

Soil Resources status and its priority for sustainable management in Eritrea

Kiflemariam Abraha
Soil Researcher
NARI-ERITREA

1. INTRODUCTION

- The State of Eritrea is located between latitudes $12^{\circ} 42' \text{ N}$ to $18^{\circ} 2' \text{ N}$ and longitudes $36^{\circ} 30' \text{ E}$ to $43^{\circ} 20' \text{ E}$, in the north-eastern part of Africa.
- Eritrea is bordered by the Red Sea to the east with about 1,200 km of coastline, by Sudan on the north-west, by Ethiopia to the south and west, and by Djibouti on its south-eastern extreme .
- The country has an area of about **124,000 km²** .
- It is situated in the Sahelian zone with high variation in topography and temperature and particularly the rainfall pattern is erratic with high variation from year to year.


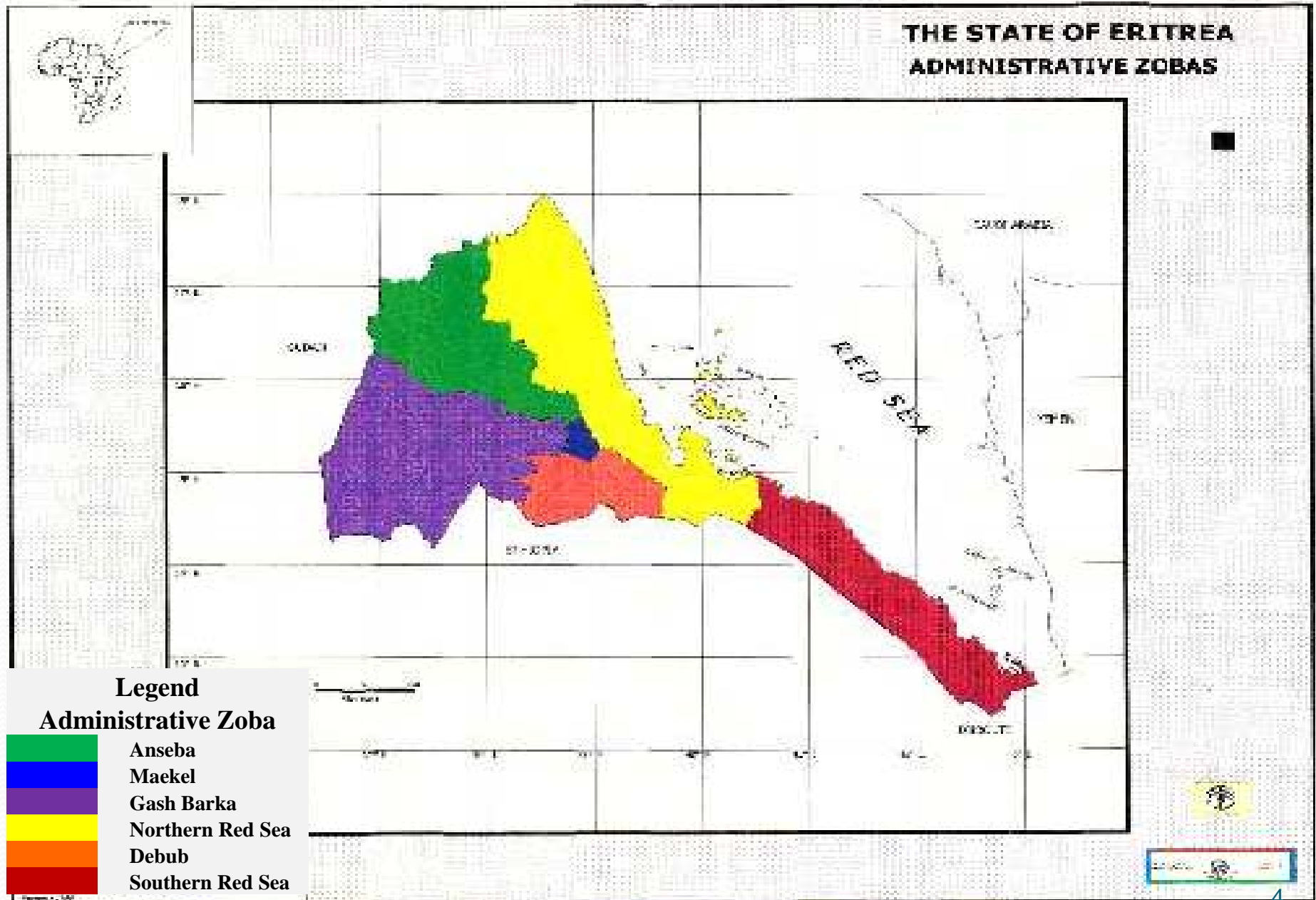

- 
- Eritrea has three distinct physiographic zones:
 - The **Red Sea Coastal Plain**-sandy and desert like, characterized by low hills, ridges, and rock out crops dominantly of Tertiary and quaternary sediments and volcanic.
 - **Central Highland**- consists of heavily eroded plateau running north to south down the centre of the country with Precambrian basement complex schists and intrusive granite. Towards the south, the basement complex is overlain Mesozoic sediments sandstone, and Tertiary basalts.
