



Somalia Soil Map

1:250.000 Scale

Preliminary irrigation and crop suitability

DRAFT INTERNAL



Index

1.	<i>INTRODUCTION AND SCOPE OF WORK</i>	4
2.	<i>GENERAL DESCRIPTION OF THE COUNTRY AND GEOGRAPHICAL SETTINGS</i>	5
3.	<i>GEOLOGY, AN OVERVIEW</i>	7
4.	<i>CLIMATE</i>	8
5.	<i>LGP – Length of Growing period</i>	9
6.	<i>VEGETATION AND LAND COVER</i>	11
7.	<i>SOILS</i>	12
8.	<i>PRELIMINARY LAND EVALUATION</i>	101



Acknowledgments

Finishing this first step of the 1:250.000 Somalia Soil Map, first I would like to thank Mr. Ugo Leonardi (Chief Technical Adviser a.i. - FAO Somalia) to having strongly believed in the utility of this map as an important country knowledge improving.

Special thanks to all the FAO-SWALIM staff, particularly to Mr. Mumuli Simon, Mr. Musse Shaie and Mr. Michele Bolognesi for the precious support, suggestions and patience to assist in the laborious preparation and the further steps of this work.

An additional thank to the Florence AICS (Italian Agency for Cooperation and Developments), especially to Mrs Antonella Bigazzi for the courtesy and support to find existing old soil data and maps in the ex IAO immense archives and library.

1. INTRODUCTION AND SCOPE OF WORK

The objective of a soil survey is to map the distribution of the different soil types, describe these types, and interpret the maps in a form that is useful for land management and ecosystem studies.

A soil survey describes the characteristics of the soils in a given area, classifies the soils according to a standard system of taxonomy, plots the boundaries of the soils on a map, stores soil property information in an organized database, and makes predictions about the suitability and limitations of each soil for multiple uses as well as their likely response to management systems. The information collected in a soil survey helps in the development of land use plans and can be used to evaluate and predict the effects of land use on the environment.

The final goal of the Soil map is to give concrete instruments for Land Evaluation to supply decision-makers in charge of land-use planning with reliable information on the state of the territory and namely of its natural resources. This is fundamental for any development activity, as land is now becoming an increasingly scarce resource for mankind. This is due on one hand to the population growth, which increases the human pressure on the environment and on the other hand to misuse and depletion of renewable resources, which lead to a general decrease in the quality and productivity of land. These two leading forces interact in producing their effects (Homer-Dixon, 1999), and the consequences of this scarcity for the mankind calls for a sustainable use of natural and human resources, and an appropriate planning of their exploitation. Planning requires knowing how the land characteristics vary within a certain area, and how this affects the suitability of the territory for a specific land utilization. The purpose of the Land Evaluation is to provide information about these characteristics.

In this phase, a Soil map at 1:250.000 scale was performed. In order to the difficulties to realize a complete soil survey of the whole country, a methodology to assess natural resources using satellite images semiautomatic interpretation was applied, based on some existing field soil data in some part of the country. The final results of this activity is the soil map with definition of different soil typology distribution at different level of fiducial grade relating to different knowledge of the soils on the ground.

So, this map must not be considered as a final “Somalia Soil map” but a dynamic map to improve continuously with and when new soil data will acquired.

The following paragraph will show the mapping methodology and the final results.

2. GENERAL DESCRIPTION OF THE COUNTRY AND GEOGRAPHICAL SETTINGS

Somalia is on the horn of Africa and is bordered by Kenya to the southwest, Ethiopia to the west and Djibouti to the far northwest in the Gulf of Aden. Somalia is officially divided into 6 proposed regional states; Somaliland, Puntland, Galmudug, Jubaland, South West State and Hir-Shabelle. It lies between latitudes 2°S and 12°N, and longitudes 41° and 52°E.

Somalia's total land area is 637,540 km², of which 30% is classified as desert land unsuitable for agricultural production, 45% is covered by rangelands suitable for livestock grazing, 14% is covered by forest or woodland, and the remaining 11% is classified as arable land (Food and Agriculture Organization, 1995).



Fig. 1 – General geography of Somalia

Somalia consists of the eastern border of the Ethiopian plateau, consisting of a series of flat surfaces sloping to the southeast, the natural continuation of the great highlands that rise to the east of the Gall-Danakil tectonic fault. The mountains along the Coast of Aden are an extension of the elevated border forming the interface between the highlands and the Danakil depression, and contain the country's highest elevations which drop down to the sea in steep cliffs.

From the mountainous border, the highlands slope away toward the southeast, merging into the plateaus of Ogaden in Ethiopia and Mijertins regions, which descend to the vast peneplain of Mudug and the coastal plain of Benadir, surrounded by long chains of sand dunes that block the passage of the Webi Shabelle to the ocean. Geologically, these lowlands constitute an ancient substructure of crystalline rocks that, after sinking, were invaded by the sea with deposition of Cenozoic and Recent sediments, which were then overlain by alluvial deposits coming from surface erosion.

Somalia can therefore be divided into two major natural regions: the north, characterized by highly incised highlands sloping toward the ocean; and the south, where the low tablelands fall away to the wide coastal plains.

The far northern part of Somalia consists of hills and low mountains, which reach to about 2,440 meters in height. The northern region is somewhat mountainous, with plateaus reaching between 900 and 2,100 meters. The highest point in the country, Mount Shimbiris, has an elevation of 2,450. To the northeast there is an extremely dry, dissected plateau that reaches a maximum elevation of nearly 2,450 meters.

Physiographically, Somalia is a land of limited contrast. In the north, a maritime plain parallels the Gulf of Aden coast, varying in width from roughly twelve kilometers in the west to as little as two kilometers in the east. Scrub-covered, semiarid, and generally drab, this plain, known as the "guban" or "scrub land", is crossed by broad, shallow watercourses that are beds of dry sand except in the rainy seasons. When the rains arrive, the vegetation, which is a combination of low bushes and grass clumps, is quickly renewed, and for a time the guban provides some grazing for livestock.

Inland from the gulf coast, the plain rises to the steep northward-facing cliffs of the dissected highlands. These form the sharp Karkaar mountain ranges that extend from the northwestern border with Ethiopia eastward to the tip of the Horn of Africa, where they end in sheer cliffs at Caseyr. The general elevation along the crest of these mountains averages about 1,800 meters above sea level south of the port town of Berbera, and eastward from that area it continues at 1,800 to 2,100 meters almost to Caseyr. The country's highest point, Shimbir Berris, which rises up to 2,407 meters, is located near the town of Erigavo. Southward the mountains descend, often in scarped ledges, to an elevated plateau devoid of perennial rivers. This region of broken mountain terrain, shallow plateau valleys, and usually dry watercourses is known to the Somalis as the "Ogo." In the Ogo's especially arid eastern part, the plateau is broken by several isolated mountain ranges, and gradually slopes toward the Indian Ocean and in central Somalia constitutes the Mudug Plain. A major feature of this eastern section is the long and broad Nugaal Valley, with its extensive network of ephemeral seasonal watercourses.

The western part of the Ogo plateau region is crossed by numerous shallow valleys and dry ephemeral watercourses. Annual rainfall is greater than in the east, and there are flat areas of arable land for rainfed cultivations. The western area has permanent wells to which the predominantly nomadic population returns during the dry seasons. The western plateau slopes gently southward and merges into an undulating area known as the Haud, a large surface representing one of the best grazing lands for Somali nomads, despite the lack of appreciable rainfall more than half the year. The value of the Haud are the natural depressions that during periods of rain become temporary lakes and ponds. The Haud zone continues for more than sixty kilometers into Ethiopia, and the vast Somali Plateau, which lies between the northern Somali mountains and the highlands of southeast Ethiopia, extends south and eastward through Ethiopia into central and southwest Somalia.

Southwestern Somalia is characterized by the main country's two permanent rivers, Juba and Shabelle. With their sources in the Ethiopian highlands, these rivers flow approximately to south, cutting wide valleys in the Somali Plateau as it descends toward the sea. The plateau's elevation falls off rapidly in this area. The adjacent coastal zone, which includes the lower reaches of the rivers and extends from the Mudug Plain to the Kenyan border, averages 180 meters above sea level. The Juba River enters the Indian Ocean at Chisimayu (Kismaayo). Although the Shabelle River at one time apparently also reached the sea near Merca, its course is thought to have changed in the past. The Shabelle now turns southwestward near Balcad (about thirty kilometers north of Mogadishu) and runs parallel to the coast for more than eighty-five kilometers. The river is perennial only to a point southwest of Mogadishu; thereafter it consists of swampy areas and dry reaches and is finally lost in the sand east of Jilib, not far from the Juba River. During the flooding seasons, the Shabelle River may fill its bed to a point near Jilib and occasionally may even break through to the Juba River. Favorable rainfall and soil conditions make the entire riverine region a fertile agricultural area.

3. GEOLOGY, AN OVERVIEW

Somalia is underlain principally by Mesozoic and Tertiary marine and continental-margin sedimentary rocks deposited unconformably on Precambrian metamorphic and igneous rocks. Quaternary and Holocene alluvial and eluvial deposits cover much of the southeastern coastal area. The Precambrian rocks are exposed in the northern block-fault mountains and in a broad uplift in the Bur region, along the Indian Ocean in southern Somalia.

The structure of the region is dominated by the apparently fault-controlled, southwest-trending margin of the Indian Ocean; the rifted and block-faulted, east-northeast trending margin of the Gulf of Aden; and the complexly faulted East African Rift on the west. These structures were formed by major crustal plate movements related to formation of the Indian Ocean, Gulf of Aden, and Red Sea during the Miocene. These tectonic features are characterized by normal faulting and isostatic uplift related to regional extension.

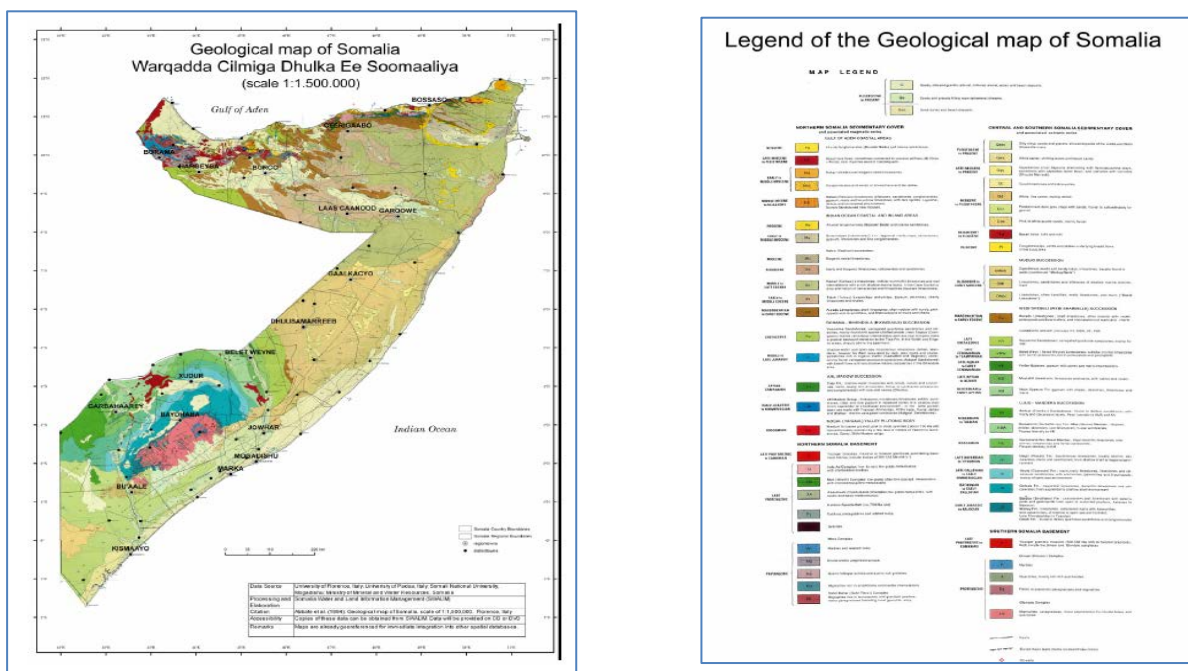


Fig. 2 – Somalia country geology map

4. CLIMATE

The climate of Somalia varies between desert and semi-humid. It is generally influenced by the north and south Inter-tropical Convergence Zone (ITCZ) with alternate movement of northeast monsoon winds blowing from the Arabian coast, southwest monsoon winds blowing from Africa, and south winds from the Indian Ocean

Somalia has two rainy seasons: the Gu (April to June) and the Dayr (October to November). Droughts usually occur every two to three years in the Dayr and every eight to ten years in both the Dayr and the Gu. The coastal region in the south around Mogadishu and Kismaayo has an additional rainy season, the Xagaaye (July to August), in which isolated rain showers may occur. In the northeast, annual rainfall is less than 100 mm; in the central plateaus, it is about 200 to 300 mm. The north-western and southwestern parts of the nation, however, receive considerably more rain, with an average of 510 to 610 mm falling per year (Kammer 1989). Although the coastal regions are hot and humid throughout the year, the hinterland is typically dry and hot. The climate of Somalia varies between desert and semi-humid. It is generally influenced by the north and south Inter-tropical Convergence Zone (ITCZ) with alternate movement of northeast monsoon winds blowing from the Arabian coast, southwest monsoon winds blowing from Africa, and south winds from the Indian Ocean

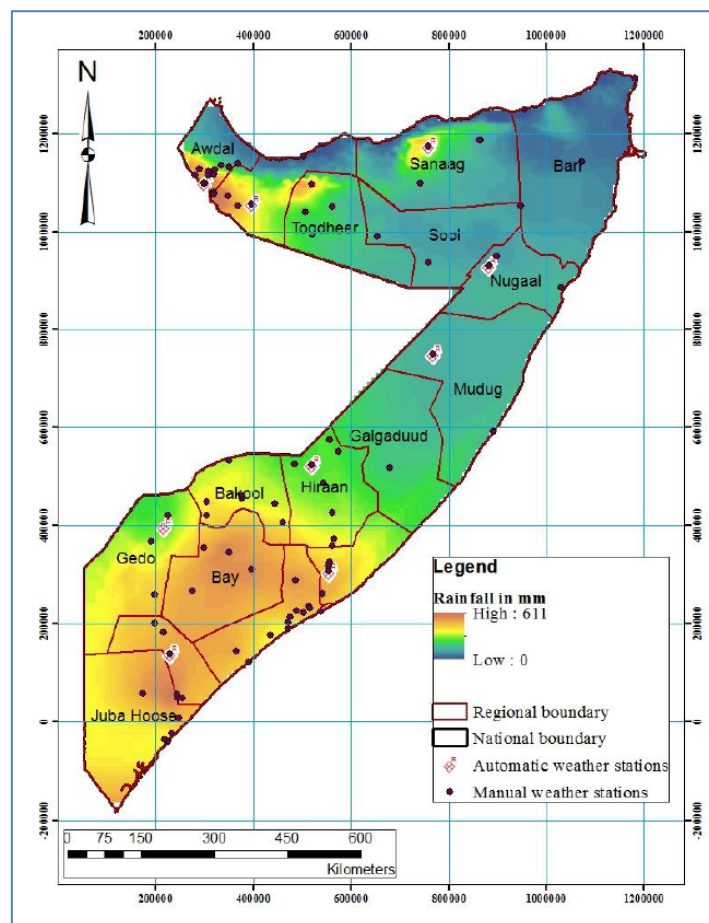


Fig. 2 – mean annual rainfall 1960-1990 in mm (Boitt, Langat, Kapoi – 2018)

Mean daily maximum temperatures range from 30 to 40 °C except at higher elevations along the eastern seaboard, where the effects of a cold offshore current can be felt. In Mogadishu, for instance, average

afternoon highs range from 28 to 32 °C in April. Berbera on the north-western coast has an afternoon high that averages more than 38 °C from June through September. Nationally, mean daily minimums usually vary from about 15 to 30 °C. The greatest range in climate occurs in northern Somalia, where temperatures sometimes are more than 45 °C in July on the littoral plains and drop below the freezing point during December in the highlands.

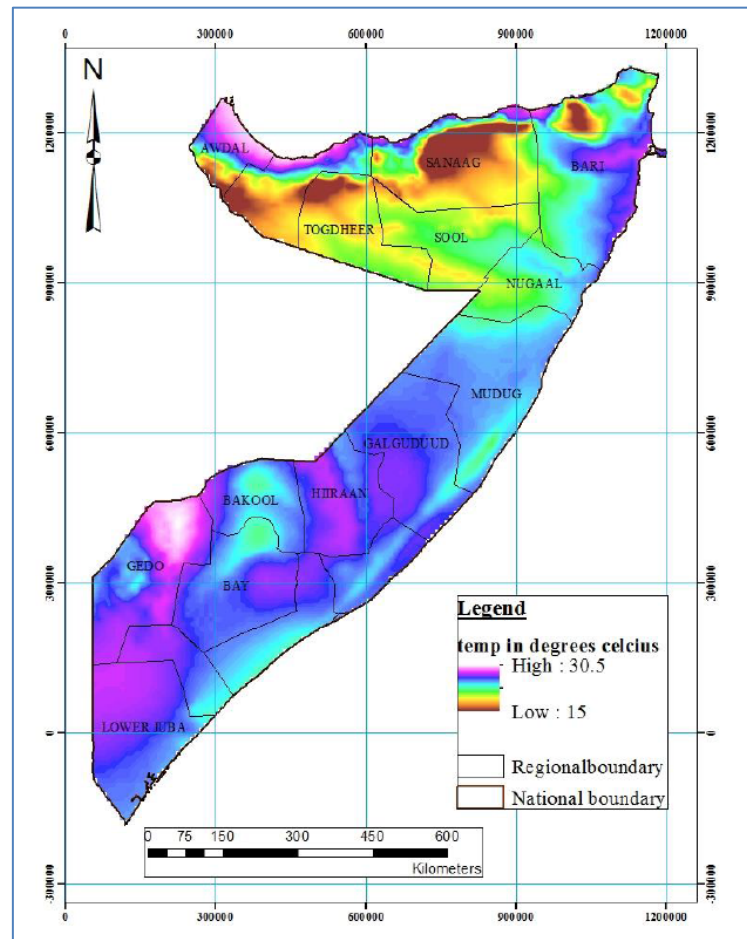


Fig. 3 – Mean annual temperature distribution (Boitt, Langat, Kapoi – 2018)

5. LGP – Length of Growing period

The Length of Growing Period (LGP) is the period (in days) that moisture supply exceeds half potential evapotranspiration² ($P > 0.5PET$). The LGP is calculated over a whole year and may consist of one or more “normal” or “intermediate” Growing Periods (GP), whereby a normal GP is a period in which P exceeds full PET ($P > PET$) and an intermediate GP a period in which P exceeds half PET, but is less than PET $0.5 PET < P < PET$).

Monthly³ rainfall (P) and potential evapotranspiration (PET) data for 49 stations throughout Somalia were derived from the FAO Climatic Database (FAOCLIM, 2001). Data used span the period 1961-1990. More recent data are also available, but they are inconsistent and fragmented and not suitable for a nationwide LGP analysis.

For each station, monthly P/PET and P/0.5PET was calculated and the number and lengths of normal and intermediate growing periods established. A classification of all stations was made, based on the number and length of intermediate4 growing periods and the length of the dry-weather interval in case of a bi-modal rainfall pattern. For stations with a total GP of less than 30 days, a further differentiation was made on the basis of mean annual rainfall and altitude.

Such a differentiation was needed because the LGP characterization does not sufficiently highlight existing rainfall patterns and agricultural potential in some arid areas. In this manner, 15 LGP zones were defined and mapped for the whole of Somalia.

Based on the definition of the 15 LGP zones, an LGP map was prepared. Mapping units (polygons) were identified, using the classification of the 49 stations as a reference and with topographic features as guiding lines.

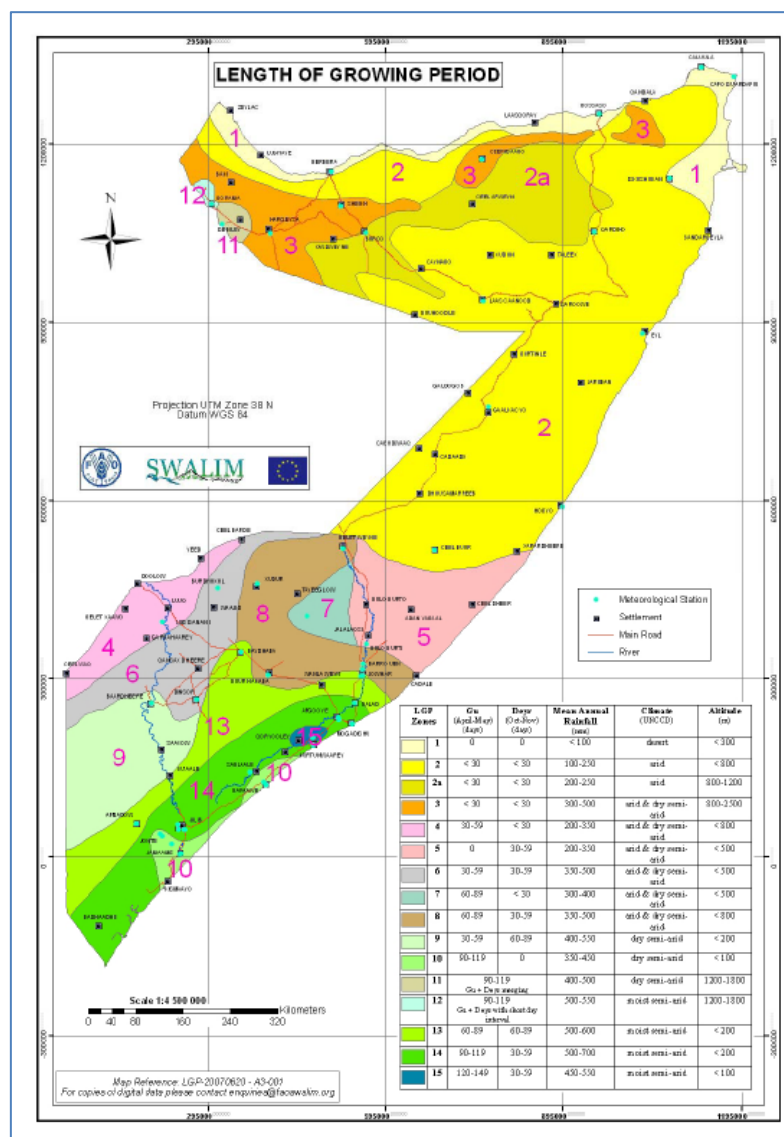


Fig. 4 – Length of Growing period LGP (SWALIM project report L-12)

6. VEGETATION AND LAND COVER

Vegetation in Somalia consists chiefly of coarse grass and stunted thorn and acacia trees. Aromatic flora, producing frankincense and myrrh, are indigenous to the mountain slopes. In southern Somalia, eucalyptus, euphorbia, and mahogany trees are found.

The region encompassing the Shabelle and Jubba rivers is relatively well watered and constitutes the country's most arable zone. The lowland between the rivers supports rich pasturage. It features arid to sub arid savanna, open woodland, and thickets that include frequently abundant underlying grasses. There are areas of grassland, and in the far southwest, near the Kenyan border, some dry evergreen forests are found.

Other vegetation includes plants and grasses found in the swamps into which the Shabelle River empties most of the year and in other large swamps in the course of the lower Jubba River. Mangrove forests are found at points along the coast, particularly from Chisimayu to near the Kenyan border. Uncontrolled exploitation appears to have caused some damage to forests in that area. Other mangrove forests are located near Mogadishu and at a number of places along the north-eastern and northern coasts.

Moreover, other types of land uses include rain-fed agriculture, irrigated agriculture and forestry. Most of the northern part of Somalia is dry and cannot support rain-fed agriculture except for small pockets of land in the areas around Hargeisa, Gediye and Borama. In the rest of the region, sparse rainfall means that agriculture is only possible where there are alternative groundwater sources to support irrigation. This is common within the alluvial plains where shallow wells and permanent springs provide supplementary water for irrigated agriculture.

In the South, rain-fed agriculture is practiced in the Shabelle and Juba river basin. There are two crop growing seasons, coinciding with the Gu and Deyr rain seasons. The crops grown include sorghum, millet, maize, groundnuts, cowpeas, mung beans, sesame, cassava and vegetables. These crops are produced for both human consumption and animal fodder. Crop production is limited by factors such as shallow and stony soil, low soil moisture, rainfall variability, soil erosion and low soil fertility. A number of soil and water conservation measures such as soil bunding, terracing, and water storage (in dams and other reservoirs) are used to conserve soils and water and extend the growing season.

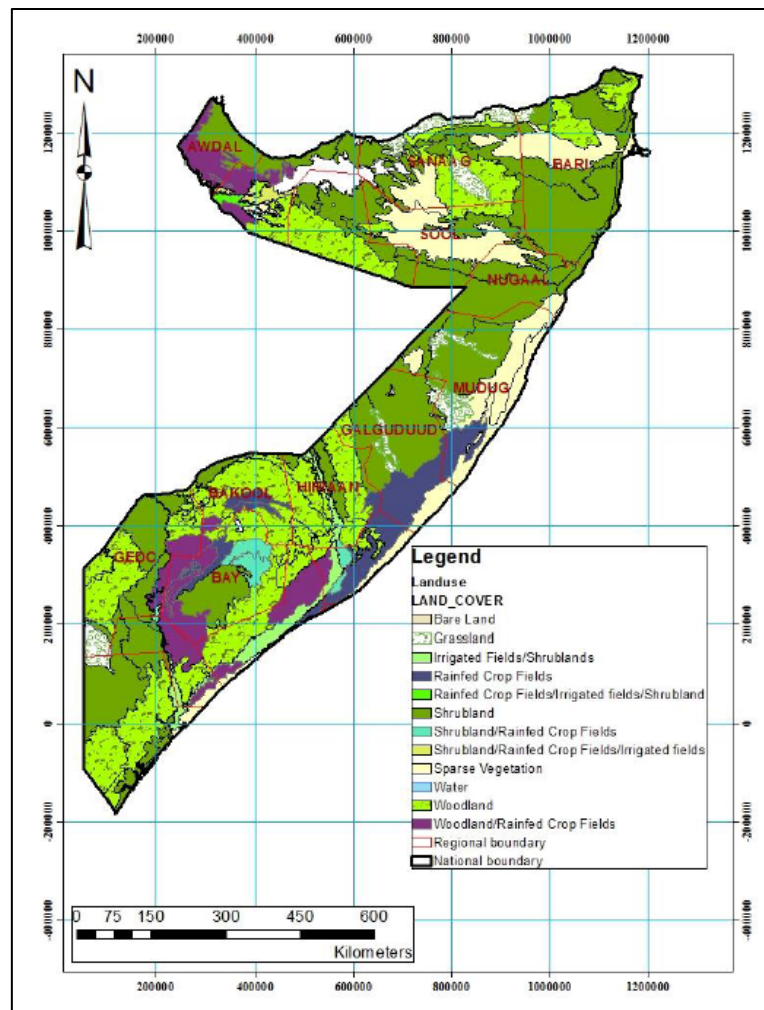


Fig. 5 – Schematic Somalia Land Cover distribution (Boitt, Langat, Kapoi – 2018)

7. SOILS

A fundamental knowledge of soil science is a prerequisite to meeting the many natural resource challenges that will face humanity in the 21st Century. It is also true that the study of soils can be both fascinating and intellectually satisfying. It is in the soils that we are able to observe all of the principles of biology, chemistry, and physics at work. It is the understanding of these principles which enables us to minimize the degradation and destruction of one of our most important natural resources.

Soil is a collection of natural bodies occupying portions of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter, acting upon parent material, as conditioned by relief, over periods of time.

A soil is a three-dimensional natural body in the same sense that a hill, valley, or mountain has three dimensions. By digging or augering a hole in the soil, you may retrieve some soil material, and, you can take this sample of soil material into the laboratory and analyze its contents, but you must go into the field to study a soil as a natural body. Soils occur on landscapes and are delineated on aerial photographs by trained soil scientists. These delineations are called polygons or polypedons, and they represent soil areas

that are similar with regard to the intended uses of that soil. Polypedons have many pedons (soil profiles) included within their boundaries.

It is the interaction of these soil forming factors in various combinations that gives us the great variety of soils we see today. The effects of these soil forming factors (weathering) results in the formation of layers within the soil from the surface down to varying depths depending on the intensity of the weathering. These layers are called horizons. The combination of these layers in a sequence from the surface of the soil down represents a soil profile.

The soil scientist aim is to learn what types of soil were present on the landscape. As they work across the study area, they observe the steepness, length and shape of slopes, the general pattern of drainage, and kind of bedrock. They dug many small holes to study the soil profile, which is the sequence of natural layers, or horizons, in the soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity. The study of the soil profile also revealed the depth to water table in the lower landscape positions and the depths to bedrock and gravelly material, which can restrict plant root growth.

The soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enabled them to identify soils. Also, during the survey some samples of the different soil profiles were collected for laboratory analyses to verify and support their field decisions. After describing the soils in the county or survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits.

The classes are used as a basis for comparison to classify soils systematically. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification adopted in this report is the World Base Resources (WRB/FAO) 2014 edition.

Individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles.

Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kind of soil in an area and to determine the boundaries. After all the map unit delineations have been made. On completion of the soil maps, the field soil survey for the survey area is completed and ready to evaluate the suitability for crops.

For Somalia country, due the present difficulties, time and economic resources to plan a field soil survey in the whole country, a different holistic approach was applied, using existing data and landscape satellite photointerpretation applying guess estimation and extrapolated data, as well explained in the following paragraphs.

7.1 METHODOLOGY APPROACH

The object of Land Evaluation is the land, considered as a whole and not as a simple sum of single environmental components. Therefore, studying and evaluating the land requires considering the complexity of the reality in all its components, which are in turn very complex sub-systems. Since every

component is mutually tied to the others, depending on them and influencing them at the same time, it is necessary to adopt a holistic approach, studying the land as the result of all the inter-relationships which occur between geology, geomorphology, soils, climate, vegetation, hydrology and human activity. The holistic approach allows the identification and subdivision of land in holistic portions, which then can be sampled and described analytically by the traditional disciplines, such as botany, geology, soil science, etc.

