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# REPORT ON AGRONOMIC PRACTICES AND SOIL FERTILITY ANALYSIS FOR IMPROVED RICE PRODUCTION IN THE KILOMBERO AND WAMI VALLEY AREA 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

The Tanzanian economy is dominated by smallholder farmers, which accounts for more than 90% of rural employment. The country's agricultural economy is dominated by food crop production with rice being the second most important food and commercial crop after maize (Bucheyeki et al., 2011; RLDC, 2011). Tanzania is ranked as the second largest producer of rice in Southern Africa after Madagascar, with a production level of 818,000 tons produced from 681,000 ha (USDA world rice statistics, 2007).

Rice production in Tanzania is undertaken through small scale farming. Small scale rice farming is characterized by; many small holder farmers, cultivating small farms (0.5 to 10 acres), where rainfed and traditional irrigation accounts for 71% and 29% respectively (RLDC, 2011). These small scale farmers use few inputs or none at all.

Major constraints facing the rice production sector include: erratic weather conditions and declining land productivity due to the application of poor agricultural technology practices; inaccessibility of improved seeds; and inherent low soil fertility and poor soil fertility management practices. As a result of these factors, the average rice yield per unit area under small scale farms is 1.0 to 1.5 t ha<sup>-1</sup>. These yields are lower than yields in the developed countries which have yields as high as 10 t ha<sup>-1</sup> in some seasons (Bucheyeki et al., 2011).

In order to increase rice 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 necessary.

This report covers work done in the rice farming valleys of Kilombero and Wami-Dakawa in Morogoro region of Tanzania. 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 rice producing areas of Kilomebro and Wami-Dakawa.

Specifically, the report covers: a) a review of current fertilizer and soil management recommendations for rice in the study area; b) a review of current rice 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 rice production based on soil test results.

## 2. MATERIALS AND METHODS

### 2.1 DESCRIPTION OF THE STUDY AREA

This study was conducted within the rice farming valleys of Kilombero and Wami-Dakawa in Morogoro region. The location of the study area is shown in Fig 1 below.

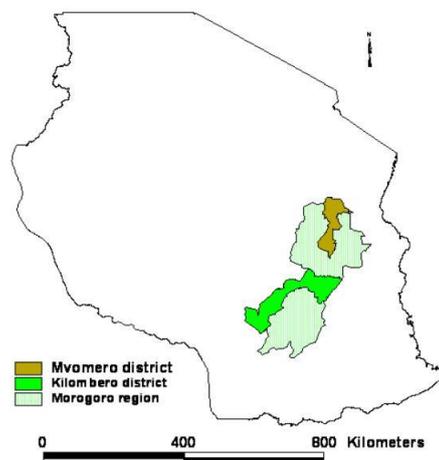


Figure 1: Location of Kilombero and Mvomero Districts in Tanzania

The Kilombero district lies along the Kilombero valley which is part of Rufiji Basin. The valley extends below the Udzungwa Mountain from the east towards the southwest. The climate of Kilombero can be described as tropical to sub-humid, with annual rainfall ranging between 1200 to 1400 mm, during the period of December and June. The valley has bimodal rainfall, with the shorter rains starting in November to January and the longer rains in March to June (URT, 2008). The annual average temperature in Kilombero ranges between 26°C and 32°C in November.

The Wami Valley is situated in Mvomero district located at latitudes 5°47'09" to 7°23'40"S, and longitudes 37°11'09" to 38°01'33"E. The annual rainfall ranges between 900 to 1400 mm, with an average annual temperature of about 30°C (URT, 2008).

### 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 senior researchers, extension staff and experienced farmers. The interview was guided with a check list which comprised of questions regarding the fertilizer recommendations currently used for rice production and soil management practices. Literature review of various publications on fertilizer recommendations was also consulted.

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

The current rice farming practices in the study sites were documented from field observations and interviews with key informants. An inventory of farming practices was developed from the field observations and interviews. The key informants consulted were; extension officers, agricultural researchers, and selected active farmers. The effects on soil fertility depletion of the inventoried current rice farming practices in the rice farming valleys of Kilombero and Wami-Dakawa were deduced from researchers' agronomic experiences and literature.

## **2.2.3 Establishment of soil sampling units**

A base map was prepared using digital elevation model (DEM) of the area, topographic maps and air photos in ArcView 3.2 GIS software. Mapping units were then established and the positions, features and boundaries were confirmed in the field. Areas with similar physical properties (soil color, texture, depth), landform features (altitude range, slope gradient, drainage pattern) and land use were considered homogeneous and thus were treated as the same sampling unit. A Global Positioning System (GPS) (Garmin etrex Vista HCx 2011) was used to mark the sampling points and necessary village centers, as well as the way points to establish farm routes and roads. These points were then uploaded in ArcView 3.2 GIS software to come up with the sampling points and location maps.