 - **Western Lowland**- the western edge of the plateau is inclined down to the western plains at about 600 m above sea level. To the east the plateau is an abrupt steep escarpment.

Figure 1. The State of Eritrea - Administrative ZONES /Zobas



Land use systems in Eritrea (1994 FAO)

	Hectares	Percent
Cultivated Rainfed Land	562, 680	4,62
Irrigated Land	22,000	0.18
Disturbed Forest	53,000	0.43
Forest Plantations	10,000	0.08
Woodland and Shrub Land	673,000	5.52
Browsing and Grazing Land	6,821,320	55.96
Barren Land	4,047,000	33.21
Potential Irrigable Land	(600,000)	(4.92)
Potential Rainfed Land	(904,320)	(7.42)
Total	12,189,000	100.00



Crop production varied considerably over the years mainly due to large variation in rainfall. For example in 1998 a bumper harvest has been recorded with total production of cereal and grains estimated at 468,000 tons compared to 149,000 tons to the previous season.

Climate

- The climate of Eritrea ranges from hot arid in the coastal plain areas to temperate sub-humid in isolated micro-catchments in the eastern highland escarpment.
- Total annual rainfall tends to increase from north to south, from less than 200 mm at the northern border with Sudan, over 800 mm in a restricted area on the southern border with Ethiopia.
- Mean temperatures range from 16° C in the highlands to extreme highs of about 30° C along the Red Sea coast.