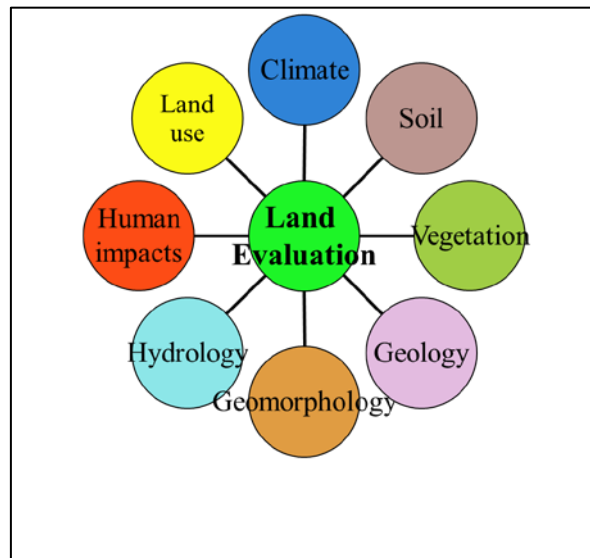


Fig. 6 – Holistic approach schematic methodology

This highlights the need for multidisciplinary integrated surveys. A Land Evaluation campaign requires the surveyors to perform many kinds of analysis and observations, trying to “capture” as much as possible of the situation of all the different environmental components in the area. Inevitably, every surveyor has a specific background, and will be more proficient in a given discipline. Therefore, the coordination between the different components of a team plays a very important role in the success of a survey. The first step of the Land Evaluation process is Land Classification, which is the grouping of similar land elements in a hierarchical subdivision.

To achieve the preliminary land unit classification, a set of updated multispectral satellite images was acquired. A set of Sentinel-2 (from January to February 2020 interval time) images covering integrally the complexes of the project area with a spatial resolution of 10m per pixel has been processed using Near infrared, green and blue spectral band combination) and analyzed using a GIS software. The analysis of the images helps to classify the areas at fourth levels:

- **Soil Region (1:3M scale)**
- **System (1:1M scale)**
- **Subsystems (1:500k scale)**
- **Land Unit (1:250k scale)**

Further based on the photointerpretation, the morphologic and physiographic analysis the homogenous land units are defined. First, a general overview of the study area done based on bibliographic material concerning existing soil surveys, geography, geology, climate, agriculture, vegetation and soil characteristics.

Particularly, in this case a mixed descending and ascending building and interpretation methodology was applied. As shown in the following picture, the descending methodology has used where existing soil data are lacking, starting from morphology, lithology and land use. Homogeneous polygons with same morphology, lithology and land use/cover may have same soils. For large part of Somalia country this methodology was applied.

The ascending methodology has applied where existing soil data was available, in Somalia some 1:50,000/1:100,000 soil maps was available in north and in south part of the country. Of course due the different scale of the final soil map, the details are different, so some existing Land Units at semidetained scale has merged to each one relating to the extensions and soil typology.

The photointerpretation has done mainly with the aid of the following:

- Sentinel-2 satellite images (Jan-Feb 2020) 10m resolution (NIR-GB spectral bands)
- SRTM Digital Elevation model 30x30 and 90x90 m resolution
- “Sm-landform” SWALIM shapefile

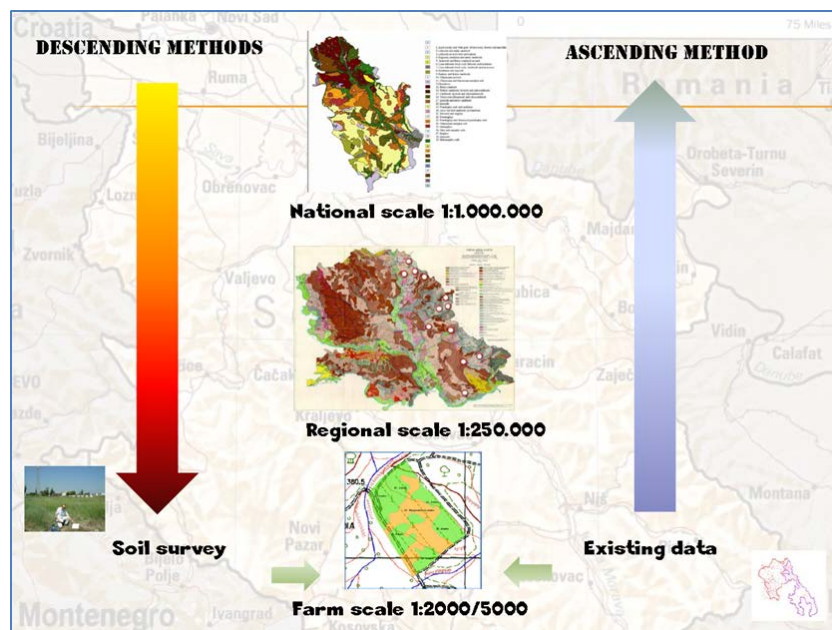


Fig. 7 – Land classification ascending and descending methodology

7.2 EXISTING DATA AND PREVIOUS SOIL STUDIES

Soil knowledge in Somalia are scarce and incomplete, The only areas surveyed in any detail are parts of the alluvial plains of the Juba and Shabelle rivers (mostly irrigation feasibility studies) and the western part of Somaliland (SWALIM).

Soil survey in Somalia was done mainly in the period 1961-1988. The most important reconnaissance soil surveys at semidetained level were done in the Juba and Shabelle region (FAO Lockwood, 1968; Hunting, 1977), and in Somaliland (Sogreah, 1981). Many other studies, without mapping, was conducted in the same period. The knowing soil studies are reported in the following table and picture.

SURVEY	LOCATION	AREA (km ²)	SCALE
ICA (1961)	Lower Juba Valley	4500	1:650,000
Selchozpromexport (1965)	Lower and Middle Juba Valley	16000	1:200,000
FAO/Lockwood (1967)	Project Area	208500	1:60,000
Technital	Juba Valley	50000	1:200,000
HTS (1977)	Project Area	200000	1:500,000
Sogreah (1983)	North-west of Somalia	33500	1:100,000
SWALIM (2007)	North-west Somalia	12915	1:100,000
SWALIM (2007)	Juba and Shabelle	88000	1:100,000

Tab. 1 – List of existing soil maps

SOIL DATA SOURCES
Lockwood Survey Corporation Limited. 1968. Landforms and Soils. Volume III. Agricultural and Water Surveys Somalia. Food and Agriculture Organization of the United Nations.
Hunting Technical Services Ltd. 1977. Inter-catchment agricultural development study. Settlement Development Agency. Somalia.
Selvaradjou, S-K., L. Montanarella, O. Spaargaren and D.Dent.2005. European Digital Archive of Soil Maps (EuDASM): Soil Maps of Africa.E. 1657.
Food and Agriculture Organization of the United Nations, UNESCO.2003.Digital Soil Map of the World and Derived Soil Properties.1.Land and Water Digital Media Series. Rome, Italy.
Food and Agriculture Organization of the United Nations.1998.The Soil and Terrain Database for Northeastern Africa. Crop Production System Zones of the IGAD Subregion.2.Land and Water Digital Media Series. Rome, Italy.
FAO, SWALIM and FSAU. 2005. Dynamic Atlas of Somalia.
Hunting Technical Services Ltd., and Sir MacDonald & Partners Consulting Engineers. 1969. Project for the Water Control and Management of the Shabelle River. Volume V. Soils and Agriculture. United Nations Development Program.
Alim, Musse Shaiye, Soil Classification and Land Suitability Studies in the Lower Shabelle Region, Somalia, in Department of Soil Science. 1987, Swedish University of Agricultural Sciences: Uppsala, Sweden.
Hunting Technical Services Ltd. 1978. Fanoole Settlement Project. Somali Democratic Republic. Settlement Development Agency.
Agnoloni, M., Il terreni dei Devista Diòn irrigui di Genale e Bulu Mesesta (Somalia), in Rel. Mon. Agrarie Subtrop. E Trop. 1968, Istituto Agronomico per L'oltremare.
Ferrari G.A., Lulli L., Moggi G., Shaie M., Elmi M., Moghe M. H.,. 1983. Carta delle unita di territorio alla foce del Giuba in Somalia e la loro capacita d'uso'. Istituto Sper. Studio e Difesa del Suolo.
Ferrari, G.A., Alim, M.S., Karama, A.S., Mohamud, J.M.,.1985.Esempi di cartografia tematica nell'area di Afgooye. Rivista Subtropica e Tropicale.
Sir MacDonald & Partners Limited. 1976. Jowhar Sugar Estate. Drainage and reclamation study. Somali Democratic Republic. Ministry of Industry. Cambridge, UK-Somalia. (Sir MacDonald & Partners Limited, 1976)
Sir MacDonald & Partners Limited. 1978. Genale-Bulu Marerta Project. Annex I. Soils. Somali Democratic Republic, Ministry of Agriculture.
Sir MacDonald & Partners Limited. 1985. Farjano Settlement Project. Land Evaluation.Somali Democratic Republic. National Refugee Commission. United Nations High Commissioner for Refugees.
Hunting Technical Services Ltd. 1979. Homboy Irrigated Settlement Project. Volume I Soils. Somali Democratic Republic. Settlement Development Agency.
Land Resources Development Centre. 1985. Land Use in Tsetse-Affected Areas of Southern Somalia. Somali Democratic Republic. National Tsetse and Trypanosomiasis Control Project. Land Use Survey.
Sir MacDonald & Partners Limited. 1980. Reconnaissance and Pre-Feasibility Studies in Jalalagsie & Jowhar Districts and Gedo Region. Pre- Feasibility Report for Jalalagsie & Jowhar Districts. Somali Democratic Republic. National Refugee Commission.

Sir MacDonald & Partners Limited. 1980. Reconnaissance and Pre-Feasibility Studies in Jalalagsie & Jowhar Districts and Gedo Region. Pre- Feasibility Report for Gedo Region. Somali Democratic Republic. National Refugee Commission.
Sir MacDonald & Partners Limited. 1988. Dara Salaam Busley Agricultural Development Project. Annex 1 Soils. Annex 2 Water Resources. Somali Democratic Republic. Ministry of Agriculture.
Sir MacDonald & Partners Limited. 1979. Mogambo Irrigation Project. Feasibility Study. Main Report and Soils. Somali Democratic Republic. State Planning Commission.
Guido Corni, Somalia Italiana. Capitolo V: Aspetti agrari della vallata dello Scebeli (Redatto a cura del Dott. R. Guidotti).
BELLONI P. - Stato attuale delle conoscenze sui terreni dell'Africa Orientale Italiana.
Analisi di terreni della Somalia. 7 pp. man. Appunti estratti dagli "Annali della SAIS, 1929
1968 – SOCIETA PROBI (Roma) – Missione di studio sulla zona di Alula (Magiurtina) per l'impianto di palme da dattero su una superficie di mille ettari, (maggio-giugno 1967).
CONFORTI E. (Ispettore per l'Agricoltura e Zootecnia, Direzione Sviluppo Economico) - Relazione sulle possibilita agricole del territorio del Nogal e consigliabili forme di intervento.
1930 gen. 15 - N.N. - I terreni della sponda sinistra del Giuba all'analisi chimica.
1967 lug. – NEWTON H. P. – Available phosphorous and potassium. Documento del "Central Agricultural Research Station, Afgoi

Tab. 2 – List of available soil studies in Somalia

At country level exist a general Somalia Soil Map, derived from East Africa Soil Map at 1M scale (1997), were soils are grouped and classified using FAO-WRB classification at principal qualifiers level.

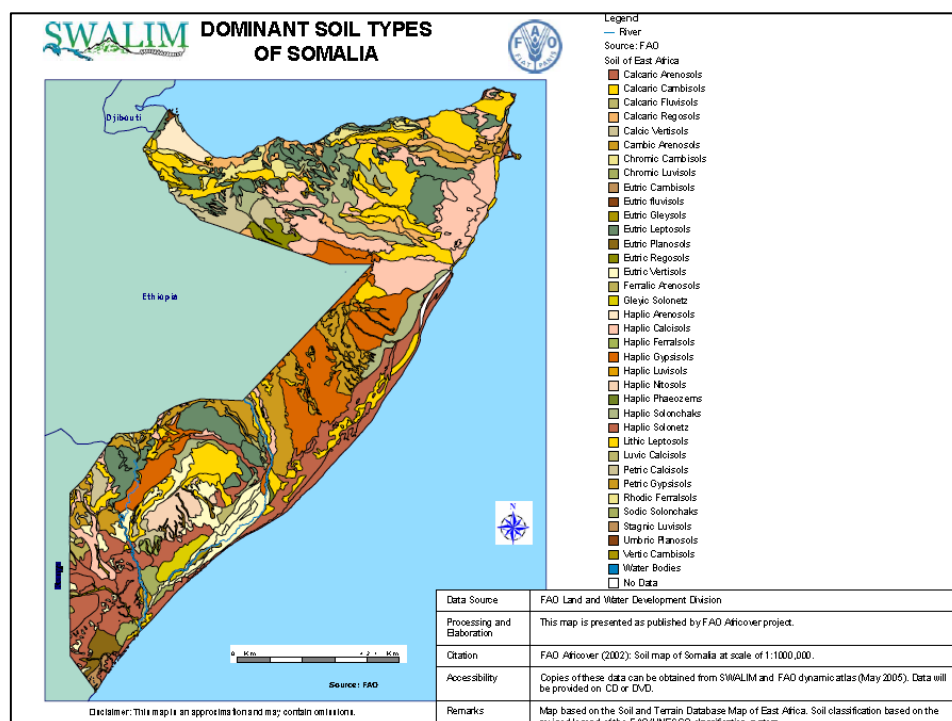


Fig. 8 – Somalia soil map at 1M scale (from Soil of East Africa, 1997)

7.3 SOIL DATA

Soil data are mainly profiles stored by SWALIM in the “Master north-south Soil -Lab Database” which include all existing field and analytical data with some profile pictures.

A revision of the existing database was done during the mapping and suitability elaborations, this because some of profiles was duplicated or show few or lacking soil qualities data. After that, a new database was done.

The total soil observations in the database include 312 profiles, 51 profiles don't have horizons and analytical data, so they are not useful, 261 profiles are almost complete.

The database was organized to perform the further irrigation and soil suitability, so the fields include existing, calculating and lacking soil qualities data, as show in the following table.

Site data		Analytical data	
Profile_N	Number of existing profile	Profile_N	Number of existing profile
Soil_Type	Typical, Representative or correlated	Soil_Type	Typical, Representative or correlated
Fiducial_g	Fiducial level of the information	Fiducial_g	Fiducial level of the information
WRB_Class	WRB 2014 classification	WRB_Class	WRB 2014 classification
X_DD	Dec degrees lat. coord.	X_DD	Dec degrees lat. coord.
Y_DD	Dec. degrees long. coord.	Y_DD	Dec. degrees long. coord
x_utm38	WGS84 UTM38N coord north	x_utm38	WGS84 UTM38N coord north
y_utm38	WGS84 UTM38N coord east	y_utm38	WGS84 UTM38N coord east
Elevation m asl	Calculating from DEM	Horizon	Progressive horizon number
Slope_°	Calculating from DEM	1_Hor_name	Horizon prefix and suffix
Aspect	Calculating from DEM	1_Depth	Horizon lower boundary
WT	Water table depth	1_Sand_°	Sand %
Permeability cm/day	estimation	1_Silt_°	Silt %
Internal drainage	Field estimation	1_Clay_°	Clay %
Rooting depth	estimation	1_Texture	Texture according USDA
Rockiness %	Field estimation	1_Coarse_frag_°	Field estimation
Stoniness %	Field estimation	1_BD g/cm3	Bulk density – Pedotransfer function
AWC mm	Pedotransfer function	1_PH_H2O	Lab data
R_depth	Rooting depth estimation	1_EC_mS_cm	Lab data – mS/m
District	Admin district	1_Exc_Ca	Lab data - meq/100g
Region	Admin region	1_Exc_Mg	Lab data - meq/100g
		1_Exc_Na	Lab data - meq/100g
		1_Exc_K	Lab data - meq/100g
		1_CEC	Lab data - meq/100g – pedotransfer function if not existing
		1_BS_°	calculating
		1_P_ppm	Lab data - ppm
		1_N_°	Lab data - %
		1_OC_°	Lab data - %
		1_OM_°	calculating
		1_CaCO3_°	Lab data - %

		1_CaSO4	Lab data – mg/Kg
		1_ESP_%	calculating

Tab. 3 – Database fields for existing soil profiles data

The final database, comprehensive of 312 profiles for 71 Land Units, is not enough to cover all the Soil map, this will affect the evaluation elaborations, because is possible to obtain a soil suitability map only for the Land Units with complete soil data, as well explained in paragraph 8. An alternative solution is possible (see Suitability paragraph 8).

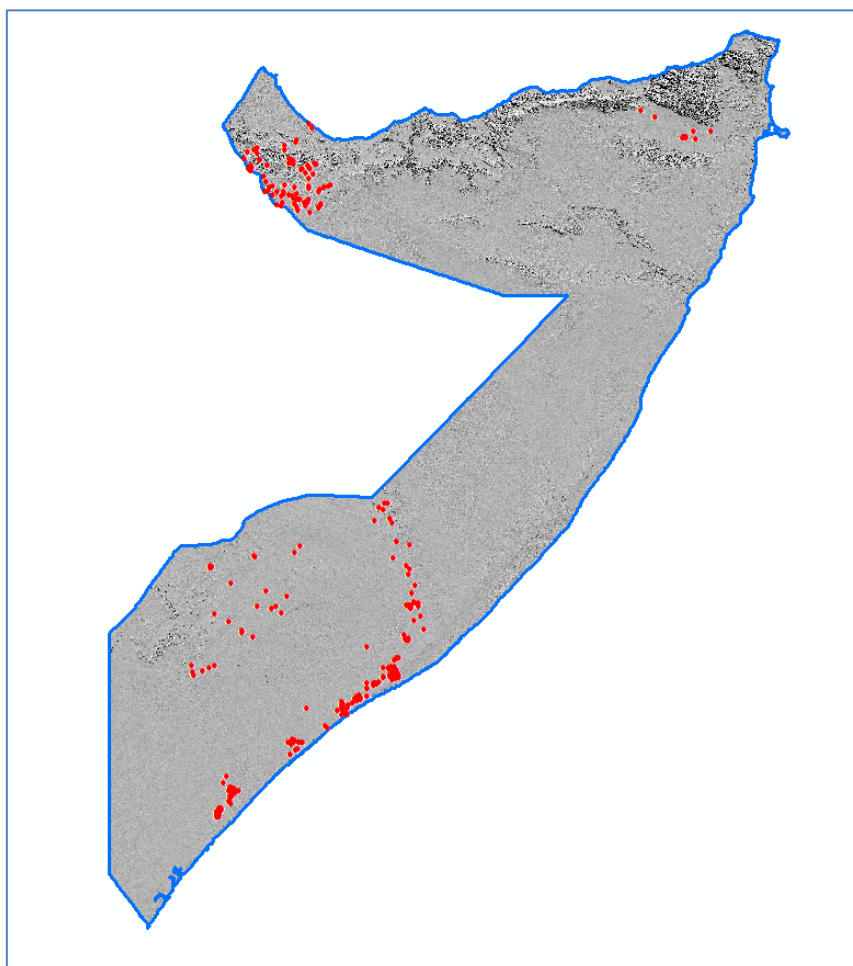


Fig. 9 – Existing soil data (profiles) in Somalia country

7.4 LAND UNIT MAP

As explained, the soil map was building done using monitor photointerpretation and semiautomatic classification using the following data:

- a. - Sentinel-2 multispectral satellite images (Jan-Feb 2020) 10m resolution (NIR-GB spectral bands)
- b. - SRTM DEM 30x30 and 90x90 m resolution
- c. - “Sm-landform” SWALIM shapefile
- d. - SWALIM Soil survey Juba and Shebelle 100k scale

- e. - SWALIM soil survey of selected study area in Somalia 100k scale

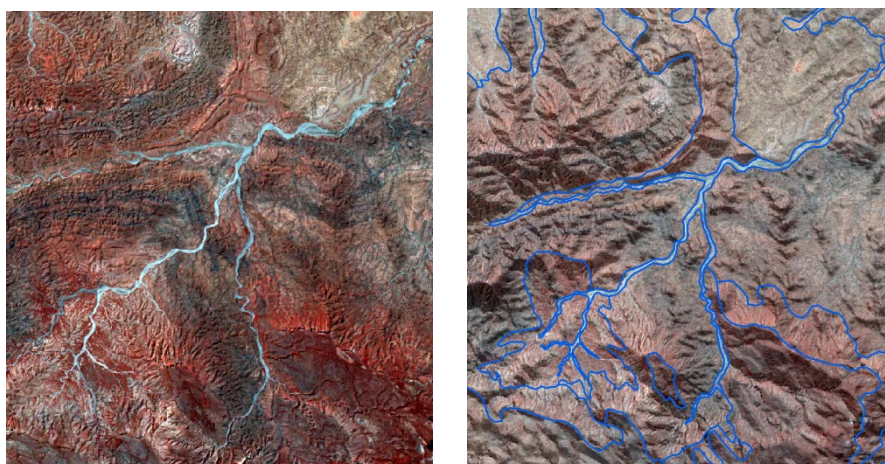


Fig. 10 – Example of northern mountainous area before and after photointerpretation using Sentinel2-multispectral images and digital elevation model

The Land Unit Classification consist in grouping of similar land elements in a hierarchical subdivision: Lithology, morphology, land cover and soils. This subdivision was made at different levels, with different details to define the following 4 levels:

- Soil Region (3M scale)
- System (1M scale)
- Subsystems (500k scale)
- Land Unit (250k scale)

Furthermore, the legend is organized in 4 different sections:

- 1st section: **Landscape** - In this section landscape parameters are described at fourth detail levels

Soil region	Landscape		
	Geographic System	Landform subsystem	Land Unit
A – North-western plateau on basalt and sandstone substrate with dominant <u>Leptosols</u>	A1 - Upper plateau on basalt substrate	A11 - Tabular plateau	Flat or gently <u>undulated</u> surfaces on bedrock with shallow engraving, with escarpment boundary to the lower plateau. Diffuse <u>Palaeodrainage</u> drainage traces. Slope absent to low. Dominant bare soils and rock outcrop

- 2nd section - **Soil** – Include the progressive number of the Land Unit, name, Landscape and profile pictures (if exist), the pedon(s) number, soil description and Soil Classification using WRB 2014.

Soils				
Land Unit			Soil description	Soil Classification
N.	Name Landscape and profile	Pedon		WRB 2014 (Tentative)
1	ISS1	No field data	No soil (estimated)	Rock outcrop

- 3rd section – **Interpretations** – In this section are reported the suitability and capability elaboration results

<i>Interpretations</i>		
Drip irrigation suitability	Surface and sprinkler irrigation suitability	Crop suitability
N2	N2	N2

For legend soil description the soil qualities has grouped in classes, as shown in the following table:

Soil depth		Coarse fragments	
<i>Classes</i>	<i>Values</i>	<i>Classes</i>	<i>values</i>
Very shallow	< 25 cm	None	< 1%
Shallow	25-50 cm	weak	1 - 5 %
Moderately deep	50-100 cm	Common	5 – 15 %
Deep	> 100 cm	Many	15 – 35 %
Soil rooting depth		Abundant	35 – 60 %
<i>Classes</i>	<i>values</i>	Very abundant	> 60%
Very shallow	< 25 cm	Lime	
shallow	25 – 50 cm	<i>Classes</i>	<i>values</i>
Moderately deep	50 – 100 cm	Not calcareous	< 0,5 %
Deep	100 – 150 cm	Very weakly calcareous	0,5 – 1 %
Very deep	> 150 cm	Weakly calcareous	1 – 5 %
Reaction (pH)		Moderately calcareous	5 – 10 %
<i>Classes</i>	<i>values</i>	Calcareous	10 – 20 %
Ultraacid	< 3,5	Very calcareous	> 20 %
Extremely acid	3,5 – 4,4	Stoniness	
Very highly acid	4,4 – 5,1	<i>Classes</i>	<i>values</i>
Highly acid	5,1 – 5,5	None	0%
Moderately acid	5,6 – 6,0	Weak	0 - 0,1 %
Weakly acid	6,1 – 6,5	Moderate	0,1 – 3 %
neutral	6,6 – 7,3	Common	3 – 15 %
Weakly alkaline	7,4 – 7,8	Many	15 – 50 %
Moderately alkaline	7,9 – 8,4	High	50 – 90 %
Highly alkaline	8,5 – 9,0	Very high	> 90 %
Very highly alkaline	> 9,0	Rockiness	
Available water capacity (AWC)		<i>Classi</i>	<i>limiti</i>
<i>Classi</i>	<i>limiti</i>	None	0%
Very low	0-50 mm	Weakly stony	0 – 2%
low	50-100 mm	Stony	2 – 10 %

Moderate	100-150 mm	Very stony	10 – 25 %
High	150-200 mm	Extremely stony	25 – 50 %
Very high	> 200 mm	Rock outcrop	> 90 %
Permeability (Ksat)		Texture	
Classes	values	Classes	Textural class
Very high	> 100 µm/s	coarse	sandy; sandy loam
High	10 – 100 µm/s	Moderately coarse	Loamy sand
Moderately high	1 – 10 µm/s	medium	Loamy; Silty loam, Silty
Moderately low	0,1 – 1 µm/s	Moderately fine	Sandy clay loam; Clay loam, Silty clay loam
low	0,01 – 0,1 µm/s	Fine	Clay, Sandy clay, Silty clay
Very low	< 0,01 µm/s	Salinity (mS/cm)	
Cation Exchange capacity (CEC)		Classes	values
Classes	values	None	< 2
Very low	< 5 cmol/Kg soil	Low	2-4
Low	5 – 10 cmol/Kg soil	Medium	4-8
medium	10 – 20 cmol/Kg soil	High	8-16
High	> 20 cmol/Kg soil	Very high	> 16
Alkalinity (ESP %)		Gypsum (%)	
Classes	values	Classes	values
None	< 8	None	< 0.3
Weak	8-15	Low	0.3 - 10
High	> 15	Medium	10-25
		High	>25

Drainage classes	Class
Well drained. Water is removed from the soil readily but not rapidly. Internal free water occurrence commonly is deep or very deep; annual duration is not specified. Water is available to plants throughout most of the growing season in humid regions. Wetness does not inhibit growth of roots for significant periods during most growing seasons. The soils are mainly free of the deep to redoximorphic features that are related to wetness.	1
Moderately well drained. Water is removed from the soil somewhat slowly during some periods of the year. Internal free water occurrence commonly is moderately deep and transitory through permanent. The soils are wet for only a short time within the rooting depth during the growing season, but long enough that most mesophytic crops are affected. They commonly have a moderately low or lower saturated hydraulic conductivity in a layer within the upper 1 m, periodically receive high rainfall, or both.	2
Somewhat poorly drained. Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season. The occurrence of internal free water commonly is shallow to moderately deep and transitory to permanent. Wetness markedly restricts the growth of mesophytic crops, unless artificial drainage is provided. The soils commonly have one or more of the following characteristics: low or very low saturated hydraulic conductivity, a high water table, additional water from seepage, or nearly continuous rainfall. Somewhat excessively drained. Water is removed from the soil rapidly. Internal free water occurrence commonly is very rare or very deep. The soils are commonly coarse-textured and have high saturated hydraulic conductivity or are very shallow.	3

<p>Poorly drained. Water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods. The occurrence of internal free water is shallow or very shallow and common or persistent. Free water is commonly at or near the surface long enough during the growing season so that most mesophytic crops cannot be grown, unless the soil is artificially drained. The soil, however, is not continuously wet directly below plow-depth. Free water at shallow depth is usually present. This water table is commonly the result of low or very low saturated hydraulic conductivity of nearly continuous rainfall, or of a combination of these.</p>	4
<p>Very poorly drained. Water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season. The occurrence of internal free water is very shallow and persistent or permanent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soils are commonly level or depressed and frequently pounded. If rainfall is high or nearly continuous, slope gradients may be greater</p> <p>Excessively drained. Water is removed very rapidly. The occurrence of internal free water commonly is very rare or very deep. The soils are commonly coarse-textured and have very high hydraulic conductivity or are very shallow.</p>	5

The final Soil Land Unit map include:

- **15 Soil Region**
- **43 Systems**
- **81 Subsystems**
- **318 Land Units**

The different map level are shown in the following pictures:

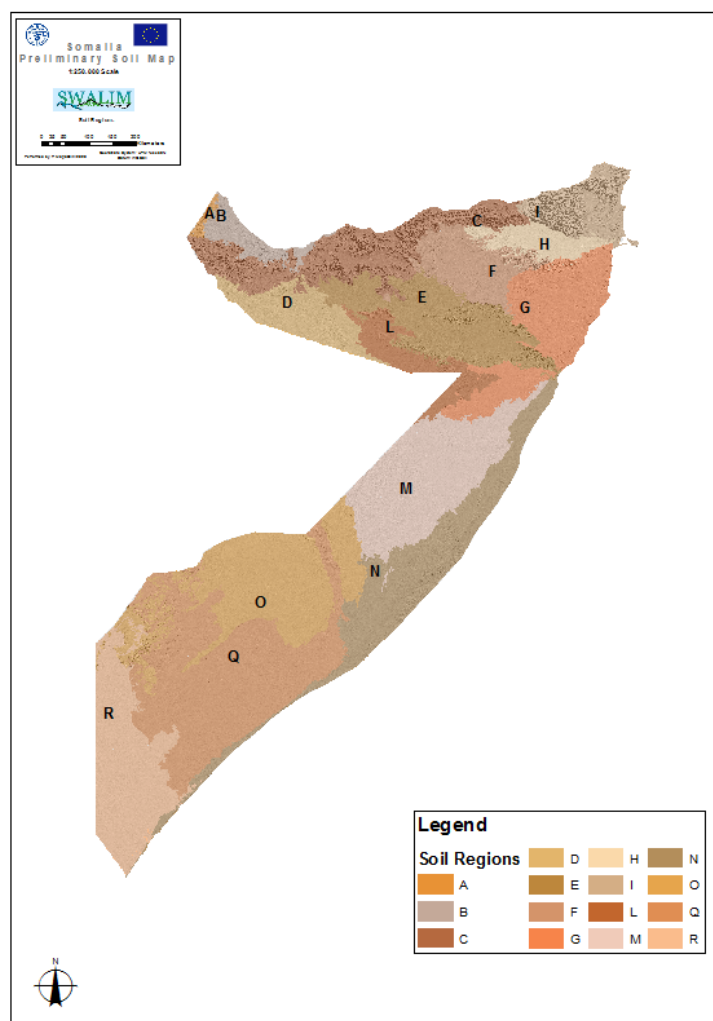
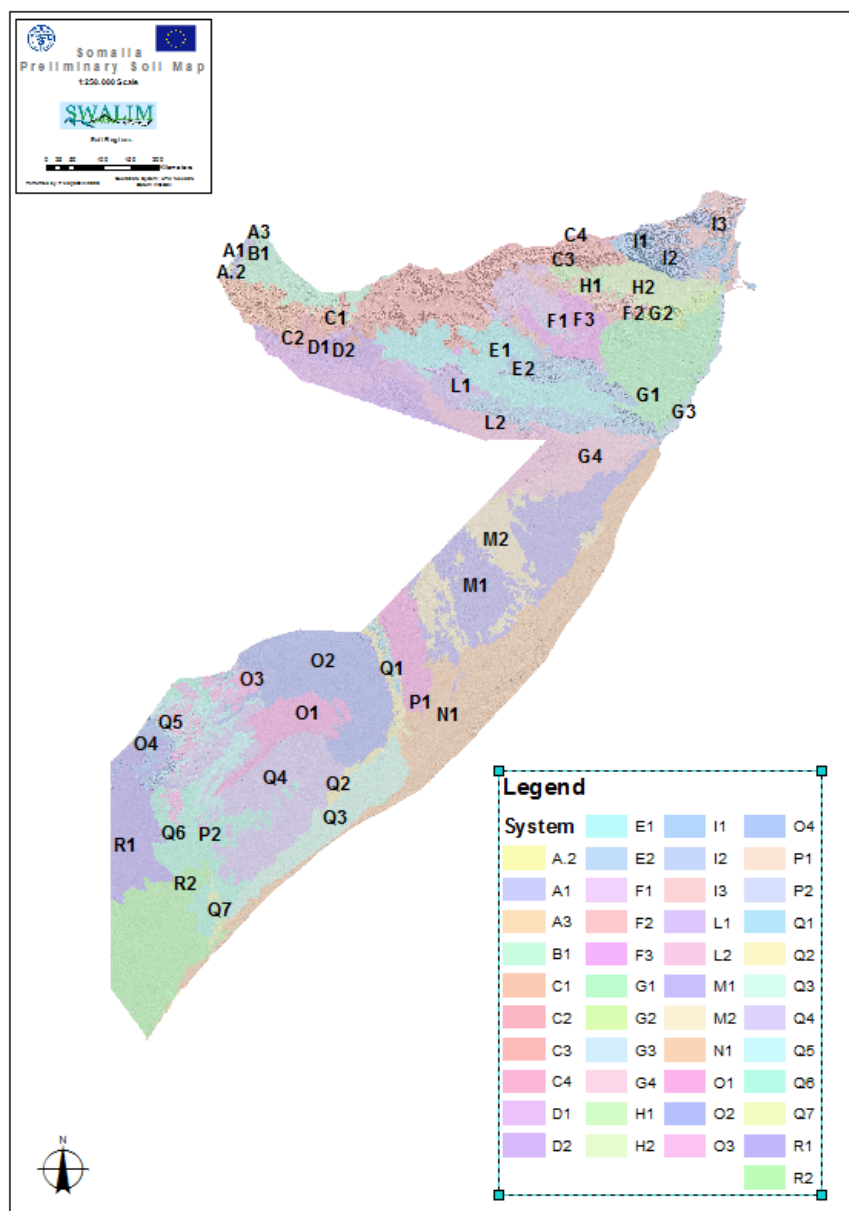


Fig. 11 – Somalia Soil Region map (3M scale)



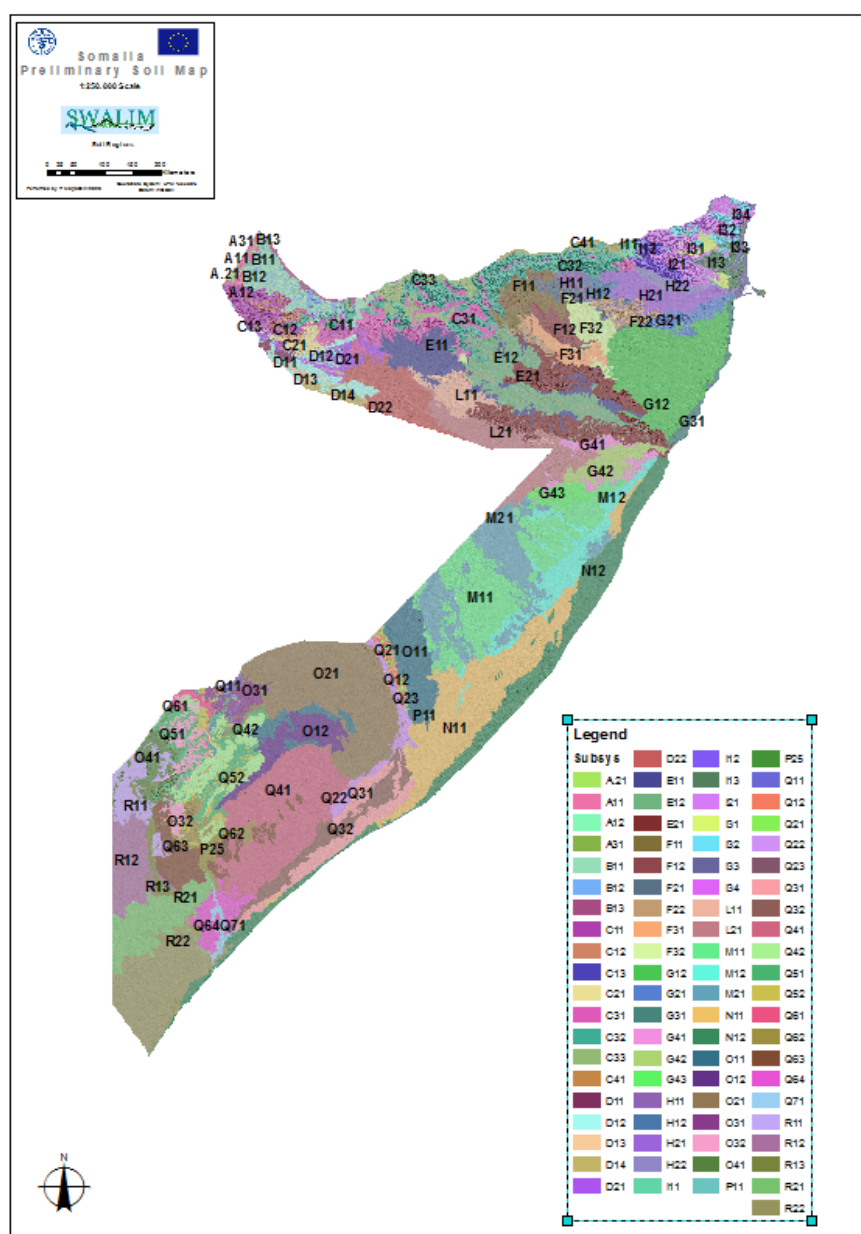


Fig. 13 – Somalia Subsystem map (500k scale)

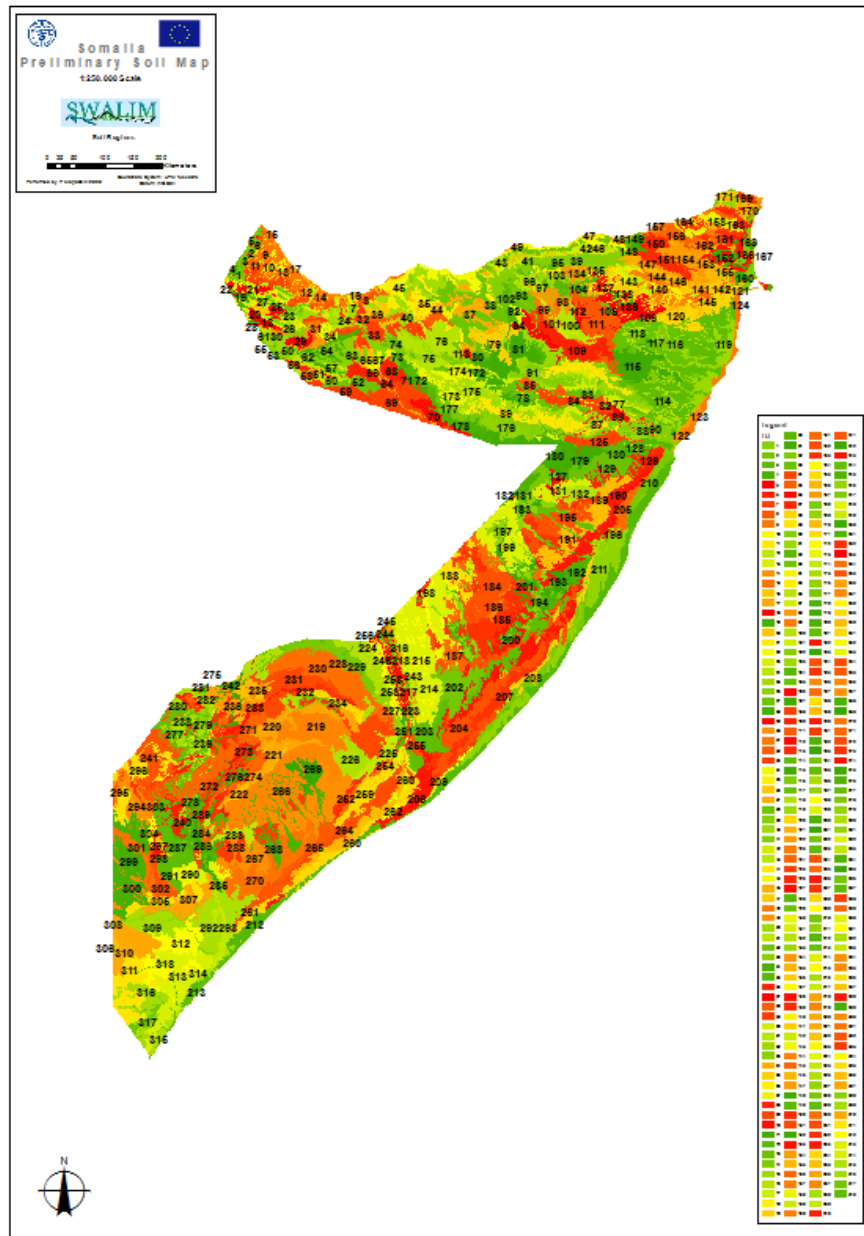


Fig. 14 – Somalia Soil Land Unit Map

The final Soil Land Unit map, in digital format, contain all the information about Land Unit, as in the Legend but, for complete understanding, is preferable to read the map together the Legend, where the description are more exhaustive.

Finally, in Somalia Soil Land Unit map at 250k scale there are **71 Land Units** with complete soil data, **10 Land Units** with not complete soil data and **237 Land Units** completely lacking soil data.

About soil classification, 55 Land Unita are represented with soil consociations, 263 as soil complex.

In soil consociations, delineated areas are dominated by a single soil component. Commonly, at least one-half of the pedons in each delineation are of the same soil taxa as the named soil. The remainder of the

delineation mostly consists of soil so similar to the named soil that major interpretations are not significantly affected.

A soil complex consist of two or more dissimilar major components that occur in a regularly repeating pattern or in an unpredictable pattern. The major components of a complex cannot be mapped separately at semidetailed scale. Typically, each major component occurs in each delineation, although the proportions may vary appreciably from one delineation to another. The major components are sufficiently different from each other in morphology or behavior that the map unit cannot be a consociation.

About soil distribution at Group level, the more represented soils in Somalia, at the present knowledge level, are Calcisols (15,165,414 ha) followed by Leptosols (11,628,125 ha), Vertisols (8,161,654 ha) and Gypsisols (8,042,030 ha).

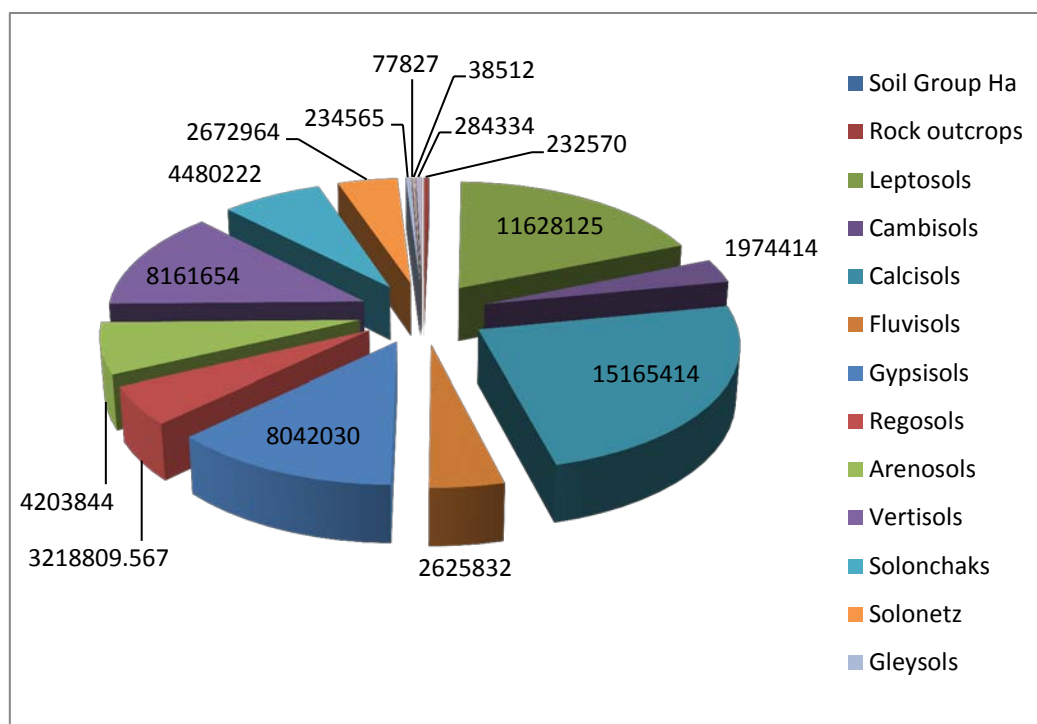


Fig. 15 – Distribution of the major Soil Groups in Somalia

The complete list of the dominant Soil Groups and Principal Qualifies, with surface extension in ha, can be found in the following table (WRB 2014 classification).

Soil Group	Principal qualifier	Surface ha
Rock outcrops		232,570
Leptosols	Eutric	2,594,265
Leptosols	Haplic	104,600
Leptosols	Hyperskeletic	3,274,398
Leptosols	Skeletic	1,075,413
Leptosols	Lithic	4,497,287
Leptosols	Nudilithic	82,162
Cambisols	Haplic	64,274
Cambisols	Arenic	674,000
Cambisols	Calcaric	812,752
Cambisols	Chromic	225,884

Cambisols	Ferralic	61,397
Cambisols	Luvic	107,943
Cambisols		28,164
Calcisols	Epileptic	2,233,745
Calcisols	Endoleptic	147,920
Calcisols	Haplic	8,136,854
Calcisols	Endopetric	390,554
Calcisols	Endosalic	149,941
Calcisols	Fluvic	554,439
Calcisols	Gypsic	1,859,874
Calcisols	Hyposodic	251,358
Calcisols	Luvic	318,974
Calcisols	Petric	584,940
Calcisols	Skeletal	157,899
Calcisols	Sodic	10,844
Calcisols	Vertic	368,072
Fluvisols	Haplic	389,603
Fluvisols	Arenic	6,745
Fluvisols	Calcaric	876,280
Fluvisols	Calcic	1,067,975
Fluvisols	Gleyic	5,147
Fluvisols	Stagnic	273,936
Fluvisols	Skeletal	6,146
Gypsisols	Haplic	2,208,075
Gypsisols	Arenic	34,821
Gypsisols	Calcaric	75,548
Gypsisols	Calcic	2,465,566
Gypsisols	Fluvic	68,658
Gypsisols	Leptic	817,761
Gypsisols	Lithic	303,917
Gypsisols	Petric	2,067,684
Regosols		9,759
Regosols	Epileptic	1,218,164
Regosols	Haplic	756,202
Regosols	Arenic	302,567
Regosols	Calcaric	189,120
Regosols	Calcic	31,893
Regosols	Eutric	394,126
Regosols	Gypsic	155,798
Regosols	Salic	390,832
Regosols	Skeletal	72,613
Arenosols		13130
Arenosols	Haplic	428,427
Arenosols	Calcaric	463,850
Arenosols	Ferralic	1,560,204
Arenosols	Gleyic	156,288
Arenosols	Luvic	177,531
Arenosols	Protic	386,037
Arenosols	Rubic	915,740
Arenosols	Sodic	51,780

Arenosols	Tidalic	50,857
Vertisols	Haplic	755,376
Vertisols	Eutric	963,696
Vertisols	Calcic	1,721,459
Vertisols	Grumic	2,379,941
Vertisols	Salic	788,711
Vertisols	Stagnic	1,552,471
Solonchaks	Haplic	3,670,450
Solonchaks	Endogleyic	130,483
Solonchaks	Gleyic	169,274
Solonchaks	Gypsic	510,015
Solonetz	Haplic	2,173,937
Solonetz	Salic	499,027
Gleysols	Eutric	49,204
Gleysols	Fluvic	129,795
Gleysols	Tidalic	55,566
Planosols	Eutric	77,827
Luvisols	Haplic	38,512
Ferralsols	Haplic	284,334

Tab. 4 – Dominant Soil groups and Principal Qualifiers in Somalia


In the following pages the complete Legend of the Soil land Unit map is reported.










Somalia 250k Land Unit Map
Final legend - December 2020
Scale 1:250.000





Dr. Piero Magazzini
Soil Scientist, ICRISAT
Mobile: +39 3482294659
Office: +39 085260017
Email:
p.magazzini@icrisat.it
p.magazzini@libero.it
p.magazzini@icrisat.it
p.magazzini@icrisat.it



Soil region	Landscape			Soils					Interpretations		
	Geographic System	Landform subsystem	Land Unit	Land Unit			Soil description	Soil Classification WRB 2014 (Tentative)	Drip irrigation suitability	Surface and sprinkler irrigation suitability	Crop suitability
				N.	Name Landscape and profile	Pedon					
A – North-western plateau on basalt and sandstone substrate with dominant Leptosols	A1 - Upper plateau on basalt substrate	A11 - Tabular plateau	Flat or gently undulated surfaces on bedrock with shallow engraving, with escarpment boundary to the lower plateau. Diffuse Palaeodrainage drainage traces. Slope absent to low. Dominant bare soils and rock outcrop	1	ISS1	No field data	No soil (estimated)	Rock outcrop	N2	N2	N2
			Dissected flat surfaces with engraved narrow dendritic valleys and short rock detrital escarpments with large colluvial glaciis near the border. Slope low to moderate. Bare soil with scattered natural vegetation in the valleys	2		No field data	Soil complex (estimated)	Rock outcrop Skeletal Leptosols (Arenic)			
		A12 - Plateau slopes on basalt substrate, severely eroded with incisions	Slopes and escarpments bordering the flat plateau surfaces with severe channel erosion and sediment deposition. Steep slopes. Dominant bare soils	3		No field data	Soil complex (estimated)	Skeletal Leptosols (Arenic) Skeletal Regosols			
	A2 - Eroded lower plateau on sandstone	A21 - Gently sloping plateau erosion engravings and river courses	Flat or gently sloping surface with shallow dendritic engraving on sandstone bedrock and with large colluvial glaciis at the border to the main valleys	4		No field data	Soil complex (estimated)	Rock outcrop Leptic Regosols			




	A3 - Alluvio colluvial valleys	A31 - Narrow and large fluvial valleys with alluvio-colluvial coarse sediments	Dendritic narrow fluvial valleys engraving sandstone or basalt bedrock, with shallow alluvial sediments and sparse natural vegetation	5		No field data	Soil consociation (estimated)	Skeletal Fluvisols (Leptic)			
			Large dendritic fluvial valleys with flat morphology and thick gravel alluvial sediments. Diffuse natural shrubs, trees and bare soils	6		No field data	Soil consociation (estimated)	Arenic Fluvisols (Skeletal)			
B – Northern coastal alluvio-colluvial plain with isolated reliefs on silt, sands and gravels with dominant Arenosols	B1 – Guban alluvial plain	B11 – Alluvio-colluvial fan and glaciis on sand and gravels	Alluvio colluvial fan down the hills, with meandering engraved ephemeral water courses and isolated igneous reliefs, Diffuse sheet erosion. Scattered natural shrub vegetation, especially along the rivers and inside the depressions, diffuse goat pasture	7		200	Soil consociation with A-C horizons, deep soils with shallow rooting depth with limitation by high exchangeable sodium content, rockiness absent, weak stoniness, moderately coarse texture, coarse fragments absent to weak with depth, highly alkaline, moderately calcareous, salinity absent to low with depth, alkalinity absent to high with depth	Calcaric Fluvisols (Sodic, Aridic)			
			Subrecent gently sloped alluvial fan with abandoned ephemeral river courses with dendritic pattern. Colluvial gravels substrate and somewhere thin aeolian sand cover. Sparse shrub natural vegetation and diffuse goat pasture	8		106	Soil consociation with A- R horizons, shallow soil with shallow rooting depth, rockiness absents, stoniness dominant, common rock fragments, coarse (sandy loam) texture, moderately alkaline, calcareous, low CEC, salinity and alkalinity absents, excessively drained, high permeability, low AWC	Haplic Fluvisol (Calcaric, Skeletic)			
			Main alluvial glaciis surface, gently sloped with large flat and slightly engraved ephemeral river courses. Sparse shrub vegetation and diffuse goat pasture with scattered isolated settlements	9		No field data	Soil consociation (from Somaliland soil map)	Haplic Regosols			
			Slightly large depressions on glaciis surfaces with uncertain drainage pattern and salt accumulation on surface. Dominant bare soils with sparse vegetation inside the scarce river traces	10		No field data	Soil consociation (estimated)	Salic Regosols			





		B12 – Depressions and braided ephemeral rivers	Large ephemeral braided water courses (Togga), somewhere with uncertain drainage pattern. Flat morphology on subrecent gravel and sandy sediments. Diffuse natural shrub vegetation	11		No field data	Soil consociation (from Somaliland soil map)	Haplic Fluvisols			
			Ancient alluvial terraces, almost flat, with thin recent sandy gravelly alluvio-colluvial cover. Open shrub vegetation, somewhere pastured	12		No field data	Soil consociation (from Somaliland soil map)	Haplic Fluvisols (Skeletal)			
			Subrecent alluvial terraces bordering the braided rivers and abandoned ephemeral water courses. Well developed shrub and trees natural vegetation	13		105	Soil consociation with A1_A2-Ck horizons, moderately deep soil, moderately deep rooting depth, rockiness absent, weak stoniness, coarse (sandy loam) texture, common coarse fragments, moderately alkaline, from moderately calcareous to calcareous with depth, CEC low to high with depth, salinity and alkalinity absents, excessively drained, high permeability, low AWC	Haplic Regosols (Calcaric, Aridic)			
			Igneous isolated reliefs on the coastal alluvial valley with diffuse rock outcrops and bare soils	14		No field data	Soil consociation (estimated)	Rock Outcrop			
	B2 – Coastal plain	B21 – Delta and depressed coastal area	Back coastal subrecent alluvial depressed areas with sebkhas and imperfect surface drainage. Bare soils alternated with dense shrub coastal vegetation and diffuse Prosopis	15		103	Soil consociation with A-Bw-2C horizons, deep soil, moderately deep rooting depth with limitation by salinity and alkalinity, rockiness and stoniness absents, moderately fine to medium texture with depth, coarse fragments absents, moderately alkaline, very calcareous, CEC medium to low, salinity low to high with depth, alkalinity weak to high with depth, well drained, moderately high permeability, moderate AWC	Calcic Endosalic Fluvisols (Aridic, Siltic)			



			Subrecent alluvial terraces on thin gravel and sandy sediments over limestone bedrock. Sparse shrub vegetation and bare soils	16		No field data	Soil consociation (estimated)	Regosols			
			Sandy coastal area, almost flat or gently undulated with sand marine dunes. Diffuse herbaceous vegetation, pastured	17		104	Soil consociation with A1_A2-2C-3C horizons, moderately deep soils with moderately deep rooting depth with limitations by sandy texture, rockiness and stoniness absents, coarse texture, coarse fragments absents, highly alkaline, weakly calcareous, CEC very low, salinity absent, alkalinity high, excessively drained, high permeability, low AWC	Sodic Arenosols (Calcaric, Aridic)			
C - Karkaar and Golis mountains, hills with footslopes, dissected plateaus and valleys on Igneous and sandstone substrate with dominant Leptosols and Cambisols	C1 – North west Karkaar mountains	C11 – Mountains on igneous or sandstone substrate and well developed surface drainage pattern	Eroded mountains with steep slopes with gravelly pediments, well developed dendritic drainage pattern and large meandering alluvial valleys. Sparse shrub natural vegetation with scattered pasture inside the valleys and at the bottom of the slopes	18	 	34 31 32	Soil consociation with A-R horizons, very shallow soils with very shallow rooting depth, very stony, stoniness high, well drained, very high permeability, very low AWC. NO ANALYTICAL DATA AVAILABLE	Hyperskeletal Lithic Leptosols			
			Dissected mountains on granite substrate with ridges and moderately steep slopes and subrounded morphology. Low developed meandering alluvial valleys. Sparse shrub natural vegetation with diffuse pasture traces with evidences of overgrazing	19		25	Soil complex with A-R horizons, very shallow soil with very shallow rooting depth with limitations by rock substrate, rockiness common, stoniness dominant, excessively drained, very high permeability, very low AWC. NO ANALYTICAL DATA AVAILABLE and Rock outcrops	Rock outcrops Hyperskeletal Leptosols			
			Subrounded eroded hills on limestone, moderately developed surface drainage pattern and colluvial slopes with gravel sediments	20		24	Soil complex, rock outcrops dominant, stoniness dominant, shallow soils between the rocks. Excessively drained, very high permeability, very low AWC. NO ANALYTICAL DATA AVAILABLE	Rock Outcrops Lithic Leptosols			




			Large slopes surfaces on granite and sandstones substrate, with moderately low slope gradient and diffuse engraved alluvial valleys. Pasture with overgrazing, diffuse shrubs inside the valleys	21	 	26 312 27 28 313	<p>Soil Complex, A-R horizons, shallow soil with very shallow rooting depth with limitations by rock substrate, weakly stony, dominant stoniness, well drained, high permeability, low AWC. NO ANALYTICAL DATA AVAILABLE</p> <p>and</p> <p>Shallow soils, very shallow rooting depth by limitation by rock substrate and calcium carbonate accumulation, , well drained, high permeability, low AWC. NO ANALYTICAL DATA AVAILABLE</p> <p>and</p> <p>Very shallow soils, very shallow rooting depth with limitation by coarse fragments, rockiness absent, stoniness dominant, excessively drained, very high permeability, very low AWC. NO ANALYTICAL DATA AVAILABLE</p>	Haplic Regosols (Skeletal) Petric Calcisols (Episkeletic, Arenic) Hyperskeletal Leptosols			
			Large alluvial fan with slightly slope, diffuse ephemeral river courses and sparse rock outcrops. Bare soils with diffuse trees and shrubs inside the valleys	22		No field data	Soil consociation (estimated)	Cambisols			
			Eroded elongated colluvial slopes at the head of the ephemeral river courses, well developed surface drainage pattern, diffuse shrub and tree natural vegetation. Diffuse pasture	23	 	114 110	<p>Soil complex with A-Bt-Ck horizons, deep soils with moderately deep rooting depth with limitation by calcium carbonate accumulation and alkalinity, rockiness and stoniness absents, from moderately coarse to moderately fine texture with depth, coarse fragments absents, moderately alkaline, very calcareous, salinity from low to absent with depth, CEC medium, alkalinity from absent to high with depth, well drained, moderately high permeability, medium AWC</p> <p>and</p> <p>soils with Ak-Ck horizons, moderately deep soil, shallow rooting depth with limitations by calcium carbonate accumulation and alkalinity, rockiness absent, stoniness weak, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC from</p>	Luvic Calcisols (Aridic, Siltic) Vertic Calcisols (Aridic, Clayic)			



							medium to high, salinity absents, alkalinity from absent to high with depth, well drained, moderately low permeability, moderate AWC				
			Piedmont alluvial fan from mountains to the coastal plain on coarse and gravel sediments, moderately steep	24		No field data	Soil complex (from Somaliland soil map)	Haplic Leptosols Hyperskeletal Leptosols			
			Meandering and braided ephemeral rivers course and large subrecent alluvial terraces. Flat morphology with bush and trees natural vegetation, pastured or with scattered rainfed cultivations	25	 	107, 201, 206 108 113 201	<p>Soil complex, soils with A-C1-C2 horizons, rockiness and stoniness absents, moderately deep soil, moderately deep rooting depth with limitation by sandy texture, from moderately coarse to coarse texture, coarse fragments absents, from moderately to highly alkaline with depth, calcareous, salinity and alkalinity absents, excessively drained, high permeability, moderate AWC</p> <p>and</p> <p>Soil with A-Bw-C1-C2 horizons, rockiness absent, stoniness moderately deep soils, deep rooting depth, moderately fine texture, coarse fragments absents, moderately alkaline, calcareous, low salinity, alkalinity absent, well drained, moderately high permeability, moderate AWC</p> <p>and</p> <p>Soils with A1_A2-C horizons, moderately deep, deep rooting depth, rockiness absent, weak stoniness, from medium to moderately fine texture with depth, coarse fragments absents, moderately alkaline, calcareous, salinity and alkalinity absents, well drained, moderately high permeability, moderate AWC</p>	Calcaric Fluvisols (Arenic, Aridic) Fluvic Cambisols (Calcaric) Calcic Fluvisols (Aridic, Siltic)			

