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# REPORT ON AGRONOMIC PRACTICES AND SOIL FERTILITY ANALYSIS FOR IMPROVED MAIZE PRODUCTION IN KITETO AND KONGWA DISTRICTS IN TANZANIA

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## **DISCLAIMER**

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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# I. INTRODUCTION

As the pillar of both the domestic and the export economy, the agricultural sector in Tanzania engages about 80 percent of the labor force. The Tanzania's agriculture economy is dominated by food production which accounts for about 85 percent of over 5 million hectares cultivated per year.

Maize is the most important staple food in Tanzania and in the East Africa region in general. In Tanzania, it accounts for 31 per cent of the total food production and constitutes more than 75 per cent of the cereal consumption in the country. The crop is cultivated on an average of two million hectares, which is about 45% of the cultivated area in Tanzania (Katinila et al., 1998). Maize represents about 30 per cent of the value of crop production in the country and 10 per cent of total value added in agricultural sector respectively (Sassi, 2004). The crop provides 60% of dietary calories and more than 50% of utilizable protein to the Tanzanian population. Maize is not only a staple crop in surplus regions but a cash crop as well.

About 85% of the maize produced in Tanzania is grown by peasants whose farms are less than 10 ha. Smallholder productivity is very low and highly variable, ranging from 0.01t/ha to 6.77t/ha, averaging 1.19t/ha. This low level of productivity is said to be due to low levels of education, lack of extension services, limited capital, land fragmentation, and unavailability and high input prices (Msuya et al, 2008)

Studies carried out by Isinika et al (2003) and MAFC (2006) show that smallholder maize productivity in the country is suffering due to the fact that, most smallholders do not practice high-yield farming methods, and produce mainly for subsistence. The Poverty and Human Development Report of 2007 (R&AWG, 2007) showed that 87 percent of Tanzanian farmers interviewed by the research and analysis group under Tanzania's NSGRP said that they were not using chemical fertilizers; 77 percent said that they were not using improved seeds; 72 percent said that they were not using pesticides, herbicides or insecticides (agrochemicals), due to the high costs of agricultural inputs and services. Kongwa and Kiteto maize farmers are not exceptional.

To increase maize productivity under small scale farming, identification of gaps between what is recommended to exploit the production potential and what is practiced by small scale farmers is required.

This report covers a work done in maize producing areas of Kongwa district in Dodoma region and Kiteto district in Manyara region of Tanzania. The two districts share a common border. The report is a prelude to a soil test exercise which intends to assist in providing site specific soil fertility status and recommendations for soil and fertilizers management in the identified maize producing areas of Kongwa and Kiteto districts.

Specifically, the report covers: a) a review of current fertilizer and soil management recommendations for maize in the study area; b) a review of current maize farming practices and their effect on soil fertility depletion in the study area; c) an analysis of soil variability within the study area in order to establish different sampling units (sites); and d) site specific fertility status and management recommendations for improved maize production based on soil test results.

## 2. MATERIALS AND METHODS

### 2.1 DESCRIPTION OF THE STUDY AREA

This study was conducted in maize growing areas of Kongwa district in Dodoma region and Kiteto district in Manyara region. The location of the study area is shown in Fig 1 below.

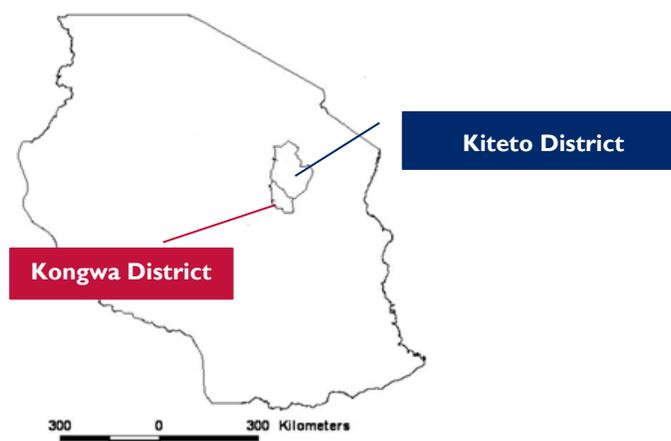


Figure 1: Location of Kongwa and Kiteto Districts in Tanzania

The area specified for maize production in Kongwa district has mainly mountainous topography at high altitude, either with extensive, undulating to hilly plateau crests or strongly dissected with limited plateau crests. Major soils are well drained, deep yellowish or reddish sandy clays to clays with moderate to strong structure and complex of rock outcrops, stony and shallow soils (De Pauw, 1984).

The rainfall is monomodal ranging between 800 to 1000 mm annually. This kind of rainfall pattern has resulted to a single growing period per year with duration of 5-7 months depending on soil moisture storage capacity and crop rooting habits. Soils have moderate AWC –available water capacity (120 mm/m) and favorable moisture storing properties

In areas of Kiteto where maize is grown, the soils are mainly formed on gently undulating to rolling plains and plateaux. Sloppy areas are strongly dissected, often rocky and severely eroded. Dominant soils are well drained, moderately deep to deep, dark reddish brown, yellowish red or red sandy clay loams and sandy clays with weak or moderate structure and low natural fertility; and moderately well to imperfectly drained, deep, brown, pale yellow, light grey or white mottled sands and loamy sands with poor structure (De Pauw, 1984).

The annual rainfall is 800-1000 mm with monomodal distribution. The rainfall distribution in the area allows only one growing period for maize.

## **2.2 METHODOLOGY**

The methodology to achieve the three outputs for this report is outlined as follow:

### **2.2.1 Review of current fertilizer and soil management recommendations**

Information on the current fertilizer recommendations and soil management was collected through interviews with key informants. The key informants included extension staff (at district, ward and village levels) and experienced farmers. The interview was guided with check list with questions regarding the fertilizer recommendations currently used for maize production and soil management practices. Review of various publications on fertilizer recommendations was also consulted.

### **2.2.2 Collection of information on the current maize farming practices**

The current maize farming practices in the study sites were documented from field observations and interview with key informants. An inventory of farming practices was developed from the field observations and interviews. The key informants consulted were extension officers, and selected active farmers. The effects on soil fertility depletion of the inventoried current maize farming practices in the maize growing areas of Kiteto and Kongwa districts were deduced from researchers' agronomic experiences and literature.

### **2.2.3 Soil variability analysis and establishment of mapping units**

The 'position on landscape' approach was first used. The digital terrain model of the study site was used to demarcate the hill tops, upper slopes, mid slopes, lower slopes, plains and valleys in ArcView 3.2 GIS software. A base map was then prepared from a digitization of the demarcated landform units which were established based on altitude range, slope gradient and drainage pattern. This base map guided field work for soil variability analysis where boundaries were cross checked and adjusted based on survey factors other than landform features derived from digital terrain model. The other factors included soil texture, soil depth, soil color, land use type and type and condition of the available vegetation.

Areas with similar physical properties (soil color, texture, depth), landform features (altitude range, slope gradient, drainage pattern), vegetation type/condition and land use type were considered homogeneous and thus were treated as the same sampling unit.

### **2.2.4 Soil sampling**

Soil sampling was done on the identified sampling areas as depicted on the base map. A zigzag approach was employed and the sampling procedure was as follows:

The surface litter and crop residues were scraped away. The sampling core was driven from the true soil surface to 20 cm depth where the soil taken was put in a bucket. Between 10 and 15 cores from each uniform soil area of about 0.4 ha was taken and put in the same bucket. A thorough mixing was done to get a composite sample from which a sample of about 1kg was taken and put in a sample bag followed by appropriate labeling.

The samples were transported to Sokoine University of Agriculture (SUA) soil laboratory and air dried in the glass house ready for physical and chemical analyses.

### **2.2.5 Soil laboratory analysis**

The collected soil samples were air-dried and ground to pass through 2 mm sieve to obtain the fine earth fractions for chemical and physical determinations.

Soil texture was determined by hydrometer method using calgon (5%) as a dispersing agent (NSS, 1990). The soil pH was determined potentiometrically in water at the ratio of 1:2.5 soil-water as described by McLean (1982) while electrical conductivity (EC) was determined by conductivity meter in a 1:2.5 soil-water suspension following a method by Rhoades (1982). Organic carbon was determined by the Walkley and Black wet oxidation method as outlined by Nelson and Sommers (1982). The total nitrogen in the soil samples was determined by Kjeldahl method (Bremner and Mulvaney, 1982) while the available N (Nitrate-N) was determined following a procedure by Okalebo (1993). Available phosphorus was extracted by Bray-I method (Bray and Kurtz, 1945) for soils with pH<sub>water</sub> less than 7 and Olsen method for soils with pH<sub>water</sub> above 7 and determined spectrophotometrically (Murphy and Riley, 1962; Watanabe and Olsen, 1965). Sulfate-sulfur was determined following a procedure outlined by Moberg (2001)

Cation exchange capacity of the soil (CEC<sub>soil</sub>) and exchangeable bases were determined by saturating soil with neutral 1M NH<sub>4</sub>OAc (ammonium acetate) and the adsorbed NH<sub>4</sub><sup>+</sup> were displaced using 1M KCl and then determined by Kjeldahl distillation method for the estimation of CEC of the soil. The exchangeable bases (Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>) were determined by atomic absorption spectrophotometer (Thomas, 1982). Diethylenetriaminepenta-acetic acid (DTPA) was used to extract four micronutrients: iron, manganese, copper and zinc as outlined in Moberg (2001) while boron was determined by hot water extraction method as described in Moberg (2001).

### **2.2.6 Estimation of rate of fertilizer to apply**

The rate of fertilizer to apply to correct nutrient deficiencies and supplement removal by maize crop was calculated based on soil test results and nutrient removal by maize crop (both by grain and straw since farmers of Kongwa and Kiteto normally do not incorporate crop residues in the soil but allow their cattle to graze on them). Maize crop of 9.5 t/ha was estimated to remove 191 kg N/ha, 39 kg P/ha, 195 kg K/ha (only about 20% is removed by grain, the rest stays in the straws), 21 kg S/ha, 40 kg Ca/ha and 44 kg Mg/ha (Barber and Olson, 1968). Other removals are 0.19 kg B/ha, 0.38 kg Zn/ha, 0.11 kg Cu/ha and 2 kg Fe/ha. The difference between the soil available nutrient and the crop removal was used as the basis for recommendations. Other factors such potential for leaching and fixation were considered on advising about how much nutrient to apply.

## 3. RESULTS AND DISCUSSIONS

### 3.1 REVIEW OF CURRENT FERTILIZER AND SOIL MANAGEMENT RECOMMENDATIONS IN MAIZE

*Overview on the current soil fertility management recommendations*

The recommended soil fertility management for sustainable agriculture stems at replenishment of nutrients removed after harvesting and other processes such as erosion, and leaching. In Tanzania, the formal fertilizer recommendations are approved and released by the Ministry of Agriculture after long term experimentations in a wide range of agro-ecological zones (Massawe and Amuri, 2012). The history of inorganic fertilizers use in Tanzania was introduced in 1956 by the British American Tobacco Company (BAT) and limited to cash crops: tobacco, coffee and cotton in Northern and Lake Zones (Massawe and Amuri, 2012). The use of such fertilizers in food crops did not start until 1980s, which was introduced through the Kilimo/FAO Fertilizer program. The first fertilizer recommendations in Tanzania were those by Samki and Harrop (1984), which were released after the Kilimo/FAO fertilizer programme in Tanzania. The currently available fertilizer recommendations in Tanzania were released in 1993 (Mowo et al., 1993), after review of recommendations by Samki and Harrop (1984).

#### 3.1.1 *Current fertilizer and soil management recommendations for maize production in Kongwa district*

During this study, the District Crops Officer for Kongwa could not remember any documented study which specifically addressed fertilizer recommendations in maize production in the district. However, there are some documented recommendations which are generalizing the central areas of Tanzania, Kongwa being one of them.

Kaliba et al (1998) recommended 40 kg N/ha for low altitude areas and for areas receiving more than 800 mm of rainfall per annum, a rate of 80-112 kg N/ha was recommended. To provide nitrogen (N), urea, calcium ammonium nitrate (CAN), or sulfate of ammonia (SA) were recommended. Nitrogen could be split into two applications, with 30-50% of the total amount being applied at planting and the remainder when maize is about one meter high.

The authors also found phosphorus (P) was deficient throughout the zone, and triple super phosphate (TSP) was recommended as basal fertilizer amounting up to 40 kg P<sub>2</sub>O<sub>5</sub>/ha. It was recommended that the fertilizer has to be placed 5 cm below the depth of the seed and about 5 cm to the side. This was to be accomplished by digging a single hole beside each seed and placing fertilizer in the hole and covering it with soil. Alternatively, it was recommended to make a continuous furrow along the length of the planting row, place fertilizer in the furrow and cover with soil. The seeds were then planted on top of this soil and covered properly.

The basis for these recommendations quoted by Kaliba et al (1998) was not stipulated.

### **3.1.2 Current fertilizer and soil management recommendations for maize production in Kiteto district**

The most recent fertilizer recommendations in Kiteto district are based on soil test carried out by Selian Agricultural Research Institute in 2006. However, these results are not yet to be published. The unpublished data of this work are giving blanket recommendations for 12 villages where sampling was done. Four alternative recommendations are given:

1. 2 bags of NPK per acre at sowing and 1 bag of urea post emergence fertilization, or
2. 1 bag of DAP per acre at sowing and 1 bag of urea post emergence fertilization, or
3. 1 bag of TSP per acre at sowing and 1 bag of urea post emergence fertilization, or
4. 7 tons of farm yard manure per acre

For effective fertilizer use by crops it was recommended 50% of N fertilizer to be applied at planting and the rest within 5 to 8 weeks after planting. The P fertilizer is recommended to be used during land tilling or at sowing.

Deep tillage (using *magoye* rippers) or intercropping maize with pigeon pea was also recommended to break soil plow pan and improve soil water conditions for crops.

The villages covered by the Selian recommendations are Njoro, Ngipa, Esekuta, Partimbo, Kimana and Mwitikira. Other villages are Chapakazi, Kiperesa, Ndareta, Sunya, Oisteti and Lesoit.

Previous recommendations which could be generalized for Kiteto district are those documented by Kaliba *et al* (1998) for central zone as explained in the previous section for Kongwa district.

From this review, it is evident that the available fertilizer recommendations (as documented by Kaliba, 1998) are old and too generalized, hence need to be reviewed due to changes of farming practices, maize varieties used, and duration of cultivation in order to improve maize productivity.

The Selian recommendations for some villages of Kiteto, though not that old, they appear to be generalized and based only on nitrogen, phosphorus and potassium, leaving away other macronutrients and micronutrients.

The review of these recommendations is inevitable as the deficiencies of additional nutrients other than N, P and K are likely to be observed, and hence response to fertilizers with those nutrients is expected.

During this study it was observed that the most farmers of Both Kongwa and Kiteto are not aware of fertilizer rates, and are actually not applying fertilizers in the maize fields. Most of them believe fertilizers are harmful to the soils. However, the same farmers who do not use fertilizers in the maize fields use it where they have high value crops in small irrigable pieces of vegetables or seed farms.

## **3.2 REVIEW OF CURRENT MAIZE AGRONOMIC PRACTICES AND THEIR EFFECTS ON SOIL FERTILITY DEPLETION**

*Overview on the current maize agronomic practices in Kongwa and Kiteto*

There is large scale maize shifting cultivation especially in the southern part of Kiteto district. According to House (2002) large scale shifting cultivation covered 109 ha of land in 2002. Currently more land is farmed this way. The large scale maize shifting cultivation is carried out by farmers who mostly come from Dodoma and Iringa regions. They come with their tractors and bring in many laborers who clear the land and burn trees and grasses. They plant maize and get 37 bags per ha without any inputs (Kimambo, 2008). The next year they clear and burn new areas in order to get high yields as fertility drops rapidly after one crop.

During the study a number of camps (temporary shelters for laborers and service providers) were observed in areas designated as grazing lands or wildlife (game) corridor. Tensions have developed between the shifting cultivators and the government authorities leading to some forced evacuations, torching of the camps, commotions and demonstrations.

Since land is limited and need to be assigned to other land users as well, it is clear that this type of large scale maize shifting cultivation is not sustainable.

