292627	1101792	Agropastoralism
65	08.06.2006	311240	1092256	Agropastoralism
66	08.06.2006	307689	1090498	Agropastoralism
67	10.06.2006	318286	1109295	Irrigated Agriculture
68	10.06.2006	318313	1099898	Irrigated Agriculture, Transhumance Pastoralism, Nomadic Pastoralism
69	10.06.2006	305572	1117255	Irrigated Agriculture, Transhumance Pastoralism, Wood Collection
70	10.06.2006	318022	1108384	Agropastoralism
71	10.06.2006	X	X	Rainfed Agriculture
72	10.06.2006	315196	1100956	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
73	10.06.2006	316411	1101183	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
74	11.06.2006	328446	1101847	Rainfed Agriculture
75	11.06.2006	334679	1096650	Nomadic Pastoralism
76	11.06.2006	344277	1094676	Irrigated Agriculture, Transhumance Pastoralism, Wood Collection
77	11.06.2006	338137	1096036	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
78	11.06.2006	335907	1094996	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
79	11.06.2006	340953	1096283	Transhumance Pastoralism, Grazing Wood Collection
80	12.06.2006	322789	1106095	Irrigated Agriculture, Rainfed Fallow Agriculture, Agropastoralism
81	12.06.2006	306050	1125383	Irrigated Agriculture
82	13.06.2006	327368	1086757	Rainfed Agriculture/Agropastoralism
83	13.06.2006	328817	1088116	Agropastoralism
84	13.06.2006	X	X	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
85	13.06.2006	316327	1091176	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
86	13.06.2006	310840	1088399	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
87	14.06.2006	335665	1071956	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
88	14.06.2006	325330	1063330	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
89	14.06.2006	327412	1064284	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
90	14.06.2006	332051	1070102	Urban Area
91	14.06.2006	333963	1072429	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
92	14.06.2006	334934	1071015	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
93	14.06.2006	333164	1084164	Irrigated Agriculture
94	14.06.2006	332137	1080695	Agropastoralism
95	14.06.2006	331870	1077941	Agropastoralism
96	15.06.2006	345141	107847	Agropastoralism
97	15.06.2006	343198	1070096	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
98	15.06.2006	336562	1061278	Rainfed Agriculture, Transhumance Pastoralism, Wood Collection
99	15.06.2006	33027	1062765	Rainfed Agriculture/Agropastoralism, Grazing and Wood Collection
100	15.06.2006	317877	1062104	Urban Area
101	15.06.2006	319788	1063890	Rainfed Agriculture, Rainfed Fallow, Agropastoralism
102	15.06.2006	344276	1086263	Nomadic Pastoralism
103	15.06.2006	343543	1081283	Agropastoralism
104	15.06.2006	343439	1072683	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance
105	18.06.2006	347168	1053619	Rainfed Agriculture, Agropastoralism, Wood Collection
106	19.06.2006	X	X	Rainfed Agriculture
107	20.06.2006	367873	1050614	Irrigated Agriculture, Agropastoralism (semi-sedentary pastoralism)
108	20.06.2006	338390	1039317	Rainfed Agriculture, Agropastoralism, Transhumance, Wood Collection
110	25.06.2006	368316	1067811	Rainfed Agriculture/Agropastoralism
111	27.06.2006	353664	1071686	Rainfed Agriculture, Agropastoralism, Wood Collection
112	27.06.2006	351287	1075334	Agropastoralism (semi-sedentary pastoralism)
113	27.06.2006	375010	1052696	Rainfed Agriculture, Transhumance Pastoralism, Wood Collection
114	28.06.2006	359143	1061443	Transhumance Pastoralism, Grazing Wood Collection
115	28.06.2006	359284	1058561	Rainfed Fallow
116	28.06.2006	357527	1058772	Agropastoralism (semi-sedentary pastoralism), Wood Collection
117	28.06.2006	353673	1062108	Rainfed Fallow, Agropastoralism, Wood Collection
118	28.06.2006	354488	1062479	Rainfed Agriculture, Agropastoralism, Transhumance, Wood Collection
119	29.06.2006	352120	1067451	Rainfed Agriculture, Rainfed Fallow, Agropastoralism

120	29.06.2006	354474	106848	Badland
121	29.06.2006	359777	1054658	Irrigated Agriculture, Agropastoralism
122	29.06.2006	353434	1051355	Rainfed Agriculture/Agropastoralism
123	29.06.2006	386745	1048440	Nomadic Pastoralism/Agropastoralism (Sedentary pastoralism), Wood Collection
124	29.06.2006	385613	1048623	Nomadic Pastoralism, Transhumance Pastoralism, Wood Collection
125	01.07.2006	354550	1047779	Rainfed Agriculture, Nomadic Pastoralism, Wood collection for Charcoal & Firewood
126	02.07.2006	347337	1046318	Agropastoralism (semi-sedentary grazing)
127	02.07.2006	340168	1037625	Rainfed Agriculture/Agropastoralism