		C12 – High mountains with straight ridges and almost flat or gently sloping surfaces	Gently sloping mountain surfaces, with shallow engraving and diffuse rock outcrops, sparse shrubs	26		21, 22 30	Soil complex with A-R horizons very shallow soils and very shallow rooting depth with limitations by rock substrate, stony, stoniness dominant, excessively drained, high permeability, very low AWC NO ANALYTICAL DATA AVAILABLE and Soils with A-R horizons, very shallow soils and very shallow rooting depth with limitations by rock substrate, stony, stoniness dominant, excessively drained, high permeability, very low AWC NO ANALYTICAL DATA AVAILABLE	Lithic Leptosols Hyperskeletal Leptosols			
			High mountains with straight elongated ridges, gently slopes summit and steep slopes with moderately developed surface drainage pattern. Sparse trees and shrubs, more dense vegetation inside the narrow valleys and on the escarpments. Somewhere pastured	27		318	Soil consociation with A-C horizons, shallow soil with very shallow rooting depth, limitations by high coarse fragments, weakly stony, dominant stoniness, well drained, high permeability, low AWC NO ANALYTICAL DATA AVAILABLE	Hyperskeletal Leptosols Rock Outcrops			
		C13 – Hargeisa alluvial plateau plain	Large alluvio colluvial plateau valley, with concave morphology, few developed surface drainage and eroded undulated hills. Diffuse rainfed cultivations	28		109, 301 203 20	Soil complex, with A1-A2-Bki horizons, deep soils and moderately rooting depth, limitations by calcium carbonate accumulation, rockiness and stoniness absents, moderately fine to fine texture with depth, coarse fragments absents, moderately alkaline, very calcareous, CEC high to medium, salinity absent, alkalinity weak to absent with depth and Soils with A-C horizons, moderately deep soils, moderately deep rooting depth, limitation by compact substrate, rockiness absent, rockiness few, moderately coarse texture, coarse fragments from absent to common with depth, from highly to moderately alkaline with depth, from moderately calcareous to calcareous, CEC medium to high with depth, well drained, high permeability, moderate AWC and Soil with A-C horizons, shallow soils and shallow rooting depth, limitations by stony substrate, rockiness absent,	Calcic Vertisols (Grumic, Epihyposodic) Haplic Regosols (Aridic) Skeletal Regosols			


							dominant stoniness, excessively drained, high permeability, low AWC				
	C2 - Plateau	C21 – Dissected plateau with slightly slopes	Gently sloped plateau surface, well developed surface drainage. Diffuse rainfed cultivations in the large concave valleys	29	 	310, 311 124	<p>Soil complex with A-B-C horizons, deep soil and moderately deep rooting depth with limitation by clay horizons, rockiness and stoniness absents, from moderately fine to fine texture with depth, coarse fragment absents, moderately alkaline, from calcareous to very calcareous with depth, CEC from medium to high, salinity absent to low with depth, alkalinity absent to weak with depth, well drained, moderately low permeability, moderate AWC</p> <p>And</p> <p>Soils with A1-A2-Ck horizons, deep soils and moderately deep rooting depth, limitations by calcium carbonate accumulation, rockiness and stoniness absents, fine to moderately fine texture with depth, moderately alkaline, very calcareous, CEC high to medium with depth, salinity and alkalinity absents</p>	<p>Haplic Calcisols (Aridic, Clayic)</p> <p>Vertic Calcisols (Aridic, Clayic)</p>			
			Short straight and eroded colluvial escarpments bottom to the eroded slopes and glacis, near the valleys, gently sloped. Rainfed cultivations in the valleys and depressions	30	 	129, 135, 165 138 137	<p>Soil complex with A-Ck1-Ck2 horizons, deep soils and moderately deep rooting depth, limitation by calcium carbonate accumulation, rockiness absent, stoniness few, from moderately fine to fine texture with depth, coarse fragments absent to many with depth, moderately alkaline, very calcareous, CEC medium, low salinity, weak alkalinity, excessively drained, high permeability, moderate AWC</p> <p>And</p> <p>Soil with A-Bt-Ck horizons, deep soils and moderately deep rooting depth, limitations by calcium carbonate</p>	<p>Endosalic Calcisols (Arenic, Clayic)</p> <p>Vertic Calcisols (Aridic, Luvic, Clayic)</p> <p>Haplic Regosols (Calcic, Arenic)</p>			







							<p>accumulation, rockiness absent, stoniness few, moderately fine to fine texture with depth, coarse fragments few, moderately alkaline, calcareous to very calcareous with depth, CEC high to medium with depth, salinity and alkalinity absents, well drained, moderately high permeability, high AWC</p> <p>and</p> <p>Soil with A-C horizons, deep soil with deep rooting depth, rockiness and stoniness absents, excessively drained, high permeability, moderate AWC. NO ANALYTICAL DATA AVAILABLE</p>				
			<p>Large flat plateau surface with alluvial fine cover on hard bedrock with diffuse depressions filled by fine sediments. Sparse trees and shrubs, more dense vegetation inside the depressions. Scattered pasture</p>	31	 	<p>316 317 36</p>	<p>Soil complex, with A-Bt-C horizons, deep soils with deep rooting depth, rockiness absent, stoniness common, fine texture, coarse fragments absents, from moderately to highly alkaline, very calcareous, CEC high, salinity absent, weak alkalinity, moderately well drained, moderately low permeability, high AWC</p> <p>and</p> <p>Soils with A-Bss-C horizons, deep soils with deep rooting depth, rockiness absent, stoniness weak, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity absent, weak alkalinity, well dained, moderately low permeability, high AWC</p> <p>and</p> <p>Soil with A-R profile, very shallow soils with very shallow rooting depth, limitations by rock substrate, weak stoniness, dominant stoniness, excessively drained, high permeability, low AWC NO ANALITYCA DATA AVAILABLE</p>	<p>Calcic Vertisols (Hyposodic, Chromic)</p> <p>Vertic Petric Calcisols (Aridic, Clayic)</p> <p>Haplic Regosols (Skeletal)</p>			

	C3 – Golis mountains	C31 – Limestone and granite mountains, escarpment and glacis	Mountains and steep plateau escarpments, on different substrates (granite and sandstone dominant), well developed surface drainage, dense shrub and trees natural vegetation, diffuse pasture	32		No field data	Soil complex (estimated)	Lithic Leptosols Eutric Leptosols			
			Dissected and eroded undulated mountains, with engraving and well developed dendritic drainage pattern. Sparse shrubs and trees	33		31 35	Soil consociation with A-R horizons, very shallow soils with very shallow rooting depth, limitation by rock substrate, weak rockiness, dominant stoniness, excessively drained, high permeability, low AWC NO ANALYTICAL DATA AVAILABLE	Hyperskeletal Leptosols			
			Limestone foothills with moderately steep slope and severe sheet and channel erosion, denudational surface with colluvial sediments on limestone substrate. Diffuse shrub vegetation, locally pastured	34	 	37 135	Soil complexn with A-Ck1-Ck2 horizons, rockiness weak, stoniness common, moderately deep soils, moderately deep rooting depth, limitation by calcium carbonate, moderately fine to fine texture with depth, coarse fragments common, moderately alkaline, very calcareous, CEC medium, salinity low, alkalinity absent, well drained, moderately low permeability, low AWC And Soil with A-R horizons, rockiness common, stoniness many, shallow soils, shallow rooting depth, limitation by rock substrate, moderately coarse texture, coarse fragments many, excessively drained, high permeability, very low AWC	Endosalic Calcisols (Aridic, Clayic) Hyperskeletal Leptosols			
			Mountains short escarpments and colluvial slopes, on gravel colluvial sediments on sandstone substrate and sparse isolated granitoid reliefs. Sparse trees and shrubs, scattered pasture	35		No field data	Soil consociation (estimated)	Lithic Leptosols			
			Large colluvial cones down the vegetated mountains, on subrecent gravel sediments, with ephemeral river traces, weakly steep. Sparse shrubs and trees, moderately pastured	36		No field data	Soil complex (estimated)	Chromic Cambisols Lithic Leptosols			




			Large alluvio colluvial glacia, with radial surface drainage on gravel and sandy sediments, sparse isolated hills, weak slope. Bare soils with sparse vegetation inside the ephemeral rivers	37		A002	Soil complex with Az-Bkz-Byz horizons, deep soils. Shallow rooting depth, limitations by salinity. Rockiness absent, stoniness common, fine texture, coarse fragments common, moderately alkaline, high to very high salinity with depth, alkalinity absent, moderately well drained, moderately low permeability, low AWC and (estimated)	Gypsic Solonchaks (lithic, Petric) Eutric Leptosols Chromic Cambisols			
		C32 – Subcoastal mountains and valleys	Complex rounded hills with moderately developed surface drainage, with alluvio-colluvial fan and large alluvial valleys. Bare soil or rock outcrops with sparse shrub and trees.	38		No field data	Soil complex (estimated)	Eutric Leptosols Chromic Cambisols			
			Engraved mountains reliefs with bedrock near the surface and alluvial fan areas, with slightly slope gradient to south, mainly on sandstone substrate, moderately developed dendritic surface drainage. Prominent shelf border with strong escarpment toward the coastline. Moderately dense natural trees and shrub vegetation, sparsely pastured	39		No field data	Soil complex (estimated)	Lithic Leptosols Eutric Leptosols			
			Subcoastal mountains on igneous substrate, with elongated ridges and steep slopes. Deep engraved meandering valleys. Sparse open trees and shrubs, somewhere pastured	40	 	34, 314 23	Soil complex with A-R horizons, very shallow soils with very shallow rooting depth, limitation by rock substrate, very stony, dominant stoniness, excessively drained, high permeability, low AWC. NO ANALYTICAL DATA AVAILABLE And Soils with A-R horizons, very shallow soils with very shallow rooting depth, limitation by rock substrate, stony, dominant stoniness, well drained, high permeability, low AWC. NO ANALYTICAL DATA AVAILABLE	Hyperskeletal Leptosols Lithic Leptosols			



			Shelf escarpment belt, down the engraved hills a directly toward the sea coast, moderately to high steep slopes, concave morphology. Dense tree forest, pastured	41		No field data	Soil consociation (estimated)	Lithic Leptosols			
			Severely eroded colluvial escarpment down the sandstone shelves , strongly engraved with narrow valleys and rock hills, closed by coastal reliefs. Good vegetation cover with shrubs and trees, pastured	42		No field data	Soil complex (estimated)	Lithic Leptosols Chromic Cambisols			
			Strongly undulated coastal hills on schist substrate with moderate diffusion of rock outcrops or thin soils alternated with elongated concave valleys filled by sandy sediments	43		No field data	Soil complex (estimated)	Chromic Cambisols Rock Outcrops			
		C33 – Pediment, colluvial cones and glaci	Colluvial cones and glaci around and bottom mountains, with gravels and sands colluvial sediments, somewhere with thin aeolian sand cover. Slightly convex morphology	44		No field data	Soil complex (estimated)	Chromic Cambisols Haplic Calcisols			
			Subcoastal glaci and alluvial surfaces, very weakly sloped, on subrecent alluvio colluvial gravel sediments with surface aeolian sand cover, bare soils with sparse shrub vegetation	45		No field data	Soil complex (estimated)	Haplic Solonchaks Calcaric Regosols			
			Large short ephemeral braided river courses on recent sandy and gravel alluvial sediments. Somewhere with large coastal delta. Evidence of surface salt accumulation near the coast. Diffuse natural shrub and trees vegetation. Shifting irrigated and rainfed cultivations	46		No field data	Soil complex (estimated)	Calcaric Fluvisols Salic Fluvisols			

	C4 – Coastal area	C41 – Coastal sand dunes and depressions	Coastal sand dunes on alluvial deposits, surface salt accumulation. Somewhere occur isolated basalt reliefs. Bare soils or very sparse shrubs	47		No field data	Soil complex (estimated)	Haplic Solonchaks Arenic Regosols			
			Back dunes depression areas with salt accumulation on surface, large ephemeral river traces and shifting aeolian sands deposits. Bare soils and very sparse trees and shrubs	48		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Coastal sandy beaches, flat surfaces or diffuse sandy moulds. Bare soils	49		No field data	Soil consociation (estimated)	Arenosols			
D - Northern Hawd plateau on limestone and sandstone with dominant Calcisols and Leptosols	D1 – Main Plateau surfaces on sandstone substrate	D11 – Flat and concave plateau surfaces	Large Plateau surfaces with weak concave morphology and few developed surface drainage, intense rainfed cultivations	50		117, 120, 302, 328 And 125, 303, 329	Soil complex with Ap-Bi1-Bi1-C horizons, deep soils, deep rooting depth, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC from medium to high with depth, salinity absent to weak with depth, alkalinity from absent to weak with depth, imperfect drainage, low permeability, high AWC Soil with Ap-Bi1-Bi2-C horizons, deep soil, moderately deep rooting depth, limitation by exchangeable sodium accumulation, rockiness and stoniness absents, fine texture, coarse fragments absents, from moderately to highly alkaline with depth, very calcareous, CEC medium, salinity absent to weak with depth, alkalinity absent to high with depth, moderately well drained, low permeability, high AWC	Calcic Vertisols (Calcic, Hyposodic) Calcic Grumic Vertisols (Hyhyposodic, Chromic)			

		D12 – Ondulated and eroded plateau	Gently undulated Plateau surfaces, well developed surface drainage with alternating bush natural vegetation, rainfed cultivation and locally bare soils and closed bush (tiger bush)	51		306, 308, 309	Soil consociation with A-Bki-C horizons, deep soils with moderately deep rooting depth, limitation by calcium carbonate accumulation, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately calcareous, CEC high, salinity absent, alkalinity absent, moderately well drained, low permeability, high AWC	Calcic Grumic Vertisols (Hyposodic, Chromic)			
			Eroded slopes with strong surface and channel erosion, shifting rainfed cultivations with large pastured open bush surfaces. Locally diffuse earth dams	52		No field data	Soil complex (estimated)	Haplic Regosols Petric Calcisols			
			Weakly convex surfaces at the plateau border, intensely cultivated mainly with rainfed cultivations and grass pasture	53		121, 325, 326	Soil consociation with Ap-Bki-Ck horizons, deep soils, deep rooting depth, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately alkaline, very calcareous, salinity absent, alkalinity absent to weak with depth, moderately well drained, low permeability, high AWC	Calcic Vertisols (Calcaric, Hyposodic)			
			Eroded elongated hilltop and rounded ridges, often with rock outcrops and surface engravings. Bare soils and open bush with evidence of past overgrazing	54	 	46, 47, 48, 51, 319, 320 45	Soil complex with A-R horizons, very shallow soils and very shallow rooting depth, limitations by rock substrate or coarse fragments, stony, stoniness dominant, excessively drained, high permeability, low AWC NO ANALYTICAL DATA AVAILABLE and soils with A-R horizons, shallow soils and shallow rooting depth, limitations by coarse fragments, weakly stony, stoniness many, well drained, high permeability, low AWC NO ANALYTICAL DATA AVAILABLE	Hyperskeletal Leptosols Haplic Regosols			
		D13 - Concave and undulated valleys on colluvial sediments and sandstone	Piedmont and concave alluvial valleys bottom the Plateau surfaces, Intensely cultivated	55	 	123 304	Soil complex with A-Bti-C horizons, deep soils with moderately deep rooting depth, limitations by alkalinity, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC medium to high, salinity absent, alkalinity absent to weak with depth, moderately well drained, low permeability, high AWC And Soils with A1-A2-Bti-C horizons, deep	Calcic Vertisols(Chromic) Calcic Mazic Vertisols (Bathhyposodic, Bathyhyposalic)			

							soils, deep rooting depth, limitation by salinity and alkalinity, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity absent to weak with depth, alkalinity absent to weak with depth, moderately well drained, low permeability, high AWC				
			Large undulated and terraced valley with concave morphology and well developed surface drainage pattern, alternating rainfed cultivations, bush natural vegetation alternating to bare soils (tiger bush)	56		305	Soil consociation with A1-A2-Bi1-Bi2 horizons, deep soils, moderately deep rooting depth, limitations by alkalinity, rockiness and stoniness absents, fine texture coarse fragments absents, moderately to highly alkaline with depth, very calcareous, CEC high, salinity absent, alkalinity absent to weak with depth, moderately well drained, low permeability, high AWC	Calcic Grumic Vertisols (Hyposodic, Chromic)			
			Sandstone outcrops hilly domes on gently undulated plateau surface, bare soil or rock outcrop, probably past overgrazing	57		No field data	Soil consociation ((from Somaliland soil map)	Lithic Leptosols			
			Weakly depressed plateau surface, with weak concave morphology, diffuse sheet erosion and sparse rainfed cultivations	58		No field data	Soil consociation ((from Somaliland soil map)	Haplic Solonchaks			
		D14 – Elevated plateau surfaces and slopes on sandstone	Almost flat high plateau surface, with scarce engraving and well developed bush natural vegetation (Shrubs and trees), shifting pasture	59		No field data	Soil consociation (estimated)	Petric Calcisols			
			Weakly elongated concave surfaces, with sandstone colluvial deposits, diffuse pasture and shifting rainfed cultivations inside rounded depressions	60		No field data	Soil complex (estimated)	Hyperskeletal Leptosols Petric Calcisols			

	D2 – Hawd plateau valley and drainage system	D21 – Plateau border and heads of valleys	Gently sloped plateau at the head of main valley, with colluvial terraced concave valleys and eroded rounded ridges, few surface drainage pattern. Diffuse rainfed cultivations in the concave valleys and bare soils on the ridges	61		115, 118, 119 No field data	<p>Soil complex with Ap_Bti-Ck horizons, deep soils moderately deep rooting depth, limitations by calcium carbonate accumulation, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately alkaline, very calcareous to calcareous with depth, CEC medium to high, salinity and alkalinity absents, imperfect drainage, low permeability, high AWC</p> <p>And</p> <p>Soils with A-R horizons, shallow soils, very shallow rooting depth, limitations by gravels or rock substrate. Excessively drained, high permeability, low AWC</p> <p>NO PROFILES AVAILABLE</p>	<p>Vertic Calcisols (Aridic, Clayic)</p> <p>Hyperskeletal Leptosols (Lithic, Calcaric)</p>			
			Large terraced concave and elongated head of valleys on plateau border, on colluvial substrate, sparse rainfed cultivations and diffuse pasture	62	 	307, 321 101 323	<p>Soil complex with A1-A2-Bki-Ck horizons, deep soils, moderately deep rooting depth, limitation by calcium carbonate and alkalinity, rockiness and stoniness absents, fine to moderately fine texture with depth, coarse fragments absents, moderately to highly alkaline with depth, very calcareous, CEC high to medium with depth, salinity absent, high alkalinity, moderately well drained, moderately low permeability, moderate AWC</p> <p>And</p> <p>Soils with A1-A2-Bi horizons, deep soil, moderately deep rooting depth, limitations by alkalinity, rockiness and stoniness absents, fine texture, coarse fragment absents, moderately to highly alkaline with depth, very calcareous, CEC high, salinity absents, high alkalinity, moderately well drained, low permeability, moderate AWC</p> <p>And</p> <p>Soils with A1-A2-Bi1-Bi1-C horizons, deep soil, moderately deep rooting depth, limitations by salinity and alkalinity, rockiness and stoniness absents, fine texture, coarse fragment absents, moderately alkaline, very calcareous, CEC high, salinity absent to medium with depth, alkalinity absent to weak with depth, moderately well</p>	<p>Calcic Mazic Vertisols (Hyposalic, Hyposodic)</p> <p>Haplic Vertisols (Calcaric, Chromic)</p> <p>Calcic Grumic Vertisols (Hyposalic, Chromic)</p>			

							drained, low permeability, moderate AWC				
			Plateau border to the Nugaal valley, with weak convex morphology and sparse rock rounded ridges. Alternate bare eroded soils and bush lines with dominant shrubs (tiger bush), diffuse pasture	63	 	102 33	<p>Soil complex with A1-A2-Bw-Bi-C horizons, moderately deep soils, moderate rooting depth, limitation by alkalinity, rockiness and stoniness absents, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC medium, salinity absent, alkalinity weak to high with depth, well drained, moderately low permeability, moderate AWC</p> <p>And</p> <p>Soil with A-R horizons, shallow soils, very shallow rooting depth, limitation by coarse fragments or rock substrate, stony, rockiness dominant, excessively drained, high permeability, low AWC</p> <p>NO ANALYTICAL DATA AVAILABLE</p>	Vertic Calcisols (Clayic, Chromic) Hyperskeletal Leptosols			
		D22 – Alluvio colluvial high part of lateral Nugaal valley, bordering plateau, on sand, silt and gravel	Alluvio colluvial surface with diffuse ephemeral streams traces down the hills, with sand and gravel subrecent deposits, sparse natural trees. Scattered shifting cultivations and diffuse pasture with large fences	64		No field data	Soil complex (estimated)	Haplic Solonchaks Calcic Petrisols			
			Subrecent alluvial terraces bordering the alluvial valleys and the ephemeral river traces. Diffuse grazing and fences	65		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Eroded alluvial terrace borders, almost flat morphology, few elevated than the alluvial valley, evidence salt accumulation on surface. Bare soils with shifting shrubs	66		No field data	Soil consociation (estimated)	Haplic Solonchaks			

			Depressed alluvial surfaces, imperfectly drained with ancient stream traces. Natural herbaceous saline vegetation and scattered shrubs and trees. Somewhere pastured	67		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Ancient large terraced glacia with diffuse subrounded depressions. Evidence of severe sheet erosion and thin aeolian sand accumulation on surface. Somewhere salt accumulation on surface. Sparse shrubs and trees, moderately dense vegetation inside the depressions	68		No field data	Soil complex (estimated)	Petric Calcisols Arenic Regosols			
			Degraded and eroded terraced glacia bordering large valley with diffuse narrow ephemeral streams traces, severe sheet and channel erosion. Colluvial sediments inside the stream traces and sparse shrub and trees vegetation, more dense inside the stream traces	69		No field data	Soil complex (estimated)	Eutric Regosols Skeletal Leptosols			
			Complex engraved ancient glacia, with diffuse ephemeral low depressed streams, well developed surface drainage pattern. Sparse pastured shrubs and trees. Dense trees vegetation inside the valleys	70		No field data	Soil complex (estimated)	Haplic Calcisols Eutric Regosols			
			High glacia surface, almost flat a weak slope gradient to south. Ancient colluvial sediments from the upper hills. Diffuse shrub and trees vegetation, pastured	71		No field data	Soil complex (estimated)	Petric Calcisols Eutric Regosols			
			Large subrecent colluvial footslope down the eroded limestone hills, weak slope gradient. Rare ephemeral stream traces. Diffuse shrub and trees vegetation, pastured	72		No field data	Soil consociation (estimated)	Petric Calcisols			

E – Nugaal valley and related alluvio-colluvial valleys on sand, silt and gravels and aeolian deposits with dominant Regosols and Solonchak	E1 – Nugaal valley	E11 – Internal endorheic valleys	Ancient alluvial terraces with colluvial covering, almost flat or gently sloped, diffuse spotted rainfed fenced cultivations with sparse pastured shrub and trees	73		No field data	Soil complex (estimated)	Haplic Solonchaks Petric Calcisols			
			Somewhat poorly drained low alluvial terraces, with salt accumulation, natural herbaceous and shrub vegetation, pastured	74		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Poorly drained alluvial plain on alluvio colluvial surfaces, somewhat depressed with uncertain drainage pattern and salt accumulation, bare soil with sparse shrub and trees, moderately pastured	75		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Calcisols Calcic Regosols			
			Large terraced glaci surface, almost flat or gently sloping, weakly engraved by large ephemeral streams, colluvial sediments on the upper part and thin aeolian sand deposits. Sparse shrub and trees	76		No field data	Soil consociation (estimated)	Haplic Calcisols			
			Colluvial gently sloping surface down the upper hills and mountains, with engraved narrow and flat valleys inside the mountains, gravelly alluvio-colluvial cones opened to the alluvial plain. Diffuse sheet erosion. Bare soils with vegetated belt in the engraving and depressions	77		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Regosols Lithic Leptosols			
		E12 – Central alluvial Nugaal valley	Main Nugaal river stream and related lateral streams, somewhere with uncertain drainage pattern. Poor or imperfect internal drainage and surface salt accumulation	78		No field data	Soil consociation (estimated)	Haplic Solonchaks			

			Large colluvial undulated area with engraving and eroded rounded hills. Bare soils and scattered vegetation in the ephemeral streams	79		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Calcisols Lithic Leptosols			
			Glacis upper part near the hills with colluvial sediments and spotted Aeolian sand accumulation. Bare soils or sparse shrub and trees	80		No field data	Soil complex (estimated)	Haplic Calcisols Lithic Leptosols			
			Large alluvio-colluvial glacis with several ephemeral streams traces and severe sheet and channel erosion. Salt accumulation on surface. Bare soils with sparse vegetation inside the streams	81		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Calcisols			
			Almost flat subrecent alluvial terraces, low elevated on the alluvial plain bordering the main Nugaal stream, with thin aeolian sand cover. Bare soils and very sparse shrub and trees	82		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Lower part of almost flat large glacis with few large ephemeral streams, shifting aeolian sand cover and diffuse salt accumulation. Bare soils and sparse natural shrubs and trees inside streams	83		No field data	Soil complex (estimated)	Haplic Solonchaks Arenic Regosols			
			Large flat alluvial plain, with meandering and uncertain depressed drainage systems and streams. Somewhere poorly or imperfectly drained with surface salt accumulation, bare soils and sparse vegetation in the depressions	84		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Solonetz			

			Large ancient colluvial cones down the mountain reliefs with gravel and sandy colluvium on deep alluvial sediments	85		No field data	Soil complex (estimated)	Skeletal Regosols Haplic Solonchaks			
			Large fluvio lacustrine almost flat surface, with depression and large ephemeral stream traces with alluvial colluvial deposits. Very poorly drained, surface salt accumulation and salted herbaceous vegetation inside the depressions.	86		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Solonetz Calcaric Regosols			
			Meandering colluvial lateral valleys in the lower part of the Nugaal valley with low developed cones bordering the main river course, sandy and gravel subrecent deposits. Bare soils dominant	87		No field data	Soil complex (estimated)	Lithic Leptosols Calcaric Regosols			
			Lower braided Nugaal river course, large flat alluvial valley on recent sediments with sparse shrub and trees vegetation	88		No field data	Soil complex (estimated)	Skeletal Leptosols Lithic Leptosols			
	E2 – Upper part of Nugaal valley and Soon plateau border	E21 – Slopes, plateau escarpments and badlands on gypsum and limestone substrate	Severely eroded lower plateau escarpment with moderately steep slopes, concave morphology, on gypsum substrate, diffuse little dissected hills and narrow ephemeral streams. Bare soils with sparse trees, more dense vegetation inside the ephemeral river courses	89		No field data	Soil complex (estimated)	Haplic Calcisols Lithic Leptosols			
			Eroded upper plateau escarpment with dissected tabular hills, severe sheet and channel erosion, narrow alluvial valleys with north-south direction. Dominant bare soils or rock outcrops, sparse shrubs and trees with trees vegetation inside the alluvial valleys	90		No field data	Soil complex (estimated)	Haplic Gypsisols Lithic Leptosols			

			Alluvial fan and long concave footslopes down the plateau escarpments, diffuse little ephemeral streams: Bare soils, sparse shrubs and trees inside the streams	91		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols Lithic Leptosols			
F – Central Sool plateau, with valleys and badlands, severe erosion on evaporites and limestone substrate with Leptosols and Cambisols	F1 - Upper part of internal endorheic valley between Nugaal and Darhoor valleys	F11 – Hills, foothills, engraved river courses and erosion channels on endorheic basin	Eroded colluvial footslopes with isolated reliefs, down mountains and hills, gently sloped surfaces with silty clay deposits, locally gravel sediments. Bare soils with scattered trees	92		No field data	Soil complex (estimated)	Calcaric Regosols Calcaric Cambisols			
			Eroded rounded and elongated ridges with mounds and isolated rounded or flat reliefs, short colluvial foothills, bare soils with sparse trees and shifting pasture	93		No field data	Soil complex (estimated)	Eutric Leptosols Calcaric Regosols			
			Large flat colluvial internal valley with well developed endorheic surface drainage with soluble salt accumulation on surface. Bare soils with shrub vegetation inside the engravings	94		No field data	Soil consociation (estimated)	Haplic Solonchaks			
			Rounded eroded low top hills on limestone merging to the endorheic alluvial valley, bare soils and very rare natural trees vegetation	95		No field data	Soil complex (estimated)	Calcaric Regosols Calcaric Cambisols			
			Large and eroded ancient glacia with very weak slope and thin subrecent colluvial gravel cover on gypsum substrate. Dominant bare soils with vegetation inside the engravings	96		No field data	Soil complex (estimated)	Haplic Gypsisols Haplic Solonchaks			

		F12 – Endorheic terraced fluvio lacustrine valley	Subrecent weakly convex colluvial surfaces bordering the terraced fluvio lacustrine surfaces. Bare soils with sparse shrub vegetation. Salt on surface inside the ephemeral streams	97		No field data	Soil complex (estimated)	Calcaric Cambisols Salic Calcisols			
			Severely eroded almost flat ancient fluvio lacustrine colluvial area, with several large erosion channels and diffuse vegetated belt with dominant shrubs, bare soil in the erosion channels	98		No field data	Soil consociation (estimated)	Calcaric Cambisols			
			Eroded ancient second order fluvio lacustrine terraces with several uncertain surface drainage tracks. Bare soils with scattered trees and shrubs	99		No field data	Soil complex (estimated)	Luvic Cambisols Haplic Solonchaks			
			Ancient first order fluvio lacustrine terraces, gently sloping surface bordering the endorheic depressed area with alluvial cover on gypsum substrate. Bare soils with very sparse shrubs	100		No field data	Soil complex (estimated)	Haplic Gypsisols Haplic Solonchaks			
			Depressed ancient fluvio lacustrine endorheic surface with uncertain surface drainage tracks. Bare soils dominant, surface salt efflorescence	101		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Solonetz			
			Ancient ephemeral surface drainage pattern in fluvio-lacustrine endorheic valleys, slightly engraved and with diffuse vegetated belts alternating bare soils	102		No field data	Soil complex (estimated)	Fluvic Cambisols Salic Regosols			

	F2 – Upper Sool plateau and badlands	F21 – Gently wavy eroded plateau surfaces with colluvium and glacies	Eroded gently wavy surfaces with ancient dendritic drainage pattern on limestone. Bare soils dominant with scattered trees	103		No field data	Soil complex /estimated)	Calcaric Cambisols Petric Calcisols			
			Wavy dissected tabular hills with eroded escarpments on limestone, diffuse rock outcrop and sparse shrub vegetation on the escarpments and engravings	104		No field data	Soil complex (estimated)	Eutric Leptosols Calcaric Cambisols			
			Severely eroded plateau escarpment with dissected flat surfaces or hills, severe sheet and channel erosion, narrow alluvial valleys with north-south direction. Dominant bare soils or rock outcrops, sparse shrubs and trees , more dense vegetation inside the alluvial valleys	105		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols			
		F22 – Eroded badlands on limestone and gypsum	Badlands, severely eroded hills on limestone, with well developed surface drainage pattern, bare soils with scattered trees and bush natural vegetation on the colluvium or inside the ephemeral river courses	106		No field data	Soil complex (estimated)	Skeletal Leptosols Eutric Leptosols			
			Eroded low hills with flat surfaces and isolated rounded reliefs, weakly developed surface drainage pattern. Bare soils with sparse shrub and trees	107		No field data	Soil complex (estimated)	Eutric Leptosols Haplic Calcisols			
	F3 – Flat plateau surfaces	F31 – Large flat area with extensive tiger bush on limestone and evaporites	Flat plateau with scarce inactive ancient surface drainage tracks. Diffuse shrub natural vegetation and scattered trees. Diffuse pasture	108		No field data	Soil consociation (estimated)	Calcaric Cambisols			