Apart from shifting cultivation, some fields especially near the settlements are cultivated every season. In most of Kongwa and parts of Kiteto settled farmers maintain their fields which are continuously losing production capacity due to declining soil fertility. Some of these farmers also scramble for new lands in the conserved areas where they move in during production season.

The following agronomic practices are employed in maize growing areas of Kiteto and Kongwa districts:

### **3.2.1 Land preparation**

Normally there are no land preparation activities in the fields where farming has been taking place. This is because these lands are maintained clear of crop residues and vegetation by grazing animals. Dry spells prior to cultivation time also assist in having clear fields as it inhibits growth of most weeds.

Leaving the land bare makes it succumb to wind erosion. It should be noted that these areas are windy and clouds of dust from wind erosion are a common phenomenon. Livestock hooves normally pulverize the surface soil and their weights compact the sub soil. Pulverized soils are easily carried by wind and are moved by runoff especially if the early rains come in big storms. Compacted sub soils inhibit water infiltration subsequently resulting to higher surface runoff which causes soil erosion. This accelerated soil erosion therefore carries the top soil with its nutrients leading to fertility depletion.



Phase 1: Grazed field a few weeks after harvesting. (Note the pulverized soil, tramped maize straws and leafless standing pigeon pea crop residues)

For the farmers practicing shifting cultivation, trees are fallen using axes and bush knives. The trees, bushes and grasses are then set to fire to leave a clear land covered by ashes from the burning. The burning results in rapid oxidation of organic matter, mineralization of nutrients (P, K, Ca, Mg, and Na) as well as loss of N and S to the air through volatilization. These processes cause rapid loss of soil organic matter (SOM) and mineralized nutrients, hence interfere with nutrient re-cycling for sustainable production.

### **3.2.2 Tillage practices**

Tillage is done by using hand hoes, power tillers, oxen ploughs, and tractors. A few farmers till using hand hoes power tillers and oxen plough. Most tillage is done by using tractors. The tractors are hired from local owners and others who normally arrive in the areas during the season from Arusha, Kilimanjaro, Morogoro and Dodoma and others parts of Manyara. Cultivation by tractor ploughs the soil deeper than oxen plough and hand hoe. In most areas it was noted that continuous use of disc plough at the same soil depth has resulted to soil plow pans. These plow pans can inhibit water infiltration and root penetrations and hence affect maize nutrient uptake for normal growth.

### **3.2.3 Water management**

Water management activities are applied at a very minimum level. No water control activities are done except some hardpan breaking using magoye rippers to improve water infiltration in the soil in limited areas. Intercropping maize with pigeon pea has also been a useful way to improve water infiltration and hence water availability to the crops. This is because pigeon pea has a deep tap root system which is capable of breaking soil plow pans. Maize-sunflower-pigeon pea intercropping farming system is common in both Kongwa and Kiteto maize growing areas. The plow pan breaking by the tap root increases water infiltration in the soil which reduces surface runoff and hence decelerate nutrient depletion through soil erosion.

### **3.2.4 Seed selection and planting techniques**

A few farmers still use local varieties selected from last crop. These varieties have low production potential. With these varieties, amount of the nutrients used for vegetative growth in comparison to improved varieties is higher with little increase of size and amount of the economic part of the plant (maize grain in this case). Therefore, from a fertility depletion point of view, it is better to use improved seed varieties which relocate more of the absorbed soil nutrients to the grains than the local varieties with fewer grains but bigger stalks.

Most farmers use composite improved maize varieties. The most common are STAHA, SITUKA and KILIMA. These maize seeds perform better in Kongwa and Kiteto agro ecological zones compared to local varieties. However, these varieties are not performing to their potential due to poor seed selection and prolonged recycling of the same seed season after season.

Recommended maize planting spacing is not adhered in Kongwa and Kiteto maize growing areas. Sowing is done following a tractor disc furrow and then covered by soil from next round of the disc while the tractor is operating. The same procedure is applied when using ox plough. Maize seeds are dropped at uneven distances, one two or three at a go. For those who are using hand hoes, planting holes are normally opened randomly; two to four seeds are dropped in it and covered by soil. About 10 to 12 kg of seeds are planted per acre. No planting fertilizers are applied. This leads to depletion of soil fertility because no replenishment is done to cover for nutrient uptakes of previous crops.

### **3.2.5 Weeding and other pests management**

Weeding is done by hand hoe in both Kongwa and Kiteto maize growing areas. The use of hand hoe limits the size of fields which can be weeded as a single person cannot do much. As a result many laborers are required short of which may cause delay and affect crop performance due to stiff weed competition. Delay in weeding results in, competition for water, light and nutrient uptake; especially when the crop is at early growing stages. Weeds are naturally better competitors for these plant life resources compared to crops such as maize. In order to maximize the soil nutrient availability to maize, improved weeding technologies must be practiced. These include herbicides applications and mechanization. Currently, only about 1% of maize farmers use herbicides (mainly glyphosate based Round up) to weed their farms. Weeding is normally done 2 to 3 weeks after planting depending on weed emergency. Number of weeding per season may go to 3 times depending on amount and distribution of rainfall which normally have influence on weed infestations. Major weeds in the area include grasses such as wild sorghum and broad leave weeds such as pigweed. Witch weed (*Striga*) is a potential problem as this weed has been noted in some areas around Chitego.

Other pests include army worms, stalk borers and birds. Physical control and spraying is done, sometimes with government intervention depending on the seriousness of infestation. Some farmers use local chemicals such as ashes to control stalk borers.

Maize diseases are not common in the area. Maize streak and smuts have been reported as isolated cases in some areas.

## **3.3 VARIABILITY OF SOILS OF MAIZE GROWING AREAS OF KITETO AND KONGWA DISTRICTS**

### *Overview on soil variability analysis approaches*

In order to produce sampling units the variability of soils for a given area need to be established. Observable soil physical characteristics such as color, texture and depth give clues on the variability of the soils. Soils differing in color most likely have different chemical properties and hence different fertility status. Similarly, soils differing in texture and depth most likely have different fertility status. It has also been established that soils located on different landscape positions normally differ in physical, mineralogical and chemical properties. Soil

fertility is a function of these physical, mineralogical and chemical properties. Thus, soils located on steep slopes are different from soils located on gentle slopes or those located on the plains and will most likely have different fertility status.

Other observable features which give clue on soil variability include differences in soil parent materials, differences in durations and types of land use, differences in drainage patterns and differences in types and status of the vegetation growing on the soil.

### 3.3.1 Soil variability in Kongwa and Kiteto



Soils of maize growing areas of Kiteto and Kongwa districts showed variations in color, texture and depth consistent to their positions on the landscape. Plate 2 shows cross section through soil depth for areas between Mtanana, Kibaigwa and Manyatta villages in Kongwa district. Variations in soils can be noticed from this plate.

Phase 2: Soil variability in Mtanana, Kibaigwa and Manyatta villages, Kongwa district

Soils on the hill tops and upper slopes are shallow, coarse and light in color. The soil grades to finer textures when moving downslope to the lower slopes and plains. Some plains and valley were however noted to have sandy textures. Soil depths generally increased downslope while soil color also darkened with decrease in elevation and slope gradient. Table I summarizes the identified soil units with their distinguishing properties such as position on landscape, texture, color, parent material etc.

Given differences on geographical locations and need for site specific fertility status and recommendation, most of the studied areas/villages have been treated separately. Fig 2 shows the position of proposed sampling units in both Kiteto and Kongwa districts.

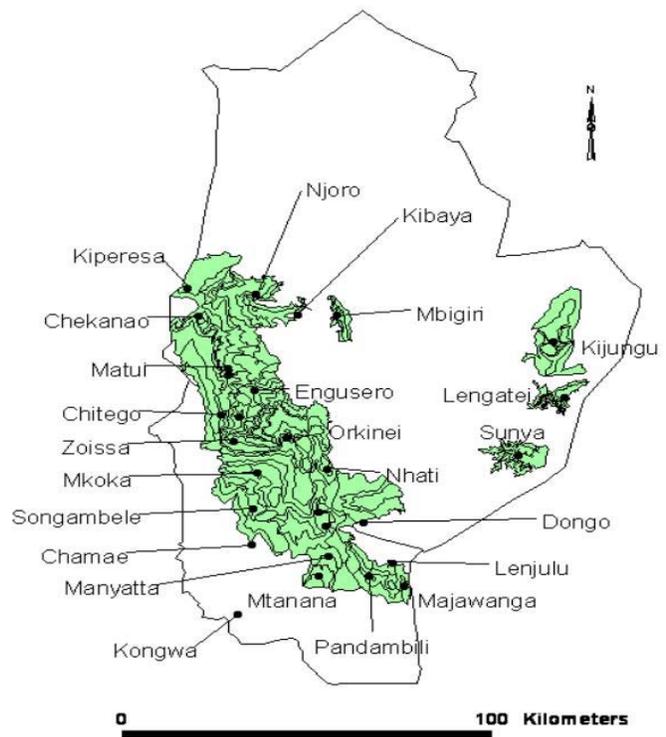


Figure 2: Location of proposed soil sampling units in Kiteto and Kongwa districts

Figures 3 and 4 show the identified sampling units for Kiteto and Kongwa districts respectively while Table 1 gives a brief description of the 99 units shown in Figs 3 and 4.

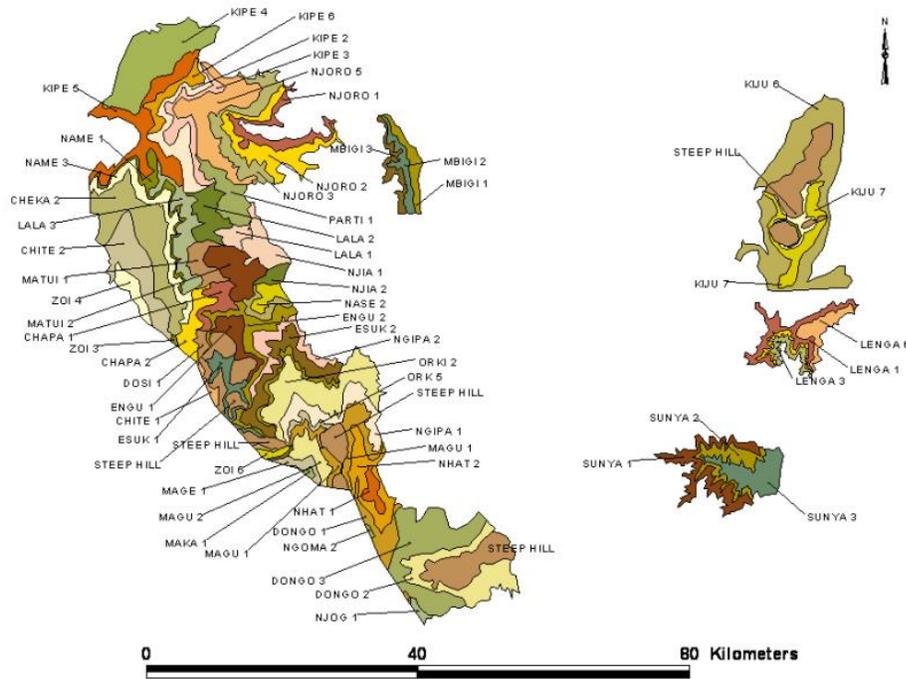


Figure 3: Soil sampling units for Kiteto district

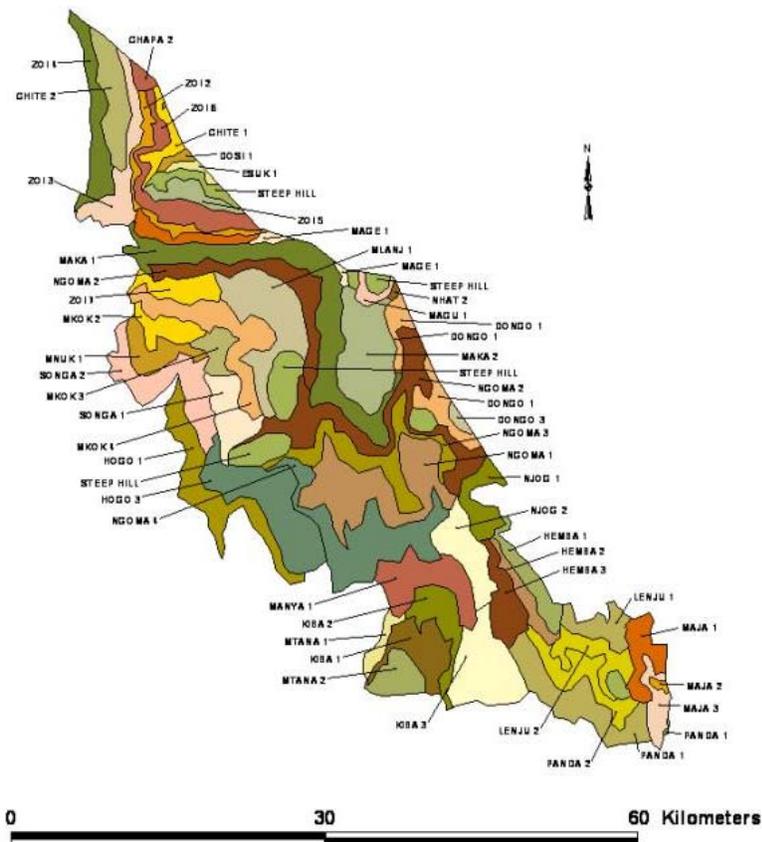


Figure 4: Soil sampling units for Kongwa district

### 3.3.2 Description of soil sampling units

S/n	Proposed mapping unit	Latitude	Longitude	Position on the landscape	Some differentiating characteristics	Name of the ward/village/hamlet
1	CHAPA 1	-5.49759	36.40470	mid slopes	no indications of salinity	Chapakazi
2	CHAPA 2	-5.50614	36.41003	lower slopes	indications of salinity	Chapakazi
3	CHEKA 2	-5.38331	36.32325	plains	reddish, sandy clays	Chekanao
4	CHEMA 1	-5.97585	36.44975	mid slopes	red soils	Chemae
5	CHITE 1	-5.62191	36.40496	mid slopes	4-6 degree slope gradient	Chitego
6	CHITE 2	-5.61287	36.35408	hill tops	relatively flat (2-3 degree slope gradient)	Chitego
7	DONGO 1	-5.82806	36.63705	plains	abandoned due to fertility problem	Dongo
8	DONGO 2	-5.87178	36.68090	upper and mid slopes	sandy clays	Dongo
9	DONGO 3	-5.83999	36.67088	lower slopes	sandy loams	Dongo
10	DOSI 1	-5.60880	36.41702	mid slopes	deep, sandy clays bordering steep hill tops	Dosidosi
11	ENGU 1	-5.56666	36.44688	mid slopes	reddish brown	Engusero
12	ENGU 2	-5.55040	36.45343	plains	black vertic soils	Engusero
13	ESUK 1	-5.62335	36.43754	mid slopes of high hill 1	parent material from hill 1	Esukuta
14	ESUK 2	-5.63893	36.47191	mid slopes of high hill 2	parent material from hill 2	Esukuta
15	HEMBA 1	-6.00146	36.69909	mid slopes	sandy clays, compacted sub soil	Hembahemba
16	HEMBA 2	-6.05419	36.72036	lower slopes	sandy loams	Hembahemba
17	HEMBA 3	-6.04985	36.69951	plains	sandy soils, visually poor soil fertility	Hembahemba
18	HOGO 1	-5.95502	36.43534	plains	brown sandy soils	Hogoro
19	HOGO 3	-5.93012	36.44843	plains	dark clayey soil	Hogoro
20	KIBA 1	-6.08161	36.63299	plains	black soils, evidence of salinity	Kibaigwa
21	KIBA 2	-6.05456	36.63614	mid slopes	reddish brown soils	Kibaigwa
22	KIBA 3	-6.08545	36.67480	plains	greyish soil, poor crop stand	Kibaigwa
23	KIJU 2	-5.40718	37.18451	lower slopes	shallow, gravelly	Kijungu
24	KIJU 4	-5.40243	37.18899	lower slopes	deep, fine textured	Kijungu
25	KIJU 6	-5.38681	37.14568	plains	parent material from hill 1	Kijungu
26	KIJU 7	-5.39354	37.16323	plains	parent material from hill 2	Kijungu
27	KIPE 2	-5.22962	36.38065	lower slopes	dark brown, sandy loams	Kiperesa
28	KIPE 3	-5.23258	36.37130	hill tops	shallow, reddish brown, sandy clay broad hill tops soils	Kiperesa
29	KIPE 4	-5.24233	36.30266	plains	deep, clayey, dark brown	Kiperesa
30	KIPE 5	-5.26782	36.30609	mid slopes	deep, sandy loams, brown	Kiperesa
31	KIPE 6	-5.23591	36.34529	lower slopes	deep, dark brown, sandy loams	Kiperesa
32	LALA 1	-5.42607	36.42916	upper plains	sandy clays, newly opened field	Laalala
33	LALA 2	-5.41710	36.40780	lower plains	old fields	Laalala
34	LALA 3	-5.39154	36.37208	hill tops and upper slopes	sandy soils, newly opened fields	Laalala
35	LENGA 1	-5.59055	37.19705	mid slopes	deep, sandy clays	Lengatei
36	LENGA 2	-5.58976	37.19721	lower slopes	deep, sandy loams	Lengatei
37	LENGA 3	-5.59826	37.19209	mid and upper slopes	shallow, gravelly	Lengatei
38	LENGA 6	-5.54761	37.20531	plains	deep, gently undulating slopes	Lengatei
39	LENJU 1	-6.05913	36.76521	hill tops	greyish sandy clays	Lenjulu
40	LENJU 2	-6.07112	36.74638	mid slopes	greyish sandy loams	Lenjulu
41	MAGE 1	-5.72361	36.49196	mid slopes	dominant slope about 4 degrees	Mageseni
42	MAGU 1	-5.72176	36.57245	mid slopes	sandy clays	Magungu
43	MAGU 2	-5.70419	36.54641	plains	sandy loams	Magungu
44	MAJA 1	-6.07674	36.80619	lower slopes	vegetation suggests high soil fertility	Majawanga