3. SOILS AND TOPOGRAPHY

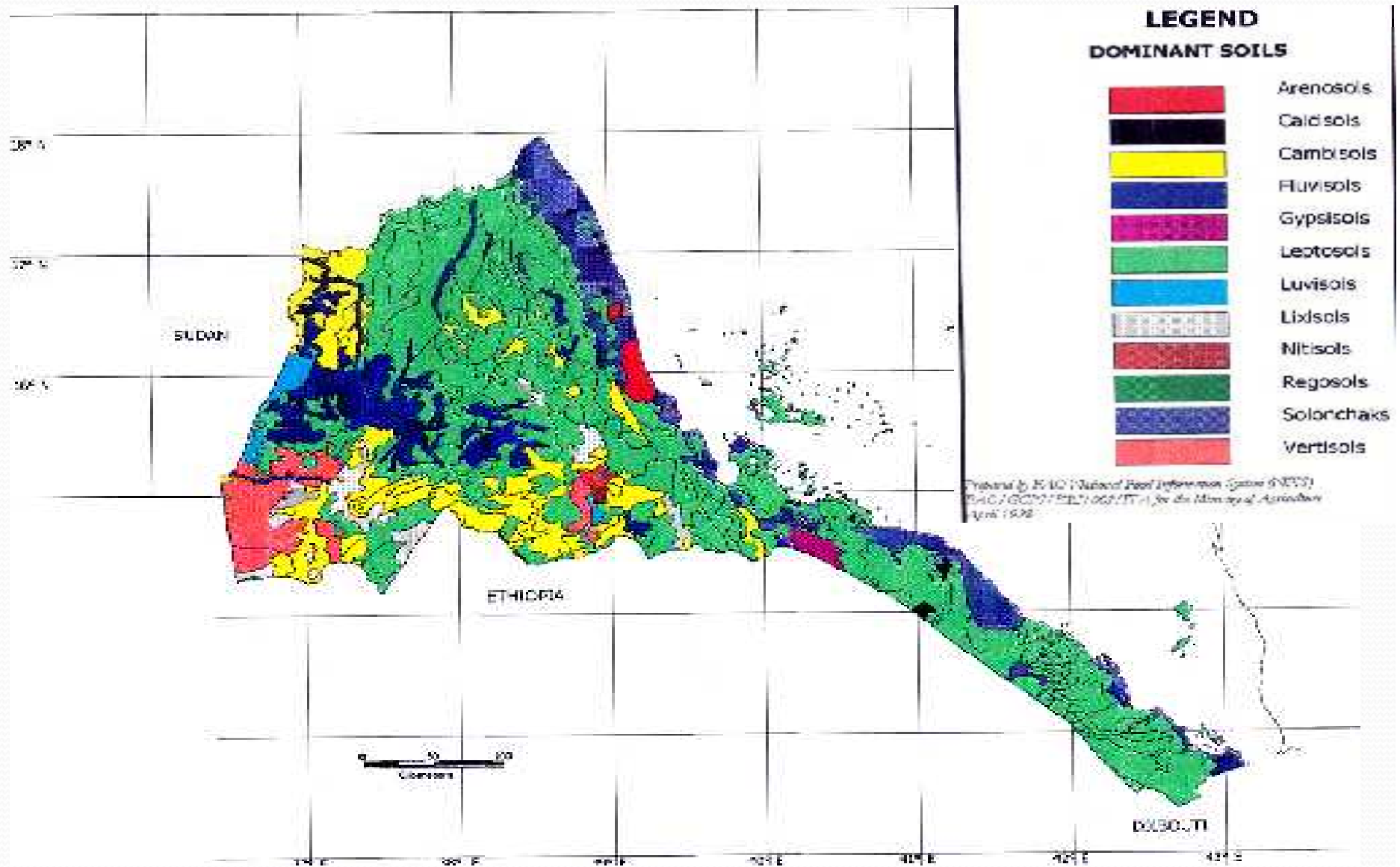
- Eritrea consists of a **central highland** which divides the country between its **eastern** and **western lowlands**.
- Altitudes vary from over 3,000 m above sea level in the highlands, to 130m below sea level in the south eastern Danakil depressions.
- The highlands have a very rugged topography.
- The lowlands are generally flat plains, often interspersed with hills.

- Soils are complex, varying from region to region in terms of texture, fertility, and other natural characteristics .
- The majority are residual soils, those developed directly from weathered bedrock.
- Soils that developed on the extensive basalt formations are the most fertile, those developed on the basement complex are of low to moderate fertility, and those on rocks are of low fertility
- Texturally most soils are stony, loams, sandy loams, or loamy sands.

Continue

- The rich dark clay and clay loams are commonly found in the **south-west** part, extending to the **central highlands** where the densely populated villages are located.
- The pH range is from slightly acid or neutral to moderately alkaline.
- According to FAO soil classification system the dominant soil types are **cambisol, regosol, leptisol, fluvisol, solonchack and vertisol**.

Figure 2. The State of Eritrea - Soil Classification



Cont'ed

- Given the great relief of much of the landscape and generally arid or semi-arid conditions, many soils are shallow with bedrock near the surface.
- The shallowness of the soils reduces their ability to hold moisture for crops or natural vegetation production.
- Soils in the western plains include vertisols and fluvisols which, with adequate rains or under irrigation, are highly suitable for agricultural development.

JUSTIFICATION

- Soil resources inventory and the assessment of land suitability classification is one of the main strategies of land use policy.
- The Soil Survey and Land Classification concentrates work in soil survey and land evaluation of the physical and chemical environment.

Cont'ed

- **Substantially increases in soil productivity**
 - can be obtained by improving the chemical, physical and biological fertility of soils, combined with increased soil water and organic matter contents.
 - Can be achieved by a holistic and integrated approach to soil management.
 - Our view that the goal of soil fertility management should be the adaption of conservation agriculture which is characterized by the following good land management practices ; **permanent soil cover, zero or minimum tillage, crop rotation - N-fixing legumes , cover crops, fertilizers and sometimes fallows.**

Cont'ed

- **Constraints to good land management**
 - can also be overcome by a more holistic approach to solutions to all the constraints by adoption of the good land management practices in the same locality by providing **new fodder, fuel and timber sources, new livestock management systems, the fencing of the cropped areas, and no – till seed drills, the conditions for crop residues in the field are greatly enhanced.**