			Flat or weakly wavy plateau, with diffuse paleodrainage channel tracks. Diffuse vegetated belt with shrubs and trees alternated to eroded bare soils (tiger bush). Diffuse pasture	109		No field data	Soil complex (estimated)	Skeletal Leptosols Calcaric Cambisols			
			Eroded flat plateau with drainage tracks almost absent, dominant eroded bare soils belts instead bush vegetation	110		No field data	Soil complex (estimated)	Eutric Leptosols Skeletal Leptosols			
		F32 – Gently wavy eroded plateau on limestone	Gently wavy plateau surface, with several inactive ancient drainage tracks and eroded top of rounded undulations, vegetated belt concentrated in the inactive streams, pastured	111		No field data	Soil complex (estimated)	Calcaric Cambisols Skeletal Leptosols			
			Large weakly depresses ancient endorheic drainage tracks on gently waving plateau surface. Degraded vegetated belts and dominant eroded bare soils	112		No field data	Soil complex (estimated)	Calcaric Cambisols Haplic Solonchaks			
			Wavy plateau surface with eroded elongated limestone hills with aeolian sand accumulation on footslopes. Bare soils with sparse natural vegetation inside the engravings	113		No field data	Soil complex (estimated)	Haplic Calcisols Arenic Regosols			
G – Coastal Sool dissected plateau with narrow valleys on limestone with dominant Calcisols	G1 – Northern coastal plateau	G12 – Weakly wavy plateau surfaces with paleodrainage traces on limestone	Plateau main almost flat surface, gently sloped to the coastline and with large paleodrainage traces, filled by alluvio colluvial sediments. Scattered bush and trees vegetation and bare soils, locally pastured	114		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols			

			Wavy plateau surface, with eroded low rounded hills and several paleodrainage braided traces. Moderately diffuse bush and trees vegetation, especially inside the channel traces, diffuse pasture	115		No field data	Soil complex (estimated)	Eutric Leptosols Skeletal Leptosols			
			Isolated sandstone severely eroded reliefs with steep and rough morphology, sand accumulation at footslopes with gravels, few inactive drainage traces. Diffuse shrubs and trees vegetation, more dense inside channel traces, intensely pastured	116		No field data	Soil complex (estimated)	Haplic Calcisols Arenic Regosols Rock Outcrops			
			Wavy and flat dissected plateau surface with erosion escarpments and several braided paleodrainage traces. Bare soil on flat surfaces and sparse vegetated shrubs and trees on the slopes, diffuse natural tree vegetation in the paleochannel traces	117		No field data	Soil complex (estimated)	Eutric Leptosols Haplic Calcisols			
		G12 – Valleys and depressions on plateau surfaces	Large few depressed paleodrainage traces and head of engraved valleys with streams channel tracks, filled by alluvio-colluvial sediments. Bare soils with vegetated belts (tiger bush), sparsely pastured	118		No field data	Soil complex (estimated)	Arenic Regosols Eutric Leptosols Haplic Calcisols			
			Plateau subcoastal engraved valleys and slopes back to the coastal reef, with strong eroded steep surfaces on large valley with ephemeral meandering streams. Dominant bare soils and salt efflorescence on surface	119		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols			
	G2 – Coastal plateau border and escarpments	G21 – Northern coastal plateau border on limestone	Dissected plateau escarpment with isolated flat surfaces and eroded slopes on alluvio-colluvial deposits and little ephemeral streams channels. Dominant bare soils with sparse natural vegetation in the engravings	120		No field data	Soil complex (estimated)	Eutric Leptosols Calcaric Cambisols			

			Dissected plateau footslopes merging to Darhoor valley, concave morphology with alluvio colluvial coarse and fine deposits. Shifting aeolian sand deposits and diffuse ephemeral vegetated streams. Dominant bare soils	121		No field data	Soil complex (estimated)	Skeletal Leptosols Calcaric Regosols Haplic Calcisols			
	G3 – Coastal limestone reef	G31 – Coastal reef on coral limestone with elongated longitudinal reliefs and flat surfaces	Coastal elongated longitudinal reliefs and slopes merging to the upper coastal plateau, with meandering ephemeral streams. Sparse vegetation inside the streams and dominant bare soils	122		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols			
			Almost flat coastal reef with shifting aeolian sand cover and low sand dunes. Steep slopes to the coast. Bare soils with open bush vegetation	123		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Cambisols Arenic Regosols			
			Steep reef escarpment to the coast, strongly eroded with salt accumulation on surface and shifting bush vegetation, trees in the streams erosion channels.	124		No field data	Soil complex (estimated)	Calcaric Cambisols Salic Leptosols			
	G4 – Southern Sool plateau	G41 – Upper plateau border with surface karstic drainage on limestone	Almost flat plateau surface border with large few depressed concave colluvial valleys and short escarpments. Diffuse tiger bush inside the valleys and sparse trees on the plateau surfaces	125		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Calcisols			
			Plateau slopes to the coastal plain, with eroded moderately steep surfaces on large valley with ephemeral meandering streams	126		No field data	Soil consociation (estimated)	Haplic Calcisols			

			Dissected plateau surface with flat elongated limestone remains, escarpments and large few depressed valleys. Good shrub and trees cover in depressions, sparse bush and trees on surfaces	127		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Calcisols			
		G42 – Flat plateau surface on limestone with surface karstic depressions	Almost flat plateau surface with few surface sublinear drainage pattern and scarce subcircular depression filled by aeolian sand, large areas with sand accumulation. Sparse natural trees vegetation , more dense inside the drainage lines. Diffuse pasture	128		No field data	Soil consociation (estimated)	Haplic Calcisols			
			Almost flat plateau or somewhere weakly wavy with low developed surface drainage and many karstic subcircular depressions, filled by ancient aeolian sand. Diffuse trees and pasture	129		No field data	Soil complex (estimated)	Haplic Calcisols Luvic Arenosols			
			Alluvio colluvial and ancient aeolian sand accumulation area inside elongated inactive or ephemeral stream depressions. Sparse shrubs and trees, more dense vegetation inside the stream channels	130		No field data	Soil complex (estimated)	Luvic Arenosols Haplic Calcisols			
		G43 – Lower plateau on limestone and gypsum, merging to the coastal plain	Lower gently sloped plateau with moderately developed linear drainage pattern in direction to the coast. Diffuse shrubs, trees and pasture	131		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Calcisols			
			Lower plateau merging to the coastal plain with shifting aeolian sand accumulation. Diffuse and sparse trees, pastured	132		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Gypsisols			

H – Darhoor terraced alluvio-colluvial valley and coastal plains on sand, silt, gravel and evaporites with dominant Regosols and Gypsisols	H1 – Upper Darhoor valley	H11 – Colluvial upper Darhoor valley down the mountains and badlands on coarse alluvial sediments and gypsum	Gypsum hills footslopes with coarse and fine sediments on a gently sloped morphology. Bare soils.	133		No field data	Soil complex (estimated)	Petric Gypsisols Fluvic Regosols			
			Very slightly elevated rounded hills with short eroded colluvial escarpments and slight engraving on gypsum substrate. Dominant bare soil with rare natural vegetation inside the valleys	134		No field data	Soil consociation (estimated)	Petric Gypsisols			
			Alluvio colluvial conoids with slightly convex morphology and large ephemeral meandering stream channels coming from upper mountains and badlands. Bare soils with scarce bush and trees vegetation inside the streams. Somewhere salt accumulation on surface	135		No field data	Soil complex (estimated)	Eutric Leptosols Haplic Calcisols			
		H12 – Ancient fluvio-lacustrine sediments on upper Darhoor valley	Gypsum eroded isolated tabular hills, with short escarpments and engraved footslopes by ephemeral streams. Bare soils with sparse shrubs and trees, degraded pasture	136		No field data	Soil complex (estimated)	Petric Gypsisols Calcaric Regosols Calcaric Fluvisols			
			Ancient dissected third order alluvial terraces on coarse and fine fluvio lacustrine sediments with short escarpments, concave valleys with ephemeral stream channels, diffuse salt on surface. Bare soils with very sparse shrubs and trees	137		No field data	Soil complex (estimated)	Petric Gypsisols Calcaric Fluvisols			
			Subrecent gently sloping second order fluvio-lacustrine terraces bordering large flat ephemeral streams, with short escarpments. Bare soils, sparse shrubs and trees inside the steam valleys	138		No field data	Soil complex (estimated)	Haplic Calcisols Petric Gypsisols			

			Gently wavy first order dissected ancient fluvio-lacustrine terraces and its escarpments, with severely eroded rounded mounds. Bare soils dominant	139		No field data	Soil complex (estimated)	Haplic Calcisols Leptic Calcisols			
	H2 - Central and southern Darhoor alluvial terraced valley	H21 – Subrecent alluvial terraces on alluvial plain and large ephemeral streams on calcareous and gypsiferous sediments	Main alluvial plain with very large braided streams somewhere with uncertain drainage on recent coarse and sandy alluvial deposits. Bare soils with sparse shrubs and trees	140		GWTP 1, 2, 3, 4, 5, 6, 7 A004	Soil complex with A-Ck-C1-2C2-3C3-4C4 horizons, moderately deep soils, moderately deep rooting depth, limitations by salinity, rockiness absent, stoniness weak, medium texture, coarse fragments few, moderately alkaline, very calcareous, salinity from absent to high with depth, alkalinity absent, well drained, moderately high permeability, moderate AWC and Soils with A-Ak-Bk-Bzk-Bz horizons, deep soils, shallow rooting depth, limitations by salinity, rockiness absent, stoniness few, medium texture, coarse fragments absent to few, moderately alkaline, very calcareous, salinity absent to high with depth, alkalinity absent, moderately well drained, moderately low permeability, low AWC	Calcaric Fluvisols Calcic Solonchaks			
			Eroded ancient second order alluvial terraces, with subrecent colluvial surface deposits on ancient coarse sediments or gypsum substrate. Aeoliana erosion and salt accumulation on surface. Bare soils with very scattered shrubs and trees, degraded pasture	141		A029	Soil complex with Ak-Bk-By-R horizons, moderately deep soils, moderately deep rooting depth, limitation by rock substrate, rockiness absent, stoniness few, medium texture, coarse fragments few, from neutral to moderately alkaline, salinity high to medium with depth, alkalinity absent, moderately well drained, moderately high permeability, moderate AWC and (estimated)	Gypsic Calcisols Calcaric Regosols			
			First order subrecent alluvial terraces on alluvial gypsiferous sediments, almost flat morphology, with diffuse sheet and channel erosion. Bare soils and sparse shrubs, salt efflorescence on surface.	142		No field data	Soil complex (estimated)	Gypsic Calcisols Calcic Solonchaks			

			Isolated and severely eroded limestone complex hills with colluvial footslopes and ephemeral flat streams. Bare soil, sparse shrubs inside the streams	143		No field data	Soil complex (estimated)	Petric Calcisol Fluvic Regosols			
			Recent alluvial terraces, few elevated on the recent alluvial plain, on coarse and fine sediments. Diffuse sheet and wind erosion, evidence of salt accumulation on surface. Bare soils and sparse shrubs in the depressions	144		A008	Soil complex with A-Ck-C1-2C2-3C3-4C4 horizons, moderately deep soils, moderately deep rooting depth, limitations by salinity, rockiness absent, stoniness weak, medium texture, coarse fragments few, moderately alkaline, very calcareous, salinity from absent to high with depth, alkalinity absent, well drained, moderately high permeability, moderate AWC and (estimated)	Calcaric Fluvisols Calcic Solonchaks			
			Alluvial terraces eroded escarpments with colluvial deposits on the bottom. Diffuse channel and sheet erosion, evidence of salt accumulation. Bare soils with sparse shrubs inside the streams	145		No field data	Soil complex (estimated)	Fluvic Gypsisols Calcic Solonchaks			
		H22 – Alluvio colluvial cones down the hills and badlands on gypsiferous gravelly sand sediments	Alluvio colluvial cones down the dissected hills and badlands merging the alluvial terraces, slightly sloped on coarse sediments. Diffuse sheet and channel erosion. Bare soils with sparse shrubs	146		A019 A027	Soil complex (estimated)	Eutric Leptosols (Petric) Calcic Vertisols (gilgai)			
			Upper colluvial cones with recent gravelly sediments, moderately steep sloped. Diffuse sheet erosion, sparse shrubs, dominant bare soils	147		No field data	Soil consociation (estimated)	Skeletal Leptosols			

I – Puntland mountains, hills and footslopes with internal coastal plains on limestone with dominant Leptosols and Calcisols	I1 – Gypsiferous complex hills	I11 – Dissected severely eroded hills, footslopes and alluvial fan on gravels	Subcoastal gypsiferous severely hills with narrow ridges and engraved valleys. Steep slopes. Bare soil and rock outcrops	148		No field data	Soil complex (estimated)	Lithic Leptosols Rock Outcrops			
			Coastal foothills and alluvial fan with large flat alluvial valleys on gravel sediments. Sparse bush and trees with pasture	149		No field data	Soil complex (estimated)	Calcaric Regosols Calcaric Fluvisols			
		I12 – Complex eroded hills and meandering valleys on gypsum substrate	Intensely eroded and engraved gypsiferous hills with elongated rounded ridges and narrow valleys, intensely developed dendritic surface drainage pattern and meandering flat valleys. Steep slopes and short foothills. Bare soil on the tophills and diffuse shrubs and trees vegetation on the slopes, more dense in the valleys	150		No field data	Soil complex (estimated)	Lithic Gypsisols Calcaric Fluvisols			
			Dissected almost flat tophills, severely eroded an with intense surface drainage system. Sparse shrubs and trees on the hills, dense vegetation inside the meandering narrow streams	151		No field data	Soil complex (estimated)	Lithic Gypsisols Petric Calcisols Fluvic Gypsisols			
		I13 – Dissected plateau on gypsiferous substrate	Dissected and eroded subcoastal plateau surface on gypsiferous substrate, with almost flat large surfaces or gently sloping to the coast, steep escarpments and large valleys. Bare soil on the plateau surfaces and diffuse vegetation in the valleys	152		No field data	Soil complex (estimated)	Haplic Calcisols Lithic Gypsisols			
			Eroded plateau escarpments, with rounded ridges and straight or convex slopes, moderately engraved. Diffuse rock outcrops with sparse shrub vegetation and scattered trees, more dense vegetation inside the engravings	153		No field data	Soil complex (estimated)	Haplic Calcisols Skeletal Leptosols Rock Outcrops			

	I2 – Limestone mountains	I21 – Complex limestone mountains with ridges, steep slopes and meandering flat valleys	Complex limestone mountains with rounded ridges and steep slopes. Well develop dendritic drainage pattern with narrow meandering flat alluvial valleys. Sparse shrubs and trees vegetation. Valleys moderately vegetated with trees and shrubs	154		No field data	Soil complex (estimated)	Lithic Leptosols Petric Calcisols Calcaric Fluvisols			
			Large ancient and subrecent alluvio colluvial fans and large colluvial cones down the limestone mountains and hills, on gravelly coarse sediments. Diffuse sheet and channel erosion. Bare soils with sparse shrubs and trees groups, diffuse vegetation inside the erosion valleys	155		No field data	Soil complex (estimated)	Skeletal Calcisols Calcaric Regosols			
			High mountains with steep slopes and well developed surface drainage. Rock outcrop on the ridges and moderately vegetated slopes and valleys with shrubs and trees. Valley pastured	156		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Calcisols Skeletal Fluvisols			
			Coastal limestone escarpments and colluvial cones, with steep slope and moderately dense trees forest on the upper side, diffuse shrubs and trees on the footslopes.	157		No field data	Soil complex (estimated)	Luvic Calcisols Skeletal Leptosols Rock Outcrops			
			Limestone mountain slopes and well developed surface drainage pattern, straight morphology. Dominant bare soils and rock outcrop. Sparse vegetation inside the narrow flat valleys	158		No field data	Soil complex (estimated)	Lithic Leptosols Skeletal Calcisols			
	I3 – Alluvial plains	I31 – Internal alluvio colluvial plains	Depressed fluvio lacustrine basin, with few surface drainage and salt accumulation on surface. Diffuse surface erosion. Bare soils with very sparse shrubs	159		No field data	Soil consociation 8estimated)	Gypsic Solonchaks			

			Alluvial subrecent fluvio lacustrine terraces bordering little fluvio lacustrine areas down mountains. Surface drainage less developed, bare soils with sparse shrubs and few trees on the escarpments and inside the meandering stream traces	160		No field data	Soil complex (estimated)	Calcic Gypsisols Gypsic Solonchaks Calcaric Fluvisols			
			Weakly wavy large alluvial fan covering ancient fluvio lacustrine terraces. Meandering ephemeral stream and vegetated shrub belts alternate to depressed bare soils areas with sand deposition	161		No field data	Soil complex (estimated)	Haplic Calcisols Calcic Gypsisols Arenic Regosols			
			Alluvio-colluvial fan and low hills down the limestone mountains, gently sloping, bordering the internal and coastal alluvial valleys. Narrow ephemeral meandering streams with shrub and trees	162		No field data	Soil complex (estimated)	Skeletal Leptosols Leptic Calcisols			
		I32 – Coastal hills and alluvio colluvial basins	Low complex subrounded hills down the mountains on limestone stratified substrate and some narrow meandering ephemeral streams. Well developed surface drainage. Rock outcrops on the tophills, sparse shrubs and trees on the slopes. Vegetated valleys with trees and shrubs	163		No field data	Soil complex (estimated)	Lithic Leptosols Haplic Calcisols			
			Basalt lava flow fields on terraced surfaces bordering large ephemeral flat streams. Bare soils and diffuse rock outcrops.	164		No field data	Soil complex (estimated)	Rock Outcrops Hyperskeletal Leptosols			
			Weakly wavy coastal shelf alluvial terraces on limestone substrate, severe sheet and channel erosion and steep escarpment to the streams and to the coastline. Bare soils, very sparse shrubs and trees inside the short streams	165		No field data	Soil complex (estimated)	Lithic Leptosols Leptic Calcisols			

			Large meandering flat and braided ephemeral streams on recent coarse alluvial sediments. Bare soils with diffuse shrubs and trees on the border	166		No field data	Soil complex (estimated)	Calcaric Fluvisols Salic Fluvisols			
		I33 – Coastal sandy beaches and plains	Coastal plain and beaches with sandy deposits and surface salt accumulation. Sparse water bodies filling depressions. Bare soils with very sparse dunal shrubs	167		No field data	Soil consociation (estimated)	Tidalic Arenosols			
			Alluvio colluvial and delta coastal area with ephemeral streams channel and lagoonal salted depression, shifting Aeolian sand cover	168		No field data	Soil complex (estimated)	Gleyic Arenosols Calcaric Regosols			
		I34 – Lower coastal plateau surface	Gently wavy and moderately sloped plateau surface in direction to the northern coast, few elevated on the coastal plain, with moderate stream engraving. Bare soils with diffuse shrubs and trees in the streams	169		No field data	Soil complex (estimated)	Calcic Regosols Haplic Calcisols			
			Severely eroded and strongly engraved lower plateau escarpments, with dendritic stream channels. Open bush with sparse shrubs and trees, more dense inside the engravings	170		No field data	Soil complex (estimated)	Skeletal Leptosols Calcic Regosols			
			Alluvio colluvial wavy and eroded coastal hilly plain, with rounded low hills engraved by several meandering ephemeral streams. Bare soils with trees and shrubs concentrated inside the stream channels	171		No field data	Soil complex (estimated)	Haplic Calcisols Calcaric Regosols Skeletal Fluvisols			

L – Central hills and plateau with large glacis on evaporites with dominant Gypsisols	L1 – Hills and mountains	L11 – Limestone and gypsiferous rounded hills on large valleys	Elongated ridges with straight strongly engraved and eroded slopes on limestone substrate. Steep slopes with diffuse stratified rock outcrops. Open bush with sparse shrubs, trees inside the engravings	172		No field data	Soil complex 8estimated)	Skeletal Leptosols Calcic Regosols Rock Outcrops			
			Complex slopes, low wavy hills with isolated limestone relief on plateau surface, severely engraved, on limestone or gypsum substrate with karstic depressions, merging to plateau surface. Alternate vegetated belts with pastured shrubs and trees, diffuse rock outcrops	173		No field data	Soil complex (estimated)	Haplic Calcisols Skeletal Leptosols Rock Outcrops			
			Footslopes, colluvial fans and colluvial valleys down the rounded hills, on gravel and coarse recent sediments, open bush with shrubs and trees, somewhere pastured	174		No field data	Soil complex (estimated)	Skeletal Leptosols Calcic Regosols			
			Large gently sloping glacis, ancient colluvial cones and channel traces, sparse depressions, gravel and coarse sediments. Vegetated belts (shrubs and trees) alternate with bare soils, dense vegetation inside the drainage lines. Evidence of overgrazing	175		No field data	Soil complex (estimated)	Calcic Gypsisols Haplic Calcisols			
	L2 - Plateau	L21 – Flat plateau and glacis on gypsum substrate	Eroded flat glacis with several dendritic drainage lines and colluvial cones. Few karstic surface depressions. Diffuse shrubs and sparse trees, dense vegetation inside the drainage lines	176		No field data	Soil complex 8estimated)	Calcic Gypsisols Gypsic Calcisols Leptic Gypsisols			
			Upper plateau, weakly wavy with isolated low rounded reliefs and diffuse karstic rounded depressions. Diffuse pasture with open bush (shrubs and trees), dense vegetation inside the depressions. Diffuse charcoal production points	177		No field data	Soil complex (estimated)	Calcic Gypsisols Haplic Calcisols Eutric Leptosols			

			Almost flat plateau surface with many rounded karstic depression filled by fine sediments, poor surface drainage pattern. Diffuse pasture on moderately dense bush with shrubs and trees	178		No field data	Soil complex (estimated)	Haplic Calcisols Luvic Gypsisols			
			Complex dissected plateau surface with diffused rock outcrop and several paleodrainage large channels with alternate vegetated belt and bare soils or rock outcrop. Limestone substrate.	179		No field data	Soil complex (estimated)	Calcic Gypsisols Leptic Calcisols			
			Low depressed large and braided paleodrainage traces, somewhat with ephemeral streams filled by alluvio colluvial coarse and fine sediments. Alternate vegetated shrub and trees belt with rock outcrops or bare soil	180		No field data	Soil complex (estimated)	Gypsic Regosols Fluvic Calcisols			
			Large plateau valley with endorheic drainage, somewhere poorly drained, diffuse irrigated and rainfed agriculture and salt accumulation on the escarpments	181		No field data	Soil complex (estimated)	Gleyic Fluvisols Calcaric Solonchaks			
			Ancient large paleodrainage flat valley, low depressed on the plateau surface. Well drained. Open bush with shrubs and trees.	182		No field data	Soil complex (estimated)	Fluvic Gypsisols Luvic Gypsisols			
M – Mudug structural plain and depressions on gypsiferous and limestone substrate, with Gypsisols and Solonchaks	M1 – Flat palins and plateau	M11 – Gypsiferous structural plain with salted depressions	Denudational plain on gypsiferous substrate, with several karstic depressions and paleodrainage traces. Sparse shrub and trees, dense bush vegetation inside the depressions. Pastured	183		No field data	Soil complex (estimated)	Petric Gypsisols Leptic Calcisols			

			Almost flat gypsiferous plateau surface, absent surface drainage pattern and evidence of karstic drainage and rounded depressions (sinkholes). Open bush with diffuse trees and shrubs. Degraded bush by human activity of charcoal production. Pastured	184		No field data	Soil complex (estimated)	Petric Gypsisols Luvic Calcisols			
			Eroded gypsiferous and limestone weakly wavy plateau surface, denudational surfaces with diffuse rounded and elongated salted karstic depressions with endorheic drainage. Degraded open bush by diffuse charcoal production, with dominant shrubs and subordinate trees. Bare soils inside the depressions. Extensive pasture	185		No field data	Soil complex (estimated)	Calcic Gypsisols Luvic Gypsisols Petric Calcisols			
			Ancient drainage traces and large low endorheic inactive depressions on plateau surface, bare soils and degraded open bush with sparse shrubs by human activity (charcoal production). Pastured	186		No field data	Soil complex (estimated)	Leptic Gypsisols Petric Gypsisols Leptic Solonchaks			
			Eroded and degraded gypsiferous plain with poor developed surface drainage and shifted aeolian sand cover, diffuse salted karstic sinkholes. Bare soils alternate to degrade open bush on sand deposits by overgrazing and charcoal production. Salted depressions	187		No field data	Soil complex (estimated)	Leptic Gypsisols Luvic Gypsisols Arenic Luvisols			
			Denudational plateau surface, with poor developed surface drainage, eroded soils with diffuse bare soils and degraded open bush with dominant shrubs. Diffuse charcoal production and pasture	188		No field data	Soil complex				

			Distal plateau surface, with moderate surface paleodrainage traces, bordering large salted and inactive endorheic depressions, few karstic drainage. Gypsum substrate bordering marine limestone. Open bush with sparse trees and shrubs. Pastured with charcoal production	189		No field data	Soil complex (estimated)	Haplic Gypsisols Luvic Gypsisols Petric Gypsisols			
		M12 – Subcoastal structural plain on marine limestone and gypsum	Gently sloping plateau border merging the coastal area with sparse surface paleodrainage traces filled by colluvial sediments. Wind erosion and shifting Aeolian sand cover, open bush with dominant shrubs e subordinate trees. Salt accumulation inside the drain traces	190		No field data	Soil complex (estimated)	Petric Gypsisols Arenic Regosols Haplic Solonchaks			
			Eroded low depressed paleodrainage traces, inactive, on colluvial sediments and gypsiferous substrate. Sparse shrub vegetation with subordinate trees	191		No field data	Soil complex (estimated)	Arenic Gypsisols Gypsic Solonchaks			
			Eroded depressed plain gently sloping to the coast, with low escarpments merging diffuse dendritic surface drainage engravings, diffuse channel erosion, salt accumulation inside the depressions. Bare soils on the plain and open bush on the escarpments and channel traces	192		No field data	Soil complex (estimated)	Leptic Gypsisols Gypsic Solonchaks Arenic Regosols			
			Severely eroded gently sloped alluvio colluvial plain surface to the coastal sandy plain, with almost flat surfaces and low engravings with ephemeral streams. Diffuse salt accumulation on surface. Sparse shrubs and few trees, more diffused inside the engravings	193		No field data	Soil complex (estimated)	Gypsic Solonchaks Fluvic Regosols			


			Alluvial plain bordering sandy coastal plain with shifting aeolian sand accumulation and few surface drainage tracks. Open bush with dominant shrubs, somewhere degraded pasture	194		No field data	Soil complex (estimated)	Calcaric Gypsisols Haplic Solonchaks (Arenic)			
			Large meandering alluvial colluvial valley with ephemeral streams coming from the upper plateau to the coast on recent gravel and sandy gypsiferous sediments. Bare soils or sparse shrubs, more dense inside the streams	195		No field data	Soil complex (estimated)	Calcaric Fluvisols Fluvic Gypsisols Haplic Solonchaks			
	M2 – Large central endorheic basin	M21 - Alluvial plain, salted depressions and escarpments on marine limestone and gypsum substrate	Gently sloping escarpment bordering large salted endorheic depressions, gently sloping morphology, large flat eroded surfaces with bare soils, several surface drainage traces with shrubs dominant, few tree, pastured	196		No field data	Soil complex (estimated)	Petric Gypsisols Haplic Solonchaks			
			Large rounded and elongated salted endorheic depressions with several erosion channel tracks. Poorly or imperfectly drained, bare soils on main flat surface, open bush with diffuse shrubs and few trees	197		No field data	Soil complex (estimated)	Haplic Solonchaks Gleyic Solonetz Gypsic Fluvisols			
			Large endorheic depression borders with few surface drainage tracks and diffuse karstic sinkholes on limestone. Open bush with dense vegetation inside the depressions	198		No field data	Soil complex (estimated)	Gypsic Calcisols Luvic Calcisols Haplic Solonchaks			
			Large depressed plains with several salted rounded depressions, few surface drainage traces and diffuse karstic sinkholes, somewhere filled by aeolian sand. Diffuse open bush with dominant shrubs. More dense vegetation inside the sinkholes. Extensive grazing	199		No field data	Soil complex (estimated)	Gypsic Calcisols Luvic Arenosols Gypsic Solonchaks			

			Gently sloped plain escarpments to the salted depressions, diffuse bush with shrubs and trees, extensive grazing and shifting rainfed cultivations. Diffuse erosion channels traces	200		No field data	Soil complex (estimated)	Calcic Gypsisols Gypsic Solonchaks Haplic Calcisols			
			Ancient salted drainage depressions terraces on structural limestone and gypsiferous plain draining to the salted depressions, diffuse pastured open bush on the terraces and bare soil on the depressed surfaces	201		No field data	Soil complex (estimated)	Gypsic Calcisols Haplic Solonchaks			
N – Central and south coastal plain on aeolian sands and limestone reef, with dominant Arenosols	N1 Ancient coastal plain with sand dunes	N11 – Ancient coastal plain with sand dunes and wind erosion on alluvial sediments, aeolian sand and gypsiferous substrate	Large plain with diffuse shifting aeolian sand accumulation bordering the coastal sandy surfaces, on subsurface limestone and gypsum. Open bush, with dominant trees and shrubs alternate to sandy bare soils and low elongated depressions. Diffuse wind erosion	202		No field data	Soil complex (estimated)	Gypsic Calcisols Luvic Arenosols			
			Consolidate and eroded ancient elongated fossil sand dunes on gypsiferous substrate, gently wavy surfaces and eroded rounded mounds. Very good bush cover with trees and shrubs dominant, sparse bare soils and little salted depressions, evidence of overgrazing	203		202b 203b, 204b	Soil complex with A1-A1-B1-B2-C horizons, deep soils, moderately deep rooting depth, limitations by alkalinity, rockiness and stoniness absents, moderately fine to moderately fine to moderately coarse texture with depth, coarse fragments absents, moderately to highly alkaline with depth, very calcareous, CEC low, salinity absent, alkalinity from absent to high with depth, somewhat excessively drained, high permeability, moderate AWC And (estimate)	Haplic Calcisol (Aridic, Arenic) Luvic Arenosols			
			Fossil ancient sand dunes, intensely weathered, wavy and gently sloping surface with subparallel drainage traces draining to the internal basins. Open bush with dominant trees, intensely pastured with overgrazing and scattered rainfed cultivations	204		329b, 330b 331b	Soil consociation with A-Bk_Ck horizons, moderately deep soils, moderately deep rooting depth, limitation by calcium carbonate and alkalinity rockiness and stoniness absents, medium to moderately coarse texture, coarse fragments absents, moderately to highly alkaline with depth, calcareous, salinity absents, alkalinity absent to high with depth, well drained, high permeability, moderate AWC	Calcic Fluvisols (Hyposodic)			