128	02.07.2006	359036	1028972	Rainfed Agriculture, Agropastoralism, Wood Collection
129	02.07.2006	351911	1035564	Rainfed Fallow, Nomadic Pastoralism, Transhumance, Wood Collection
130	02.07.2006	360997	1027031	Agropastoralism, Nomadic Pastoralism, Grazing and Wood Collection for Charcoal & Firewood
131	02.07.2006	361600	1031992	Rainfed Agriculture, Nomadic Pastoralism, Wood collection for Charcoal & Firewood
132	02.07.2006	340941	1041484	Nomadic Pastoralism
133	03.07.2006	372239	1030950	Rainfed Agriculture, Agropastoralism
134	03.07.2006	X	X	Transhumance Pastoralism
135	03.07.2006	X	X	Transhumance Pastoralism, Agropastoralism (semi-sedentary grazing)
136	03.07.2006	376315	1040112	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
137	03.07.2006	366845	1040927	Rainfed Agriculture, Agropastoralism, Wood Collection
138	03.07.2006	370662	1040165	Rainfed Agriculture, Agropastoralism, Wood Collection
139	04.07.2006	388413	1029533	Agropastoralism (semi-sedentary grazing)
140	04.07.2006	386121	1025009	Agropastoralism (semi-sedentary grazing)
141	04.07.2006	386748	1015371	Transhumance Pastoralism
142	04.07.2006	389138	1044010	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance, Wood Collection
143	04.07.2006	380830	1033551	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
144	04.07.2006	383996	1036896	Rainfed Agriculture, Agropastoralism
145	05.07.2006	404575	1036601	Agropastoralism (semi-sedentary grazing)
146	05.07.2006	393223	1019284	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
147	05.07.2006	392737	1023854	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
148	05.07.2006	395962	1034945	Agropastoralism, Nomadic Pastoralism, Wood collection for Charcoal & Firewood
149	05.07.2006	394540	1031734	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
150	05.07.2006	400209	1049806	Irrigated Agriculture, Agropastoralism
151	06.07.2006	431870	1073085	Irrigated Agriculture, Transhumance Pastoralism, Wood Collection
152	06.07.2006	429765	1071200	Rainfed Agriculture, Nomadic Pastoralism, Wood collection for Charcoal & Firewood
153	06.07.2006	431224	1071539	Irrigated Agriculture, Agropastoralism
154	06.07.2006	414690	1030862	Agropastoralism, Transhumance Pastoralism
155	09.07.2006	413920	1065366	Transhumance Pastoralism
156	09.07.2006	420342	1067879	Nomadic Pastoralism
157	09.07.2006	418665	1068447	Transhumance Pastoralism, Agropastoralism
158	09.07.2006	427641	1070735	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance, Wood Collection
159	09.07.2006	422936	1071569	Irrigated Agriculture, Agropastoralism, Wood collection for Charcoal & Firewood
160	09.07.2006	420532	1070286	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
161	09.07.2006	420263	1069314	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
162	10.07.2006	415400	1074815	Irrigated Agriculture
163	10.07.2006	415828	1074296	Agropastoralism (semi-sedentary grazing)
164	10.07.2006	413727	1072431	Irrigated Agriculture, Agropastoralism
165	10.07.2006	379628	1051564	Irrigated Agriculture, Agropastoralism
166	10.07.2006	379328	1055114	Rainfed Agriculture, Rainfed Fallow, Agropastoralism, Transhumance, Wood Collection
167	10.07.2006	381908	1054251	Rainfed Agriculture, Agropastoralism, Wood Collection
168	11.07.2006	386558	1080374	Transhumance Pastoralism
169	11.07.2006	389482	1074117	Nomadic Pastoralism (Restricted Grazing Area)
170	11.07.2006	389897	1073715	Transhumance Pastoralism
171	11.07.2006	391164	1071763	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
172	11.07.2006	392474	1071501	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
173	11.07.2006	392864	1070873	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
174	11.07.2006	392433	1069463	Irrigated Agriculture, Agropastoralism
175	12.07.2006	394167	1091630	Irrigated Agriculture, Transhumance Pastoralism
176	12.07.2006	394053	1090678	Irrigated Agriculture
177	12.07.2006	404449	1067723	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
178	12.07.2006	402903	1066858	Rainfed Fallow, Agropastoralism, Transhumance, Wood Collection
179	12.07.2006	399817	1074005	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
180	13.07.2006	394107	1101488	Transhumance Pastoralism

181	13.07.2006	395587	1099048	Transhumance Pastoralism
182	13.07.2006	390469	1087555	Irrigated Agriculture, Agropastoralism
183	13.07.2006	387920	1087591	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
184	13.07.2006	387136	1090088	Nomadic Pastoralism, Wood collection for Charcoal & Firewood
185	14.07.2006	405577	1107070	Transhumance Pastoralism