S/n	Proposed mapping unit	Latitude	Longitude	Position on the landscape	Some differentiating characteristics	Name of the ward/village/hamlet
45	MAJA 2	-6.10503	36.81533	mid slopes	reddish, vegetation status show poor fertility	Majawanga
46	MAJA 3	-6.11859	36.82251	plains	dark, clayey soils	Majawanga
47	MAKA 1	-5.74209	36.52579	plains	reddish soils	Makawa
48	MAKA 2	-5.78523	36.56114	lower slopes	grey soils	Makawa
49	MANYA 1	-6.00831	36.61771	mid and lower slopes	dark red soils	Manyatta
50	MATUI 1	-5.44368	36.38999	hill tops	greyish soil, poor crop stand	Matui
51	MATUI 2	-5.45279	36.42044	lower slopes	brownish, better crop stand	Matui
52	MBIGI 1	-5.31811	36.67371	plains	clayey, dark soils	Mbigiri
53	MBIGI 2	-5.30555	36.66345	mid slopes of low hills	sandy loams, reddish soils	Mbigiri
54	MBIGI 3	-5.30986	36.65661	hill tops	shallow, sandy clays	Mbigiri
55	MKOK 2	-5.80617	36.40561	mid slopes	reddish brown soils	Mkoka
56	MKOK 3	-5.81053	36.44441	plains	dark soils	Mkoka
57	MKOK 4	-5.80651	36.46176	hill tops	reddish brown	Matongoro
58	MLANJ 1	-5.76505	36.46455	mid slopes	sandy clays	Mlanje
59	MNUK 1	-5.80646	36.37077	plains	undulating	Mnuku
60	MTANA 1	-6.08447	36.57837	hill tops	reddish brown soils	Mtanana
61	MTANA 2	-6.08546	36.59624	plains	back soils, evidence of high salinity	Mtanana
62	NAME 1	-5.39012	36.35353	hill tops	shallow, sandy clays	Namelok
63	NAME 3	-5.36723	36.34115	lower slopes	deep, brown	Namelok
64	NASE 1	-5.52149	36.46486	hill tops	shallow, gravelly soils	Nasetani
65	NASE 2	-5.49091	36.47710	mid slopes	deep, sandy clays	Nasetani
66	NGIPA 1	-5.64918	36.53124	hill tops	sandy clays	Ngipa
67	NGIPA 2	-5.55380	36.47580	mid slopes	sandy loams	Ngipa
68	NGOMA 1	-5.91614	36.62554	mid slopes	reddish brown	Chilangilizi
69	NGOMA 2	-5.83389	36.60563	plains	brown	Chilangilizi
70	NGOMA 3	-5.87341	36.59784	valleys	dark soil	Ngomai
71	NGOMA 4	-5.96895	36.62217	mid slopes	reddish brown soils	Ngomai
72	NHAT 1	-5.77845	36.62990	upper slopes	shallow gravelly soils	Nhati
73	NHAT 2	-5.73710	36.60789	lower slopes	deep, sandy clays	Nhati
74	NJIA 1	-5.44483	36.47022	hill tops and mid slopes	sandy clays, gentle slopes	Njiapanda
75	NJIA 2	-5.47132	36.48504	lower slopes	loams	Njiapanda
76	NJOG 1	-5.96252	36.67477	plains	sandy clays	Njoge
77	NJOG 2	-5.96111	36.65141	mid and lower slopes	sandy soils	Njoge
78	NJORO 1	-5.27043	36.48882	mid slopes	dominant slope about 7 degrees	Njoro
79	NJORO 2	-5.24456	36.49216	lower slopes	dominant slope about 4 degrees	Njoro
80	NJORO 3	-5.22962	36.48417	plains	dominant slope about 2 degrees	Njoro
81	NJORO 5	-5.24289	36.42833	mid slopes	dominant slope about 4 degrees	Njoro
82	ORKI 1	-5.67229	36.52256	plains	grey sandy soils	Orkinei
83	ORKI 2	-5.65208	36.50404	mid slopes	brown sandy clays	Orkinei
84	ORKI 5	-5.65790	36.53279	plains	dark soils, clayey	Orkinei
85	PANDA 1	-6.13124	36.80350	mid slopes	reddish soils	Pandambili
86	PANDA 2	-6.09415	36.75150	hill tops	reddish brown soils	Pandambili
87	PARTI 1	-5.35279	36.42462	hill tops and upper slopes	newly opened, evidence of good crop from residues	Partimbo_Nalangtomon

S/n	Proposed mapping unit	Latitude	Longitude	Position on the landscape	Some differentiating characteristics	Name of the ward/village/hamlet
88	SONGA 1	-5.85062	36.44340	plains	sandy soils	Songambebe
89	SONGA 2	-5.87828	36.42731	lower slopes	sandy clays	Songambebe
90	SUNYA 1	-5.74561	37.08197	broad base hill tops	reddish brown, sandy clay broad hill tops soils	Sunya
91	SUNYA 2	-5.70315	37.10429	mid slopes	brown, sandy loams	Sunya
92	SUNYA 3	-5.72629	37.09188	valleys	dark soils, vertic, clayey	Sunya
93	ZOI 1	-5.71332	36.38089	mid slopes	reddish brown soils, sandy clays	Zoissa Kinangali
94	ZOI 2	-5.71629	36.40230	lower slopes	reddish brown, clayey	Zoissa Kinangali
95	ZOI 3	-5.69471	36.36461	mid slopes	shallow and rocky	Leganga
96	ZOI 4	-5.66593	36.34393	plains	newly opened from grazing land	Leganga
97	ZOI 5	-5.67933	36.41650	mid slopes	sandy clays	Kingalame
98	ZOI 6	-5.71052	36.40624	lower slopes	loams	Zoissa
99	ZOI 7	-5.76487	36.42245	plains	clayey	Zoissa

**Table 1: Description of soil sampling units**

### 3.4 SITE SPECIFIC SOIL TEST RESULTS AND RECOMMENDATIONS FOR SOIL FERTILITY MANAGEMENT IN KITETO DISTRICT

<b>Village name:</b>	Chapakazi	<b>Chapakazi_I, Chapakazi village</b>						
<b>Latitude</b>	-5.49759							
<b>Longitude</b>	36.4047							
<b>Sampling unit</b>	CHAPA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.7	Neutral	Phosphorus (ppm)	28.02ol	High	Boron (ppm)	0.07	Low
Ec (dS/m)	0.06	Salt free	Potassium (cmol(+)/kg)	0.81	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	11.0	Medium	Sulfate sulfur (ppm)	7.0	Deficient	Manganese (ppm)	36.5	High
Organic carbon (%)	0.68	Low	Calcium (cmol(+)/kg)	2.03	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol(+)/kg)	1.35	Sufficient	Iron (ppm)	14.54	High
Nitrate N (ppm)	78	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

#### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.05 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Chapakazi	<b>Chapakazi_2, Chapakazi village</b>						
<b>Latitude</b>	-5.50614							
<b>Longitude</b>	36.41003							
<b>Sampling unit</b>	CHAPA_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.2	Strongly acidic	Phosphorus (ppm)	18.21br	Medium	Boron (ppm)	0.3	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.37	Sufficient	Copper (ppm)	1.16	High
CEC (cmol(+)/kg)	8.0	Low	Sulfate sulfur (ppm)	27.61	Sufficient	Manganese (ppm)	14.7	High
Organic carbon (%)	0.37	Low	Calcium (cmol(+)/kg)	0.45	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol(+)/kg)	0.39	Sufficient	Iron (ppm)	37.22	High
Nitrate N (ppm)	90	Low	Sodium (cmol(+)/kg)	0.17	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Chekanao	<b><i>Chekanao_I, Chekanao village</i></b>						
<b>Latitude</b>	-5.38331							
<b>Longitude</b>	36.32325							
<b>Sampling unit</b>	CHEKA_I	<b><i>Sandy clay</i></b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.8	Very strongly acidic	Phosphorus (ppm)	8.87	Medium	Boron (ppm)	0.11	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.66	High	Copper (ppm)	2.15	High
CEC (cmol(+)/kg)	15.4	Medium	Sulfate sulfur ([[m)	11.34	Marginal	Manganese (ppm)	34.5	High
Organic carbon (%)	0.87	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol(+)/kg)	1.53	Sufficient	Iron (ppm)	40.31	High
Nitrate N (ppm)	73	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 65 kg N/ha is recommended in two or more equal side dressing applications. The soil is very acidic, so avoid using acidifying fertilizers such as sulphur containing fertilizers.
- **Phosphorus:** Banding of 35 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Sulfur:** 5 kg S/ha is recommended. Foliar application is recommended as basal or top dressing in sulphate or elemental form may increase acidity of the already very strongly acidic soil.

<b>Village name:</b>	Dongo	<b>Dongo_I, Dongo village</b>						
<b>Latitude</b>	-5.82806							
<b>Longitude</b>	36.63705							
<b>Sampling unit</b>	DONGO_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.6	Very strongly acidic	Phosphorus (ppm)	5.86br	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.55	High	Copper (ppm)	1.71	High
CEC (cmol(+)/kg)	12.4	Medium	Sulfate sulfur (ppm)	23.33	Sufficient	Manganese (ppm)	26.6	High
Organic carbon (%)	0.76	Low	Calcium (cmol(+)/kg)	1.24	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.82	Sufficient	Iron (ppm)	64.31	High
Nitrate N (ppm)	81	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 50 kg N/ha is recommended. Two or more equal applications as side dressing. The soil is very acidic, so avoid using acidifying fertilizers such as sulphur containing fertilizers.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Dongo	<b>Dongo_2, Dongo village</b>						
<b>Latitude</b>	-5.87178							
<b>Longitude</b>	36.6809							
<b>Sampling unit</b>	DONGO_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (ppm)	3.66br	Low	Boron (ppm)	1.16	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol+)/kg)	0.58	High	Copper (ppm)	1.16	High
CEC (cmol+)/kg)	11.2	Medium	Sulfate sulfur (ppm)	10.89	Marginal	Manganese (ppm)	58.3	High
Organic carbon (%)	1.67	Medium	Calcium (cmol+)/kg)	3.61	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol+)/kg)	1.29	Sufficient	Iron (ppm)	16.60	High
Nitrate N (ppm)	70	Low	Sodium (cmol+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Dongo	<b>Dongo_3, Dongo village</b>						
<b>Latitude</b>	-5.83999							
<b>Longitude</b>	36.67088							
<b>Sampling unit</b>	DONGO_3	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.3	Slightly acidic	Phosphorus (ppm)	5.65br	Low	Boron (ppm)	1.14	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol+)/kg)	0.24	Medium	Copper (ppm)	0.51	Sufficient
CEC (cmol+)/kg)	8.8	Low	Sulfate sulfur (ppm)	18.28	Sufficient	Manganese (ppm)	24.6	High
Organic carbon (%)	0.40	Low	Calcium (cmol+)/kg)	0.97	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol+)/kg)	0.59	Sufficient	Iron (ppm)	11.96	High
Nitrate N (ppm)	70	Low	Sodium (cmol+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Potassium:* 35 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.

<b>Village name:</b>	Dosidosi	<b><i>Dosidosi_I, Dosidosi village</i></b>						
<b>Latitude</b>	-5.60880							
<b>Longitude</b>	36.41702							
<b>Sampling unit</b>	DOSI_I	<b><i>Sandy clay loam</i></b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.3	Strongly acidic	Phosphorus (ppm)	3.35br	Low	Boron (ppm)	0.21	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol+)/kg)	0.46	High	Copper (ppm)	0.62	High
CEC (cmol+)/kg)	8.4	Low	Sulfate sulfur (ppm)	7.72	Deficient	Manganese (ppm)	34.5	High
Organic carbon (%)	0.63	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol+)/kg)	1.23	Sufficient	Iron (ppm)	26.39	High
Nitrate N (ppm)	92	Low	Sodium (cmol+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Soil pH*: Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter*: Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen*: 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus*: Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- *Sulfur*: 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Engusero	<b>Engusero_I, Engusero village</b>						
<b>Latitude</b>	-5.56666							
<b>Longitude</b>	36.44688							
<b>Sampling unit</b>	ENGU_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.4	Strongly acidic	Phosphorus (ppm)	4.08br	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.45	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	8.4	Low	Sulfate sulfur (ppm)	4.34	Deficient	Manganese (ppm)	56.3	High
Organic carbon (%)	0.62	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.49	Sufficient
Total nitrogen (%)	0.05	Low	Magnesium (cmol(+)/kg)	0.65	Sufficient	Iron (ppm)	28.45	High
Nitrate N (ppm)	73	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Sulfur:** 18 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. It is important to raise the soil pH first to avoid further acidification.

<b>Village name:</b>	Engusero	<b>Engusero_2, Engusero village</b>						
<b>Latitude</b>	-5.55040							
<b>Longitude</b>	36.45343							
<b>Sampling unit</b>	ENGU_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.9	Mildly alkaline	Phosphorus (ppm)	2.73ol	Low	Boron (ppm)	0.31	Satisfactory
Ec (mS/cm)	0.23	Salt free	Potassium (cmol(+)/kg)	0.46	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	41.4	High	Sulfate sulfur (ppm)	11.10	Marginal	Manganese (ppm)	4.8	High
Organic carbon (%)	0.47	Low	Calcium (cmol(+)/kg)	21.76	Sufficient	Zinc (ppm)	0.19	Marginal
Total nitrogen (%)	0.07	Low	Magnesium (cmol(+)/kg)	9.75	Sufficient	Iron (ppm)	6.29	High
Nitrate N (ppm)	76	Low	Sodium (cmol(+)/kg)	0.42	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Application of gypsum or elemental sulphur may be required to lower the soil pH. Determination of the rate of gypsum to apply requires analysis of soil free carbonates.
- *Soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Esukuta	<b>Esukuta_I, Esukuta village</b>						
<b>Latitude</b>	-5.62335							
<b>Longitude</b>	36.43754							
<b>Sampling unit</b>	ESUK_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (ppm)	6.18br	Low	Boron (ppm)	0.07	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.42	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	10.8	Low	Sulfate sulfur (ppm)	10.11	Marginal	Manganese (ppm)	52.8	High
Organic carbon (%)	0.49	Low	Calcium (cmol(+)/kg)	0.7	Sufficient	Zinc (ppm)	0.63	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.71	Sufficient	Iron (ppm)	18.14	High
Nitrate N (ppm)	106	Medium	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.05 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rate as it may result to boron toxicity.