## **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 of the sample.
- 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 a 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 water less than 7 and Olsen method for soils with pH water 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 rice crop was calculated based on soil test results and nutrient removal by rice crop, both by grain and straw (De Datta, 1989). The estimated rate of fertilizer application was based on the use of high yielding varieties, which are recommended in rice intensification and an average grain yield of 4.5 t/ha. Higher than the current recommended N and P was estimated following the response trials by Mkangwa (1993) as a guide to amount of fertilizer to apply. Micronutrient response trials by Msolla et al., (2006) for Zn in sandy clay loam and sandy loam soil, and Dunn et al., (2005) for B in silt loam soils were also used as guide to the rate of application. The rates of all nutrients to be applied (N, P, K, B, and Zn) were then adjusted based on soil test levels and rice requirement.

## 3. RESULTS AND DISCUSSIONS

### 3.1 REVIEW OF CURRENT FERTILIZER AND SOIL MANAGEMENT RECOMMENDATIONS IN RICE PRODUCTION IN TANZANIA

*Overview on the current soil fertility management recommendations*

Although nutrient depletion rate studies in Kilombero and Wami valleys have not been documented, studies by Sanchez et al (1997) and Lynam et al (1998) show that over the past decades, small-scale farmers have removed large quantities of nutrients from the soil, without replenishing it with sufficient quantities of manure or fertilizer in their farming activities. According to the authors, this has resulted in, a very high average annual depletion rate, 22 kg N, 2.5 kg P, and 15 kg K per hectare of cultivated land over the last 30 years in 37 African countries, an annual loss equivalent to U.S. \$4 billion in fertilizer.

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. The history of inorganic fertilizer use in Tanzania was introduced in 1956 by the British American Tobacco Company (BAT) and was only limited to cash crops: tobacco, coffee and cotton in the Northern and Lake Zones. The use of such fertilizers in food crops did not start until the 980s and 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 program in Tanzania. The current available fertilizer recommendations in Tanzania were released in 1993 (Mowo et al., 1993), after the review of recommendations by Samki and Harrop (1984). Both fertilizer recommendations in rice considered the two major macronutrients, nitrogen and phosphorus. Later Scalgia (1997) revised the 1993 fertilizer recommendations, and provided blanket fertilizer recommendations for rice production in different agro ecological zones. The author's recommendations concentrated only on nitrogen fertilizer.

#### **3.1.1 Fertilizer and soil management recommendations for rice production in Kilombero and Wami valley**

According to Mkangwa (1984) the fertilizer recommended for rice in Kilombero valley is 60 kg N ha<sup>-1</sup> and 25kg P ha<sup>-1</sup> for areas with light-textured soils and 60 to 90 kg N ha<sup>-1</sup> and 20 kg P ha<sup>-1</sup> for areas with heavy clay soils. In addition the fertilizer recommendations for rice in Wami valley is 120 kg N ha<sup>-1</sup> and 10 kg P ha<sup>-1</sup> for areas with light-textured soils (Mkangwa, 1993). These recommendations were based on fertilizer trials conducted at Dakawa.

However, taking into consideration the economics of fertilizer use, the fertilizer recommendations were revised to a blanket rate of 40 kg N ha<sup>-1</sup> and 10 kg P ha<sup>-1</sup> for rice production in both Kilombero and Wami valley equivalent to 0.4 bag of urea or 0.6 bags of CAN or 0.8 bag SA for N per acre and 0.2 bag Tripple Super Phosphate (TSP) for P per acre (Mowo et al., 1993). The low rate of P in this recommendation was due to the fact that rice did not respond to the nutrient.

In 1997, Scalgia made new recommendations for rice production in Kilombero and Wami valley where 60 kg N ha<sup>-1</sup> (equivalent to 1 bag urea per acre) and 0 kg P ha<sup>-1</sup> was recommended. This fertilizer recommendations of 60 kg N ha<sup>-1</sup> and no P fertilizer has been used in Mlimba, Mngeta, Mofu and Mang'ula soils in Kilombero valley , and Dihombo, Hembeti, Mvomero, and Dakawa in Wami valley for the past 15 years or so. The recommendations by Scalgia (1997) have been the basis for more emphasis on N fertilizers within the extension service areas. More emphasis on N fertilizer was partly due to the lack of a consistent response of P fertilizer in rice in the trials and demonstration plots at that time (Scalgia, 1997). It is because of this, the author recommended that the need for P fertilizers must be determined for specific areas before its application.

It is evident that the available documented fertilizer recommendations, could have affected the data integrity of this study because, the information available was too historical and general to be reliable and accurate. Therefore, it was necessary to review the recommendations because of; changes in farming practices, use of different rice varieties as well as the duration of cultivation in order to achieve rice intensification. The review of these formal recommendations was inevitable as the deficiencies of additional nutrients other than N and P were likely to be observed and responses to fertilizers with those nutrients would be expected.

