LAND RESOURCES OF UTUNGE FARM AND THEIR POTENTIAL FOR AGRICULTURE,

RUFIJI DISTRICT, COAST REGION

Prepared by:
Joseph D.J. Mbogoni
TARI Mlingano
P.O. Box 5088
TANGA, Tanzania

September 2018

Table of Contents

Introduction

This report presents results of a rapid soil fertility evaluation of Utunge farm which is located in Chem Chem ward, Rufiji District, Coast Region. The study was commissioned to TARI Mlingano by Mama Mmari, the owner of the farm. The objective was to appraise the fertility status of soils and the quality of water from the farm, eventually to recommend on suitable soil and water management technologies for sustainable production. Figure 1 show the approximate location of the farm in Rufiji district.

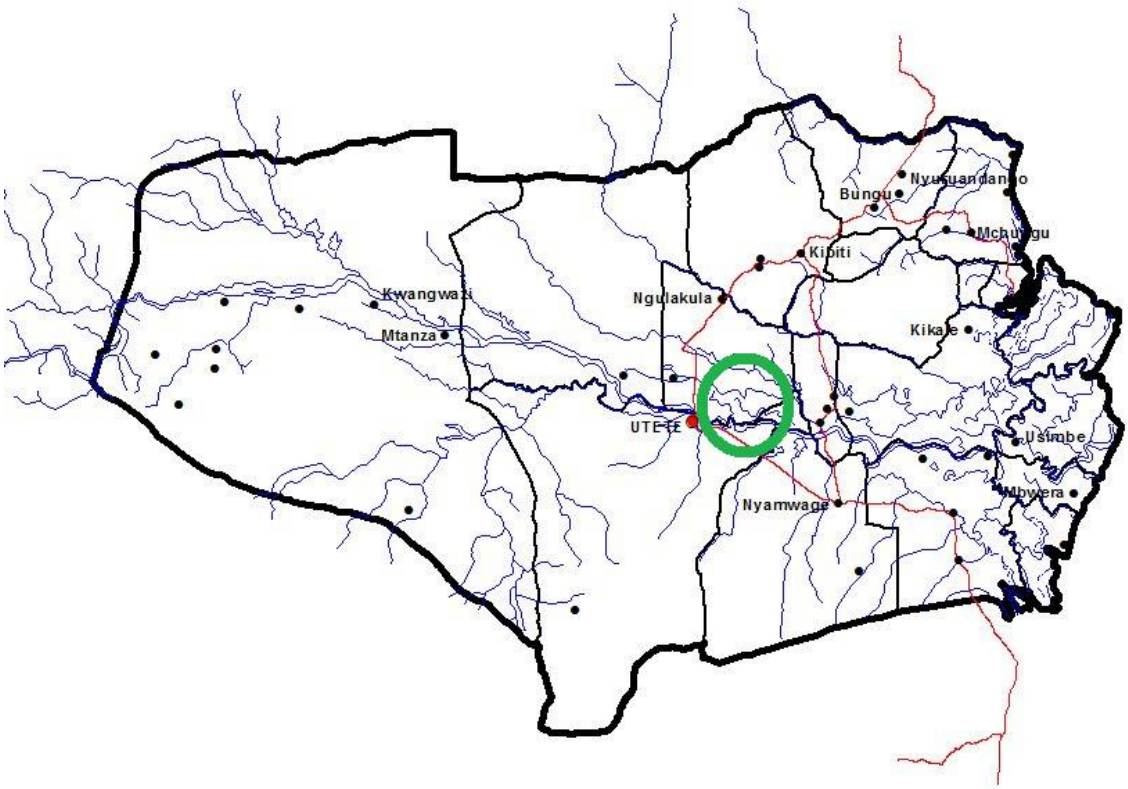

Figure 1. Approximate location of Utunge farm in Rufiji district.

Topography and land use

The farm occurs in the Flood plain of Rufiji river. The upper part of the Flood plain begins at an attitude of 67 m above sea level where the river leaves the Stiegler's gorge. From this point the Flood plain spreads out along the flat valley floor and extends up to 130 kilometers downstream to the Delta and Coastal zone. The main staple crops grown are rice, maize, cassava, sesame, sunflower, legumes, pumpkins, fruits and vegetables. The main cash crops are cashew and cotton. The Flood plain covers the Mwaaseni, Ngorongo, Kipugira, Mkongo, Utete, Ikwiriri, Mgomba, Umwe, Chumbi and Mtunda wards.