<b>Village name:</b>	Esukuta	<b>Esukuta_2, Esukuta village</b>						
<b>Latitude</b>	-5.63893							
<b>Longitude</b>	36.47191							
<b>Sampling unit</b>	ESUK_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.1	Slightly acidic	Phosphorus (ppm)	7.17	Medium	Boron (ppm)	0.3	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.53	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	7.8	Low	Sulfate sulfur (ppm)	14.09	Sufficient	Manganese (ppm)	40.5	High
Organic carbon (%)	0.53	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.49	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.82	Sufficient	Iron (ppm)	16.08	High
Nitrate N (ppm)	84	Low	Sodium (cmol(+)/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 45 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.

<b>Village name:</b>	Kijungu	<b>Kijungu_2, Kijungu village</b>						
<b>Latitude</b>	-5.40718							
<b>Longitude</b>	37.18451							
<b>Sampling unit</b>	KIJU_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.0	Medium acidic	Phosphorus (ppm)	4.81br	Low	Boron (ppm)	1.1	Sufficient
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.57	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	9.2	Low	Sulfate sulfur (ppm)	11.82	Marginal	Manganese (ppm)	52.4	High
Org. carbon (%)	0.6	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.19	Marginal
Total nitrogen (%)	0.13	Low	Magnesium (cmol(+)/kg)	0.96	Sufficient	Iron (ppm)	32.06	High
Nitrate N (ppm)	84	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 45 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Kijungu	<b>Kijungu_4, Kijungu village</b>						
<b>Latitude</b>	-5.40243							
<b>Longitude</b>	37.18899							
<b>Sampling unit</b>	KIJU_4	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (ppm)	1.21br	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol+)/kg)	0.82	High	Copper (ppm)	1.49	High
CEC (cmol+)/kg)	12.8	Medium	Sulfate sulfur (ppm)	18.28	Sufficient	Manganese (ppm)	48.4	High
Org. carbon (%)	1.05	Low	Calcium (cmol+)/kg)	3.34	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol+)/kg)	1.26	Sufficient	Iron (ppm)	27.42	High
Nitrate N (ppm)	64	Low	Sodium (cmol+)/kg)	0.17	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 85 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Kijungu	<b>Kijungu_6, Kijungu village</b>						
<b>Latitude</b>	-5.38681							
<b>Longitude</b>	37.14568							
<b>Sampling unit</b>	KIJU_6	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.8	Neutral	Phosphorus (ppm)	8.06br	Medium	Boron (ppm)	0.1	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	1.43	High	Copper (ppm)	1.27	High
CEC (cmol(+)/kg)	16.2	Medium	Sulfate sulfur (ppm)	9.33	Marginal	Manganese (ppm)	68.2	High
Organic carbon (%)	1.0	Low	Calcium (cmol(+)/kg)	4.66	High	Zinc (ppm)	0.73	Sufficient
Total nitrogen (%)	0.1	Low	Magnesium (cmol(+)/kg)	2.82	High	Iron (ppm)	18.65	High
Nitrate N (ppm)	67	Low	Sodium (cmol(+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Kijungu	<b>Kijungu_7, Kijungu village</b>						
<b>Latitude</b>	-5.39354							
<b>Longitude</b>	37.16323							
<b>Sampling unit</b>	KIJU_7	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.8	Neutral	Phosphorus (ppm)	33.1 lbr	High	Boron (ppm)	0.1	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol+)/kg)	0.81	High	Copper (ppm)	1.93	High
CEC (cmol+)/kg)	12.8	Medium	Sulfate sulfur (ppm)	16.72	Sufficient	Manganese (ppm)	64.2	High
Organic carbon (%)	1.03	Low	Calcium (cmol+)/kg)	4.66	High	Zinc (ppm)	0.63	Sufficient
Total nitrogen (%)	0.09	Low	Magnesium (cmol+)/kg)	1.40	Sufficient	Iron (ppm)	28.96	High
Nitrate N (ppm)	78	Low	Sodium (cmol+)/kg)	0.19	Sufficient			

#### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 55 kg N/ha is recommended. Two or more equal applications as side dressing.

<b>Village name:</b>	Kiperesa	<b>Kiperesa_2, Kiperesa village</b>						
<b>Latitude</b>	-5.22962							
<b>Longitude</b>	36.38065							
<b>Sampling unit</b>	KIPE_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.0	Very strongly acidic	Phosphorus (ppm)	5.08br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol+)/kg)	0.53	High	Copper (ppm)	1.60	High
CEC (cmol+)/kg)	9.0	Low	Sulfate sulfur (ppm)	14.78	Sufficient	Manganese (ppm)	26.5	High
Organic carbon (%)	0.43	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.05	Low	Magnesium (cmol+)/kg)	0.42	Sufficient	Iron (ppm)	44.43	High
Nitrate N (ppm)	81	Low	Sodium (cmol+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.2kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Kiperesa	<b>Kiperesa_3, Kiperesa village</b>						
<b>Latitude</b>	-5.23258							
<b>Longitude</b>	36.37130							
<b>Sampling unit</b>	KIPE_3	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.0	Neutral	Phosphorus (ppm)	3.38ol	Low	Boron (ppm)	0.02	Low
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.60	High	Copper (ppm)	1.70	High
CEC (cmol(+)/kg)	9.4	Low	Sulfate sulfur (ppm)	12.06	Marginal	Manganese (ppm)	36.5	High
Organic carbon (%)	0.78	Low	Calcium (cmol(+)/kg)	3.87	Sufficient	Zinc (ppm)	0.58	Sufficient
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	0.80	Sufficient	Iron (ppm)	11.96	High
Nitrate N (ppm)	64	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.15kgB/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Kiperesa	<b>Kiperesa_4, Kiperesa village</b>						
<b>Latitude</b>	-5.24233							
<b>Longitude</b>	36.30266							
<b>Sampling unit</b>	KIPE_4	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	4.09br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.06	Salt free	Potassium (cmol+)/kg)	1.32	High	Copper (ppm)	2.15	High
CEC (cmol+)/kg)	15.0	Medium	Sulfate sulfur (ppm)	21.39	Sufficient	Manganese (ppm)	80.1	High
Organic carbon (%)	1.01	Low	Calcium (cmol+)/kg)	4.39	Sufficient	Zinc (ppm)	0.83	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol+)/kg)	2.82	Sufficient	Iron (ppm)	37.22	High
Nitrate N (ppm)	78	Low	Sodium (cmol+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 55 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.2kgB/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Kiperesa	<b><i>Kiperesa_5, Kiperesa village</i></b>						
<b>Latitude</b>	-5.26782							
<b>Longitude</b>	36.30609							
<b>Sampling unit</b>	KIPE_5	<b><i>Sandy loam</i></b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (ppm)	3.42br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.50	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	8.0	Low	Sulfate sulfur (ppm)	13.61	Sufficient	Manganese (ppm)	28.5	High
Organic carbon (%)	0.49	Low	Calcium (cmol(+)/kg)	3.08	Sufficient	Zinc (ppm)	0.49	Sufficient
Total nitrogen (%)	0.05	Low	Magnesium (cmol(+)/kg)	0.73	Sufficient	Iron (ppm)	15.57	High
Nitrate N (ppm)	114	Medium	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.2kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Kiperesa	<b>Kiperesa_6, Kiperesa village</b>						
<b>Latitude</b>	-5.23591							
<b>Longitude</b>	36.34529							
<b>Sampling unit</b>	KIPE_6	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.7	Very strongly acidic	Phosphorus (ppm)	70.64br	High	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.06	Salt free	Potassium (cmol+)/kg)	0.44	High	Copper (ppm)	0.83	High
CEC (cmol+)/kg)	10.8	Low	Sulfate sulfur (ppm)	16.33	Sufficient	Manganese (ppm)	28.5	High
Organic carbon (%)	0.76	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.49	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol+)/kg)	0.75	Sufficient	Iron (ppm)	92.85	High
Nitrate N (ppm)	143	Medium	Sodium (cmol+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 30 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 10 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.2kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Laalala	<b>Laalala_I, Laalala village</b>						
<b>Latitude</b>	-5.42607							
<b>Longitude</b>	36.42916							
<b>Sampling unit</b>	LALA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.7	Neutral	Phosphorus (ppm)	7.61	Medium	Boron (ppm)	0.1	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol+)/kg)	0.81	High	Copper (ppm)	1.16	High
CEC (cmol+)/kg)	13.0	Medium	Sulfate sulfur (ppm)	22.17	Sufficient	Manganese (ppm)	52.4	High
Organic carbon (%)	0.94	Low	Calcium (cmol+)/kg)	4.13	Sufficient	Zinc (ppm)	0.48	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol+)/kg)	1.45	Sufficient	Iron (ppm)	11.96	High
Nitrate N (ppm)	73	Low	Sodium (cmol+)/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.

<b>Village name:</b>	Laalala	<b>Laalala_2, Laalala village</b>						
<b>Latitude</b>	-5.41710							
<b>Longitude</b>	36.40780							
<b>Sampling unit</b>	LALA_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.2	Strongly acidic	Phosphorus (ppm)	9.49br	Medium	Boron (ppm)	0.1	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol+)/kg)	0.47	High	Copper (ppm)	1.38	High
CEC (cmol+)/kg)	8.8	Low	Sulfate sulfur (ppm)	16.72	Sufficient	Manganese (ppm)	28.5	High
Organic carbon (%)	0.55	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol+)/kg)	0.48	Sufficient	Iron (ppm)	58.15	High
Nitrate N (ppm)	101	Medium	Sodium (cmol+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Laalala	<b>Laalala_3, Laalala village</b>						
<b>Latitude</b>	-5.39154							
<b>Longitude</b>	36.37208							
<b>Sampling unit</b>	LALA_3	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (ppm)	5.41br	Low	Boron (ppm)	0.25	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol+)/kg)	0.44	High	Copper (ppm)	0.83	High
CEC (cmol+)/kg)	8.8	Low	Sulfate sulfur (ppm)	17.11	Sufficient	Manganese (ppm)	24.6	High
Organic carbon (%)	0.57	Low	Calcium (cmol+)/kg)	3.08	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol+)/kg)	0.57	Sufficient	Iron (ppm)	12.47	High
Nitrate N (ppm)	95	Low	Sodium (cmol+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.

<b>Village name:</b>	Lengatei	<b>Lengatei_I, Lengatei village</b>						
<b>Latitude</b>	-5.59055							
<b>Longitude</b>	37.19705							
<b>Sampling unit</b>	LENGA_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.3	Slightly acidic	Phosphorus (ppm)	6.51br	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol+)/kg)	0.45	High	Copper (ppm)	0.94	High
CEC (cmol+)/kg)	9.0	Low	Sulfate sulfur (ppm)	18.67	Sufficient	Manganese (ppm)	48.4	High
Organic carbon (%)	1.31	Medium	Calcium (cmol+)/kg)	2.03	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol+)/kg)	0.74	Sufficient	Iron (ppm)	21.75	High
Nitrate N (ppm)	78	Low	Sodium (cmol+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Lengatei	<b>Lengatei_2, Lengatei village</b>						
<b>Latitude</b>	-5.58976							
<b>Longitude</b>	37.19721							
<b>Sampling unit</b>	LENGA_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (ppm)	6.84br	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol+)/kg)	0.28	Medium	Copper (ppm)	0.83	High
CEC (cmol+)/kg)	9.0	Low	Sulfate sulfur (ppm)	22.94	Sufficient	Manganese (ppm)	40.5	High
OC (%)	0.45	Low	Calcium (cmol+)/kg)	1.50	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol+)/kg)	0.42	Sufficient	Iron (ppm)	18.66	High
Nitrate N (ppm)	77	Low	Sodium (cmol+)/kg)	0.28	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Potassium:* 40 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.

<b>Village name:</b>	Lengatei	<b>Lengatei_3, Lengatei village</b>						
<b>Latitude</b>	-5.59826							
<b>Longitude</b>	37.19209							
<b>Sampling unit</b>	LENGA_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (ppm)	14.31br	Medium	Boron (ppm)	0.17	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol+)/kg)	0.57	High	Copper (ppm)	1.05	High
CEC (cmol+)/kg)	14.0	Medium	Sulfate sulfur (ppm)	17.89	Sufficient	Manganese (ppm)	70.2	High
Organic carbon (%)	1.13	Low	Calcium (cmol+)/kg)	2.03	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol+)/kg)	2.08	Sufficient	Iron (ppm)	24.84	High
Nitrate N (ppm)	90	Low	Sodium (cmol+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 15 kg P/ha is recommended at sowing.

<b>Village name:</b>	Lengatei	<b>Lengatei_6, Lengatei village</b>						
<b>Latitude</b>	-5.54761							
<b>Longitude</b>	37.20531							
<b>Sampling unit</b>	LENGA_6	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.2	Slightly acidic	Phosphorus (ppm)	6.51br	Low	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol+)/kg)	0.30	Medium	Copper (ppm)	0.94	High
CEC (cmol+)/kg)	8.6	Low	Sulfate sulfur (ppm)	28.0	Sufficient	Manganese (ppm)	32.5	High
Organic carbon (%)	0.37	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.19	Marginal
Total nitrogen (%)	0.05	Low	Magnesium (cmol+)/kg)	0.65	Sufficient	Iron (ppm)	22.78	High
Nitrate N (ppm)	90	Low	Sodium (cmol+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Potassium:* 35 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.
- *Boron:* 0.1 kgB/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing or as foliar.

<b>Village name:</b>	Magungu	<b>Magungu_I, Magungu village</b>						
<b>Latitude</b>	-5.72176							
<b>Longitude</b>	36.57245							
<b>Sampling unit</b>	MAGU_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.3	Strongly acidic	Phosphorus (ppm)	5.96br	Low	Boron (ppm)	0.23	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol+)/kg)	0.78	High	Copper (ppm)	0.94	High
CEC (cmol+)/kg)	9.6	Low	Sulfate sulfur (ppm)	24.50	Sufficient	Manganese (ppm)	32.5	High
Organic carbon (%)	0.59	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol+)/kg)	0.86	Sufficient	Iron (ppm)	33.60	High
Nitrate N (ppm)	95	Low	Sodium (cmol+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 20 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Magungu	<b>Magungu_2, Magungu village</b>						
<b>Latitude</b>	-5.70419							
<b>Longitude</b>	36.54641							
<b>Sampling unit</b>	MAGU_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.6	Medium acidic	Phosphorus (ppm)	3.64br	Low	Boron (ppm)	0.14	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol+)/kg)	0.86	High	Copper (ppm)	0.83	High
CEC (cmol+)/kg)	13.0	Medium	Sulfate sulfur (ppm)	19.06	Sufficient	Manganese (ppm)	44.4	High
Organic carbon (%)	0.78	Low	Calcium (cmol+)/kg)	2.03	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol+)/kg)	1.88	Sufficient	Iron (ppm)	27.94	High
Nitrate N (ppm)	81	Low	Sodium (cmol+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 45 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Matui	<b>Matui_I, Matui village</b>						
<b>Latitude</b>	-5.44368							
<b>Longitude</b>	36.38999							
<b>Sampling unit</b>	MATU_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.1	Strongly acidic	Phosphorus (ppm)	7.84br	Medium	Boron (ppm)	0.18	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol+)/kg)	0.33	Medium	Copper (ppm)	0.62	High
CEC (cmol+)/kg)	8.0	Low	Sulfate sulfur (ppm)	14.0	Sufficient	Manganese (ppm)	6.7	High
Organic carbon (%)	0.43	Low	Calcium (cmol+)/kg)	0.71	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol+)/kg)	0.28	Sufficient	Iron (ppm)	72.7	High
Nitrate N (ppm)	90	Low	Sodium (cmol+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Matui	<b>Matui_2, Matui village</b>						
<b>Latitude</b>	-5.45279							
<b>Longitude</b>	36.42044							
<b>Sampling unit</b>	MATU_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (ppm)	5.41br	Low	Boron (ppm)	0.48	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.56	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	10.0	Low	Sulfate sulfur (ppm)	13.61	Marginal	Manganese (ppm)	40.5	High
Organic carbon (%)	0.66	Low	Calcium (cmol(+)/kg)	1.50	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.84	Sufficient	Iron (ppm)	16.08	High
Nitrate N (ppm)	121	Medium	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mbigiri	<b>Mbigiri_I, Mbigiri village</b>						
<b>Latitude</b>	-5.31811							
<b>Longitude</b>	36.67371							
<b>Sampling unit</b>	MBIG_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.8	Neutral	Phosphorus (ppm)	21.41br	Marginal	Boron (ppm)	0.34	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol+)/kg)	0.76	High	Copper (ppm)	1.38	High
CEC (cmol+)/kg)	15.0	Medium	Sulfate sulfur (ppm)	13.61	Marginal	Manganese (ppm)	40.5	High
Organic carbon (%)	0.99	Low	Calcium (cmol+)/kg)	4.13	Sufficient	Zinc (ppm)	0.53	Sufficient
Total nitrogen (%)	0.03	Low	Magnesium (cmol+)/kg)	2.34	Sufficient	Iron (ppm)	26.39	High
Nitrate N (ppm)	90	Low	Sodium (cmol+)/kg)	0.26	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 10 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mbigiri	<b>Mbigiri_2, Mbigiri village</b>						
<b>Latitude</b>	-5.30555							
<b>Longitude</b>	36.66345							
<b>Sampling unit</b>	MBIG_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.4	Mildly alkaline	Phosphorus (ppm)	4.32ol	Low	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.53	High	Copper (ppm)	0.51	High
CEC (cmol(+)/kg)	9.8	low	Sulfate sulfur (ppm)	10.50	Marginal	Manganese (ppm)	16.7	High
Organic carbon (%)	0.68	Low	Calcium (cmol(+)/kg)	3.08	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol(+)/kg)	1.03	Sufficient	Iron (ppm)	8.35	High
Nitrate N (ppm)	129	Medium	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mbigiri	<b>Mbigiri_3, Mbigiri village</b>						
<b>Latitude</b>	-5.30986							
<b>Longitude</b>	36.65661							
<b>Sampling unit</b>	MBIG_3	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.3	Neutral	Phosphorus (ppm)	15.401	High	Boron (ppm)	0.2	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.71	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	9.4	Low	Sulfate sulfur (ppm)	14.78	Sufficient	Manganese (ppm)	34.5	High
Organic carbon (%)	0.66	Low	Calcium (cmol(+)/kg)	3.34	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	1.29	Sufficient	Iron (ppm)	15.57	High
Nitrate N (ppm)	117	medium	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 10 kg P/ha is recommended at sowing.