During this study, it was also observed that the rate of adoption of the fertilizer recommendations were very low and limited to the few areas with irrigation schemes. Additionally, in the areas where fertilizers are used, farmers use higher fertilizer rates compared to the recommended rate of 120 kg N ha<sup>-1</sup> in Mkindo and Dakawa irrigation schemes. For the rest of the areas, farmers do not use any fertilizers and neither are they aware of the fertilizer recommendations in their areas.

### **3.1.2 Recommended soil management practices for rice production**

Along with fertilizer application, soil management is essential for achieving sustainable rice production. One of the great contributions of the revised fertilizer recommendations by Scalgia (1997) was the introduction of soil management practices and organic fertilizers in field trials. It was revealed that rice yields were greater in lowland downslope than upslope due to wetter conditions in the downslope areas. Similarly, use of earth bunds (majaruba) increased yields both with and without fertilizers (Scalgia, 1997). It was therefore recommended that for increased paddy rice yields earth bunds should be used. Not only do the earth bunds harvest rainwater and increase soil moisture retention, but they also help to retain the fertilizers applied in the field by shielding them from being washed away by floods or runoffs. With respect to tillage, a case study by Scalgia (1997) demonstrated that cultivation by tractors enhances more paddy rice yields than hand hoes. However, the author believes that this can only be true for soils with relatively deep surface soils in Kilombero. Observations in Kilombero show that disc ploughs are responsible for bringing up relatively nutrient-poor sub surface soils and mixing them with the surface soils. This was observed in most parts of Mlimba and some parts of Mang'ula and Mngeta where fertile surface soils are shallow, underlying nutrient-poor coarse textured soils.

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

### *Overview on the current rice agronomic practices*

The current rice agronomic practices in these two valleys stem from the interaction of many cultures. These valleys are currently inhabited by people with different ethnicity and primary land use intentions. For example, the Sukuma people, who began migrating into the Kilombero Valley in the mid-1980s, were looking for grazing land and reliable water sources for their cattle

herds. After a short period they started cultivating rice while keeping their livestock as well. The Sukuma do not use flooding areas along tributaries for their paddy fields; instead, they use natural swamps scattered in open spaces and cultivate with an ox plowing. They sometimes enclose a field with ridges for water harvesting and then transplant rice seedlings. The native villagers do not normally use the swamps and instead use flooding areas along tributaries. The technique of enclosing paddy fields with ridges is not suitable for rice cultivation alongside tributaries because the impounded water can easily leak through the deep sandy soil layer.

Information on the decline of rice yields in Kilombero and Wami valleys has not been documented. However, due to the continuous establishment of fields and shifting to new lands from upper slopes to downslopes, the decline might not be that obvious. A study by Kato (2007) gives a good example on how the farmers in Kilombero valley countered rice yield decline by shifting to better lands. The author gives an example of Itete-Minazini village. At the beginning, the villagers cultivated rice in flooding areas along the Mchiripa River and in other grasslands with floodwater about 2–3 km away from the village. When the production of rice decreased the villagers abandoned the fields and exploited new fields in 1986, downstream along the Mchiripa River, about 8 km away from the village. In 1994, they expanded their fields further downstream of the areas opened in 1986, about 10 km away from the village. In 2003, the paddy fields reached the floodplain of the Kilombero River, more than 15 km away from the village.

By forecasting the future situation in the Kilombero and Wami valleys, rice cultivation may not be sustainable due to the current rice area expansion practices. This is because paddy fields have already reached the floodplains of the Kilombero and Wami Rivers and there is little or no additional land suitable for rice cultivation. However, the demarcation of the Kilombero Game Controlled Area and reserved wetlands around the center of the valleys by the Tanzanian government, the enlargement of teak plantations and conflict with pastoralists will prevent further expansion of paddy fields.

The following agronomic practices are employed in rice growing areas of Kilombero and Wami valleys:

### **3.2.1 Land preparation**

Most farmers in Kilombero (Mlimba, Mngeta, Mofu and Mang'ula) clear their land by slashing using a slasher, followed by burning residue biomass either after piling them on various spots or spreading them on the farm area. Recently, farmers (about 2 years ago) started using pre-planting herbicide (roundup) before burning and cultivating. In the few areas where water control is practiced, residue biomass is piled on the earth bund to control water. Burning of crop residues and weeds after harvesting and during farm preparations contributes to unsustainable productivity. The burning of residue 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 interfering with nutrient re-cycling for sustainable production.