Climate of the Rufiji area

The climatic station nearest to the farm is Utete meteorological station which is used for description of the climate. Rufiji District has bimodal rainfall pattern whereby the main rain season (masika) begins in mid March and ends in early June. The short rains fall between mid November and early January. The Köppen Climate Classification subtype for the Utete area is "Aw". (Tropical Savanna Climate). The average temperature for the year in Utete is 26.3°C.

The warmest month, on average, is February with an average temperature of 28.1°C. The coolest month on average is July, with an average temperature of 23.9°C. The average amount of precipitation for the year in Utete is 942.3 mm. The month with the most precipitation on average is April, with 213.4 mm of precipitation. The month with the least precipitation on average is July, with an average of 10.2 mm. There are an average of 104.7 days of precipitation, with the most precipitation occurring in April (with 16.4 days) and the least precipitation occurring in September (with 3.0 days).

General soil conditions

Existing reports describe dominant soils of the Chem Chem area as reddish and yellowish sands and loamy sands which developed on sediments, granites and acid gneisses, classifying as Ferralic Cambisols. They are moderately deep to deep, well drained, have poor structure and profile development. The natural fertility is very low (clay content 5-15 %, pH of 5-7, organic carbon 0.5-1.5 %, base saturation of 20-60, no weatherable minerals). The soils have good infiltration but low to moderate moisture storing properties (De Pauw, 1984).

Other soils occurring in the area are the bleached sands and loamy sands with more clayey subsoils developed on sandy sediments, classifying as Cambic Arenosols. The soils are deep, moderately well to imperfectly drained (with fluctuating ground water level), brown, pale yellow, light grey or white mottled sands on stratified sandy loams and sandy clays with low to moderate natural fertility (pH 5-7, organic carbon 1-2 %, base saturation 20-60 %). The soils have moderate moisture storing properties (De Pauw, 1984).

Table 1 presents analytical data of composite topsoil samples from Utunge farm. The composite topsoil samples represent the upper 0-30 cm depth. The soil data indicate that Soil type 1 has lowest fertility status than all other soils. The soil reaction is extremely acid (pH<4.5), the soil has very low total nitrogen (N), organic carbon (OC), available phosphorus (P), cation exchange capacity (CEC), and exchangeable calcium (Ca). Exchangeable Mg is present in low levels. The fertility status of Soil type 2 is also very low but has strongly acid reaction (pH 5.1-5.5 range), low OC, medium levels of Ca and Mg which is slightly better than soil type 1. Soil types 3 and 4 have medium acid reaction but very low levels of N and CEC. They have varying amounts of OC, P and CEC. Levels of basic cations (Ca, Mg, K and Na) are generally medium to high.

Evaluation of the fertility status of soils and ground water quality

The four composite topsoil samples represent the main soil types occurring in the farm and when considered together with physiography and prevailing climate, it is possible to make general statements on ecological suitability for agriculture. The main parameters to consider are moisture availability for crop growth and nutrient levels in the soils.

Moisture availability

Soils of Utunge farm have more than 70 % sand in the fine earth fraction. The soil textures are sands and loamy sands. This imply that the water storing capacity of soils is very low. External supply of water by rainfall or irrigation determine the growth of crops. The area has about 3 months of rainfall during the Masika season and about 2 months during the Vuli season, implying semi-humid conditions. Owing to low water holding capacity of soils, the growing periods are suitable for drought tolerant annual crops such as sorghum, sesame, sunflower, vegetables as well as perennials such as cassava, cashew, coconuts and fruits.

Nutrient availability

The main constraint to optimum growth of the crops is low to very low natural fertility status of the soils. Levels of N and P are very limiting. The low to very low levels of organic matter contribute to low nutrient retention capacity and low nutrient levels. The present potential of soils to supply adequate nutrients for crop growth is low.

Water Quality Evaluation

Irrigated agriculture is dependent on an adequate water supply of usable quality. Water quality refers to the characteristics of a water supply that will influence its suitability for a specific use, i.e. how well the quality meets the needs of the user. The quality of irrigation water depends on the type and quantity of dissolved salts. Salts originate from dissolution or weathering of the rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. These salts are carried with the water to wherever it is used. In the case of irrigation, the salts are applied with the water and remain behind in the soil as water evaporates or is used by the crop. Water quality or suitability for use is judged on the potential severity of problems that can be expected to develop during long-term use.

Table 2 present analytical data of water samples from Utunge farm. It is evident that the soil reaction (pH), electrical conductivity (EC), levels of calcium (Ca) and magnesium (Mg) are within the normal range. However, levels of exchangeable potassium (K), exchangeable sodium (Na) and chlorides (Cl) are slightly high, thus posing a slight to moderate limitation.