<b>Village name:</b>	Nameloki	<b>Nameloki_I, Nameloki village</b>						
<b>Latitude</b>	-5.39012							
<b>Longitude</b>	36.35353							
<b>Sampling unit</b>	NAME_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (ppm)	1.99br	Low	Boron (ppm)	0.05	Low
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.41	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	9.6	Low	Sulfate sulfur (ppm)	24.89	Sufficient	Manganese (ppm)	24.6	High
Organic carbon (%)	1.00	Low	Calcium (cmol(+)/kg)	2.03	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	1.04	Sufficient	Iron (ppm)	12.98	High
Nitrate N (ppm)	70	Low	Sodium (cmol(+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 70 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kgB/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Nameloki	<b>Nameloki_3, Nameloki village</b>						
<b>Latitude</b>	-5.36723							
<b>Longitude</b>	36.34115							
<b>Sampling unit</b>	NAME_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.0	Neutral	Phosphorus (ppm)	10.1601	Marginal	Boron (ppm)	0.19	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.78	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	14.8	Medium	Sulfate sulfur (ppm)	8.56	Deficient	Manganese (ppm)	56.3	High
Organic carbon (%)	1.09	Low	Calcium (cmol(+)/kg)	3.87	Sufficient	Zinc (ppm)	1.45	High
Total nitrogen (%)	0.08	Low	Magnesium (cmol(+)/kg)	1.17	Sufficient	Iron (ppm)	15.57	High
Nitrate N (ppm)	67	Low	Sodium (cmol(+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 75 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 10 kg P/ha is recommended at sowing.
- *Sulfur:* 7 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Nasetan	<b>Nasetan_I, Nasetan village</b>						
<b>Latitude</b>	-5.52149							
<b>Longitude</b>	36.46486							
<b>Sampling unit</b>	NASE_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.8	Very strongly acidic	Phosphorus (ppm)	5.54br	Low	Boron (ppm)	0.1	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.25	Medium	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	9.0	Low	Sulfate sulfur (ppm)	7.24	Sufficient	Manganese (ppm)	8.7	High
Organic carbon (%)	0.45	Low	Calcium (cmol(+)/kg)	0.45	Low	Zinc (ppm)	0.19	Low
Total nitrogen (%)	0.04	Low	Magnesium (cmol(+)/kg)	0.43	Low	Iron (ppm)	76.06	High
Nitrate N (ppm)	81	Low	Sodium (cmol(+)/kg)	0.23	Low			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 55 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Potassium:** 40 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.
- **Sulfur:** 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. Liming is important before soil application.
- **Zinc:** 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Nasetan	<b>Nasetan_2, Nasetan village</b>						
<b>Latitude</b>	-5.49091							
<b>Longitude</b>	36.47710							
<b>Sampling unit</b>	NASE_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.0	Medium acidic	Phosphorus (ppm)	4.08br	Low	Boron (ppm)	0.22	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.38	Sufficient	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	7.4	Low	Sulfate sulfur (ppm)	7.24	Deficient	Manganese (ppm)	32.5	High
Organic carbon (%)	0.58	Low	Calcium (cmol(+)/kg)	0.97	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.55	Sufficient	Iron (ppm)	33.09	High
Nitrate N (ppm)	92	Low	Sodium (cmol(+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Ngipa	<b>Ngipa_I, Ngipa village</b>						
<b>Latitude</b>	-5.64918							
<b>Longitude</b>	36.53124							
<b>Sampling unit</b>	NGIPA_I	<b>Sandy</b>						
<b>Soil texture</b>	S							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.4	Strongly acidic	Phosphorus (ppm)	7.94br	Medium	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.15	Low	Copper (ppm)	0.40	Marginal
CEC (cmol(+)/kg)	6.8	Low	Sulfate sulfur (ppm)	23.72	Sufficient	Manganese (ppm)	12.7	High
Organic carbon (%)	0.45	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.03	Low	Magnesium (cmol(+)/kg)	0.15	Sufficient	Iron (ppm)	24.33	High
Nitrate N (ppm)	98	Low	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing.
- **Potassium:** 50 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.
- **Magnesium:** 10 kg Mg/ha from dolomitic lime. Or side dressing, single dose from Mg containing fertilizers.
- **Boron:** 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Ngipa	<b>Ngipa-2, Ngipa village</b>						
<b>Latitude</b>	-5.5538							
<b>Longitude</b>	36.47580							
<b>Sampling unit</b>	NGIPA_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	6.72br	Low	Boron (ppm)	0.05	Low
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	0.69	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	11.4	Low	Sulfate sulfur (ppm)	22.56	Sufficient	Manganese (ppm)	26.5	High
Organic carbon (%)	0.74	Low	Calcium (cmol(+)/kg)	0.71	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol(+)/kg)	1.17	Sufficient	Iron (ppm)	34.64	High
Nitrate N (ppm)	137	Medium	Sodium (cmol(+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Nhati	<b>Nhati_I, Nhati village</b>						
<b>Latitude</b>	-5.77845							
<b>Longitude</b>	36.62990							
<b>Sampling unit</b>	NHAT_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.2	Neutral	Phosphorus (ppm)	5.8601	Medium	Boron (ppm)	0.15	Satisfactory
Ec (mS/cm)	0.09	Salt free	Potassium (cmol(+)/kg)	0.81	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	15.2	Medium	Sulfate sulfur (ppm)	17.89	Sufficient	Manganese (ppm)	30.5	High
Organic carbon (%)	1.11	Low	Calcium (cmol(+)/kg)	5.18	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	1.91	Sufficient	Iron (ppm)	9.89	High
Nitrate N (ppm)	81	Low	Sodium (cmol(+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.

<b>Village name:</b>	Nhati	<b>Nhati_2, Nhati village</b>						
<b>Latitude</b>	-5.73710							
<b>Longitude</b>	36.60789							
<b>Sampling unit</b>	NHAT_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.0	Medium acidic	Phosphorus (ppm)	7.29br	Medium	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.76	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	10.6	Low	Sulfate sulfur (ppm)	25.67	Sufficient	Manganese (ppm)	30.5	High
Organic carbon (%)	0.72	Low	Calcium (cmol(+)/kg)	1.24	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.07	Low	Magnesium (cmol(+)/kg)	1.16	Sufficient	Iron (ppm)	47.53	High
Nitrate N (ppm)	84	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 45 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njiapanda	<b>Njiapanda_I, Njiapanda village</b>						
<b>Latitude</b>	-5.44483							
<b>Longitude</b>	36.47022							
<b>Sampling unit</b>	NJIA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.5	Strongly acidic	Phosphorus (ppm)	7.51br	Medium	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.76	High	Copper (ppm)	1.82	High
CEC (cmol(+)/kg)	11.0	Low	Sulfate sulfur (ppm)	14.78	Sufficient	Manganese (ppm)	54.3	High
Organic carbon (%)	0.78	Low	Calcium (cmol(+)/kg)	1.50	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	1.45	Sufficient	Iron (ppm)	66.54	High
Nitrate N (ppm)	73	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 75 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njiapanda	<b>Njiapanda_2, Njiapanda village</b>						
<b>Latitude</b>	-5.47132							
<b>Longitude</b>	36.48504							
<b>Sampling unit</b>	NJIA_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.8	Very strongly acidic	Phosphorus (ppm)	17.21br	Medium	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.11	Salt free	Potassium (cmol+)/kg)	0.76	High	Copper (ppm)	1.38	High
CEC (cmol+)/kg)	12.8	Medium	Sulfate sulfur (ppm)	12.06	Marginal	Manganese (ppm)	46.4	High
Organic carbon (%)	0.78	Low	Calcium (cmol+)/kg)	0.97	Sufficient	Zinc (ppm)	0.45	Sufficient
Total nitrogen (%)	0.11	Low	Magnesium (cmol+)/kg)	0.81	Sufficient	Iron (ppm)	64.31	High
Nitrate N (ppm)	90	Low	Sodium (cmol+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 10 kg P/ha is recommended at sowing. Minjingu rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Sulfur:** 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. Raising the pH before soil application is important.
- **Boron:** 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njoro	<b>Njoro_I, Njoro village</b>						
<b>Latitude</b>	-5.27043							
<b>Longitude</b>	36.48882							
<b>Sampling unit</b>	NJORO_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.1	Neutral	Phosphorus (ppm)	1.5401	Low	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.91	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	10.6	Low	Sulfate sulfur (ppm)	18.28	Sufficient	Manganese (ppm)	42.4	High
Organic carbon (%)	0.9	Low	Calcium (cmol(+)/kg)	4.66	Sufficient	Zinc (ppm)	0.53	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol(+)/kg)	1.49	Sufficient	Iron (ppm)	8.87	High
Nitrate N (ppm)	104	Medium	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njoro	<b>Njoro_2, Njoro village</b>						
<b>Latitude</b>	-5.24456							
<b>Longitude</b>	36.49216							
<b>Sampling unit</b>	NJORO_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.3	Slightly acidic	Phosphorus (ppm)	5.3br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.03	Salt free	Potassium (cmol+)/kg)	0.48	High	Copper (ppm)	0.73	High
CEC (cmol+)/kg)	7.6	Low	Sulfate sulfur (ppm)	16.72	Sufficient	Manganese (ppm)	44.4	High
Organic carbon (%)	0.55	Low	Calcium (cmol+)/kg)	2.29	Sufficient	Zinc (ppm)	0.53	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol+)/kg)	0.77	Sufficient	Iron (ppm)	17.64	High
Nitrate N (ppm)	109	Medium	Sodium (cmol+)/kg)	0.18	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njoro	<b>Njoro_3, Njoro village</b>						
<b>Latitude</b>	-5.22962							
<b>Longitude</b>	36.48417							
<b>Sampling unit</b>	NJORO_3	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	2.43br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.37	Sufficient	Copper (ppm)	0.51	High
CEC (cmol(+)/kg)	8.6	Low	Sulfate sulfur (ppm)	15.17	Sufficient	Manganese (ppm)	60.3	High
Organic carbon (%)	0.43	Low	Calcium (cmol(+)/kg)	2.03	Sufficient	Zinc (ppm)	0.48	Sufficient
Total nitrogen (%)	0.05	Low	Magnesium (cmol(+)/kg)	0.65	Sufficient	Iron (ppm)	18.66	High
Nitrate N (ppm)	95	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njoro	<b>Njoro_5, Njoro village</b>						
<b>Latitude</b>	-5.24289							
<b>Longitude</b>	36.42833							
<b>Sampling unit</b>	NJORO_5	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.9	Medium acidic	Phosphorus (ppm)	3.75br	Low	Boron (ppm)	0.04	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.57	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	10.2	Low	Sulfate sulfur (ppm)	17.89	Sufficient	Manganese (ppm)	40.5	High
Organic carbon (%)	0.39	Low	Calcium (cmol(+)/kg)	0.45	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.05	Low	Magnesium (cmol(+)/kg)	0.86	Sufficient	Iron (ppm)	24.33	High
Nitrate N (ppm)	73	Low	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Orkine	<b>Orkine_I, Orkine village</b>						
<b>Latitude</b>	-5.67229							
<b>Longitude</b>	36.52256							
<b>Sampling unit</b>	ORKI_I	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	3.31br	Low	Boron (ppm)	0.05	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.36	Sufficient	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	13.2	Medium	Sulfate sulfur (ppm)	7.0	Sufficient	Manganese (ppm)	22.6	High
Organic carbon (%)	0.33	Medium	Calcium (cmol(+)/kg)	1.50	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.03	Low	Magnesium (cmol(+)/kg)	0.48	Sufficient	Iron (ppm)	25.87	High
Nitrate N (ppm)	87	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 45 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Mbingu	<b>Orkine_2, Orkine village</b>						
<b>Latitude</b>	-5.65208							
<b>Longitude</b>	36.50404							
<b>Sampling unit</b>	ORKI_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	3.09br	Low	Boron (ppm)	0.23	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.69	High	Copper (ppm)	1.49	High
CEC (cmol(+)/kg)	17.1	Medium	Sulfate sulfur (ppm)	15.94	Sufficient	Manganese (ppm)	44.4	High
Organic carbon (%)	0.73	Low	Calcium (cmol(+)/kg)	2.03	Sufficient	Zinc (ppm)	0.39	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	1.26	Sufficient	Iron (ppm)	30.51	High
Nitrate N (ppm)	67	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 75 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Orkine	<b>Orkine_5, Orkine village</b>						
<b>Latitude</b>	-5.65790							
<b>Longitude</b>	36.53279							
<b>Sampling unit</b>	ORKI_5	<b>Clay</b>						
<b>Soil texture</b>	C							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (ppm)	1.76	Low	Boron (ppm)	0.06	Low
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	1.31	High	Copper (ppm)	1.93	High
CEC (cmol(+)/kg)	22.8	Medium	Sulfate sulfur (ppm)	9.33	Marginal	Manganese (ppm)	46.4	High
Organic carbon (%)	1.7	Medium	Calcium (cmol(+)/kg)	12.55	Sufficient	Zinc (ppm)	0.58	Sufficient
Total nitrogen (%)	0.17	Low	Magnesium (cmol(+)/kg)	9.98	Sufficient	Iron (ppm)	27.42	High
Nitrate N (ppm)	92	Low	Sodium (cmol(+)/kg)	0.26	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Partimbo	<b>Partimbo_I, Partimbo village</b>						
<b>Latitude</b>	-5.35279							
<b>Longitude</b>	36.42462							
<b>Sampling unit</b>	PARTI_I	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.2	Neutral	Phosphorus (ppm)	15.08ol	Marginal	Boron (ppm)	0.19	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.43	High	Copper (ppm)	0.51	Sufficient
CEC (cmol(+)/kg)	9.2	Low	Sulfate sulfur (ppm)	9.34	Sufficient	Manganese (ppm)	26.6	High
Organic carbon (%)	0.78	Low	Calcium (cmol(+)/kg)	3.08	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.94	Sufficient	Iron (ppm)	11.96	High
Nitrate N (ppm)	64	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 10 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Sunya	<b>Sunya_I, Sunya village</b>						
<b>Latitude</b>	-5.74561							
<b>Longitude</b>	37.08197							
<b>Sampling unit</b>	SUNYA-I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.2	Slightly acidic	Phosphorus (ppm)	1.76br	Low	Boron (ppm)	1.0	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol+)/kg)	0.64	High	Copper (ppm)	0.62	High
CEC (cmol+)/kg)	13.0	Medium	Sulfate sulfur (ppm)	8.17	Deficient	Manganese (ppm)	34.5	High
Organic carbon (%)	1.07	Medium	Calcium (cmol+)/kg)	3.08	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol+)/kg)	2.06	Sufficient	Iron (ppm)	20.72	High
Nitrate N (ppm)	92	Low	Sodium (cmol+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Sunya	<b>Sunya_2, Sunya village</b>						
<b>Latitude</b>	-5.70315							
<b>Longitude</b>	37.10429							
<b>Sampling unit</b>	SUNYA_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (ppm)	1.21br	Low	Boron (ppm)	0.03	Low
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.61	High	Copper (ppm)	1.38	High
CEC (cmol(+)/kg)	15.4	Medium	Sulfate sulfur (ppm)	9.33	Marginal	Manganese (ppm)	28.5	High
Organic carbon (%)	0.94	Low	Calcium (cmol(+)/kg)	2.03	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol(+)/kg)	2.76	Sufficient	Iron (ppm)	15.57	High
Nitrate N (ppm)	89	Low	Sodium (cmol(+)/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Sunya	<b>Sunya_3, Sunya village</b>						
<b>Latitude</b>	-5.72629							
<b>Longitude</b>	37.09188							
<b>Sampling unit</b>	SUNYA_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.9	Neutral	Phosphorus (ppm)	10.59br	Medium	Boron (ppm)	0.05	Low
Ec (mS/cm)	0.09	Salt free	Potassium (cmol(+)/kg)	1.17	High	Copper (ppm)	1.70	High
CEC (cmol(+)/kg)	21.4	Medium	Sulfate sulfur (ppm)	16.33	Sufficient	Manganese (ppm)	40.50	High
Organic carbon (%)	1.81	Medium	Calcium (cmol(+)/kg)	6.50	Sufficient	Zinc (ppm)	0.48	Sufficient
Total nitrogen (%)	0.13	Low	Magnesium (cmol(+)/kg)	4.49	Sufficient	Iron (ppm)	27.94	high
Nitrate N (ppm)	95	Low	Sodium (cmol(+)/kg)	0.31	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