							And (estimated)				
			Ancient coastline plain, with alluvial deposition with aeolian sand cover, diffuse salted depressions. Bare soils with scattered shrubs and trees inside the few surface drainage traces	205		No field data	Soil complex (estimated)	Haplic Solonchaks Haplic Calcisols			
			Depressed backdunal surfaces, almost flat or weakly concave and weakly wavy, several subparallel surface drainage and old stream channels, aeolian sand accumulation. Open bush with diffuse pasture and sparse rainfed cultivations	206		P95 P99	Soil complex with A-By-Cy horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by gypsum and calcium carbonate, medium texture, coarse fragments absents, moderately alkaline, very calcareous, salinity absent to medium with depth, alkalinity absent, well drained, high permeability, moderate AWC And SOIL WITH Ap-Bi-Ck horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by vertic properties and salinity, fine texture, coarse fragments absents, moderately alkaline, very calcareous, salinity absent to medium with depth, alkalinity absent to low with depth, moderately well drained, moderately low permeability, moderate AWC And (estimate)	Haplic Gypsisols (Calcaric) Haplic Vertisols (Gypsic, Calcaric, Chromic) Ferralic Arenosols			




			Subcoastal discontinuous ancient consolidated sand dunes, strongly weathered, slightly convex morphology, somewhere eroded and drainage on the opposite side from the coast. Dense bush cover with shrubs and trees, diffuse overgrazing	207		No field data	Soil complex (estimated)	Ferralic Arenosol (Aridic) Ferralic Cambisol (Aridic, Rhodic)			
		N12 – Coastal plain and coastal sand dunes fields	Subrecent sand dunes fields, large elongated and wavy aeolian sand accumulation areas, bare soils with sparse herbaceous vegetation.	208		221	Soil complex with AC-C1-C2-C3 horizons, shallow soils, shallow rooting depth, limitation by sandy texture, rockiness and stoniness absents, carse texture, coarse fragments absents, moderately alkaline, not calcareous, CEC very lowm salinity and alkalinity absents, excessively drained, very high permeability, low AWC And (estimated)	Protic Arenosols (Aridic) Haplic Arenosol (Calcaric)			
			Coastal dune fields border, with thin and shifting recent aeolian sand cover on ancient consolidated and depressed sandy surface. Wind erosion and deposition. Bare soils on the dunes, overgrazed open bush in the depressions	209		No field data	Soil complex (estimated)	Ferralic Cambisols (Aridic, Rhodic) Haplic Arenosols (Calcaric)			
			Thin sand aeolian cover on sandy beach recent deposits and backdunal depressions. Diffuse shrubs and trees with bare sandy areas. Diffuse wind erosion	210		No field data	Soil complex (estimated)	Haplic Arenosols (Calcaric) Calcaric Cambisols (Arenic)			
			Elongated salted interdunal depressions, with sand deposit and deflated surfaces by wind erosion. Open bush with sparse trees and shrubs, locally pastured	211		No field data	Soil complex (estimated)	Arenic Cambisols (Aridic) Salic Arenosols			

			Coastal plain, alluvial deposits and sand deflation area with aeolian sand cover, sparse little dune fields on alluvial sediments or on ancient consolidated sand, sparse old alluvial stream channels and depressions. Overgrazed bush with shrubs and trees	212		216 P62	Soil complex with A-C1-C2-C3-C4 horizons, shallow soils, shallow rooting depth. Limitations by coarse texture, rockiness and stoniness absents, coarse fragments absents, highly alkaline, weakly to moderately calcareous with depth, CEC very low, salinity and alkalinity absents, excessively drained, very high permeability, very low AWC And Soil with A-C horizons, moderately deep soils, moderately deep rooting depth, limitations by salinity, rockiness and stoniness absents, moderately fine texture, coarse fragments absents, moderately alkaline, calcareous, medium salinity, alkalinity absent, well drained, moderately high permeability, moderate AWC	Ferralic Arenosols (Aridic) Haplic Fluvisol (Calcaric,Clayic)			
			Beaches and recent marine sand deposits. Bare soils	213		No field data	Soil consociation (estimated)	Protic Arenosol (Aridic)			
O - Shebelle and Juba interriverine platform with dominant Leptosols and Vertisols	O1 – Sandstone plateau	O11 – Wavy sandstone plateau bordering upper Shebelle valley	Lower plateau surface on Shebelle valley, gently wavy to flat morphology with steep shelf escarpment on the valley. Sparse aeolian sand cover. Diffuse subrounded endorheic depressions. Degraded open bush cover with dominant trees and overgrazing evidences	214		No field data	Soil complex (estimated)	Rubic Arenosols (Aridic) Luvic Cambisols (Aridic)			
			Large subrounded endorheic depressions on sandstone plateau with ancient colluvial sediments, almost flat morphology, open bush with diffuse overgrazing and scattered rainfed cultivations	215		No field data	Soil consociation (estimated)	Luvic Arenosols (Aridic)			

			Narrow and steep Shelf escarpments on Shebelle valley with diffuse rock outcrops. Steep slope, sparse trees and shrubs alternate to bare soils	216		No field datas	Soil complex (estimate)	Rubic Arenosol (Aridic) Hyperskeletal Leptosols (Aridic) Rock Outcrops			
			Severely eroded footslope and colluvial cones with colluvial coarse and gravelly sediments from the upper plateau, diffuse engravings stream. Bare soils with sparse trees and shrubs, more concentrated inside the streams	217		No field data	Soil complex (estimate)	Endoleptic Calcisol (Arenic) Haplic Calcisol (Siltic, Chromic)			
			Plateau pediment, gently sloped alluvial fan on gravel and sandy colluvial sediments. Sparse isolated sandstone reliefs and surface sand accumulation. Open bush with shrub and trees, pastured	218		No field data	Soil complex (estimate)	Haplic Calcisol (Siltic, Chromic) Rubic Arenosol (Aridic)			
		O12 – Lower limestone plateau	Large almost flat and eroded lower plateau surface, wavy rounded ridges and karstic drainage pattern with several ancient engraved concave endorheic valleys. Sand accumulation in the valleys. Dense bush cover with dominant trees. Diffuse pasture	219		No field data	Soil complex (estimate)	Hyperskeletal Leptosols (Aridic) Haplic Regosols (Skeletal)			
			Eroded gently sloping plateau surface, with less developed surface paleodrainage pattern and few endorheic depressions. Degraded open bush by overgrazing	220		109b 108b	Soil complex with A-R horizons, shallow soils with shallow rooting depth, limitations by rock substrate or gravels, rockiness absents, stoniness common, medium texture, coarse fragment many, moderately alkaline, calcareous, CEC low, salinity and alkalinity absents, well drained, high permeability, low AWC And Soil with A-R horizons, shallow soils, shallow rooting depth, limitation by rock substrate, rockiness absent, stoniness common, medium texture, coarse fragments many, highly alkaline, very calcareous, CEC very low, salinity and alkalinity absents, excessively drained, high permeability, very low	Epileptic Calcisols (Arenic, Chromic) Calcaric Leptosols (Skeletal, Aridic)			

							AWC				
			Limestone border platform surface open to the coast, on consolidate alluvial sandy and gravelly quaternary deposits, almost flat or gently wavy with diffuse herbaceous natural cover, diffuse rainfed cultivations and extensive grazing	221		110b, 114b, 116	Soil consociation with A1-A1-Btiz,Ckz horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by alkalinity and calcium carbonate, fine texture, coarse fragments absents, highly alkaline, calcareous, CEC high, salinity absent, alkalinity absent to high with depth, moderately well drained, low permeability, high AWC	Grumic Vertisols (Luvic, Calcaric, Hyposodic)			
			Concave eroded valleys and platform border escarpment on consolidated sand and gravels. Diffuse herbaceous vegetation and rainfed cultivations, extensive grazing	222		113b	Soil complex with A1-A1-Btiz,Ckz horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by alkalinity and calcium carbonate, moderately fine to fine texture with depth , coarse fragments absents, highly alkaline, calcareous, CEC high, salinity absent, alkalinity absent to high with depth, moderately well drained, low permeability, high AWC And (estimated)	Grumic Vertisols (Luvic, Calcaric, Hyposodic) Lithic Leptosols (Calcaric)			
	O2 – Upper Shebelle valley hills and mountains	O21 – Gypsum or limestone low hills and limestone mountains on right valley side	Lower limestone concave escarpment on upper Shebelle valley right side, with rock outcrops and colluvium. Dendritic surface erosion channels and streams. Diffuse pastured open bush, more dense inside the stream channels	223		No field data	Soil complex (estimated)	Hyperskeletal Leptosols (Aridic) Haplic Regosols (Skeletal, Calcaric) Lithic Leptosols (Calcaric)			
			Eroded platform border to the limestone escarpment, almost flat or weakly concave morphology. Degraded bush cover by overgrazing	224		321b	Soil consociation with A-Bw-C horizons, rockiness absents, stoniness weak, moderately deep soils with moderately deep rooting depth, limitation by alkalinity, medium to fine texture with depth, coarse fragments common, highly to moderate alkaline with depth, calcareous to very calcareous, CEC low to high, salinity absent, alkalinity high to absent with depth, moderately well	Vertic Calcisols (Chromic, Episodic)			

							drained, moderately low permeability, moderate AWC				
			Alluvio colluvial fans and concave engravings on limestone platform with colluvial sediments and severe surface and channel erosion, sparse pastured bush with shrubs dominant, diffuse bare soils	225		318b	Soil consociation with A-Bz-C horizons, moderately deep soils, shallow rooting depth, limitation by alkalinity, rockiness absents, stoniness weak, medium to coarse texture with depth, coarse fragments many, weakly to moderately alkaline with depth, very calcareous to calcareous with depth, CEC low to very low with depth, salinity medium to absent with depth, alkalinity absent to high with depth, wel drained, moderately high permeability, low AWC	Hyposodic Calcisols (Leptic, Aridic, Siltic)			
			Large glacia down the limestone platforms, with few surface drainage pattern and diffuse bush with alternating bare soils (tiger bush), pastured	226		No field data	Soil complex (estimated)	Epileptic Calcisols (Arenic) Endopetric Calcisols (Arenic, Aridic) Grumic Vertisols (Calcaric)			
			Basalt eroded gently sloped surface, with severe channel and sheet erosion. Diffuse good bush cover, pastured, and bare soils on mounds and sand cover.	227		307b	Soil consociation with A-Bw-C horizons, rockiness weak, stoniness common, moderately deep soils, moderately deep rooting depth, limitation sandy texture, medium to moderately fine texture with depth, common coarse fragments, highly alkaline, calcareous, high CEC, salinity and alkalinity absents, well drained, moderately high permeability, moderate AWC	Endoleptic Calcisols (Arenic)			
			Mountain pediment merging to limestone platform, with gravelly debris fan and moderately steep slopes. Intensely pastured open bush with clear areas	228		No field data	Soil complex (estimated)	Endopetric Calcisols (Arenic, Aridic) Hyperskeletal Leptosols (Aridic) Nudilithic Leptosols (Calcaric)			

			Glacis debris flow large valleys with mass movements and alluvio-colluvial sediments. Bare soil, sparse shrubs and intense overgrazing	229		No field data	Soil complex (estimated)	Haplic Calcisols (Aridic) Calcic Solonchaks			
			Limestone mountains, with ridges and steep slopes. Well developed dendritic surface drainage. Bare soil and rock outcrops on the ridges, sparse shrub vegetation on the slopes, shrub and trees inside the engravings, alternate to bare soils	230		No field data	Soil complex (estimated)	Hyperskeletal Leptosols (Aridic) Nudilithic Leptosols (Calcaric) Rock Outcrops			
			Rounded and weakly wavy limestone platform down mountains reliefs, with pediment and colluvial cones. Surface sand accumulation. Open shrubs with good shrub cover and intense overgrazing	231		102b	Soil complex with A-R horizons, rockiness absents, weak stoniness, shallow soils, shallow rooting depth, limitation by limestone substrate, moderately fine texture, coarse fragments absents, highly alkaline, very calcareous, CEC low, salinity and alkalinity absents, excessively drained, high permeability, very low AWC And (estimate)	Epileptic Calcisols (Chromic) Haplic Regosols (Skeletal)			
			Ancient colluvial pediment bordering a large lateral Shebelle valley, gently sloped morphology with shallow engravings and stream channels. Intense rainfed agriculture	232		100	Soil consociation with Ap-Bti1-Bti2-2C horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitations by hard substrate, moderately fine texture, coarse fragments absents, highly to moderately alkaline with depth, very calcareous, CEC low, salinity absent, alkalinity absent, well drained, moderately high permeability, moderate AWC	Haplic Vertisols (Calcaric, Chromic)			
			Limestone platform large concave internal and inactive alluvial valleys. Less developed surface drainage pattern,. Surface shifting sand accumulation. Pastured open bush	233		No field data	Soil complex (estimated)	Lithic Leptosols (Calcaric) Epileptic Calcisols (Arenic, Chromic) Haplic Regosol (Skeletal)			

			Severely eroded colluvial surface, with diffuse channel erosion and colluvial inactive streams. Open bush with severe overgrazing	234		No field data	Soil complex (estimated)	Lithic Leptosols (Calcaric) Haplic Regosols (Skeletal)			
	O3– Juba hills and mountains	O31 – Wavy basalt platform	Flat or gently wavy platform surface with few depressions and diffuse shallow inactive surface drainage. Bare soil alternate to sparse shrub and trees vegetation in the drainage lines, pastured	235		105b	Soil complex with Ap-A-Btk-C horizons, rockiness absent, stoniness common, moderately deep soils, shallow rooting depth, limitations by alkalinity, moderately fine to fine texture with depth, weak coarse fragments, highly to very highly alkaline with depth, calcareous, CEC low to medium, salinity absent, alkalinity high, moderately well drained, moderately low permeability, medium AWC And (estimated)	Calcic Endoleptic Vertisol (Calcaric, Chromic) Lithic Leptosols			
			Hillslope pediment down the basalt platform, gently sloping, severely eroded with bare soils, sparse shrubs and trees, moderately pastured. Somewhere isolated basalt hills	236		No field data	Soil complex (estimated)	Lithic Leptosols (Calcaric) Calcic Endoleptic Vertisol (Calcaric, Chromic) Epileptic Calcisols (Arenic, Chromic)			
			Severely eroded rounded hills on basalt platform surface, bare soils with sparse shrubs and trees	237		104b	Soil consociation with A-Ck-R horizons, rockiness weak, stoniness common, shallow soil, shallow rooting depth, limitations by basalt substrate, medium texture, common coarse fragments, highly alkaline, calcareous, CEC low, salinity and alkalinity absents, excessively drained, high permeability, low AWC	Epileptic Calcisols (Siltic, Chromic)			
		O32 – Dissected limestone hills	Eroded almost flat dissected hills surface on limestone with several alluvio colluvial valleys, diffuse ephemeral streams in the valleys, pediments on the right side of the valleys. Sparse shrubs and trees, more dense inside the valleys	238		No field data	Soil consociation (estimated)	Lithic Leptosols (Calcaric)			

			Elongated rounded ridges and platform escarpments on limestone with steep slopes and diffuse rock outcrops. Open bush with good density of shrubs and trees.	239		No field data	Soil complex (estimated)	Nudilithic Leptosols (Calcaric) Lithic Leptosols (Calcaric) Hyperskeletal Leptosols (Aridic)			
			Colluvial pediments and foothills on limestone gravels and sands with isolated limestone flat reliefs (mesas). Diffuse narrow valley with ephemeral streams. Open bush with good density of shrubs and trees, sparse bare soils. Diffuse pasture	240		No field data	Soil complex (estimated)	Lithic Leptosols (Aridic) Epilithic Calcisols (Aridic, Siltic) Nudilithic Leptosols (Calcaric)			
	Q4 – Juba right side valley	Q41 – Dissected sandstone platform on the right Juba valley side	Dissected and eroded platform escarpment on sandstone, with rounded hills engraved several alluvio-colluvial engraved valleys. Pediments on bottom side. Well cover by shrubs and trees, diffuse rock outcrops. Sparse pasture	241		No field data	Soil complex (estimated)	Lithic Leptosols Epilithic Calcisols Calcaric Fluvisols			
Q – Shebelle and Juba floodplain with depressions and subrecent river terraces on silty clay sand and gravel alluvial sediments with dominant Vertisols, Solonetz, Fluvisols and Gleysols	Q1 – Shebelle hills	Q11 – Basalt hills and valleys	Eroded steep basalt escarpments and valleys with and lava flow and several engravings. Sparse shrub and trees on the slopes, diffuse shrub vegetation inside the engravings	242		129b	Soil consociation with A1-A2-Bti-Cr-R horizons, rockiness absent, stoniness weak, moderately deep soil, moderately deep rooting depth, limitations by basalt substrate, moderately fine to medium texture, weak to many coarse fragments with depth, moderately to highly alkaline with depth, calcareous CEC high to medium with depth, salinity and alkalinity absents, well drained, moderately high permeability, moderate AWC	Calcic Endoleptic Vertisol (Chromic)			
		Q12 – Gypsum and sandstone eroded hills.	Gypsum and sandstone rounded hills, moderately steep slopes with well developed surface drainage and severe sheet erosion. Rock outcrops, open bush with dominant trees and diffuse pasture with animal tracks	243		No field data	Soil complex (estimated)	Hyperskeletal Leptosols (Aridic) Nudilithic Leptosols (Calcaric)			

			Gypsum and sandstone hills concave pediment , down the gypsiferous hills on main Shebelle valley and on lateral valleys. Severe sheet erosion. Sparse pastured shrubs and trees and shifting bare soils	244		No field data	Soil complex (estimated)	Haplic Calcisols (Siltic, Chromic) Endoleptic Calcisols (Arenic) Lithic Leptosol (Aridic)			
	Q2 – Upper and medium Shebelle floodplain and terraces	Q21 – Ancient and recent terraced surfaces	Upper dissected ancient alluvio-colluvial terraces, down the hills pediment, merging the flood Shebelle plain and its subrecent terraces. Diffuse rainfed cultivations and pastured bush	245		No field data	Soil complex (estimated)	Haplic Calcisols (Siltic, Chromic) Haplic Luvisols (Chromic)			
			Terraced Shebelle lateral valleys, with alluvio-colluvial fine and coarse sediments and ephemeral meandering streams. Diffuse natural trees and shrub vegetation, pasture and rainfed cultivations	246		313b	Soil consociation with A-Bt-C horizons, rockiness and stoniness absents, deep soils and deep rooting depth, moderately fine texture, coarse fragments absents, highly to moderately alkaline with depth, weakly to moderately calcareous with depth, CEC low to high with depth, salinity and alkalinity absents, well drained, moderately high permeability, high AWC	Haplic Luvisols (Chromic)			
			Eroded Shebelle lateral engraved valley, with braided ephemeral streams and diffuse sheet erosion. Few natural vegetation with trees and shrubs, locally pastured	247		No field data	Soil complex (estimated)	Lithic Leptosols (Aridic) Endosalic Calcisols (Clayic) Haplic Luvisols (Chromic)			
			Large subrecent fluvio lacustrine depression on alluvial terraced lateral valleys, slightly concave morphology and diffuse rainfed cultivations.	248		No field data	Soil complex (estimated)	Grumic Vertisols (Calcaric) Endosalic Calcisols (Clayic)			
		Q22 – Upper and medium Shebelle alluvial plain	Pediments and terraced alluvio colluvial cones down the hills merging the terraces surfaces or the flood plain. Gently sloped with convex morphology and severe channel and sheet erosion. Bare soils or sparse trees and shrubs, locally pastured	249		323b	Soil complex with Az-Bkz-Ckz horizons. Rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitation by alkalinity, moderately coarse texture, coarse fragments absents, highly alkaline to moderately alkaline with depth, calcareous, CEC low, low salinity, high alkalinity, well drained, moderately high permeability, low AWC	Sodic Calcisols (Siltic, Chromic) Epileptic Calcisols (Aridic, Siltic)			

							And (estimated)				
			Ancient fourth order alluvial terraces, almost flat or gently sloping on coarse or sandy sediments, with moderately dense trees and shrubs, pastured, few diffusion of rainfed cultivations	250		No field data	Soil complex (estimated)	Calcic Fluvisols (Aridic, Clayic) Lithic Leptosols (Calcaric)			
			Ancient third order alluvial terrace, almost flat and weakly wavy, diffuse paleochannel traces a depressed areas. Rainfed cultivations dominant and sparse open pastured bush	251		303b 314b 315b	<p>Soil complex with A-Bw1-Bw2-C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, moderately fine texture, coarse fragments absents, highly to moderately alkaline with depth, calcareous, CEC low, salinity absent, alkalinity weak, moderately well drained, moderately high permeability, high AWC</p> <p>And</p> <p>Soil with A-Bw-Btk-Ck horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitations by alkalinity and calcium carbonate, medium to fine texture with depth, coarse fragments absents, highly alkaline, calcareous to very calcareous with depth, CEC low, salinity absent, alkalinity absent to weak with depth, moderately well drained, moderately high permeability, moderate AWC</p> <p>And</p> <p>A1-A2-Biz horizons, rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitations by alkalinity, fine texture, coarse fragments absents, highly to moderately alkaline, calcareous, CEC high, salinity absent, alkalinity weak to high with depth, moderately well drained, low permeability, moderate AWC</p>	Haplic Cambisols (Calcaric, Aridic) Calcic Luvisols ((Rhodic) Calcic Vertisols (Calcaric)			

			Subrecent second order alluvial terrace, almost flat, on coarse sediments, diffuse meandering paleochannel traces, sparse trees and shrubs, diffuse bare soils, pastured with scattered rainfed cultivations around human settlements	252		<p>P136,P137, P139, P140, P142, P144, P145, P149</p> <p>305b, 308b</p> <p>P146, P148</p>	<p>Soil complex with A-C1-C2-C3 horizons, rockiness and stoniness absents, deep soils, shallow rooting depth, limitation by salinity, moderately alkaline, calcareous, CEC high, high to weak salinity with depth, well drained, moderately high permeability, low AWC</p> <p>and</p> <p>Soil with A1-A2-Bi horizons, rockiness and stoniness absents, deep soils, deep rooting depth, moderately fine texture, coarse fragments absents, highly alkaline, very calcareous, CEC low to medium, salinity and alkalinity absents, well drained, moderately high permeability, high AWC</p> <p>and</p> <p>Soil with A1-A2-Bi-C horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by salinity, moderately well drained, moderately low permeability, moderate AWC</p>	<p>Fluvic Cambisols (Calcaric, Chromic)</p> <p>Vertic Hypocalcic Calcisols (Aridici, Clayic)</p> <p>Haplic Vertisols (Calcaric)</p>			
			Large sub recent first order alluvial terrace few elevated than the flood meandering plain, flat morphology with several paleochannel traces and moderate sheet erosion. Intense rainfed cultivations and few irrigated cultivations, mostly abandoned	253		333	<p>Soil consociation with A-Bw-Bk-2C horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by calcium carbonate and gypsum, medium texture, coarse fragments absents, highly to very highly alkaline with depth, very calcareous, CEC high, salinity and alkalinity absent, well drained, moderately high permeability, high AWC</p>	Calcic Fluvisols (Siltic)			
			Ancient alluvial terraces on the lower Shebelle floodplain, near the flooding surfaces, flat morphology and ancient drainage pattern traces. Mostly abandoned cultivated area and bare salted soils in the channel traces	254		301b	<p>Soil complex with A-Bz-Btz-Ck horizons, rockiness and stoniness absents, deep soils, shallow rooting depth, limitation by alkalinity, medium to moderately coarse texture with depth, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity low, high alkalinity, well drained, moderately high permeability, low AWC</p> <p>And</p> <p>(estimated)</p>	<p>Luvic Calcisols (Chromic, Sodic)</p> <p>Calcic Solonchaks</p>			

			Large eroded platform terrace near the lower Shebelle alluvial plain. Gently sloping to the plain, sand accumulation on surface. Open bush with overgrazing	255		302b	Soil consociation with A-Bw-C horizons, rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitation by sandy texture, coarse fragments absents, moderately alkaline, not calcareous, weakly to moderately alkaline, CEC very low, excessively drained, high permeability, very low AWC	Rubic Arenosols (Aridic)			
			Upper and medium Shebelle alluvial plain bordering the flooding area, few elevated than the alluvial surface, flat morphology with short soft escarpment to the river. Dominant rainfed cultivations, sparse grazing areas. Locally irrigated orchards	256		319b 325b 327	Soil complex with Ap-Bti-Bi-C horizons, rockiness and stoniness absents, deep soil, moderately deep rooting depth, limitation by alkalinity, moderately fine to fine texture with depth, moderately coarse texture over 100 cm, coarse fragments absents, moderately to highly alkaline with depth, very calcareous to calcareous with depth, CEC high to low with depth, salinity absent to low with depth, alkalinity absent to high with depth, moderately well drained, moderately low permeability, moderate AWC And Soil with A-Bti1-Bti2-C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, moderately fine to fine texture with depth, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity and alkalinity absents, well drained, moderately low permeability, high AWC	Calcic Mazic Vertisols (Endosodic, Pellic) Vertic Calcisols (Clayic)			
			Upper Shebelle eroded alluvial plain escarpment to the flooding area, with several erosion channels and severe surface erosion. Weakly concave morphology, diffuse grazing and sparse rainfed cultivation, mostly abandoned	257		304b	Soil consociation with A-Bt-Ckm horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by alkalinity and petrocalcic horizon, moderately coarse texture, coarse fragments absents, highly to moderately alkaline with depth, moderately calcareous to calcareous with depth, CEC low, salinity absent to low with depth, alkalinity absent to high with depth, well drained, moderately high permeability, low AWC	Endopetric Calcisols (Sodic, Arenic, Aridic)			

			Upper and medium Shebelle meandering flooding area, recent alluvial plain with large meandering paleochannels traces . Intense rainfed and irrigated agriculture, somewhere abandoned	258		309b P139	Soil complex with A1-A2-2B-3C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, moderately coarse to medium texture with depth, coarse fragments absents, moderately to highly alkaline with depth, calcareous, CEC low, salinity and alkalinity absents, well drained, moderately high permeability, high AWC And Soils with A-Bw-2C horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by surface salinity, coarse fragments absents, moderately alkaline, calcareous, CEC high lo medium with depth, salinity high to low with depth, moderately well drained, moderately low permeability, moderate AWC	Haplic Fluvisols (Calcaric, Aridic) Fluvic Cambisols (Calcarici, Chromic)			
	Q3 – Lower Shebelle alluvial plain and internal delta surface	Q31 – Lower Shebelle flooding plain	Shebelle large subcoastal alluvial plain bordering the flooding area and the sand coastal dunes, with several meandering paleochannel traces and depressions Rarely flooded and with diffuse irrigated and rainfed cultivations with sparse grazing areas and abandoned area near the paleochannels	259		209 214 211 P53 P89 P91 P92 P93 P75 P61 P87 P88 210 And	Soil complex with A-Bti-Btiz-Cz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by alkalinity, moderately fine to fine texture with depth, coarse fragments absents, highly alkaline, very calcareous to calcareous with depth, CEC high, salinity absents, alkalinity absent to high with depth, moderately well drained, low permeability, moderate AWC And Soil with A-C1-C2-C3 horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by salinity, moderately fine texture, coarse fragments absents, moderately alkaline, calcareous, CEC high to medium with depth, salinity low to high with depth, alkalinity absent, moderately well drained, low permeability, moderate AWC And Soil with A-Big-Cg horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth,	Calcic Mazic Vertisols (Endosodic, Chromic) Haplic Fluvisols (Calcaric, Siltic) Stagnic Vertisols (Gypsic, Calcaric, Endosalic, Endosodic)			

							limitation by hydromorphic conditions, salinity and alkalinity, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity and alkalinity low to high with depth, imperfectly drained, low permeability, moderate AWC				
			Lower Shebelle meandering flooding area, recent alluvial plain with large meandering paleochannel traces . Intense rainfed and irrigated agriculture, locally abandoned	260		<p>P118 P121 P123 P125 P126 P127 P98 P90 P86 P76 P80 P81 P84 P82 P77 P78 P72 P64 217 P63 P220 P66 P73 218 213 201b</p> <p>And</p> <p>206b P119 P122 P124 P79 P74 P134 219 P128 P85 P70 P58 P59</p>	<p>Soil complex with Ap-Bti-Biz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by alkalinity, moderately fine to fine texture with depth, coarse fragments absents, highly to moderately alkaline, calcareous, CEC high, salinity absents, alkalinity absent to high with depth, moderately well drained, low permeability, moderate AWC</p> <p>And</p> <p>Soil with Ap-C1-C2-C3 horizons, rockiness and stoniness absents, moderately deep soils, deep rooting depth, limitation by calcium carbonate, fine to moderately fine texture, coarse fragments absents, highly alkaline, calcareous to very calcareous with depth, CEC high, salinity and alkalinity absents, moderately well drained, low permeability, high AWC</p> <p>And</p> <p>Soil with Ap-Big-Cg horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by hydromorphic conditions and calcium carbonate, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity and alkalinity absents, imperfectly drained, low permeability, moderate AWC</p>	<p>Calcic Vertisols (Endosodic, Chromic)</p> <p>Calcic Fluvisols (Clayic)</p> <p>Stagnic Vertisols (Calcaric)</p>			