The salts are associated with a shallow water table present within 2 metres of the surface. A salinity problem can arise in Utunge farm if salts of K and Na accumulate in the crop root zone to a concentration that causes a loss in yield. Yield reductions will occur when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in induced water stress for a significant period of time.

Table 1. Analytical data of soil samples from Utunge farm

SampleID	Depth	LabNo	Sand	Coarse Silt	Fine Silt	Clay	Texture class
	Cm		%	%	%	%	
1	0-30	18/447	88	2	2	8	Sand
2	0-30	18/448	82	2	4	12	Loamy sand
3	0-30	18/449	74	6	6	14	Loamy sand
4	0-30	18/450	80	4	4	12	Loamy sand

SampleID	Depth	LabNo	pH	pH	EC	TN	OC	AvailP	CEC	Ca	Mg	K	Na	BS
	Cm		water	KCl	dS/m	%	%	mg/kg	cmol/kg	cmol/kg	cmol/kg	cmol/kg	cmol/kg	%
1	0-30	18/447	4.3	4	0.01	0.02	0.55	4.73	2.1	0.14	0.26	0.31	0.03	35
2	0-30	18/448	5.4	5	0.02	0.04	0.91	2.59	4	1.7	0.88	0.61	0.06	81
3	0-30	18/449	6	4.2	0.06	0.04	0.82	2.77	6.3	2.7	1.03	1.63	0.05	86
4	0-30	18/450	6	5.5	0.04	0.04	0.85	10.61	3.2	0.88	0.75	0.51	0.02	68

Table 2. Analytical data of water samples from utunge farm

SampleID	LabNo	pH	EC	Ca	Mg	K	Na	Cl
			dS/m	mg/l	mg/l	mg/l	mg/l	mg/l
W01	18/451	6	0.09	5	2.2	3	6.5	4.99
W02	18/452	6	0.09	5.4	2.3	3	6.5	7.49

Legend for colour patterns

	Very low		Low		Medium		High		Very high

Conclusions and recommendations

- Low nutrient availability for N and P is the most limiting soil fertility constraint in all soils for optimum crop growth.
- Low and very low levels of OC and CEC are unfavourable and can hamper successful use of fertilizers.
- Soils have very low water holding capacity and therefore susceptible to drought during dry spells.
- Ground water from the farm has high levels of exchangeable potassium (K), exchangeable sodium (Na) and chlorides (Cl), thus posing a slight to moderate limitation.
- A suitable soil health improvement programme has to start with build-up of soil organic matter through:
  - Application of manure
  - Growing of leguminous crops able to fix atmospheric N
  - Ploughing under of crop residues during land preparation

Application of N and P fertilizers is important for enhancement of nutrient availability to plants as follows:

Crop	DAP	UREA	UREA
Rice	21 kg/acre at planting	61 kg/acre 2 weeks after planting	62 kg/acre at flowering
Maize	24 kg/acre at planting	38 kg/acre 4 weeks after planting	
Cassava	61 kg/acre at planting	47 kg/acre 4 weeks after planting	47 kg/acre 8 weeks after planting
Cowpeas	17 kg/acre at planting		
Sorghum	28 kg/acre at planting		

- Application of manure and build-up of soil organic matter are effective for enhancing the water holding capacity of soils in the farm.
- Adequate drainage provisions are necessary for control of salt build-up in soils.
- Control of an existing shallow water table is essential to control salinity for successful long-term irrigated agriculture of Utunge farm.

Bibliography

De Pauw, E. 1984. Soils, Physiography and Agro-ecological Zones of Tanzania. Crop Monitoring and Early Warning Systems Project. GCPS/URT/047/NET, Kilimo/FAO, Dar es Salaam.

Euroconsult, 1989. Agricultural Compendium for Rural Development in the Tropics and Subtropics. . Elsevier, Amsterdam.

FAO, 1974. Effective Rainfall. FAO Irrigation and Drainage Paper 25. FAO, Rome.

FAO, 1979. Soil Survey Investigations for Irrigation. FAO Soils Bulletin 42. FAO, Rome.

FAO, 1983. Guidelines for Land Evaluation for Rainfed Agriculture. FAO Soils Bulletin 52, FAO, Rome.

London, J. R. (editor) (1991) *Booker Tropical Soil Manual*. A handbook for soil survey and agricultural land evaluation in the tropics and subtropics. Longman Scientific & Technical Co-published in the USA with John Wiley and Sons, Inc. New York, 474 pp.

National Soil Service (NSS) (1990). *Laboratory Procedures for Routine Soil Analysis*, 3rd edition Agricultural research institute, Mlingano Tanga, Tanzania. Miscellaneous report M13.