### 3.5 SITE SPECIFIC SOIL TEST RESULTS AND RECOMMENDATIONS FOR SOIL FERTILITY MANAGEMENT IN KONGWA DISTRICT

<b>Village name:</b>	Chemae	<b>Chemae_I, Chemae village</b>						
<b>Latitude</b>	-5.97585							
<b>Longitude</b>	36.44975							
<b>Sampling unit</b>	CHEMA_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.0	Medium acidic	Phosphorus (mg/kg)	2.82br	Low	Boron (ppm)	1.03	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.96	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	12.0	Medium	Sulphate-S (ppm)	9.65	Marginal	Zinc (ppm)	0.39	Sufficient
Organic carbon (%)	0.62	Low	Ca (cmolc/kg)	2.03	Sufficient	Manganese (ppm)	32.5	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.43	Sufficient	Iron (ppm)	9.89	High
Nitrate N (ppm)	70	Low	Na (cmolc/kg)	0.23	Sufficient			

#### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 70 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Chitego	<b>Chitego_I, Chitego village</b>						
<b>Latitude</b>	-5.62191							
<b>Longitude</b>	36.40496							
<b>Sampling unit</b>	CHITE_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.3	Slightly acidic	Phosphorus (mg/kg)	3.97br	Low	Boron (ppm)	0.3	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.42	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	9.0	Low	Sulphate-S (ppm)	28.00	Sufficient	Zinc (ppm)	0.39	Sufficient
Organic carbon (%)	0.33	Low	Ca (cmolc/kg)	0.71	Sufficient	Manganese (ppm)	40.5	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	0.78	Sufficient	Iron (ppm)	14.02	High
Nitrate N (ppm)	105	Medium	Na (cmolc/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Chitego	<b>Chitego_2, Chitego village</b>						
<b>Latitude</b>	-5.61287							
<b>Longitude</b>	36.35408							
<b>Sampling unit</b>	CHITE_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (mg/kg)	3.09br	Low	Boron (ppm)	0.2	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.79	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	14.0	Medium	Sulphate-S (ppm)	15.94	Sufficient	Zinc (ppm)	0.34	Sufficient
Organic carbon (%)	0.84	Low	Ca (cmolc/kg)	3.08	Sufficient	Manganese (ppm)	50.4	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.35	Sufficient	Iron (ppm)	16.08	High
Nitrate N (ppm)	70	Low	Na (cmolc/kg)	0.18	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 70 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Hembahemba	<b>Hembahemba_I, Hembahemba village</b>						
<b>Latitude</b>	-6.00146							
<b>Longitude</b>	36.69909							
<b>Sampling unit</b>	HEMBA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.1	Slightly acidic	Phosphorus (mg/kg)	10.88br	Medium	Boron (ppm)	0.11	Satisfactory
Ec (dS/m)	0.09	Salt free	K (cmolc/kg)	0.75	High	Copper (ppm)	1.82	High
CEC (cmol(+)/kg)	11.8	Low	Sulphate-S (ppm)	7.78	Deficient	Zinc (ppm)	1.02	High
Organic carbon (%)	0.51	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese (ppm)	66.2	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	1.26	Sufficient	Iron (ppm)	33.60	High
Nitrate N (ppm)	71	Low	Na (cmolc/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 70 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Hembahemba	<b>Hembahemba_2, Hembahemba village</b>						
<b>Latitude</b>	-6.05419							
<b>Longitude</b>	36.72036							
<b>Sampling unit</b>	HEMBA_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (mg/kg)	8.69br	Medium	Boron (ppm)	0.17	Satisfactory
Ec (dS/m)	0.06	Salt free	K (cmolc/kg)	0.32	Sufficient	Copper (ppm)	1.82	High
CEC (cmol(+)/kg)	7.6	Low	Sulphate-S (ppm)	9.89	Marginal	Zinc (ppm)	0.39	Sufficient
Organic carbon (%)	0.54	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese(ppm)	22.6	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.47	Sufficient	Iron (ppm)	23.81	High
Nitrate N (ppm)	81	Low	Na (cmolc/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Hembahemba	<b>Hembahemba_3, Hembahemba village</b>						
<b>Latitude</b>	-6.04985							
<b>Longitude</b>	36.69951							
<b>Sampling unit</b>	HEMBA_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (mg/kg)	8.69br	Medium	Boron (ppm)	0.17	Satisfactory
Ec (dS/m)	0.06	Salt free	K (cmolc/kg)	0.32	Sufficient	Copper (ppm)	1.82	High
CEC (cmol(+)/kg)	7.6	Low	Sulphate-S (ppm)	9.89	Marginal	Zinc (ppm)	0.39	Sufficient
Organic carbon (%)	0.54	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese(ppm)	22.6	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.47	Sufficient	Iron (ppm)	23.81	High
Nitrate N (ppm)	81	Low	Na (cmolc/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Hogoro	<b>Hogoro_I, Hogoro village</b>						
<b>Latitude</b>	-5.95502							
<b>Longitude</b>	36.43534							
<b>Sampling unit</b>	HOGO_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (mg/kg)	9.60br	Medium	Boron (ppm)	0.09	Low
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.75	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	8.0	Low	SO4_S (ppm)	11.28	Marginal	Zinc (ppm)	0.49	Sufficient
Organic carbon (%)	0.6	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese (ppm)	28.5	High
Total nitrogen (%)	0.05	Low	Mg (cmolc/kg)	0.83	Sufficient	Iron (ppm)	18.14	High
Nitrate N (ppm)	76	Low	Na (cmolc/kg)	0.2	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.01 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Hogoro	<b>Hogoro_3, Hogoro village</b>						
<b>Latitude</b>	-5.93012							
<b>Longitude</b>	36.44843							
<b>Sampling unit</b>	HOGO_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.2	Slightly acidic	Phosphorus (mg/kg)	6.95br	Low	Boron (ppm)	0.2	Satisfactory
Ec (dS/m)	0.12	Salt free	K (cmolc/kg)	0.81	High	Copper (ppm)	2.81	High
CEC (cmol(+)/kg)	11.0	Low	SO <sub>4</sub> _S (ppm)	10.11	Marginal	Zinc (ppm)	0.63	Sufficient
Organic carbon (%)	0.72	Low	Ca (cmolc/kg)	2.29	Sufficient	Manganese (ppm)	54.3	High
Total nitrogen (%)	0.16	Low	Mg (cmolc/kg)	1.75	Sufficient	Iron (ppm)	12.98	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Kibaigwa	<b><i>Kibaigwa_I, Kibaigwa village</i></b>						
<b>Latitude</b>	-6.08161							
<b>Longitude</b>	36.63299							
<b>Sampling unit</b>	KIBA_I	<b><i>Sandy clay</i></b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.2	Neutral	Phosphorus (mg/kg)	4.0ol	Low	Boron (ppm)	1.01	Satisfactory
Ec (dS/m)	0.07	Salt free	K (cmolc/kg)	1.82	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	32.6	High	SO4_S (ppm)	18.33	Sufficient	Zinc (ppm)	0.48	Sufficient
Organic carbon (%)	0.44	Low	Ca (cmolc/kg)	9.92	Sufficient	Manganese (ppm)	20.6	High
Total nitrogen (%)	0.13	Low	Mg (cmolc/kg)	8.53	Sufficient	Iron (ppm)	13.51	High
Nitrate N (ppm)	90	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Kibaigwa	<b>Kibaigwa_2, Kibaigwa village</b>						
<b>Latitude</b>	-6.05456							
<b>Longitude</b>	36.63614							
<b>Sampling unit</b>	KIBA_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.7	Neutral	Phosphorus (mg/kg)	2.2br	Low	Boron (ppm)	0.23	Satisfactory
Ec (dS/m)	0.01	Salt free	K (cmolc/kg)	2.25	High	Copper (ppm)	1.49	High
CEC (cmol(+)/kg)	25.8	High	SO4_S (ppm)	12.30	Marginal	Zinc (ppm)	0.19	Low
Organic carbon (%)	1.07	Low	Ca (cmolc/kg)	7.82	Sufficient	Manganese (ppm)	46.4	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	4.91	Sufficient	Iron (ppm)	42.88	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Kibaigwa	<b>Kibaigwa_3, Kibaigwa village</b>						
<b>Latitude</b>	-6.08545							
<b>Longitude</b>	36.67480							
<b>Sampling unit</b>	KIBA_3	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.1	Strongly acidic	Phosphorus (mg/kg)	5.96br	Low	Boron (ppm)	0.31	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.50	High	Copper (ppm)	1.60	High
CEC (cmol(+)/kg)	10.4	Low	SO4_S (ppm)	11.82	Marginal	Zinc (ppm)	0.29	Sufficient
Organic carbon (%)	0.54	Low	Ca (cmolc/kg)	0.71	Sufficient	Manganese (ppm)	26.6	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	0.53	Sufficient	Iron (ppm)	16.59	High
Nitrate N (ppm)	101	Medium	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing. Minjingu rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Lenjulu	<b>Lenjulu_I, Lenjulu village</b>						
<b>Latitude</b>	-6.05913							
<b>Longitude</b>	36.76521							
<b>Sampling unit</b>	LENJU_I	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (mg/kg)	6.29br	Low	Boron (ppm)	0.44	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.50	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	10.4	Low	SO4_S (ppm)	21.39	Sufficient	Zinc (ppm)	0.19	Low
Organic carbon (%)	0.51	Low	Ca (cmolc/kg)	2.03	Sufficient	Manganese (ppm)	32.50	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.44	Sufficient	Iron (ppm)	26.91	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Lenjulu	<b>Lenjulu_2, Lenjulu village</b>						
<b>Latitude</b>	-6.07112							
<b>Longitude</b>	36.74638							
<b>Sampling unit</b>	LENJU_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.0	Very strongly acidic	Phosphorus (mg/kg)	6.62br	Low	Boron (ppm)	0.01	Low
Ec (dS/m)	0.02	Salt free	K (cmolc/kg)	0.71	High	Copper (ppm)	1.38	High
CEC (cmol(+)/kg)	10.2	Low	SO4_S (ppm)	26.44	Sufficient	Zinc (ppm)	0.19	Low
Organic carbon (%)	0.51	Low	Ca (cmolc/kg)	0.97	Sufficient	Manganese (ppm)	12.7	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	0.98	Sufficient	Iron (ppm)	48.08	High
Nitrate N (ppm)	87	Low	Na (cmolc/kg)	0.20	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.
- **Zinc:** 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Mageseni	<b>Mageseni_I, Mageseni village</b>						
<b>Latitude</b>	-5.72361							
<b>Longitude</b>	36.49196							
<b>Sampling unit</b>	MAGE_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (mg/kg)	5.86br	Low	Boron (ppm)	0.15	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.55	High	Copper (ppm)	1.24	High
CEC (cmol(+)/kg)	8.8	Low	SO <sub>4</sub> _S (ppm)	5.55	Deficient	Zinc (ppm)	1.06	High
Organic carbon (%)	0.73	Low	Ca (cmolc/kg)	0.97	Sufficient	Manganese (ppm)	52.4	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.80	Sufficient	Iron (ppm)	15.05	High
Nitrate N (ppm)	84	Low	Na (cmolc/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 12 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Majawanga	<b>Majawanga_I, Majawanga village</b>						
<b>Latitude</b>	-6.07674							
<b>Longitude</b>	36.80619							
<b>Sampling unit</b>	MAJA_I	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.0	Neutral	Phosphorus (mg/kg)	2.78ol	Low	Boron (ppm)	0.04	Low
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.56	High	Copper (ppm)	0.51	Marginal
CEC (cmol(+)/kg)	10.4	Low	SO4_S (ppm)	14.78	Sufficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.33	Low	Ca (cmolc/kg)	1.50	Sufficient	Manganese (ppm)	22.6	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	0.90	Sufficient	Iron (ppm)	11.96	High
Nitrate N (ppm)	64	Low	Na (cmolc/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Majawanga	<b>Majawanga_2, Majawanga village</b>						
<b>Latitude</b>	-6.10503							
<b>Longitude</b>	36.81533							
<b>Sampling unit</b>	MAJA_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.8	Neutral	Available phosphorus (mg/kg)	2.61br	Low	Boron (ppm)	0.25	Satisfactory
Ec (dS/m)	0.05	Salt free	K (cmolc/kg)	0.91	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	15.8	Medium	Sulphate-S (ppm)	21.78	Sufficient	Zinc (ppm)	0.19	Low
Organic carbon (%)	0.89	Low	Ca (cmolc/kg)	4.13	Sufficient	Manganese (ppm)	42.4	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	1.94	Sufficient	Iron (ppm)	10.4	High
Nitrate N (ppm)	75	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Zinc:* 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Majawanga	<b>Majawanga_3, Majawanga village</b>						
<b>Latitude</b>	-6.11859							
<b>Longitude</b>	36.82251							
<b>Sampling unit</b>	MAJA_3	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.7	Neutral	Phosphorus (mg/kg)	2.09br	Low	Boron (ppm)	0.05	Low
Ec (dS/m)	0.07	Salt free	K (cmolc/kg)	1.63	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	36.4	High	SO4_S (ppm)	11.28	Marginal	Zinc (ppm)	0.19	Low
Organic carbon (%)	1.81	Medium	Ca (cmolc/kg)	13.61	Sufficient	Manganese (ppm)	32.5	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	4.30	Sufficient	Iron (ppm)	12.47	High
Nitrate N (ppm)	81	Low	Na (cmolc/kg)	0.26	Sufficient			