			Coastal levee alluvial plain bordering lower Shebelle flooding plain, almost flat morphology with diffuse depressions, paleochannel traces and sand accumulation. Dense herbaceous and shrub coastal vegetation	261		P42	Soil complex with A-Biz-Cz horizons, rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitations by alkalinity and salinity, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity medium to high with depth, alkalinity high, imperfectly drained, low permeability, low AWC And (estimated)	Salic Vertisols (Sodic, Calcaric) Arenic Fluvisols (Calcaric)			
			Levee coastal alluvial plain, bordering sandy coastal plain and Juba flooding area, diffuse meandering traces and depressions, diffuse rainfed cultivation and sparse pastured bush	262		P103, P103, P105, P107, P111, P112, P114, P115, P116, P120, P96, P101, P104, P106, P108 P100, P102, P94, P97, P113	Soil complex with Ap-Bgi-Cg horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by hydromorphic conditions, moderately fine to fine texture with depth, coarse fragments absents, highly to moderately alkaline with depth, calcareous to very calcareous, CEC high, salinity and alkalinity absents, imperfectly drained, low permeability, moderate AWC And Soil with A-C1-C2 horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by clay texture, moderately coarse to fine texture with depth, coarse fragments absents, moderately alkaline, calcareous to very calcareous, moderate to high CEC with depth, salinity absent to low with depth, alkalinity absent to high with depth, moderately well drained, moderately high permeability to moderately low permeability with depth, moderate AWC And Soil with Ap-Bi-C profiles, rockiness and stoniness absents, deep soils, deep rooting depth, fine to moderately fine texture with depth, coarse fragments absents, highly to moderately alkaline with depth, very calcareous, CEC high, salinity absent to medium with depth, alkalinity absent to low with depth, moderately well drained, moderately low permeability, high AWC	Stagnic Vertisols (Calcaric,Chromic) Haplic Fluvisols (Calcaric, Endosodic) Grumic Vertisols (Endosalic, Calcaric)			

		Q32 – Lower Shebelle internal delta plain	Internal Shebelle large flooding alluvial plain, poorly drained with diffuse water bodies and waterlogging areas. Diffuse intensely old reclaimed irrigated surfaces, mostly degraded and abandoned, with diffuse water logging and salt on surface. Severe flooding risk	263		P132 P133 P135	Soil complex with Ap-Bgz-Cgz horizons, rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitation by salinity, fine texture, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity medium to high with depth, alkalinity absent to weak with depth, imperfectly drained, low permeability, low AWC And Soil with Ap-Bi-C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, fine texture, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity and alkalinity absents, moderately well drained, low permeability, high AWC	Endogleyic Solonchaks (Calcaric) Haplic Vertisols (Calcaric, Chromic)			
			Shebelle delta plain flooding area with meandering river and abandoned meandering traces, diffuse waterlogging and surface salt accumulation. Rainfed and irrigate agriculture on the well drained surfaces, mostly abandoned, dense coastal herbaceous and dense shrub bush on the imperfectly drained surfaces, pastured	264		P52 P41 P39 P680 208 P37 P38 P35 P36	Soil complex with A-Bi-Cz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by salinity, fine texture, coarse fragments absents, moderately alkaline, calcareous, salinity absent to high with depth, alkalinity absent, moderately well drained, moderately low permeability, moderate AWC and Soil with A-Biz1-Biz2-Cz, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by alkalinity, medium to fine texture with depth, coarse fragments absents, moderately to highly alkaline with depth, very calcareous, CEC low to high with depth, salinity absent, alkalinity absent to high with depth, moderately well drained, moderately low permeability, moderate AWC And Soils with A-Bgi-Cg horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by hydromorphic conditions, fine texture, coarse fragments absents, weakly to moderately alkaline, very calcareous, CEC high, salinity absent to medium with depth, alkalinity absent, imperfectly drained, low permeability,	Haplic Vertisols (Gypsic, Calcaric, Bathysalic) Calcic Vertisols (Sodic) Gleyic Vertisols (Calcaric, Pellic)			

							moderate AWC				
			Delta alluvial plain, flooding surfaces with waterlogged depressions, imperfectly drained, with weak colluvial sediments at the borders. Sparse mostly abandoned cultivations, coastal herbaceous and shrubs pastured vegetation	265		<p>P50, P 54, P55, P60</p> <p>P49</p> <p>P51 P57</p>	<p>Soil complex with A-Bg-Cgy horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by hydromorphic conditions, fine texture, coarse fragments absents, weakly to moderately alkaline with depth, calcareous, CEC hgh, salinity and alkalinity absents, imperfectly drained, low permeability, moderate AWC</p> <p>And</p> <p>Soil with A-Cg horizon, rockiness and stoniness absents, moderately deep soils, shallow rooting depth, limitations by hydromorphic conditions, fine texture, coarse fragments absents, salinity absent to medium with depth, poorly drained, low permeability, low AWC</p> <p>And</p> <p>Soil with A-Bi-2Cz horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitations by salinity and alkalinity, medium to fine texture with depth, coarse fragments absents, weakly to moderately alkaline with depth, calcareous, CEC high, salinity absent to medium with depth, alkalinity absent to high with depth, moderately well drained, moderately low permeability, moderate AWC</p>	<p>Stagnic Vertisols (Bathygypsic, Calcaric)</p> <p>Haplic Gleysols (Calcaric)</p> <p>Fluvic Vertic Cambisol (Endosodic, Calcaric)</p>			
	Q4 - Interriverine terraced plateau	Q41 - Terraced plateau escarpment and pediment	Large plateau terraced escarpment slope with several dendritic engravings and ephemeral streams valleys. Sparse aeolian sand accumulation. Good shrub and trees cover and diffuse pasture, moderate diffusion of rainfed agriculture in the valleys	266		No field data	Soil complex 8estimated)	<p>Grumic Vertisols (Calcaric)</p> <p>Haplic Nitosols</p> <p>Calcaric Cambisols</p>			

			Terraced plateau pediment on fine alluvio-colluvial sediments, merging the alluvial coastal plain. Slightly concave morphology. Open pastured bush, overgraze, and diffuse rainfed agriculture	267		No field data	Soil complex (estimated)	Eutric Vertisols Eutric Planosols			
			Terraced large dry valleys engraving the plateau escarpments and pediments. With large colluvial cones merging the alluvial plain. Intensely pastured bush, evidence of overgrazing. Few rainfed cultivations	268		No field data	Soil complex (estimated)	Grumic Vertisols (Calcaric) Eutric Planosols			
			Gently sloping and weakly wavy pediment, with low engraved valleys and sparse sand accumulation. Intensely cultivated terraced plateau with rainfed agriculture	269		No field data	Soil complex (estimated)	Grumic Vertisols (Calcaric) Calcaric Cambisols			
			Coastal lower terraced pediment and subcoastal alluvial plain with tidal traces and few alluvio colluvial sediments from pediment and somewhere with recent alluvial cover. Salt accumulation on surface. Coastal pastured bush	270		P65	Soil consociation with No description and analytical data available	Salic Vertisols (Bathygypsic, Calcaric, Chromic)			
		Q42 – Plateau limestone hills and depressed valleys	Gently sloped and rounded limestone hills and slopes, with convex morphology with colluvial depressions and alternate bare soils with moderately dense bush vegetation, pastured. Rainfed cultivations in the colluvial depressions	271		118b	Soil complex with A-C horizons, rockiness weak, stoniness common, shallow soils, shallow rooting depth, limitations by limestone substrate or gravels, medium texture, coarse fragments common to many with depth, weakly alkaline, very weakly calcareous, CEC low, salinity and alkalinity absents, well drained, high permeability, low AWC And (estimated)	Epileptic Regosols (Aridic, Siltic) Calcaric Vertisols Lithic Leptosols			

	Q5 - Juba lateral terraced valleys	Q51 – Narrow terraced lateral valleys on left Juba valley with rounded hills on gypsum and limestone substrate	Complex eroded hillslope on limestone substrate with rounded hills, rock outcrops and pediments on coarse colluvial sediments. Degraded bush by overgrazing	272		No field data	Soil complex (estimated)	Haplic Vertisols (Calcaric, Chromic) Haplic Regosols (Skeletal, Calcaric) Epileptic Regosols (Calcaric, Skeletic)			
			Complex hills, with eroded slopes and colluvial cones with gravel and fine sediments, moderately steep slopes. Degraded bush by overgrazing	273		119b, 124b 112b	Soil complex with A-R horizons, rockiness weak, stoniness many, shallow soils, shallow rooting depth, limitation by rock substrate, moderately fine texture, coarse fragments many, moderately alkaline, calcareous, CEC low, salinity and alkalinity absents, somewhat excessively drained, high permeability, low AWC And Soils with A-C-R horizons, rockiness weak, stoniness weak, shallow soils, shallow rooting depth, limitation by coarse fragments, texture moderately fine, coarse fragments many, highly alkaline, calcareous, CEC low, salinity and alkalinity absents, somewhat excessively drained, high permeability, low AWC	Epileptic Regosols (Calcaric, Skeletic) Haplic Regosols (Skeletal, Calcaric)			
			Lateral terraced valleys with pediments and colluvial coarse or fine sediments from gypsum and basalt hills. Ephemeral streams and fluvio-lacustrine surfaces at valleys bottom. Open bush, diffuse pasture with evidences of overgrazing	274		115b	Soil consociation with A1-Bk-R horizons, rockiness absents, stoniness common, shallow soils, shallow rooting depth, limitation by rock substrate, moderately fine to medium texture with depth, coarse fragments common, highly alkaline, calcareous, CEC medium, salinity and alkalinity absents, somewhat excessively drained, high permeability, low AWC	Epileptic Calcisols (Chromic)			
			Lateral terraced alluvial valleys with ephemeral water courses, engraving basalt and gypsum hills. Rainfed cultivations and overgrazed bush	275		132	Soil consociation with A1-A1-2C horizons, rockiness absents, stoniness weak, moderately deep soils, moderately deep rooting depth, limitation by coarse fragments, moderately coarse to medium texture with depth, coarse fragments weak, moderately to highly alkaline with depth, very to moderately calcareous with depth, CEC low to medium with depth, salinity low to absent with depth, alkalinity absent, well drained, high permeability, low AWC	Fluventic Calcisols (Arenic)			

			Depressed fluvio-lacustrine alluvial plains bottom to the gypsiferous or limestone hills. Grazing area with sparse bushes and few rainfed cultivations	276		117b 120b And	Soil complex with Ap-Bt-2Cgy horizons, rockiness absents, stoniness weak, deep soils, moderately deep rooting depth, limitations by gypsum and hydromorphic conditions, moderately fine to fine and medium texture with depth, coarse fragments weak, highly to moderately alkaline with depth, calcareous, CEC high, salinity absents, alkalinity absent to high with depth, moderately well drained, moderately low permeability, high AWC Soil with A-Bi-C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, moderately fine texture, coarse fragments absents, moderately alkaline, very weakly calcareous, CEC high, salinity and alkalinity absents, well drained, moderately low permeability, high AWC	Grumic Vertisols (Endogypsic, Calcaric) Endoleptic Grumic Vertisols (Chromic)			
		Q52 – Right Juba valley side, and costal plain terraces, with hills, colluvium and eroded escarpments	Eroded large alluvial fan and colluvial slopes with ephemeral streams on the right side of Juba valley. weakly steep slope, Gypsiferous or limestone substrate near the surface. Bare soils and diffuse open bush with shrubs and trees	277		No field data	Soil complex (estimated)	Lithic Leptosols (Aridic) Epileptic Calcisols (Aridic, Siltic)			
			Short and eroded streams escarpments on the right side of the internal lateral valleys. Bare soils with rock outcrops and sparse shrubs and trees	278		No field data	Soil complex (estimated)	Hyperskeletal Leptosols (Aridic) Haplic Regosols (Skeletal)			
			Severely eroded and engraved slopes on gypsum substrate on the right side of the Juba valley, severe channel and sheet erosion. Degraded open bush with sparse shrubs and trees, overgrazing pasture and bare soils	279		No field data	Soil complex (estimated)	Epileptic Calcisols (Arenic) Lithic Leptosols (Calcaric)			

	Q6 – Juba alluvial valley	Q61 – Upper Juba terraced alluvial valley	Second order ancient alluvial terrace. Weakly wavy with rounded eroded surfaces and paleochannel depressions. Grazing depression and degraded open bush on the rounded elevated surfaces. Shifting rainfed cultivations	280		P150 P151 And	Soil complex with A-Bw-C1-2C2 horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by salinity, moderately coarse texture, coarse fragments absents, weakly to moderately alkaline with depth, moderately calcareous to calcareous with depth, CEC medium, salinity absent to medium with depth, alkalinity absent, well drained, moderately high permeability, moderate AWC Soils with A-Bi-C horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by salinity, salinity low to very high with depth, moderately well drained, permeability moderately low, moderate AWC	Fluvic Cambisols (Bathysalic, Calcaric, Chromic) Gypsic Duric Vertisols (Calcaric, Endosalic)			
			First order subrecent eroded alluvial terrace, almost flat or weakly wavy surfaces, with short strongly eroded escarpment to the flooding alluvial plain. Sand accumulations on surface. Bare soils with sparse shrubs and trees. Diffuse pasture on degraded grazing surfaces	281		P154, P155 P152, P156	Soil complex with A-Bi-C horizons, rockiness and stoniness absents, deep soils, deep rooting depth, salinity absent, well drained, moderately low permeability, high AWC And Soils with A-Biz-Cz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by salinity, salinity low to high with depth, moderately well drained, moderately low permeability, moderate AWC	Haplic Vertisols (Calcaric, Chromic) Salic Vertisols (Bathygypsic, Calcaric, Chromic)			
			Juba river recent alluvial plain and flooding area. Flat morphology Intense irrigated and rainfed agriculture	282		P153	Soil consociation with A-Bw-C horizons, rockiness and stoniness absents, moderately deep soils, deep rooting depth, CEC low to medium, salinity and alkalinity absents	Fluvic Cambisols (Calcaric, Chromic)			

		Q62 – Medium and lower terraced Juba alluvial valley	Large eroded ancient gently sloping terraced surface open on the coastal plain, with paleochannel traces and ancient surface sand accumulation. Open pastured bush and large rainfed cultivation areas	283		No field data	Soil complex (estimated)	Calcic Vertisols Haplic Solonetz			
			Ancient first order fluvio-lacustrine terrace with fine colluvial sediments from hills and slopes. Diffuse erosion channels. Grazing area with sparse rainfed cultivations	284		125b	Soil consociation with A-Bti-Btgzy-Cgyz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by alkalinity and hydromorphic conditions, moderately fine to fine texture, coarse fragments absents, highly to moderately alkaline with depth, calcareous to very calcareous, CEC high, salinity absent to low with depth, alkalinity absent to high with depth, imperfectly drained, low permeability, high AWC	Grumic Vertisols (Endogleyic, Endogypsic, Endosodic)			
			Subrecent alluvial plain, rarely flooded, with eroded ancient fluvio-lacustrine terrace hills remains and paleochannel tracks, short eroded escarpments to the flooding area, locally poorly drained with salt accumulation. Grazing area with sparse rainfed cultivations. Pastured shrubs and trees on the escarpments	285		128	Soil consociation with Ap-Bgy-Btgzy horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by hydromorphic properties, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity and alkalinity absents, imperfectly drained, low permeability, high AWC	Grumic Vertisols (Gleyic, Calcic, Endogypsic)			
			Medium and lower Juba river meandering alluvial valley, flooding area, flay morphology, diffuse rainfed and irrigated cultivations and grazing	286		No field data	Soil complex (estimated)	Fluvic Cambisols (Calcaric) Gleyic Fluvisols (Calcaric)			
		Q63 – Juba valley fluvio lacustrine terraces, delta coastal alluvial and tidal plain	Large fluvio lacustrine terrace with colluvial sediment from upper mountains, open on Juba valley and coastal plain ancient fine sediment from Juba and Togga Faar Barmil rivers, diffuse salted herbaceous and shrub vegetation, pastured	287		No field data	Soil complex (estimated)	Haplic Solonetz Gypsic Solonchaks			

			Ancient sandy consolidated hills bottom to the plateau escarpments and pediments, bordering the coastal plain, rounded and eroded morphology with concave colluvial valleys. Degraded open bush by overgrazing, shifting rainfed cultivations in the valleys	288		No field data	Soil complex (estimated)	Haplic Ferralsols Nudilithic Leptosols (Calcaric)			
			Eroded isolated low hills on alluvial plain, probably ancient severely eroded terraces remains. Bare soils and degrade bush by overgrazing	289		126b	Soil consociation with A-Bi-C-2R horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by rock substrate, moderately fine texture, coarse fragments absents, highly alkaline, very calcareous, CEC high, salinity and alkalinity absents, well drained, moderately low permeability, moderate AWC	Calcic Endoleptic Vertisols (Humic, Chromic)			
			Ancient tidal and alluvial flat surface with several dendritic few depressed water flow traces and rounded depression with waterlogging. Diffuse degraded bush by overgrazing	290		No field data	Soil complex (estimated)	Haplic Solonchaks (Sodic, Arenic) Haplic Vertisols (Calcaric, Hyposalic, Hyposodic)			
			Large low depressed tidal channels bordering the ancient coastline, with diffuse rounded depressions. Diffuse degraded bush by overgrazing, dense bush inside the depressions	291		No field data	Soil complex (estimated)	Haplic Solonchaks (Sodic, Arenic)			
	Q7 – Coastal alluvial plain	Q71 – Coastal alluvial plain with meandering tidal and river channels and waterlogging	Coastal alluvial plain with diffuse depressions and meandering tidal channel traces, sparse levee areas near old channel traces, on recent fine alluvial sediments. Abandoned reclaimed areas with waterlogging and strong salinity on surface, degraded bush with herbaceous and shrubs coastal vegetation, overgrazing. Poorly drained, water table near the surface	292		P3, P5, P33, P40, P44, P46, P48 P1, P32, P43 P12, P45	Soil complex with A-Big-Bicz-Cgz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitations by hydromorphic conditions, salinity and alkalinity, fine texture, coarse fragments absents, moderately alkaline, moderately calcareous, CEC high, salinity and alkalinity absent to high with depth, poorly drained, low permeability, moderate AWC and Soils with A-C1-Cg2 horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by hydromorphic	Stagnic Vertisols (Endosalic, Endosodic, Pellic) Calcaric Fluvisols (Gleyic) Haplic Vertisols (Bathygypsic, Endosodic)			

							<p>conditions, fine texture, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity and alkalinity absents</p> <p>and</p> <p>Soil with A-Bi-Biz-Cz horizons, rockiness and stoniness absents, deep soils, moderately deep rooting depth, limitation by alkalinity, fine texture, coarse fragments absents, moderately alkaline, moderately calcareous, CEC high, salinity absent to medium with depth, alkalinity absent to high with depth, imperfectly drained, low permeability, high AWC</p>				
			<p>Large final Juba meandering alluvial flooding area and delta coastal plain with sea intrusion. Several water filled depressions, diffuse waterlogging and water table near the surface. Sparse fluvial levee surfaces. Irrigated agriculture in the upper part, abandoned old large reclaimed areas near the coast, salted on surface. Herbaceous and shrub coastal vegetation in natural areas</p>	293		<p>P2, P4, P7, P8, P18, P19, P21, P24, P25, P27, P28, P29, P30, P47</p> <p>P6, P13, P17, P22, P26, P31, P67</p> <p>P9, P10, P11, P16, P29, P23, P68</p>	<p>Soil complex with A-Bigz-Cgz horizons, rockiness and stoniness absents, deep soils, shallow rooting depth, limitations by hydromorphic conditions and alkalinity, fine texture, coarse fragments absents, moderately alkaline, calcareous, CEC high, salinity absent to high with depth, alkalinity high, poorly drained, low permeability, low AWC</p> <p>And</p> <p>Soil with A-Biz-Cz horizons, rockiness and stoniness absents, deep soils, shallow rooting depth, limitations by salinity and alkalinity, fine texture, coarse fragments absents, moderately alkaline, very calcareous, CEC high, salinity low to high with depth, alkalinity low to high with depth, imperfectly drained, low permeability, low AWC</p> <p>And</p> <p>Soils with Az-C1-C2 horizons, rockiness and stoniness absents, moderately deep soils, moderately deep rooting depth, limitation by sandy texture, medium to coarse texture with depth, coarse fragments absents, moderately to highly alkaline with depth, moderately calcareous, salinity high to absent with depth, alkalinity absent, moderately well drained, moderately high permeability, low AWC</p>	<p>Stagnic Vertisols (Sodic, Endosalic, Calcaric)</p> <p>Salic Vertisols (Bathygyptic, Endosodic, Calcaric)</p> <p>Salic Fluvisols (Bathygyptic, Calcaric)</p>			

R – Southern mountains on limestone and gypsum, coastal plain with delta plain on alluvial fine sediments and aeolian sands with dominant Leptosols, Calcisols and Gypsisols, on the plains Arenosols and Luvisols	R1 - Togga Faar Barmilil river valley and plain	R11 – Convex and rounded eroded limestone hillslopes, glacis and pediments	Large and extensive and very gently sloping glacis surfaces with sparse low elevated eroded rounded hills on limestone substrate. Few developed surface drainage. Open degraded bush by overgrazing and charcoal production	294		No field data	Soil complex (estimated)	Haplic Regosol (Skeletal, Calcaric) Lithic Leptosols (Calcaric)			
			Hillslope pediments down Juba hills to Togga Faar Barmilil valley, on fine calcaric colluvial subrecent sediments. Diffuse concave engravings. Pastured open bush with more dense cover inside the colluvial engravings	295		No field data	Soil complex (estimated)	Haplic Calcisols (Skeletal) Fluvic Regosols (Arenic)			
			Ancient alluvial fans and large depressions at the head of the main south valley draining to north or south, with low developed surface drainage and locally salt accumulation on surface. Pastured open bush and degraded bush with sparse shrubs on the salted depressions	296		No field data	Soil complex (estimated)	Salic Regosols(Calcaric) Cambic Arenosols			
			Eroded and dissected rounded sandstone hills with engraving and pediments. Diffuse rock outcrops, bare soils, sparse shrubs and trees in the engravings	297		No field data	Soil complex (estimated)	Lithic Leptosols Skeletal Regosols			
			Sandstone hills pediments on moderately coarse sediments, very gently sloped, merging the lower river terraces. Open pastured bush	298		No field data	Soil complex (estimated)	Calcaric Cambisols Arenic Regosols			
		R12 – Fluvio lacustrine internal plain	Large almost flat fluvio lacustrine surfaces, with ancient lagoonal drainage traces and depressions, on clay and sandy fluvio-lacustrine sediments. Open bush with dominant shrubs, pastured	299		No field data	Soil complex (estimated)	Haplic Calcisols Luvic Arenosols Haplic Solonchaks			

			Fluvio lacustrine large surface drainage traces, low depressed on the main fluvio lacustrine surface. Open bush with dense bish inside the depressions	300		No field data	Soil complex (estimated)	Haplic Solonchaks Salic Fluvisols			
			Flat ancient fluvio lacustrine basin terraced border, without surface drainage and several rounded salted depressions. Open pastured bush with dense bush bordering the salted depressions	301		No field data	Soil complex (estimated)	Haplic Solonetz Salic Arenosols			
		R13 - Togga Faar Barmilil alluvial terraced plain and marshland	Subrecent lower valley alluvial plain, sometime flooded with levee surfaces and meandering main river and several meandering ancient tidal traces. Sparse bush vegetation on the levee surfaces, more dense bush vegetation on the channel traces, locally waterlogged	302		No field data	Soil complex (estimated)	Fluvic Gleysols Vertic Calcisols			
			Main meandering river course and surround alluvio-colluvial flooding and marsh area, almost flat morphology. Diffuse marsh herbaceous and shrub vegetation	303		No field data	Soil complex (estimated)	Haplic Solonetz Fluvic Gleysols			
			Low subrecent terraced surface near the Togga meandering alluvial plain, flat morphology. Open pastures salted bush	304		No field data	Soil complex (estimated)	Haplic Solonetz Salic Arenosols			
	R2 – Southern coastal and delta plain	R21 – Salted levee areas and depressed marshland delta plain	Internal delta levee border, with diffuse surface drainage traces, depressions and salted bare soils with sparse pastured open bush areas	305		No field data	Soil complex (estimated)	Gleyic Solonchaks Haplic Solonetz			

			Structural consolidated levee sandy surface on ancient fluvio lacustrine sandy and gravel sediments, bordering delta coastal plain. Pastured open bush with dominant shrubs a subordinate trees	306		No field data	Soil consociation (estimated)	Calcaric Arenosols			
			Internal delta flat surface with complex meandering surface drainage, salted depressions and levee surfaces. Degraded open bush by overgrazing and charcoal production.	307		No field data	Soil complex (estimated)	Haplic Solonetz Fluvic Gleysols			
			Complex coastal meandering drainage traces on delta coastal plain, with large river course and marsh flooding areas. Marsh herbaceous and shrub vegetation	308		No field data	Soil complex (estimated)	Tidalic Gleysols Gleyic Solonetz			
			Dry marsh flat surface bordering the meandering coastal rivers, with large salted depressions and several tidal meandering traces. Bare soils in the depressions, sparse shrubs on the levee surfaces	309		No field data	Soil complex (estimated)	Haplic Solonetz Eutric Gleysols			
			Depressed dry marsh surface bordering coastal ancient sand dunes, open bush with dominant shrubs, pastured	310		No field data	Soil complex (estimated)	Haplic Solonetz Gleyic Solonchaks			
		R22 – Coastal ancient and recent sand dunes, alluvial plain with marsh depressions	Ancient eroded sand dunes or ancient sandy coastal terraces. Rounded surfaces with several depressions and stream traces. Good bush cover, pastured	311		No field data	Soil complex (estimated)	Calcaric Arenosols Vertic Fluvisols			

			Moderately well drained completely flat coastal plain, temporary marsh area with dense vegetation cover	312		No field data	Soil complex (estimated)	Stagnic Vertisols Haplic Solonetz			
			Poorly drained coastal alluvial plain large depressed marsh surfaces, with flooding traces and several little meandering streams. Dense bush cover and intense pasture	313		No field data	Soil complex (estimated)	Haplic Solonetz Calcaric Gleysols Eutric Planosols			
			Flat and somewhere depressed coastal plain bordering the poorly drained coastal area. Intensely pastured open bush	314		No field data	Soil complex (estimated)	Salic Vertic Solonets (Clayic) Haplic Solonchaks (Sodic)			
			Depressed salted and poorly drained coastal area bordering ancient and recent sand dunes or coastal beach. Bare soils with sparse shrub vegetation, weakly pastured	315		No field data	Soil complex (estimated)	Salic Vertic Solonetz (Clayic) Haplic Arenosols (Calcaric) Stagnic Fluvisols (Clayic)			
			Dry marsh coastal plain on sandy marine sediments, with uncertain meandering surface drainage system, good bush cover and intense pasture	316		No field data	Soil complex (estimated)	Stagnic Fluvisols Haplic Solonetz			
			Elongated and eroded ancient sand dunes, elevated on the coastal plain, with poorly drained depressions. Good bush cover, herbaceous vegetation in the depressions	317		No field data	Soil complex (estimated)	Eutric Planosols Gleyic Solonetz			

			Coastal plain surface drainage system, with meandering streams, flooding marsh surface, with good herbaceous and shrub cover.	318		No field data	Soil complex (estimated)	Eutric Gleyisols Haplic Solonetz			
--	--	--	---	-----	--	---------------	--------------------------	-------------------------------------	--	--	--

8. PRELIMINARY LAND EVALUATION

The evaluation for agricultural purpose may be done using different techniques, depending from the available data and the scope of the work.

Soil Map at 250k scale and its soil qualities data, normally allow to apply different evaluation methodologies, qualitative and/or quantitative.

Land Capability (LCC) is a qualitative non parametric classification that involves only qualitative soil data, Land Suitability is a parametric quantitative approach to soil evaluation and gives results for single crops or for specific use.

For Somalia country the LCC is easily applicable, but due to the scope of land evaluation, it doesn't give detailed information about a specific use of the land, so a Land Suitability classification has been applied for irrigation purpose (drop, sprinkler and surface) and for three specific crops.

8.1 LAND CAPABILITY CLASSIFICATION

Land capability classification system is a qualitative classification used to show, in a general way, the suitability of soils as for croplands. Soils are grouped according to their limitations for field crops, their risk of damage if used for crops, and to the way they respond to management. The term "land capability" has been introduced by the Soil Conservation Service of the U.S. Department of Agriculture (Klingebiel and Montgomery, 1961).

Land capability is a different concept with respect to **land suitability** (FAO, 1978), although they are occasionally related to each other. Land capability evaluation is primarily the potential biological productivity of land. Land suitability evaluation involves instead the identification of land use patterns and the economic and environmental feasibility of its current use.

The principles of LCC are the following:

- 1 - areas of land are put into classes ranging from best (Class I) to worst (Class VIII)
- 2 - land allocated to a particular capability class has the potential for the use specified for that class and for all classes below it,
- 3 - the perspective is one of a land use hierarchy: some land uses are more desirable than others (cultivation is preferable to pastures, pastures preferable to woodland etc.),
- 4 - allocation into a particular capability class is based on limitations of the land or restrictions on the range of uses or the management/conservation practices needed for the particular use,
- 5 - commonly considered limitations are erosion hazard, excess water, depth, stoniness, climatic limitations,

8.2 LAND SUITABILITY CLASSIFICATION

Land Suitability is the fitness of a given type of land for a specified use, taking also into account its sustainability. Land suitability assessment methods always use quantitative inputs, but results can be expressed in qualitative as well as in quantitative forms.

In the first case, the results are expressed in qualitative terms only, while in the latter numerical estimates are provided, in physical terms (i.e. crop yields and production) or in economic terms (costs and prices) (FAO, 1976) and refer to a general agricultural use and not to a specific crop or specific use (Land Capability).

Classifications can refer to the actual suitability or consider the potential suitability, which is the suitability after major land improvements that could be implemented in the future. Land utilization types which we considered for the suitability are rainfed agriculture and irrigated agriculture.

For each land utilization type, it is necessary to establish the land-use requirements, which are the conditions which are fully satisfactory, acceptable or unsatisfactory for its management. At the same time, it is necessary to assess the properties of the land units in terms of land characteristics and land qualities. The matching of land-use requirements with land qualities and land characteristics determines the suitability of a particular land unit for a particular land utilization type.

Land qualities represent the immediate requirements of the land utilization types.