### **3.2.2 Tillage practices**

Tillage is done by using hand hoes, power tillers, ox ploughs and tractors. Cultivation by a tractor, ploughs the soil deeper compared to an ox plough or hand hoe. In most of the valleys in Mlimba and Mang'ula area and some parts of Mngeta, Mofu, and Mbingu, the top soils are shallow, 10-15-cm deep or less and overlaying either fine sandy layer or reddish-brown-gleyic subsoil. These sub-soils are relatively less fertile; hence mixing up with relatively fertile top soil during deep cultivation, lowers the soil fertility. In lowland paddy field and irrigated areas, the field is puddled using either hand hoes or power tillers before transplanting.

### 3.2.3 Water management

Smallscale farmers of Kilombero and Wami Dakawa valleys grow lowland rice under rain fed or flooded rivers with no water control. Water supply and duration of water standing in the field depends entirely on the frequency of rainfall, river flooding, and drainage class of the area. In some parts of Kilombero where there is moderately well drained alluvial soils (Ngalimila, Kichangani, Kitete, Mofu) water stands for a few days when the rainfall frequency is low even when heavy rainfall is received. In other areas with heavy clays like some parts of Dakawa (Luhindo, Vidunda A and B, Lumanda, Mpapa, and Makutule-Milama) water stands in the fields for longer periods. Rice is a semi aquatic plant and does not need standing water for a successful rice crop. The areas with heavy clays, cause rice to suffer from water stress due to the soils ability to retain water causing the existing water, to become unavailable for plant absorption. Lack of water control (water storage and drainage) would pose serious environmental problems if fertilizers and pesticides are used intensively. Lack of bunds to control water will result in dissolved nutrient being washed away from applied fertilizers which will inturn reduce the response of fertilizers. Also lack of water control will contribute to the loss of nutrients from the natural fertility of soils.

To improve rice production, effort should be invested in water management techniques such as *insitu* water harvesting techniques using earth bunds '*majaruba*' and improve drainage. Water management will help in delaying the on-set of moisture stress in case of insufficient rainfalls, therefore reducing the risk of crop failure and preserving soil fertility.

### 3.2.4 Seed selection and planting techniques

Farmers in Kilombero and Wami valleys grow both local and improved rice varieties. The local varieties include; *mbawa mbili*, *Zambia*, *India*, and *shingo ya mwali*. Improved rice varieties such as SARO 5 TXD 306 and IR series are also used in these areas. Most farmers grow local varieties because they think the local varieties adapt better to their environment compared to the improved varieties. However, most of these local varieties are late maturing, and low yielding compared to the improved seeds. Additionally, most of the high yielding improved varieties have a high nutrient demand than the local varieties. The use of these improved varieties without application of fertilizers will further contribute to the depletion of nutrients other than N and P.

Most farmers in both Kilombero and Wami valleys plant rice by broadcasting at varied seed rates, ranging from 16 kg/acre to 48 kg/acre. Farmers broadcast rice at the seed rate of about 16 kg/acre when using an ox- plough, or about 20 kg/acre when using a tractor. Planting rice by broadcasting is most commonly practiced in *mbuga* fields- fields with no water control. Usually broadcasting is done early in the season before flooding. This is because the seeds require moist and aerated conditions to germinate. Broadcasting is done either by hand, using a locally designed planting-tillage or through harrowing in a single operation using tractors or ox ploughs. Broadcasting by tractor requires more seeds because some seeds are buried too deep in the soil to germinate. Broadcasting at these rates gives very close spacing, resulting in high plant population, which limits tillering and adequate growth due to competition for nutrients and light.

The recommended spacing or planting is 20 x 20 cm single rows, or 10 x 10 x 20 cm double rows, either by transplanting seedlings or direct seeding. Rice seedlings for transplanting have to be atleast as old as 14 days after planting, for effective growth and maximum tillering. When carrying out direct seeding, 2 to 3 seeds should be planted per hole and later thinned to one seedling per hole after germination.

Transplanting of rice seedlings is best practiced in areas with a great supply of water, either under irrigation schemes in Njage village in Kilombero, Mkindo, Dakawa, and Dihombo in the Wami basin or in the lowland wet areas of the valley in Dehere and Lumanda, or when there is too much water in the fields. Most farmers transplant rice seedlings randomly without line, at varied but relatively close spacing. Despite extension work on recommended spacing for rice transplanting, the adoption rate is still low. The direct seeding at recommended spacing is not practiced at all, because of lack of implements or seeders to achieve the recommended spacing. As a result, farmers rely on broadcasting.

### **3.2.5 Crop protection**

Crop protection in rice production aims at controlling major groups of pests, that is, weeds, insects and diseases. The major weed problem in rice is; wild rice (*Oryza longistaminata* and/or *O. punctata*) in all areas studied, *Cyperus* spp in wetter areas, star grasses, and many others. Problematic insect pests are army worms (*Spodoptera exempta*) especially in upslope fields with no flooding, green semiloops, stem borer (*Chilo partellus*, *C. orichalcociliellus*, *Maliarpha separatella*, *Sesamia calamistis*), Stalk Eyed fly (*Diopsis spp*), chafer grub, which cut roots, and is a major problem if the rain is low or in areas that are not flooded frequently. The diseases affecting rice production include; Rice Yellow Mottle Virus (RYMV), which is transmitted by sucking insect vector such as all Coleoptera (*Chaectonema spp.*), *Sesselia pusilla* Gerst and *Trichispa sericea* Guerin.