### Parameters to address in this site:

- **Nitrogen:** 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 30 kg P/ha is recommended at sowing.
- **Sulfur:** 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- **Boron:** 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.
- **Zinc:** 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Makawa	<b>Makawa_I, Makawa village</b>						
<b>Latitude</b>	-5.74209							
<b>Longitude</b>	36.52579							
<b>Sampling unit</b>	MAKA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.0	Medium acidic	Phosphorus (mg/kg)	6.38br	Low	Boron (ppm)	0.43	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.76	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	12.2	Medium	Sulphate-S (ppm)	7.78	Deficient	Zinc (ppm)	0.48	Sufficient
Organic carbon (%)	0.90	Low	Ca (cmolc/kg)	1.76	Sufficient	Manganese (ppm)	30.5	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.03	Sufficient	Iron (ppm)	34.12	High
Nitrate N (ppm)	62	Low	Na (cmolc/kg)	0.26	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 85 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Makawa	<b>Makawa_2, Makawa village</b>						
<b>Latitude</b>	-5.78523							
<b>Longitude</b>	36.56114							
<b>Sampling unit</b>	MAKA_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.2	Strongly acidic	Phosphorus (mg/kg)	8.58br	Medium	Boron (ppm)	0.05	Low
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.58	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	12.8	Medium	SO <sub>4</sub> _S (ppm)	25.67	Sufficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.49	Low	Ca (cmolc/kg)	0.71	Sufficient	Manganese (ppm)	34.5	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	0.79	Sufficient	Iron (ppm)	30.0	High
Nitrate N (ppm)	53	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 110 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.1 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Manyatta	<b>Manyatta_I, Manyatta village</b>						
<b>Latitude</b>	-6.00831							
<b>Longitude</b>	36.61771							
<b>Sampling unit</b>	MANYA_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.7	Very strongly acidic	Phosphorus (mg/kg)	3.35br	Low	Boron (ppm)	0.44	Satisfactory
Ec (dS/m)	0.09	Salt free	K (cmolc/kg)	0.67	High	Copper (ppm)	3.91	High
CEC (cmol(+)/kg)	11.0	Low	SO4_S (ppm)	24.36	Sufficient	Zinc (ppm)	0.34	Sufficient
Organic carbon (%)	0.63	Low	Ca (cmolc/kg)	0.45	Sufficient	Manganese (ppm)	52.4	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.58	Sufficient	Iron (ppm)	17.11	High
Nitrate N (ppm)	76	Low	Na (cmolc/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing. Minjingu rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Mkoka	<b>Mkoka_2, Mkoka village</b>						
<b>Latitude</b>	-5.80617							
<b>Longitude</b>	36.40561							
<b>Sampling unit</b>	MKOK_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.1	Neutral	Phosphorus (mg/kg)	16.0ol	High	Boron (ppm)	0.01	Low
Ec (dS/m)	0.2	Salt free	K (cmolc/kg)	1.32	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	14.4	Medium	SO4_S (ppm)	14.23	Sufficient	Zinc (ppm)	0.48	Sufficient
Organic carbon (%)	0.96	Low	Ca (cmolc/kg)	4.92	Sufficient	Manganese (ppm)	22.6	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	1.44	Sufficient	Iron (ppm)	7.8	High
Nitrate N (ppm)	78	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 10 kg P/ha is recommended at sowing.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Mkoka	<b>Mkoka_3, Mkoka village</b>						
<b>Latitude</b>	-5.81053							
<b>Longitude</b>	36.44441							
<b>Sampling unit</b>	MKOK_3	<b>Clay</b>						
<b>Soil texture</b>	C							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.5	Mildly alkaline	Available Phosphorus (mg/kg)	3.0801	Low	Boron (ppm)	0.18	Satisfactory
Ec (dS/m)	0.17	Salt free	K (cmolc/kg)	1.82	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	45.0	High	SO4_S (ppm)	13.99	Marginal	Zinc (ppm)	0.19	Sufficient
Organic carbon (%)	1.45	Medium	Ca (cmolc/kg)	25.76	Sufficient	Manganese (ppm)	4.8	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	7.79	Sufficient	Iron (ppm)	5.77	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.32	Sufficient			

### Parameters to address in this site:

- **Nitrogen:** 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 25 kg P/ha is recommended at sowing.
- **Sulfur:** 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- **Zinc:** 0.3 kg Zn/ha is recommended. Apply as part of starter fertilizer at sowing.

<b>Village name:</b>	Matogoro	<b>Mkoka_4, Matogoro village</b>						
<b>Latitude</b>	-5.80651							
<b>Longitude</b>	36.46176							
<b>Sampling unit</b>	MKOK_4	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Slightly acidic	Phosphorus (mg/kg)	3.98br	Low	Boron (ppm)	0.12	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.65	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	11.6	Low	SO4_S (ppm)	6.27	Deficient	Zinc (ppm)	0.34	Sufficient
Organic carbon (%)	0.54	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese (ppm)	22.6	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	1.26	Sufficient	Iron (ppm)	16.59	High
Nitrate N (ppm)	76	Low	Na (cmolc/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Nitrogen*: 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus*: Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur*: 12 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mlanje	<b>Mlanje_I, Mlanje village</b>						
<b>Latitude</b>	-5.76505							
<b>Longitude</b>	36.46455							
<b>Sampling unit</b>	MLANJ_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.4	Mildly alkaline	Phosphorus (mg/kg)	0.32ols	Low	Boron (ppm)	1.03	Satisfactory
Ec (dS/m)	0.05	Salt free	K (cmolc/kg)	1.63	High	Copper (ppm)	1.70	High
CEC (cmol(+)/kg)	23.8	High	SO4_S (ppm)	2.65	Deficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	1.18	Low	Ca (cmolc/kg)	7.55	Sufficient	Manganese (ppm)	40.5	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	3.16	Sufficient	Iron (ppm)	33.60	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 18 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mnuku	<b>Mnuku_I, Mnuku village</b>						
<b>Latitude</b>	-5.80646							
<b>Longitude</b>	36.37077							
<b>Sampling unit</b>	MNUK_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.7	Medium acidic	Phosphorus (mg/kg)	2.30br	Low	Boron (ppm)	0.21	Satisfactory
Ec (dS/m)	0.05	Salt free	K (cmolc/kg)	0.74	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	12.8	Medium	Sulphate-S (ppm)	10.13	Marginal	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.85	Low	Ca (cmolc/kg)	2.03	Sufficient	Manganese (ppm)	26.6	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	1.15	Sufficient	Iron (ppm)	21.75	High
Nitrate N (ppm)	67	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 75 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Mtanana	<b>Mtanana_I, Mtanana village</b>						
<b>Latitude</b>	-6.08447							
<b>Longitude</b>	36.57837							
<b>Sampling unit</b>	MTAN_I	<b>Clay loam</b>						
<b>Soil texture</b>	CL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	8.2	Alkaline	Phosphorus (mg/kg)	4.32	Low	Boron (ppm)	0.1	Satisfactory
Ec (dS/m)	0.17	Salt free	K (cmolc/kg)	1.48	High	Copper (ppm)	0.62	High
CEC (cmol(+)/kg)	30.4	High	Sulphate-S (ppm)	20.61	Sufficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	1.67	Low	Ca (cmolc/kg)	14.92	Sufficient	Manganese (ppm)	2.8	High
Total nitrogen (%)	0.15	Low	Mg (cmolc/kg)	3.77	Sufficient	Iron (ppm)	3.71	Sufficient
Nitrate N (ppm)	84	Low	Na (cmolc/kg)	0.28	Sufficient			

### Parameters to address in this site:

- *Soil pH:* application of gypsum or elemental sulphur is recommended to lower the pH to above 7.2. Determination of free carbonates is required before knowing the amount of gypsum to apply.
- *Soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Mtanana	<b>Mtanana_2, Mtanana village</b>						
<b>Latitude</b>	-6.08546							
<b>Longitude</b>	36.59624							
<b>Sampling unit</b>	MTAN_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.3	Strongly acidic	Phosphorus (mg/kg)	2.82br	Low	Boron (ppm)	0.16	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.66	High	Copper (ppm)	1.32	High
CEC (cmol(+)/kg)	12.4	Medium	Sulphate-S (ppm)	15.17	Sufficient	Zinc (ppm)	0.13	High
Organic carbon (%)	0.58	Low	Ca (cmolc/kg)	1.24	Low	Manganese (ppm)	53.39	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.86	Medium	Iron (ppm)	21.95	High
Nitrate N (ppm)	84	Low	Na (cmolc/kg)	0.20	Low			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 35 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.

<b>Village name:</b>	Chilangilizi	<b>Ngomai_I, Chilangilizi village</b>						
<b>Latitude</b>	-5.91614							
<b>Longitude</b>	36.62554							
<b>Sampling unit</b>	NGOMA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.9	Neutral	Phosphorus (mg/kg)	6.69br	Medium	Boron (ppm)	0.11	Satisfactory
Ec (dS/m)	0.06	Salt free	K (cmolc/kg)	1.22	High	Copper (ppm)	1.49	High
CEC (cmol(+)/kg)	14.0	Medium	Sulphate-S (ppm)	15.94	Sufficient	Zinc (ppm)	0.53	Sufficient
Organic carbon (%)	0.93	Low	Ca (cmolc/kg)	4.13	Sufficient	Manganese (ppm)	58.3	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	1.75	Sufficient	Iron (ppm)	11.44	High
Nitrate N (ppm)	70	Low	Na (cmolc/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 70 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.

<b>Village name:</b>	Chilangilizi	<b>Ngomai_2, Chilangilizi village</b>						
<b>Latitude</b>	-5.83389							
<b>Longitude</b>	36.60563							
<b>Sampling unit</b>	NGOMA_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	7.2	Neutral	Phosphorus (mg/kg)	42.48ol	High	Boron (ppm)	1.1	Satisfactory
Ec (dS/m)	0.07	Salt free	K (cmolc/kg)	0.91	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	11.2	Low	Sulphate-S (ppm)	10.11	Marginal	Zinc (ppm)	1.65	High
Organic carbon (%)	0.71	Low	Ca (cmolc/kg)	3.34	Sufficient	Manganese (ppm)	42.4	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	1.43	Sufficient	Iron (ppm)	12.98	High
Nitrate N (ppm)	76	Low	Na (cmolc/kg)	0.18	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Ngomae	<b>Ngomai_3, Ngomae village</b>						
<b>Latitude</b>	-5.87341							
<b>Longitude</b>	36.59784							
<b>Sampling unit</b>	NGOMA_3	<b>Loamy sand</b>						
<b>Soil texture</b>	LS							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.4	Slightly acidic	Phosphorus (mg/kg)	6.80br	Low	Boron (ppm)	0.17	Satisfactory
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.32	Medium	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	9.0	Low	Sulphate-S (ppm)	8.56	Sufficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.42	Low	Ca (cmolc/kg)	1.24	Sufficient	Manganese (ppm)	26.6	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.83	Sufficient	Iron (ppm)	24.84	High
Nitrate N (ppm)	64	Low	Na (cmolc/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Ngomae	<b>Ngomai_4, Ngomae village</b>						
<b>Latitude</b>	-5.96895							
<b>Longitude</b>	36.62217							
<b>Sampling unit</b>	NGOMA_4	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.7	Neutral	Phosphorus (mg/kg)	9.94	Medium	Boron (ppm)	0.22	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.54	High	Copper (ppm)	0.73	High
CEC (cmol(+)/kg)	9.6	Low	Sulphate-S (ppm)	10.89	Marginal	Zinc (ppm)	0.39	Sufficient
Organic carbon (%)	0.54	Low	Ca (cmolc/kg)	0.97	Sufficient	Manganese (ppm)	34.5	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	0.84	Sufficient	Iron (ppm)	22.27	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Njoge	<b><i>Njoge_I, Njoge village</i></b>						
<b>Latitude</b>	-5.96252							
<b>Longitude</b>	36.67477							
<b>Sampling unit</b>	NJOG_I	<b><i>Sandy clay loam</i></b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (mg/kg)	6.73br	Low	Boron (ppm)	0.02	Low
Ec (dS/m)	0.01	Salt free	K (cmolc/kg)	0.76	High	Copper (ppm)	2.26	High
CEC (cmol(+)/kg)	10.2	Low	Sulphate-S (ppm)	26.83	Sufficient	Zinc (ppm)	0.63	Sufficient
Organic carbon (%)	0.59	Low	Ca (cmolc/kg)	2.03	Sufficient	Manganese (ppm)	72.2	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.49	Sufficient	Iron (ppm)	16.08	High
Nitrate N (ppm)	76	Low	Na (cmolc/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 60 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Njoge	<b>Njoge_2, Njoge village</b>						
<b>Latitude</b>	-5.96111							
<b>Longitude</b>	36.65141							
<b>Sampling unit</b>	NJOG_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.9	Medium acidic	Phosphorus (mg/kg)	9.82br	Medium	Boron (ppm)	0.05	Low
Ec (dS/m)	0.03	Salt free	K (cmolc/kg)	0.52	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	8.4	Low	Sulphate-S (ppm)	17.11	Sufficient	Zinc (ppm)	0.47	Sufficient
Organic carbon (%)	0.57	Low	Ca (cmolc/kg)	0.97	Sufficient	Manganese (ppm)	40.5	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	0.51	Sufficient	Iron (ppm)	24.84	High
Nitrate N (ppm)	92	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 20 kg P/ha is recommended at sowing.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Pandambili	<b>Pandambili_I, Pandambili village</b>						
<b>Latitude</b>	-6.13124							
<b>Longitude</b>	36.8035							
<b>Sampling unit</b>	PANDA_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (mg/kg)	1.99br	Low	Boron (ppm)	0.31	Satisfactory
Ec (dS/m)	0.04	Salt free	K (cmolc/kg)	0.81	High	Copper (ppm)	1.70	High
CEC (cmol(+)/kg)	13.2	Medium	Sulphate-S (ppm)	2.89	Deficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.89	Low	Ca (cmolc/kg)	3.08	Sufficient	Manganese (ppm)	52.4	High
Total nitrogen (%)	0.06	Low	Mg (cmolc/kg)	1.36	Sufficient	Iron (ppm)	16.08	High
Nitrate N (ppm)	73	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 15 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Pandambili	<b>Pandambili_2, Pandambili village</b>						
<b>Latitude</b>	-6.09415							
<b>Longitude</b>	36.75150							
<b>Sampling unit</b>	PANDA_2	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.6	Neutral	Phosphorus (mg/kg)	4.81br	Low	Boron (ppm)	0.31	Satisfactory
Ec (dS/m)	0.13	Salt free	K (cmolc/kg)	1.17	High	Copper (ppm)	1.05	High
CEC (cmol(+)/kg)	14.0	Medium	Sulphate-S (ppm)	13.51	Marginal	Zinc (ppm)	0.34	Sufficient
Organic carbon (%)	0.65	Low	Ca (cmolc/kg)	3.87	Sufficient	Manganese (ppm)	22.6	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	1.74	Sufficient	Iron (ppm)	11.44	High
Nitrate N (ppm)	98	Low	Na (cmolc/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

<b>Village name:</b>	Songambele	<b>Songambele_I, Songambele village</b>						
<b>Latitude</b>	-5.85062							
<b>Longitude</b>	36.44340							
<b>Sampling unit</b>	SONGA_I	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	8.0	Alkaline	Phosphorus (mg/kg)	2.31br	Low	Boron (ppm)	0.11	Satisfactory
Ec (dS/m)	0.19	Salt free	K (cmolc/kg)	1.84	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	18.8	Medium	Sulphate-S (ppm)	14.39	Sufficient	Zinc (ppm)	1.45	High
Organic carbon (%)	1.03	Low	Ca (cmolc/kg)	11.50	Sufficient	Manganese (ppm)	32.5	High
Total nitrogen (%)	0.09	Low	Mg (cmolc/kg)	2.47	Sufficient	Iron (ppm)	8.35	High
Nitrate N (ppm)	84	Low	Na (cmolc/kg)	0.21	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Application of gypsum or elemental sulphur to lower the pH is recommended. Determination of free carbonates is required to estimate the amount of gypsum material to apply.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Songambele	<b>Songambele_2, Songambele village</b>						
<b>Latitude</b>	-5.87828							
<b>Longitude</b>	36.42731							
<b>Sampling unit</b>	SONGA_2	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.8	Medium acidic	Phosphorus (mg/kg)	3.76br	Low	Boron (ppm)	0.27	Satisfactory
Ec (dS/m)	0.02	Salt free	K (cmolc/kg)	0.32	Medium	Copper (ppm)	0.51	Marginal
CEC (cmol(+)/kg)	7.2	Low	Sulphate-S (ppm)	16.33	Sufficient	Zinc (ppm)	0.24	Sufficient
Organic carbon (%)	0.29	Low	Ca (cmolc/kg)	0.71	Sufficient	Manganese (ppm)	16.7	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	0.51	Sufficient	Iron (ppm)	22.27	High
Nitrate N (ppm)	67	Low	Na (cmolc/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 80 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.