They refer either to crop, management or conservation requirements. Examples are radiation regime, moisture availability and soil workability. Land qualities are practical consequences of land characteristics, which are measurable properties of the physical environment directly related to land use, made available after a field survey.

Thus, land characteristics are employed to assess land qualities. For example, to assess moisture availability (which is a land quality) it is necessary to use measured values of rainfall, evapotranspiration, drainage, etc., which are all land characteristics.

The evaluation of land qualities and land characteristics aims to understand if they are satisfactory, acceptable or unsatisfactory for the defined land-use, and can be achieved through a parametric approach, which is a numeral rating of different limitation levels of the land characteristics. Therefore, a five level scale in the range of degree of limitations for the specific land use is realized for each land characteristic considered, according to the results of the agronomic research. The scale ranges from a situation with no limitations to a situation where the land characteristic's conditions are absolutely unfavorable for the land-use considered.

Then, a numeral rating is attributed to each level of limitation in a numerical scale from a maximum value (normally 100), in case of absence of limitations, to a minimum value in case of very severe limitations.

The successful application of the system implies the respect of few rules, in order to avoid repetitions and expresses the ratings in the best way according to the importance of the considered characteristic.

Furthermore, the depth to which the land index has to be calculated must be defined for each land utilization type, and should generally coincide with the normal depth of the root system of each crop in a deep soil, which is the control section (Sys, Van Ranst and Debaveye, 1991). This means that the parameters' values for each soil horizon have to be weighted and summarized up to the control section depth (which is crop-specific), then an average value for the whole profile is obtained.

Thus, the evaluation of the land suitability requires the selection of the land qualities which are more significant for their effects upon the land-use considered, in the area considered,

taking into account also the practicability ease of obtaining access to information for their measure and estimation through the land characteristics correlated.

For each characteristic a subdivision of the measures in different classes is obtained, each related with a degree of limitation which integrate the effects of a number of different characteristics on the quality. The exam of existing scientific literature provides important information for this selection, as well as for the ranking to be assigned to the values obtained.

Then the ranking values are summarized, giving for each land unit a class of suitability. The classes are S1 (suitable), S2 (moderately suitable), S3 (marginally suitable), N (not suitable).

ORDER	DEFINITION	CLASS
Suitable	Land on which sustained use for the defined purpose in the defined manner is expected to yield benefits that justify required recurrent inputs without unacceptable risk to land resources on the site or in adjacent areas.	S1: suitable S2: moderately suitable S3: marginally suitable
Not Suitable	Land having characteristics which appear to preclude its sustained use for the defined purpose in the defined manner or which create production, upkeep and/or conservation problems requiring a level of recurrent inputs unacceptable at the time of the interpretation.	N: not suitable N1: actually unsuitable but potentially suitable. N2: actually and potentially unsuitable.

Tab. 5 - FAO Land Suitability classification.

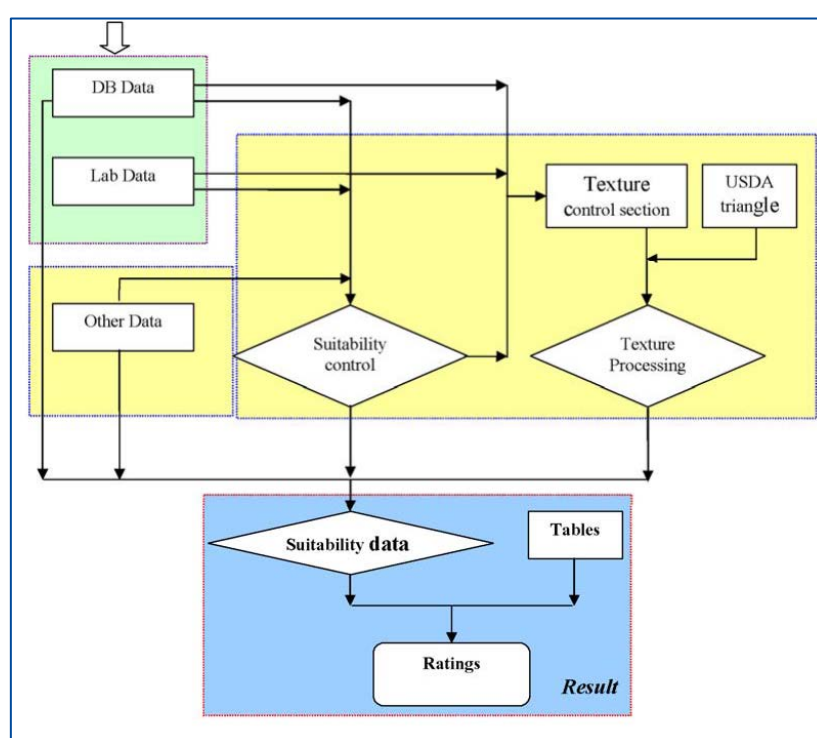


Fig. 16 – Flowchart for suitability data processing

8.2 SUITABILITY CLASSIFICATION FOR IRRIGATED AGRICULTURE

Evaluation will be performed for two different types of irrigation: surface irrigation, and drip irrigation.

To evaluate the land suitability for irrigated agriculture, the parametric evaluation system was used (Sys *et al.*, 1991). This method is based on morphology, physical and chemical properties of soil. The followings parameters were considered for 80 cm control section depth:

Landscape parameters:

- Slope % - Calculated from SRTM DEM 30X30m
- Surface coarse fragments %
- Erosion risk (optional)– calculated using the USLE/LEAM method
- Flooding risk – estimated
- Water table – cm from surface (if available)

Soil parameters:

- Soil rooting depth in cm – derived from profiles description
- Texture (USDA classes)
- KSat (Permeability) cm/day - classes
- Internal drainage -. Classes
- Structure – classes derived from profile description
- AWC (available water capacity) – calculated using pedotransfer function

Fertility parameters:

- pH in H²O
- Salinity in dS/m
- Alkalinity – calculated ESP %
- CEC meq/100g - measured or calculated using pedotransfer function

Using the above data for each Soil Land Units, the following matching tables for surface and drip irrigation was defined and applied to the model for soil suitability irrigation results.

Rating table for surface irrigation suitability (Control section = 80 cm)						
Suitability class	S1	S2	S3	N1	N2	Weight
Rating	100	85	65	45	25	0
Landscape (t)						
Slope %	<3	3-5	5-8	8-16	>16	1
Erosion risk (USLE modified)	0 – 0.2	0.2 – 0.5	0.5 – 1.0 1.0 – 2.0	2.0 – 4.0 4.0 – 6.0	> 6.0	1
Flooding risk	1 -. No floods	2-Very rare with short period (< 2 days) 3- Rare with short period (2-3 days)	4 – Common for less than 1 week	5 – Often for less than 1 week	6 – Often for more than 1 week	1
Soil (s)						
Surface coarse fragments	1 – (< 5%)	1 – (< 5%)	2 – (5 – 10%)	3 – (10-25%)	4 – (25 – 35%) 5 – (>35%)	1
Internal drainage	4- Well drained	3 - Moderately well drained 5 - Somewhat excessively drained	2 - Somewhat Poorly drained	1 - poorly drained	6 - No drainage	1
Rooting depth (cm)	>100	80-100	60-80	60 - 20	<20	2
Texture	CL, L, SiL	SCL, SiCL	Si, SiC	C, SL, SC	LS, S	1

Structure	2 – fine blocky	1 – fine granular /crumb 3 – medium blocky, coarse granular	4 – coarse blocky	5 – Prismatic medium or coarse	6 – Columnar or massive	1
KSat (permeability cm/day)	3 - Low 0.86 – 86.0	4 - Moderately low 0.86 – 8.64	5 - Moderately high 8.64 – 86.4	6 - High 86.4 – 864.0	1 - Saturated < 0.086 7 - Very high >864.0	1
AWC mm (available water capacity)	>250	200 - 250	150 - 200	100-150	< 100	1
Water table (cm from surface)	>100	80-100	100-50	25 - 50	<25	1
Fertility (f)						
pH	6.5-7.0	6.0–6.5 7.0-7.5	6.5 – 5.5 7.5 – 8.5	<5.5 8.6-9.0	<4.5 >9.0	1
Salinity dS/m	< 3	3 - 5	5 - 9	9 - 12 ESP 8 – 15%	> 12 ESP > 15%	1
Alkalinity (ESP%)	<6	6-10	10-15	>15	>15	1
CEC (meq/100gr)	>18	12-18	10-12	5 - 10	<5	1

Tab. 6 – Matching table for surface irrigation suitability (in yellow the lacking data)

Rating table for drip irrigation suitability (Control section = 80 cm)						
Suitability class	S1	S2	S3	N1	N2	Weight
Rating	100	85	65	45	25	0
Landscape (t)						
Slope %	<5	5-8	8-16	16-30	>30	1
Erosion risk (USLE modified)	0 – 0.2 0.2 – 0.5	0.5– 1.0	1.0 – 2.0	2.0 – 4.0 4.0 – 6.0	> 6.0	1
Flooding risk	1 -. No floods	2-Very rare with short period (< 2 days) 3- Rare with short period (2-3 days)	4 – Common for less than 1 week	5 – Often for less than 1 week	6 – Often for more than 1 week	1
Soil (s)						
Surface coarse fragments	1 – (<5%)	2 – (5-10%)	3 – (10-25%)	4 – (25–35%)	5 – (>35%)	1
Internal drainage	4 - Well drained	3 - Moderately well drained	5 - Somewhat excessively drained 2 – Somewhat poorly drained	1 - Poorly drained	6 - No drainage	1
Rooting depth (cm)	>90	70-90	50-70	20 - 50	<20	2
Texture	CL, SiL, L	SiCL, Si	SCL, C, SC, SiC	LS, SL	S	1
Structure	1 – fine granular /crumb 2 – fine blocky	3 – medium blocky, coarse granular	4 – coarse blocky	5 – Prismatic medium or coarse	6 – Columnar or massive	1
KSat (permeability cm/day)	4 - Moderately low 0.86 – 8.64	3 - Low 0.86 – 86.0 5 - Moderately high 8.64 – 86.4	6 - High 86.4 – 864.0	2 - Very low < 0.086 7 - Very high >864.0	1 - Saturated < 0.086 7 - Very high >864.0	1
AWC mm (available water capacity)	>200	150 - 200	100 - 150	50 - 100	< 50	2
Water table (cm from surface)	>100	80-100	100-50	25 - 50	<25	1
Fertility (f)						
pH	6.5-7.2	6.0–6.5 7.2-7.9	6.0 – 5.0 8.0 – 8.4	<5.0 8.5-9.0	<4.5 >9.0	1
Salinity dS/m	< 3	3 - 5	5 - 9	9 - 12 ESP 8 – 15%	> 12 ESP > 15%	1
Alkalinity (ESP%)	<6	6-10	10-15	>15	>15	1
CEC (meq/100gr)	>18	12-18	10-12	5 - 10	<5	1

Tab. 7 – Matching table for drip irrigation suitability (in yellow the lacking data)

Rates are assigned to the parameters according to the tables indicated above, and the final suitability rates calculation is done using the mean of the weight for each parameters. The final suitability class I given relating the following rating values:

Rating	Suitability class
85 - 100	S1 - Suitable
65 - 85	S2 – Moderately suitable
45 - 65	S3 – Marginally suitable
25 - 45	N1 – Temporary unsuitable
0 - 25	N2 – Permanently unsuitable

Tab. 8 – Rating and suitability classes for irrigation

8.3 LAND SUITABILITY FOR SPECIFIC CROPS

The same methodology as for irrigation, but using different parameters allow calculate a land suitability for 3 specific crops as forage, mais, sorghum (or rice, bananas and so on) .

In this case to create the matching table need **soil data** and **crop data** using more parameter than for irrigation suitability.

An example matching table and the related values are reported in the followings table. The parameters for crops will be defined by literature and several experience for specific country and climate.

Rating table for xxx crop suitability (Control section = 80 cm)						
Suitability class	S1	S2	S3	N1	N2	Weight
Rating	100	85	65	45	25	0
Climate (c)						
Rainfall mm/year	600-700	500-600 700-800	300-500 800-1000	<300 >1000	<300 >1000	1
Medium daily temperature	14-15	12-13	5-12	0-5	<0	2
Landscape (t)						
Slope %	<5	5-10	10-15	15-25	>25	1
Elevation m slm	300 - 500	500–700 200-300	700-900 100-200	>900 <100	>900 <100	1
Aspect	Flat SE-SO	S – NE - E	SO - O	N - NO	N	1
Stoniness (%)	<1	1-3	3 -15	15 - 35	>35	1
Rockiness (%)	<2	2-5	5-10	10-50	>50	1
Soil (s)						
Internal drainage	Well drained	Moderately well drained Somewhat Poorly drained	Somewhat excessively drained Poorly drained	Excessively drained, very poorly drained	No drainage, Excessively drained	1
Rooting depth (cm)	>100	70-100	50-70	50 - 35	<35	2
Texture	L, SLC, SiL	CL, SL, SC	Si, FLA, AL,	C < 60%, LS	S, C > 60%	1
Coarse fragments (%)	<5	5-10	10-25	25–35	>35	1
KSat (permeability mm/h)	Moderately high 1 – 10 □	Moderately low 0.1 – 1 □	low 0.01 – 0.1 um/s high 10 – 100 um/s	Very low < 0.01 um/s Very high >100 um/s	Very low < 0.01 um/s Very high >100 um/s	1
AWC mm (available water capacity)	>200	150 - 200	100 - 150	50 - 100	< 50	2
Water table (cm from surface)	>100	80-100	100-50	25 - 50	<25	1

Fertility (f)						
pH	5,5-7,2	5.0-5.5 7.2-8.0	4.5 – 5.0 8.0 – 8.5	<4.5 8.5-9.0	<4.5 >9.0	1
Salinity dS/m	< 3	3 - 5	5 - 9	9 - 12 ESP 8 – 15%	> 12 ESP > 15%	1
Alkalinity (ESP%)	<6	6-10	10-15	>15	>15	1
CEC (meq/100gr)	>18	12-18	10-12	5 - 10	<5	1
Calcium carbonate %	<8%	8-15%	15-25%	25-35%	>35%	2
Active calcium carbonate %	<2.5%	2.5-5%	5-8%	>8%	>8%	2

Tab. 9 – Suitability matching table for specific crop example

8.4 PROVISIONAL SUITABILITY RESULTS AND FURTHER ANALYSIS

Somalia soil data are implemented in a specific database for a semiautomatic suitability classification. Due the present available data, we have only 312 soil profiles in the whole country and complete data only for 71 Land Units of 318.

This means that for 247 Land Units we have only an estimated Soil Classification without any other soil qualities data.

As in the following picture, the total surface without soil data are 47,254,781 ha, 74,6% of the total Somalia surface. So, only for the 25.4 % of the whole Somalia country can be obtain a suitability using the existing data.

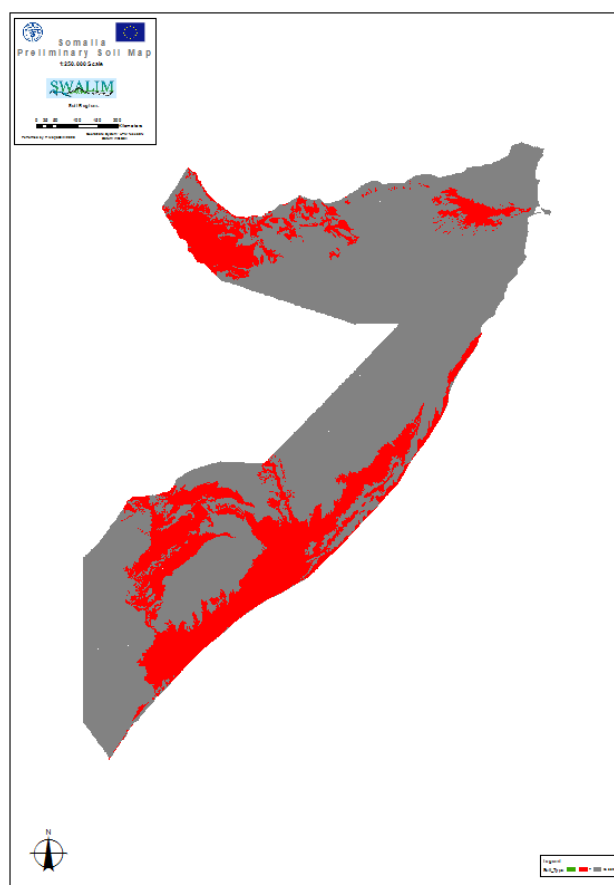


Fig. 17 – Distribution of the Land Units with soil data (in red), and with estimated soil classification (in grey)

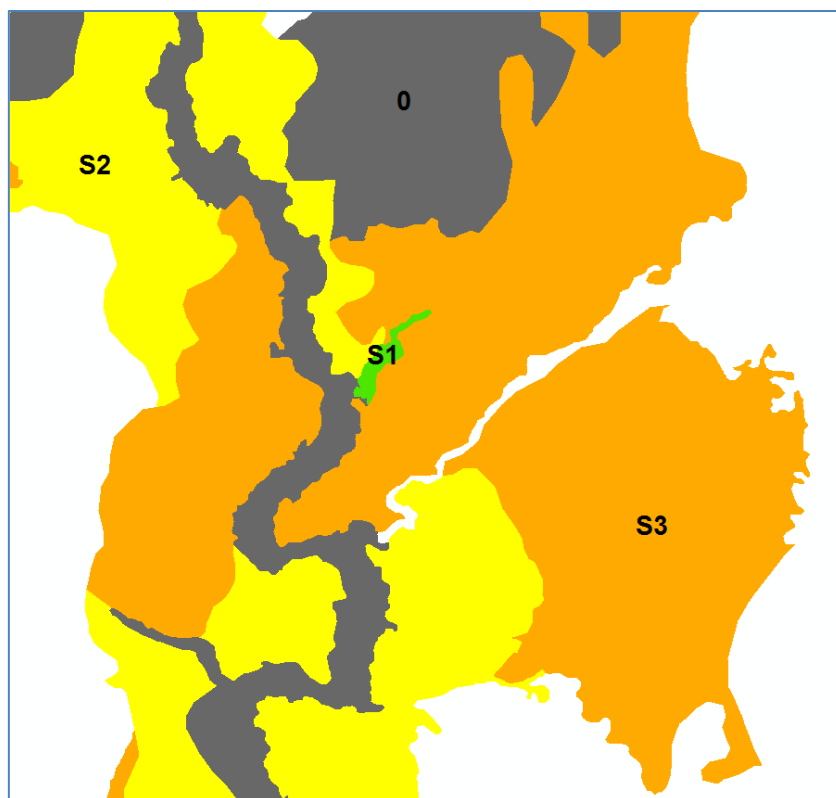


Fig. 18 – Surface irrigation suitability in a sample area using existing data

In Fig. 18 a provisional surface irrigation suitability has been done using the existing data in a sample Juba area, where soil data are almost abundant. Despite the good data availability, many areas, in grey color, mean that there are parts of the land without soil data, so the suitability elaborations are affected by the absence of data.

Due to the scarcity of data we have two ways to acquire soil data for all Somalia country and to complete the land evaluation:

1. Using WOSIS (World Soil Information Service) Soil Profile Database by ISRIC to extrapolate soil data from surrounding countries. See in Fig. 19 the distribution of soil data in Somalia surrounding countries.
2. Using the Africa Soilgrids – Global gridded Information by ISRIC, where all needed soil data are available in raster format with 250m resolution. SoilGrids is a system for global digital soil mapping that uses state-of-the-art machine learning methods to map the spatial distribution of soil properties across the globe. SoilGrids prediction models are fitted using over 230,000 soil profile observations from the WoSIS database and a series of environmental covariates.

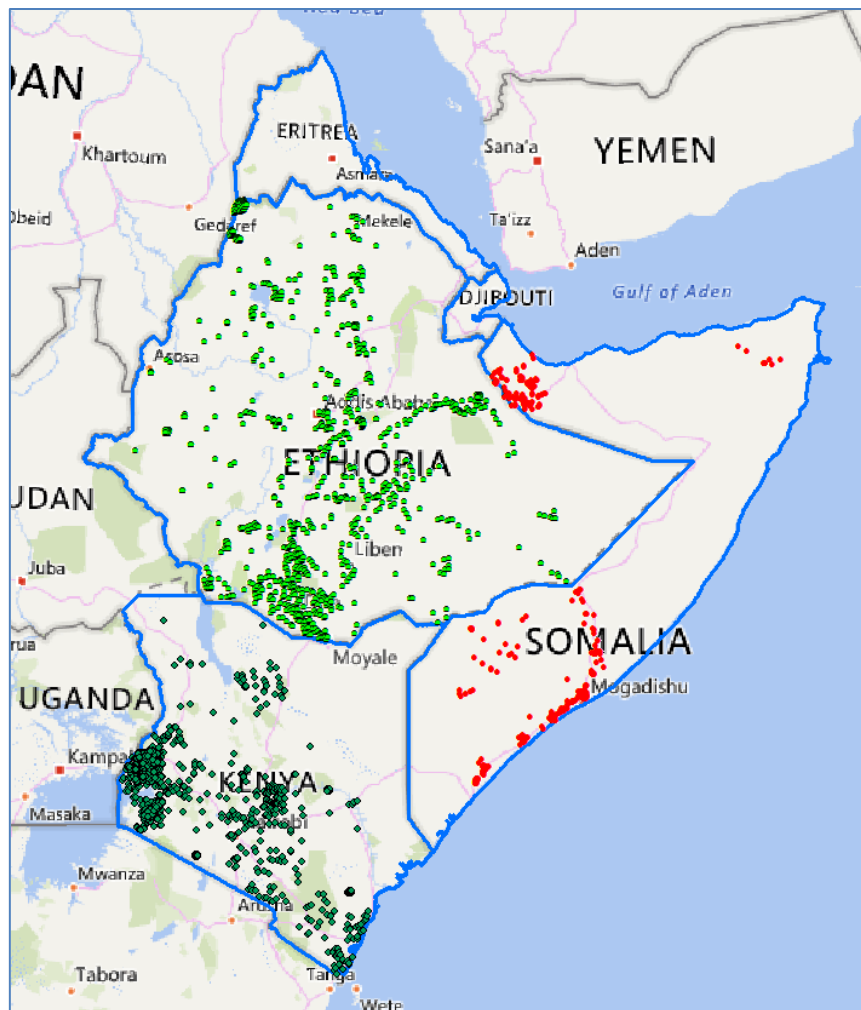


Fig. 19 – WOSIS soil profile data for Somalia and surroundings countries

Using Soilgrids is possible to derivate alla needed data (last update 2016) at 6 different depths as:

- Bulk density
- Surface coarse fragments
- Rooting depth
- Organic Carbon
- Soil pH
- Soil texture (sand, silt and clay)
- Cation exchange capacity
- Exchangeable Ca,Mg,K,Na
- Total Nitrogen
- Calcium carbonate
- Salinity (EC)
- Alkalinity (ESP %)

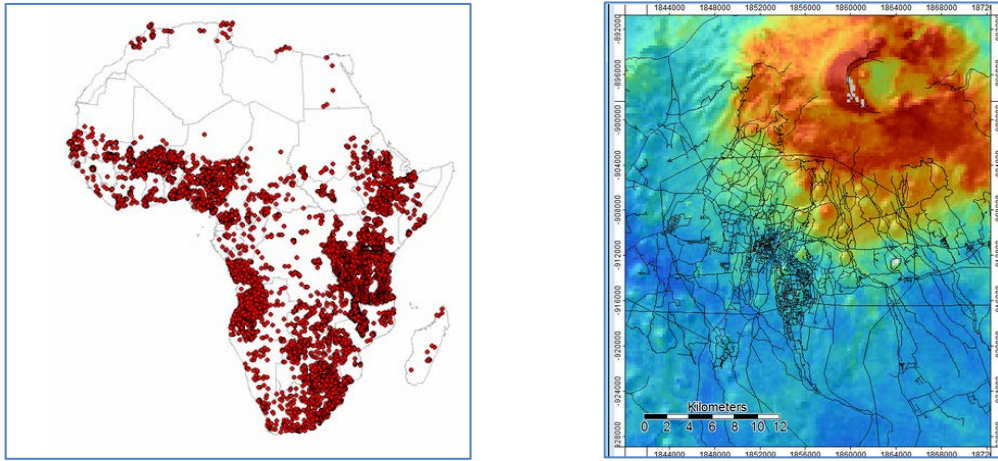


Fig. 20 – Distribution of soil sample location in Africa used to build spatial predictive model and data example at 250 m resolution for Organic Carbon content

So, considering the good reliability of Soilgrids, my opinion is that before to finalize the suitability elaborations using only existing data, with worse results, is better to change the plan for final elaborations with the integration of Soilgrids to exiting data.

Bibliography

- Abbate, E. et al., 1994. Geological Map of Somalia, scale 1:1.5 mln. Somali National University & CNR, Italy
- Alim, Musse Shaiye, 1987. Soil classification and land suitability studies in the Lower Shabelle Region, Somalia. Dept. of Soil Science. University of Uppsala, Sweden.
- Boitt M.C., Langat F.C., Kapoi J. K. – 2018 - Geospatial agro-climatic characterization for assessment of potential agricultural areas in Somalia, Africa
- Bonnemayer, J., 2006. Land use and land resources evaluation. Methodology. FAOSWALIM Internal Report. March 2006. Nairobi.
- Di Gregorio A. and Jansen L.J.M. (2000) - Land Cover Classification System (LCCS). Classification, concepts and user manual. FAO, Rome.
- FAO-Lockwood, 1967. Agricultural and Water Surveys Somalia. Final Report. Vol I: General. Project FAO/SF:36/SOM
- FAO-Lockwood, 1968. Agricultural and Water Surveys Somalia. Final Report. Vol III: Landforms and Soils. Project FAO/SF:36/SOM
- FAO, 1976. A framework for land evaluation. Soils bulletin No 32. Rome.
- FAO (1979) - Soil survey investigation for irrigation. Soils bulletin n.42, FAO Rome,
- FAO, 1983. Guidelines: land evaluation for rainfed agriculture. Soils Bulletin No 52. Rome.
- FAO, 1984. Land evaluation for forestry. Forestry Paper 48. Rome
- FAO, 1985. Guidelines: land evaluation for irrigated agriculture. Soils Bulletin No 55. Rome.
- FAO, 1989. Arid Zone Forestry. FAO Conservation Guide No. 20. Forestry Dept. Rome
- FAO (1990) - Guidelines for soil description, pp. 69. FAO, Rome, Italy.
- FAO, 1991. Guidelines: land evaluation for extensive grazing. Soils Bulletin No 58. Rome.
- FAO, 1993. Guidelines for land-use planning. FAO Development Series 1. Rome.
- FAO (1995) - Global and national soils and terrain digital databases (SOTER). Procedures manual. World Soils Resources Reports, 74 Rev. 1, pp. 125. FAO, Rome, Italy.
- FAO, 1996. Agro-ecological Zoning – Guidelines. Soils Bulletin 73. FAO, Rome.
- FAO, 1998. The Soil and Terrain Database for Northeastern Africa. FAO Land and Water Digital Media Series no. 2. Rome.
- FAO, 2001. FAOCLIM. Climatic Database (1961-1990). Sustainable Development Department. FAO, Rome.
- FAO. 2003. Data Sets, Indicators and Methods to Assess Land Degradation in Drylands. Rome, Italy.
- FAO, 2007. Land Evaluation. Towards a revised framework. Land and Water Discussion Paper 6. FAO, Rome.

- FAO ISRIC (2014) - World reference base for soil resources. FAO Rome, pp. 88.
- FAO-SWALIM. 2007. Somalia Dynamic Atlas. SWALIM, April 2007. Nairobi, Kenya.
- FAO-SWALIM Technical Report L-14: Omuto, C.T., Vargas, R. R., Alim, M.S., Ismail, A., Osman, A., Iman. H.M. 2009. Land degradation assessment and a monitoring framework in Somalia. Nairobi, Kenya
- Horn Relief, 2006. Environmental study of degradation in the Sool plateau and Gebi valley: Sanaag region of northern Somalia.
- Kinnell P.I.A. (2010) Event soil loss, runoff and the Universal Soil Loss Equation family of models: A review - Journal of Hydrology, Volume 385, Issue 1, p. 384-397.
- Natural Resources Conservation Service, USDA, (1998) - Field book for describing and sampling soils, version 1.1.
- O'Connor K. F., Overmars F. B., Ralston M. M. (1990). Land evaluation for nature conservation. Conservation Sciences Publication No. 3. Department of Conservation, Wellington, New Zealand.
- Panagos P., Borrelli P. et al. - Estimating the soil erosion cover-management factor at the European scale – Elsevier (2015)
- Pavlovic P. et Al. (2017) – The Soils of Serbia – Springer
- Shiskov T., Kolev N. (2014) – The Soil of Bulgaria - Springer
- Sys C., Van Ranst E., Debaveye Ir.J and Beernaert F., (1993). Land evaluation, part III. Crop requirements. Agriculture publications n.7, General Administration for Development Cooperation. Brussels, Belgium, pp.166.
- Sys I., Van Ranst E., and Debaveye J. (1991) - Land evaluation, part II. Methods in land evaluation. Agriculture publications n.7, General Administration for Development Cooperation. Brussels, Belgium pp. 70-76.
- USDA-United States Department of Agriculture (2014) - Key to soil taxonomy. Soil survey Staff, 12th edition, Blacksburg, VA, Pocahontas Press.
- van Velthuisen, H. and Verelst, L. 1995. Crop Production System Zones of the IGADD Sub-region. Agrometeorology Working Paper Series N. 10. IGADD-FAO. Rome.
- Vargas, R.R., Alim, M.S. and Omuto, C.T., 2007. Soil Survey of the Juba and Shabelle riverine areas in Southern Somalia. Technical Project Report L-08. FAOSWALIM. Nairobi.
- Vargas, R. R., Alim, M. 2007. Soil survey of a Selected Study Area in Somaliland. FAO-SWALIM. Project Report L-05. Nairobi, Kenya.
- Venema, J.H. and Vargas, R. R. 2007b. Land suitability assessment of the Juba and Shabelle riverine areas in S. Aspinall, R. J. (1995) - Geographic information systems: their use for environmental management and nature conservation. Parks, 5: 20-31.
- Wang e: et Al. (2006) - Predicting Soil Erosion for Alternative Land Uses - J. Environ. Qual. 35:459–467

Wischmeier and Smith's (1978) – Predicting rainfall erosion losses a guide to conservation planning -
USDA Southern Somalia. Technical Project Report L-09. FAOSWALIM. Nairobi.

