6.7 Country Report of Sudan

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Preliminary Study of the Soils and Salinity Problems in the Northern Province of the Democratic Republic of the Sudan

The Democratic Republic of the Sudan extends from Lat.0 to Lat.22 North. Accordingly it enjoys a variety of climatic conditions that includes the dry desert type in the far north and humid tropics in the far south with a gentle gradual change in between. The mean annual rainfall ranges from over 1 500 mm in the far south to less than 10 mm in the far north. The temperature increases from south to north with a mean maximum of 49°C and a mean minimum of about 15°C. Due to this heterogenity of the climatic conditions, and some other factors, a variety of soils have been formed. The soils are mostly calcareous, fine textured and of recent formation. The water table is deep and runoff is negligible except in some areas of the Central Clay Plains where surface soil expands and inhibits further moisture penetration.

Salinity problems appear or increase from south to north starting at the northern part of the Gezira Scheme and Managil Extension and along the Nile to the far north of the country. They appear sporadically where drainage is impeded due to the high content of clay, and in some cases due to the presence of impermeable subsoil horizons. This spotted salinity appears where irrigation schemes are present. Salinity in this area is mainly due to the upward movement of salts from the subsoil as a result of high evaporation due to high temperature and low humidity. The Northern Province soils are good examples of this type.

The Northern Province lies in the far north of the country along the river Nile between latitudes 16° - 22° N and longitudes 25° - 34° W. The area lies partly in the semi-desert at the south and partly in the desert at the north. The population is mainly concentrated along the river banks where they practise traditional agriculture as their main source of living. Agriculture has been practised in this area for thousands of years mostly in flood basins and along river shores.

The scarcity of agricultural land in the Province is becoming a critical problem. The narrow strip of the flood plain is under cropping at present and more land is needed for agriculture to meet the demands of the growing population. There are certain crops which are traditionally and geographically favoured in this area and which cannot be easily produced in other parts of the country.

The soils of the Province are of three types, namely: Gerif soils, Karu soils, and high terrace soils. The Gerif soils are of alluvial origin, annually flooded and of fairly recent formation. They contain a high amount of silt with weak structure and a minimum degree of cracking, being mainly restricted to the top layer. The soils are neutral in reaction and have a low soluble salt content. These soils are considered to be among the most productive soils in the Province. According to the 7th approximation system of the USDA, these soils could be classified as "entisols".

Karu soils occur in basins and depressions which at one time were river courses. Being deposited in stationary or slow running water, they have a fine texture. The clay content exceeds 60%. The profile is compact, poorly permeable to water and air. From their swelling and shrinking properties, they are assumed to contain a high proportion of montmorillonite. They are sticky when wet and hard when dry, often forming a crust which hinders the emergence of seedlings. These soils could be classified as "vertisols". Salinity and alkalinity form major problems in many areas. The main soluble salts present are generally sodium sulphate and sodium chloride. The cation exchange capacity ranges from 37-62 meq/100 gr soil. The pH values range from 7.8 to 8.5. Total soluble salts and exchangeable sodium percentage increase rapidly with depth.

High terrace soils occur on the landward side of the Karu soils. These soils show a high degree of heterogenity and vary over short distances in both chemical and physical properties. The surface is slightly undulating, covered with a sandy or pebbly layer. The profile is rich in calcium carbonate concretions. Gypsum is also present in both amorphous and crystalline forms. These soils could be classified as aridisols. Salinity and alkalinity are a common feature of these soils. Sodium and calcium are the dominating cations. Magnesium is present in varying concentrations. Potassium is present in very low amounts.

Chlorides and sulphates are the dominant cations. Bicarbonate content is relatively low and carbonate is generally absent except in a very few restricted areas.

Karu soils have been under agriculture for a long time and some appreciable information is available regarding their cropping. A great deal of this information is available at the Hudeiba Agricultural Research Station. In general crop yields are low. Although there are a number of factors responsible for the low yields, it can be shown that salinity and alkalinity are among the main factors responsible for yield reduction. Symptoms of salt injury were noticed and high salt contents were correlated with low yields. Leaf burn in citrus was also found to be due to chloride toxicity. Problems of disorder or a wilt-like disease in field beans (phaseolus vulgaris) were reported. The visual symptoms were drying of the edges of the bottom leaves which worked its way to the whole plant. The crop loss due to this exceeded 50% in some areas. To investigate this problem, soil samples were taken from the root zones of both healthy and wilted plants and a positive correlation was found between the wilt incidence and sodium chloride content of the soil. Another experiment was carried out to study the effect of soil amendments on the wilt occurrence. Soils were treated with gypsum, sulphuric acid, sodium chloride plus calcium chloride, and sodium bicarbonate. The soils treated with sulphuric acid and gypsum were leached with tap water before seeding. Plants grown on sulphuric acid and gypsum treated soils escaped the wilt, were healthy and gave the highest dry matter yield.

The reclamation of Karu and high terrace soils is very essential in most cases for better crop yields, but this is expensive and not easy. Preliminary field experiments, made at the Hudeiba Research Station, to test the effectiveness of leaching and gypsum application on Karu soils showed that four months of flooding did not moisten the soil to more than 2 m depth, and that about 60% of the moisture was lost by evaporation. Leaching and gypsum application reduced the soluble salts content and exchangeable sodium percentage of the Karu soils, but 12 weeks of cropping with lubia (dolichos lablab) brought up the E.C. and E.S.P. to almost their original values. In a disturbed soil experiment of high terrace soils, leaching with tap water was carried out under different treatments of gypsum, sulphur and animal manure. All treatments were effective in decreasing the E.C. of saturated extract from 40 mmhos/cm at 25°C to less than 8 mmhos/cm. However, the gypsum treatment was most effective in decreasing the E.S.P. A reduction of E.S.P. from 45 to 10 was obtained by this treatment.

To sum up, the following points should be mentioned:

1. Under the Karu soil conditions, in the Northern Province, where we have heavy clays, a very low rate of permeability and increasing salt content with depth, it is thought unreasonable to carry out soil reclamation trials at present. The best solution, in the author's opinion, is to find the most suitable practical management to "live with the problem". Salt tolerant crops have to be selected. Breeding for salt tolerance has to be done and the most suitable soil management and irrigation practices have to be followed.

2. Several millions of acres of high terrace soils are available for cultivation not far from the main course of the Nile. These soils are highly affected with salinity and alkalinity. The improvement of these soils for more crop production is essential. To achieve this goal, pilot farms for soil reclamation have to be established. Information concerning the intensity of field drainage systems, kinds and types of drains, methods of leaching and quantities and types of amendments has to be gathered, keeping in mind our soil properties, local conditions and economic feasibility.

References

1. Agr.Res.Corp. Annual report 1968, Soil Science Section, Hudeiba Research Station, Sudan.

2. Agr.Res.Corp. Annual report 1970, Agronomy Section, Hudeiba Research Station, Sudan.

3. Ayoub, A.T. Unpublished data.

4. Ministry of Agriculture. Roseires soil survey. Report No.5. Sudan. 1964

5. Ministry of Agriculture. Roseires soil survey. Report No.15. Sudan. 1967

6. Tothill, J.D. Agriculture in the Sudan. Oxford University Press, London. 1952.