<b>Village name:</b>	Kinangali	<b>Zoissa_I, Kinangali village</b>						
<b>Latitude</b>	-5.71332							
<b>Longitude</b>	36.38089							
<b>Sampling unit</b>	ZOI_I	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.3	Strongly acidic	Phosphorus (ppm)	3.2br	Low	Boron (ppm)	0.16	Satisfactory
Ec (dS/m)	0.02	Salt free	Potassium (cmol(+)/kg)	0.45	High	Copper (ppm)	0.83	High
CEC (cmol(+)/kg)	44	High	Sulfate sulfur (ppm)	6.6l	Deficient	Manganese (ppm)	32.5	High
Organic carbon (%)	0.55	Low	Calcium (cmol(+)/kg)	0.97	Sufficient	Zinc (ppm)	0.34	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.90	Sufficient	Iron (ppm)	16.6	High
Nitrate N (ppm)	106	Medium	Sodium (cmol(+)/kg)	0.18	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Sulfur:** 12 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. The low pH problem should be addressed first.

<b>Village name:</b>	Kinangali	<b>Zoissa_2, Kinangali village</b>						
<b>Latitude</b>	-5.71629							
<b>Longitude</b>	36.40230							
<b>Sampling unit</b>	ZOI_2	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.7	Very strongly acidic	Phosphorus (ppm)	4.74br	Low	Boron (ppm)	0.4	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.35	Sufficient	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	6.6	Low	Sulfate sulfur (ppm)	8.17	Deficient	Manganese (ppm)	14.70	High
Organic carbon (%)	0.45	Low	Calcium (cmol(+)/kg)	0.97	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.04	Low	Magnesium (cmol(+)/kg)	0.47	Sufficient	Iron (ppm)	14.54	High
Nitrate N (ppm)	112	Medium	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- *Sulfur:* 8 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. Liming should be done first to avoid sulphur to further acidify the soil.

<b>Village name:</b>	Leganga	<b>Zoissa_3, Leganga village</b>						
<b>Latitude</b>	-5.69471							
<b>Longitude</b>	36.36461							
<b>Sampling unit</b>	ZOI_3	<b>Sandy clay</b>						
<b>Soil texture</b>	SC							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	5.2	Strongly acidic	Phosphorus (ppm)	2.65br	Low	Boron (ppm)	0.48	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.73	High	Copper (ppm)	1.70	High
CEC (cmol(+)/kg)	9.0	Low	Sulfate sulfur (ppm)	8.94	Sufficient	Manganese (ppm)	22.6	High
Organic carbon (%)	1.01	Low	Calcium (cmol(+)/kg)	3.08	Sufficient	Zinc (ppm)	0.29	Sufficient
Total nitrogen (%)	0.1	Low	Magnesium (cmol(+)/kg)	2.22	Sufficient	Iron (ppm)	46.5	High
Nitrate N (ppm)	67	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 75 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 35 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- *Sulfur:* 7 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form. Lime the soil first to avoid further acidification of the soil.

<b>Village name:</b>	Leganga	<b>Zoissa_4, Leganga village</b>						
<b>Latitude</b>	-5.66593							
<b>Longitude</b>	36.34393							
<b>Sampling unit</b>	ZOI_4	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.8	Neutral	Phosphorus (ppm)	1.99br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.43	High	Copper (ppm)	0.94	High
CEC (cmol(+)/kg)	9.4	Low	Sulfate sulfur (ppm)	9.33	Marginal	Manganese (ppm)	42.4	High
Organic carbon (%)	0.45	Low	Calcium (cmol(+)/kg)	0.97	Sufficient	Zinc (ppm)	0.43	Sufficient
Total nitrogen (%)	0.06	Low	Magnesium (cmol(+)/kg)	0.57	Sufficient	Iron (ppm)	9.38	High
Nitrate N (ppm)	86	Low	Sodium (cmol(+)/kg)	0.20	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 30 kg P/ha is recommended at sowing.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Kingalame	<b>Zoissa_5, Kingalame village</b>						
<b>Latitude</b>	-5.67933							
<b>Longitude</b>	36.4165							
<b>Sampling unit</b>	ZOI_5	<b>Sandy loam</b>						
<b>Soil texture</b>	SL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.2	Slightly acidic	Phosphorus (ppm)	6.4br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.29	Medium	Copper (ppm)	1.60	High
CEC (cmol(+)/kg)	3.4	Low	Sulfate sulfur (ppm)	12.06	Sufficient	Manganese (ppm)	52.4	High
Organic carbon (%)	0.49	Low	Calcium (cmol(+)/kg)	0.45	Low	Zinc (ppm)	0.49	Low
Total nitrogen (%)	0.04	Low	Magnesium (cmol(+)/kg)	0.19	Low	Iron (ppm)	25.87	High
Nitrate N (ppm)	73	Low	Sodium (cmol(+)/kg)	0.19	Low			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended.
- *Nitrogen:* 65 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 25 kg P/ha is recommended at sowing.
- *Potassium:* 40 kg K/ha is recommended. Broadcast before final cultivation or band with P in the starter dose.
- *Magnesium:* Apply 4 kg Mg/ha side dressing, single dose from Mg containing fertilizers.
- *Sulfur:* 5 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.
- *Boron:* 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Zoissa	<b>Zoissa_6, Zoissa village</b>						
<b>Latitude</b>	-5.71052							
<b>Longitude</b>	36.40624							
<b>Sampling unit</b>	ZOI_6	<b>Sandy clay loam</b>						
<b>Soil texture</b>	SCL							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	4.7	Very strongly acidic	Phosphorus (ppm)	1.66br	Low	Boron (ppm)	0.01	Low
Ec (mS/cm)	0.04	Salt free	Potassium (cmol+)/kg)	0.62	High	Copper (ppm)	2.15	High
CEC (cmol+)/kg)	7.6	Low	Sulfate sulfur (ppm)	15.94	Sufficient	Manganese (ppm)	62.3	High
Organic carbon (%)	0.99	Low	Calcium (cmol+)/kg)	1.24	Sufficient	Zinc (ppm)	0.68	Sufficient
Total nitrogen (%)	0.08	Low	Magnesium (cmol+)/kg)	0.87	Sufficient	Iron (ppm)	26.39	High
Nitrate N (ppm)	104	Medium	Sodium (cmol+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to above 5.5. Lime requirement analysis should be done to know the amount of lime required.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- **Nitrogen:** 40 kg N/ha is recommended. Two or more equal applications as side dressing.
- **Phosphorus:** Banding of 30 kg P/ha is recommended at sowing. Rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the soil pH.
- **Boron:** 0.2 kg B/ha is recommended, as foliar application. Care should be taken not to exceed the rates as it may result to boron toxicity.

<b>Village name:</b>	Zoissa	<b>Zoissa_7, Zoissa village</b>						
<b>Latitude</b>	-5.76487							
<b>Longitude</b>	36.42245							
<b>Sampling unit</b>	ZOI_7	<b>Clay</b>						
<b>Soil texture</b>	C							
<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>	<b>Parameter</b>	<b>Values</b>	<b>Interpretation</b>
pH(water)	6.5	Slightly acidic	Phosphorus (ppm)	0.89br	Low	Boron (ppm)	1.3	Satisfactory
Ec (mS/cm)	0.04	Salt free	Potassium (cmol(+)/kg)	1.63	High	Copper (ppm)	1.24	High
CEC (cmol(+)/kg)	12.4	Medium	Sulfate sulfur (ppm)	8.94	Deficient	Manganese (ppm)	46.4	High
Organic carbon (%)	0.88	Low	Calcium (cmol(+)/kg)	6.50	Sufficient	Zinc (ppm)	0.24	Sufficient
Total nitrogen (%)	0.09	Low	Magnesium (cmol(+)/kg)	4.10	Sufficient	Iron (ppm)	12.47	High
Nitrate N (ppm)	78	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Grazing on crop residues after harvesting should be avoided.
- *Nitrogen:* 50 kg N/ha is recommended. Two or more equal applications as side dressing.
- *Phosphorus:* Banding of 35 kg P/ha is recommended at sowing.
- *Sulfur:* 7 kg S/ha is recommended. Single dose, basal or top dressing in sulfate form.

## 4. CONCLUSION AND PROPOSED WAY FORWARD

The following are the conclusions drawn from this study and proposed way forward:

- At the time of this study there were no any recent documented site specific soil management and fertilizer recommendations available for both Kongwa and Kiteto districts. It is therefore anticipated that this document will provide that information for the studied sites. It should be noted that the recommendations provided based on soil test results. Supplementing these recommendations with plant analysis and fertilizer trials will make them more useful. Soil test is not a 'once for life' activity, therefore a mechanism to update this information need to be in place.
- Most farmers in the area do not have a right idea on the usefulness of fertilizers to replenish the soil nutrients which have been absorbed by plants. They believe fertilizers have negative effects on soils, especially causing acidity. This can be one of the reasons that most farmers do not apply fertilizers in their maize fields. Education and use of demonstration plots may help in removing this wrong perception.
- Shifting maize cultivation is practiced at an unacceptable level in Kiteto district. Grazing lands and conserved lands are encroached at an astonishing speed. This practice is accelerated by the fact that new lands have higher fertility due to retained organic matter and other fertility indicators resulting to high maize yields in the first few seasons. However, yields decline very fast with time due to poor soil fertility management, thus seek for new lands becomes insatiable. Actions need to be taken by appropriate authorities and stakeholders to stop this unsustainable agricultural practice by enacting and enforcing regulations and by improving farmers' skills in soil fertility management practices.
- Some agronomic practices carried out in maize growing areas contribute to depletion of soil fertility. These practices include burning during land clearing and grazing on crop residues resulting to mining agriculture, soil compaction and erosion. Here, the district authorities dealing with agriculture and livestock need to intervene. Other stakeholders such as NGOs and community based organizations can join hands on this for sustainability of agriculture.
- Soils of both Kiteto and Kongwa districts vary spatially in physical, mineralogical and chemical properties. The variations in soil properties have influence on their productivity and management. The following conclusion and recommendation are made on the studied soil properties:
  - *Soil texture* of the study sites varies from clay to sandy clays. This textural range has no direct effect on the maize crop in the studied sites.
  - *Cation exchange capacity* values in both Kiteto and Kongwa are generally low. These affect ability of the soil to retain nutrients. Incorporation of crop residue will help in increasing the

soil charges and thus the ability to retain nutrients. To avoid nutrient loss by leaching due to low retention, splitting of fertilizer applications is recommended. Applying fertilizers close to the root zone will assist in their uptake, but care should be taken not to harm the roots by too close placement of fertilizer materials.

- *Soil pH* values in majority of the sites (about 80%) fall in a range favorable for maize production (i.e. 5.5 – 7.8). Majority of the rest fall in more acidic category which require liming for optimum maize production. Very few sites have pH above 7.8. These sites require application of gypsum, elemental sulphur or any other acidifying material to reduce the pH in order to have optimal conditions for maize production. An exercise to determine lime and gypsum requirements for the sites having unfavorable pH levels for maize production need to be carried out to assist in extension and advisory services.
- *Electrical conductivity* which is a measure of soil salinity was found to be optimum in all studied sites.
- *Soil organic carbon* was found to be low throughout the study sites. This could be due to mining agriculture whereby all the crop residues are fed to livestock. Incorporation of crop residues is important to replenish the soil carbon which is very crucial in improving soil structure, water holding capacity, soil temperature, soil microbes and nutrient holding capacity. The district's land use planning department should put more efforts to separate agricultural land from grazing land.
- *Nitrogen* levels of the soils are generally low throughout. Application of N fertilizers to correct the deficiency is recommended in each site. Two or more fertilizer splits are recommended due to low CEC and some coarse texture soils which accelerates leaching of nitrate-nitrogen. Non acidifying fertilizers (such as those containing sulphate) should not be applied to the acidic or near acidic soils.
- The *available phosphorus* levels are generally low in most of the sites. P fertilizers are therefore recommended. P fertilizer trials are required to affirm crop response to different application levels and combinations.
- The Exchangeable bases (i.e. *potassium, magnesium, calcium and sodium*) are in optimum level for maize production in almost all studied sites.
- *Soil sulfur* levels are ranging from deficient to sufficient. In sites with deficient and marginal levels application of sulphur is recommended. Addressing low pH levels for some sites is important to avoid detrimental acidification by sulphur application.
- The soil micronutrient (*copper, zinc, manganese and iron*) levels are generally high and sufficient in all sites. However, boron deficiency has been noted in many sites. Basal or foliar application can be used to correct boron deficiency. However care should be taken not to over-apply which could result to boron toxicity.

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# ANNEXES

## ANNEX 2: CHECKLIST OF INFORMATIONS COLLECTED FROM KEY INFORMANTS

### A. Current Maize Farming Practices:

Name of District		Name of Village	
Date of Survey		Name of Key Informant	
<i>I. Farm preparations: How is the land prepared?</i>			
Land clearing (burning, slashing etc.)			
Residue management			
Land cultivation: Using hand hoe/tractor/power tillers)			
Harrowing			
<i>II. Planting/Sowing method</i>			
Broadcast (amount of seeds per area			
Planting in rows (line spacing)			
Maize varieties planted			
<i>III. Soil water management</i>			
Water harvesting?			
Runoff management			
<i>IV. Weeds management</i>			
Herbicides used (Yes/No)			
Type of herbicides used			
Use of hand hoes			
Time of weeding			
<i>V. Crop protection</i>			
Major weeds problem			
Major insects pest and how they are controlled			
Major maize diseases and how they are managed			

## B. Information about fertilizer use

<b>Name of District</b>		<b>Name of Village</b>	
<b>Date of survey</b>		<b>Name of Key informant</b>	
<i>I. Fertilizer use by small scale maize farmers</i>			
Use of fertilizers (yes/No)			
Type of fertilizers used (type organic/industrial name)			
Time of fertilizer application (in relation to type)			
Quantity of fertilizer applied per area (rate of fertilizer used)			
<i>II. Fertilizer recommendations</i>			
<b>a) What is the current recommendation rate for N fertilizers:</b>			
Urea (bags/acre(ha)?)			
CAN (bags/acre(ha)?)			
SA (bags/acre(ha)?)			
Manure			
<b>b) What is the current recommendation rate for P fertilizers:</b>			
DAP (46% P <sub>2</sub> O <sub>5</sub> ) _ (bags/acre(ha)?)			
TSP (46% P <sub>2</sub> O <sub>5</sub> ) _ (bags/acre(ha)?)			
Minjingu P (29% P <sub>2</sub> O <sub>5</sub> ) _ (bags/acre(ha)?)			
Minjingu mazao (20% P <sub>2</sub> O <sub>5</sub> ) _ (bags/acre(ha)?)			
<b>c) Other fertilizers (name type of fertilizer and their recommended rates)</b>			
<i>III. Source of fertilizer recommendations</i>			
<b>What is the source of current recommendations rates:</b>			
Ministry of Agriculture			
DALDO Extension staff			
Agricultural Research Institutes			
Sokoine University of Agriculture (SUA)			
Fertilizer company (give name)			
Agro-dealers			
Others			

## ANNEX 3: INVENTORY OF CURRENT MAIZE FARMING PRACTICES IN KITETO AND KONGWA

Rice farming practices	Village
<i>A. Land preparation</i>	
Slashing and burning	All new areas
Residue incorporation	Non
<i>B. Tillage</i>	
Tractors	All villages surveyed
Oxen plough	All villages surveyed in Kilombero, not common in Wami valley
Power tillers	Used by a few farmers in all villages due to availability
Hand hoe	All villages surveyed
<i>C. Harrowing</i>	
Hand hoes	Non
Power tillers	Non
Tractors	Non
<i>D. Soil fertility Management</i>	
Use of N fertilizers	Non
Use of P fertilizers	Non
Use of Manure	Non
Nonuse of fertilizers	Most of farmers in all villages
<i>E. Seed selection</i>	
Local seeds	A few farmers in all surveyed villages
SITUKA	All
STAHA	All
KATUMANI	A few villages of Kongwa
<i>F. Planting practices:</i>	
Broadcasting	Non
Sowing per recommended spacing	Non
Sowing following tractor or oxen plough	All villages
<i>G. Weeding</i>	
Herbicide use	Non
Hand hoe	All villages

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