To control these pests farmers use a wide range of crop protection techniques. To control weeds most farmers use mechanical means by cultivating the fields to reduce the pressure of weeds, especially grass weeds. After planting, farmers use 2, 4 D to control broad leaf weeds followed by hand pulling to control wild rice and other grass weeds. Recently, the use of glyphosate (roundup) before planting has increased following recommendations by extension staff and their availability due to increased supply from private agricultural input companies (Syngenta, Balton Tanzania, Suba Agro, By Trade, Twiga Chemicals etc.). Despite all these efforts by farmers, weeds are still a major problem, sometimes forcing farmers to abandon their fields.

The major challenges in chemical weed control are inappropriate handling and use of herbicides. Availability of clean water for mixing herbicides, suitable spraying times and rates of application are inappropriate. In some areas of Mlimba (Kalengakelu), Mang'ula (Kanyenje) farmers spike Roundup in the 2, 4 D mixing tank, expecting to control both grasses and broadleaf weeds. This practice not only affects the growth rate of rice by causing a uniform yellowing of rice plants, but also violates judicious herbicide use, resulting in unsustainable rice production. According to farmers, although post emergency spraying of low amounts of roundup on rice reduces labor time for hand pulling grasses, it also increases unfilled grains, resulting in reduced rice yields. The insect pests are controlled by insecticides; except for the Coleoptera which spreads RYMV - its control is difficult. It is recommended that the best way to control RYMV, is by delaying planting to avoid an onset of the vector and the disease. Although pest problems and crop protection has no direct effect to the soil fertility, it still has a significant effect on soil productivity as it can severely affect rice yields. Therefore, crop protection has to be integrated in soil fertility management to increase rice yields.

## **3.3 PHYSICAL AND CHEMICAL PROPERTIES OF RICE GROWING SOILS OF KILOMBERO AND WAMI VALLEYS**

Physical and chemical analysis of soil is the principal tool for soil fertility evaluation. The dose of fertilizer to be applied to the soil is mainly based on, the diagnosis of the nutrient availability in the soil. This section of the paper presents, results of physical and chemical properties of sampled soils from lowland rice producing areas of, Kilombero and Wami valleys based on the identified soil sampling units.

### 3.3.1 Soil sampling units

The homogeneity of the sampling areas was analyzed basing on soil texture, soil depth, soil color, slope gradients, position on slope and current and past land use. Figures 2 and 3 below show the position of the sampling units in the Kilombero and Mvomero districts.