Constraints

Land Management Practice	Constraints to adaption
1.Fertilizers	Cost, lack of credit, lack of knowledge on types and quantities to apply, risks of drought annulling the benefits of fertilizer.
2.Water Conservation measures	Too demanding on labour for construction and maintenance
3. Crop Rotations	In specific area well practiced but in most of the areas are not practiced well, reduced straw for livestock,
4. Fallows	Reduces cropping area, land area too small and production to justify fallows, lack of fence, liable to grazing by livestock reducing the benefit of fallows

Constraints (Cont'ed)


Land Management Practice	Constraints to adaption
5. Manures	Collecting problems because livestock not stall-fed or corralled, or too far from cropping areas, too few livestock, manure used for fuel and plastering wells
6. Compost	Only in specific areas used, lack of manure and crop residues, requires too much labour, lack of knowledge on compost production
7. Leaving crop residues in the field	Used for fodder, construction and fuel, sold or grazed, lack of fences, residues traditional used for communal grazing

Constraints (Cont'ed)

Land Management Practice	Constraints to adaption
8. Conservation tillage	Started in small scale, lack of knowledge of conservation agriculture tillage, lack of no-till seeders and planters, lack of suitable herbicides
9. Live Barriers	Lack of suitable species, takes land out of production, cause competition with the crop, extra labour required to maintain the barriers, not highly effective at reducing runoff
10. Develop Soil Classification and soil map	Lack of training staffs, there is no awareness of soil classification and land suitability,

Current status of soil fertility in Eritrea

- The continuous removal of the highly fertile top soils from cultivated areas by water and wind erosion is the main prominent factor that directly contributed to the degradation and the decline in soil fertility in different agro-ecological zones of Eritrea, consequentially decrease in productivity.
- Soil erosion, particularly in the highlands, is very serious and losses are estimated at about 15 tons/ha/year (Firebrace and Holland, 1985)
- In addition to ongoing soil erosion of the fertile top soil, an insidious decline in soil fertility as a result of the kind of agricultural practices is being undertaken.



Currently there is a lack of reliable scientific data that could support the degree of soil fertility decline in Eritrea. However, the low contribution of agricultural sector to GDP, low crop yield, soil laboratory analysis results can be considered as a good indicator to evaluate the fertility status of the soils.


Since its establishment in 1987, the soil laboratory was involved in collecting soil samples and carrying soil analysis to determine the nutrient status of Eritrean soils.

In almost all soil samples it became clear that soils are depleted in nitrogen and organic matter low to medium in phosphorous while potassium was found from low to high.



Current status of soil survey for soil classification

- There is almost no information available on the morphological study of the Eritrean soils although there are some scattered studies of surface soils carried out at different times. Thus, without such information, it is difficult to classify the soils of Eritrea.
- Soil survey is basically an inventory of the soil resources and consists of a soil map, descriptions of the soils and soil map units and prediction (interpretations) of soil behaviour for different uses and managements. This is the fundamental for productive natural resource management.
- To date exploratory and reconnaissance soil surveys were carried out in selected areas to quantify and characterize areas considered to have potential for irrigation development, to assist in the development of appropriate parameters for the land resource survey and land evaluation for sustainable irrigation development.
- In 1998 sector study on national soil and water resources and irrigation potential was carried out in different locations but not finalized.



The soil research unit within the national agricultural research institute have done soil survey works in some potential areas and at a small scale in research site and small farm areas for irrigation development.

To date soil survey work has conducted. However, the soil survey works so far conducted was not being supported by satellite images or Arial Photos and GIS that essentially work the survey in complete to classify our soils according to their common properties and use a proper land use system.



For the restoration of soil fertility:

- Halting the erosion process to avoid further degradation of soils
- Building up and improvement of soil structure-
Introduction and promotion of conservation agriculture.
- Replenishment of soil nutrient reserves
- Characterize soils of Eritrea according to their common properties



Main Challenges

- As little information is available about the morphological characteristic of the Eritrean soils there is a need for urgent soil survey and soil classification works at national level. Unless the soils of Eritrea are thoroughly studied and classified according to their common properties it will be hard to talk about development programs. For this to be effective assistance from the international community will be needed in upgrading the skills of soil researchers.
- In order to assess the fertility status of the Eritrean soils periodic soil analysis need to be carried out. For this purpose there is a need in strengthening the national soil laboratory and when possible establish satellite soil laboratory services at zonal level.



- Thank you