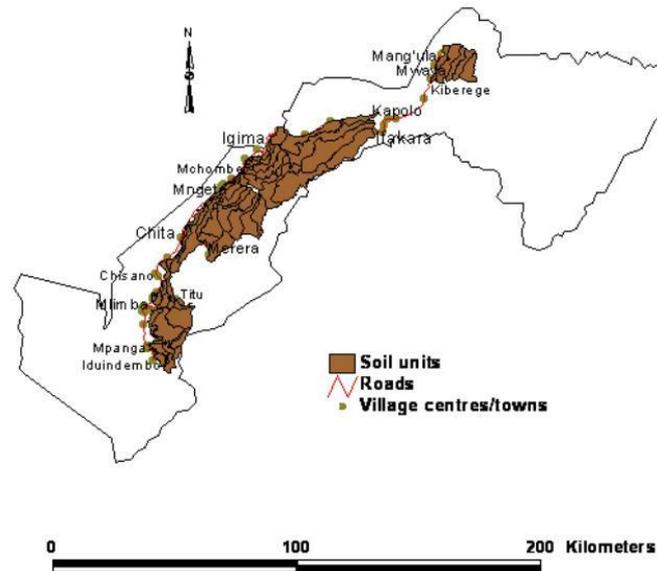


Figure 2: Location of sampling units in Kilombero District

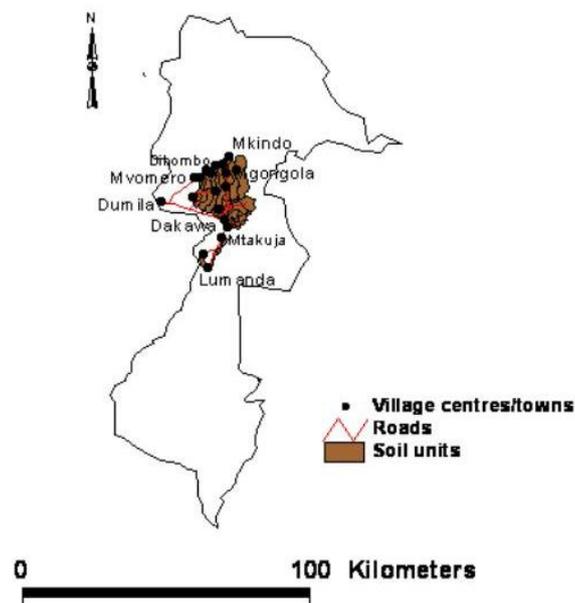


Figure 3: Location of sampling units in Mvomero District

The soils of both Kilombero and Wami valley show variability in texture. Generally, the texture changes with elevation, whereby it grades from sandy and sandy clay to fine clays as you move from the upper slopes to the lower slopes within the valleys. The soil depth factor was not employed in making decision on homogeneity of the sampling units, because the soils in both Kilombero and Wami valleys were deep (>100 cm deep).

Generally, the soils in Kilombero have shallow surface horizons (10 – 15 cm in most parts) with sandy and gleyic sub soils, showing clear stratifications as a result of cyclic deposition of alluvial materials while those in Wami, have a relatively deeper surface horizon which does not differ significantly in physical properties with their subsoil.

The soil colors in Kilombero varied mostly within the tillage depth. The dark brown color of the surface soils was observed in soils which have relatively deep surface horizons or, soils where deep ploughing had not been practiced. Shallow soils where deep ploughing had been practiced had light colors as a result of surface and subsurface horizons mixing. In Wami valley the soil colors did not differ much from one sampling unit to another.

The slope gradients are relatively gentle in both valleys, ranging dominantly from 1 to 3%. The position on slopes was an important factor in deciding the homogeneity of the sampling points. This is because, within these valleys soil texture, drainage pattern and land use are influenced by their position on slope. As mentioned earlier, soil texture varied with slope position. This is due to deposition where, coarser materials are deposited in the upper slopes and finer materials are deposited in the lower slopes. In addition, water moves faster in the upper slopes and slows down as it goes towards the lower slopes, hence affecting the drainage pattern.

In most parts of Kilombero and Dakawa valleys, the differences in the duration of the land use for rice production, follows the trend of the slope position. It was observed that the farmers started to settle in the upper slopes and started cultivating rice in the nearby areas (within the upper slopes). As the fertility diminished due to continuous usage, these farms were abandoned or turned to upland for crops like maize and banana, while the farmers moved downslope to open up new lands for rice production. Figures 4 and 5 below shows the position of the sampling units in relation to changes in altitude for Kilombero and Wami rice growing areas respectively.

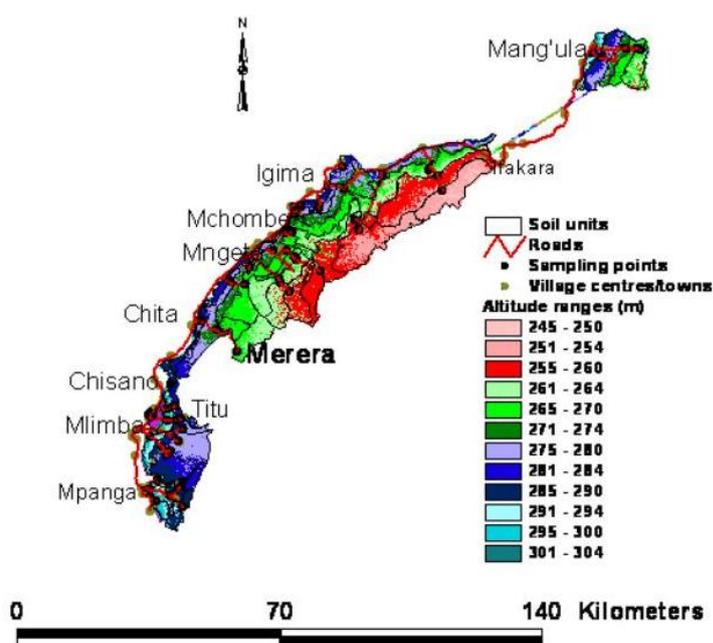


Figure 4: Position of Kilombero sampling units in relation to altitude ranges

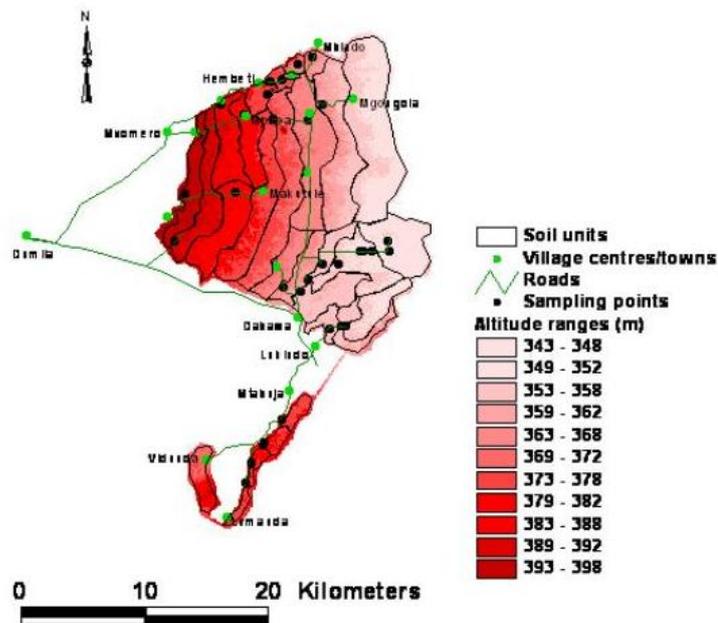


Figure 5: Position of Wami sampling units in relation to altitude ranges

Figures 6 and 7 below show the identified sampling units and the sampling points for studied areas of Kilombero and Wami valley respectively.

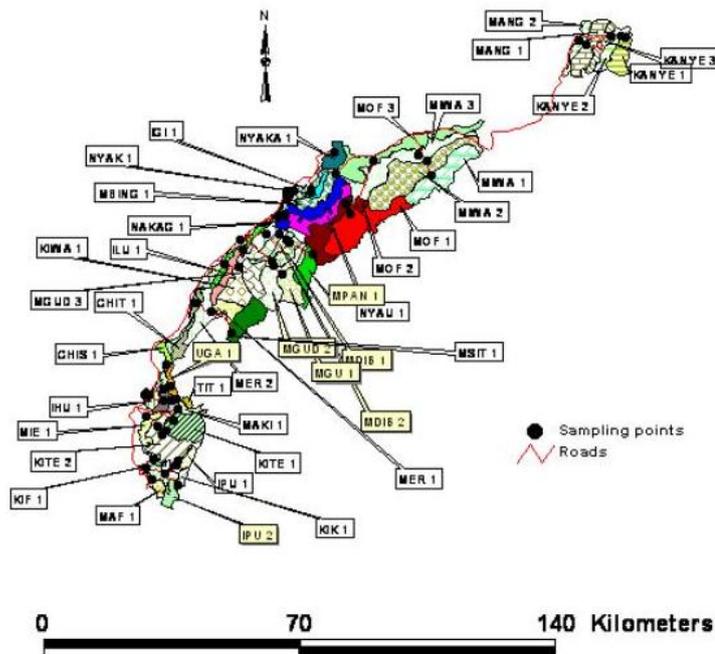


Figure 6: Sampling areas and points in Kilombero valley

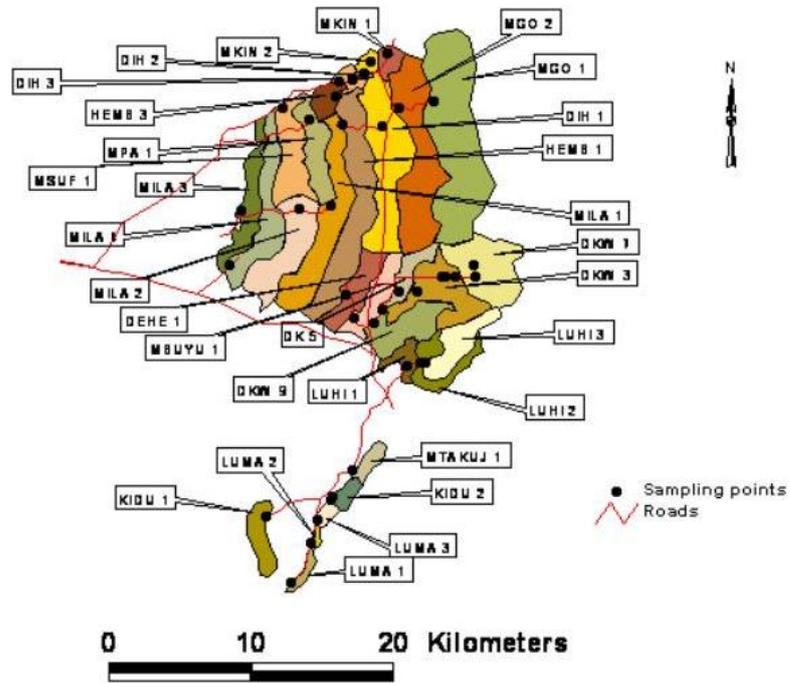


Figure 7: Sampling areas and points in Wami Valley

### 3.4 SITE SPECIFIC SOIL TEST RESULTS AND RECOMMENDATIONS FOR SOIL FERTILITY MANAGEMENT IN KILOMBERO VALLEY

<b>Village name:</b>	Mpanga	<i>Kifungwa area, Mpanga village</i>						
<b>Latitude</b>	-8.92917							
<b>Longitude</b>	35.83654							
<b>Sampling unit</b>	KIF_I	<i>Clay</i>						
<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)	5.1	Strongly acidic	Phosphorus (ppm)	9.29	Medium	Boron (ppm)	2.06	Satisfactory
Ec (dS/m)	0.09	Salt free	Potassium (cmol(+)/kg)	0.41	High	Copper (ppm)	4.08	High
CEC (cmol(+)/kg)	26	High	Sulfate sulfur (ppm)	6.80	Marginal	Manganese (ppm)	74.55	High
Organic carbon (%)	2.33	Medium	Calcium (cmol(+)/kg)	2.87	Medium	Zinc (ppm)	0.97	Medium
Total nitrogen (%)	0.21	Medium	Magnesium (cmol(+)/kg)	1.66	Medium	Iron (ppm)	79.35	High
Nitrate N (ppm)	44.80	Low	Sodium (cmol(+)/kg)	0.46	Medium			

#### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement. An application of 1.65 t/ha of CaCO<sub>3</sub> equivalent for every 1 cmolc/kg of soil of exchangeable Al is often used as a measure of the lime requirement for acidic tropical soils.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application before or during planting. 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 soil pH.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Mpanga	<b>Mfiliga area, Mpanga village</b>						
<b>Latitude</b>	-8.90734							
<b>Longitude</b>	35.85331							
<b>Sampling unit</b>	MFI_1	<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)	5.2	Strongly acidic	Phosphorus (ppm)	41.34	High	Boron (ppm)	1.48	Medium
Ec (mS/cm)	0.17	Salt free	Potassium (cmol(+)/kg)	0.35	Medium	Copper (ppm)	2.75	High
CEC (cmol(+)/kg)	22	Medium	Sulfate sulfur (ppm)	5.40	Deficient	Manganese (ppm)	147.27	High
Organic carbon (%)	2.41	Medium	Calcium (cmol(+)/kg)	4.66	High	Zinc (ppm)	3.23	High
Total nitrogen (%)	0.18	Low	Magnesium (cmol(+)/kg)	3.58	High	Iron (ppm)	195.98	High
Nitrate N (ppm)	58.80	Low	Sodium (cmol(+)/kg)	0.44	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended to improve soil organic matter content and soil ability to retain cations (CEC). Burning as a method of land clearing should be avoided.
- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential Al toxicity. The amount of lime required will be known after determination of exchangeable acidity and lime requirement. An application of 1.65 t/ha of CaCO<sub>3</sub> equivalent for every 1 cmolc/kg soil of exchangeable Al has been found to be effective measure of the lime requirement for acidic tropical soils.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing

<b>Village name:</b>	Miembeni	<b><i>Ipopoo area, Miembeni village</i></b>						
<b>Latitude</b>	-8.83718							
<b>Longitude</b>	35.88480							
<b>Sampling unit</b>	KITE_3	<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)	4.7	Very strongly acidic	Phosphorus (ppm)	5.81	Low	Boron (ppm)	2.29	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.32	Medium	Copper (ppm)	0.68	High
CEC (cmol(+)/kg)	34	High	Sulfate sulfur ([m])	12.92	Sufficient	Manganese (ppm)	13.52	High
Organic carbon (%)	5.32	Very high	Calcium (cmol(+)/kg)	1.42	Sufficient	Zinc (ppm)	0.54	Low
Total nitrogen (%)	0.48	Medium	Magnesium (cmol(+)/kg)	0.5	Sufficient	Iron (ppm)	79.35	High
Nitrate N (ppm)	49	Low	Sodium (cmol(+)/kg)	0.5	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential for Al toxicity. The amount of lime required will be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 25 kg P/ha is recommended, as basal application, as basal application at planting. 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.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label while splitting to achieve 0.18 kg Zn/ha per season.

<b>Village name:</b>	Miembeni	<b>Kitete area, Miembeni village</b>						
<b>Latitude</b>	-8.82626							
<b>Longitude</b>	35.86425							
<b>Sampling unit</b>	KITE_2	<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)	5.2	Strongly acidic	Phosphorus (ppm)	14.50	Medium	Boron (ppm)	1.77	Satisfactory
Ec (mS/cm)	0.08	Salt free	Potassium (cmol(+)/kg)	0.27	Medium	Copper (ppm)	4.83	High
CEC (cmol(+)/kg)	27	High	Sulfate sulfur (ppm)	12.43	Marginal	Manganese (ppm)	77.58	High
Organic carbon (%)	2.36	Medium	Calcium (cmol(+)/kg)	4.66	High	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.18	Low	Magnesium (cmol(+)/kg)	2.55	High	Iron (ppm)	195.48	High
Nitrate N (ppm)	47.60	Low	Sodium (cmol(+)/kg)	0.41	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential for Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application, as basal application at planting. Minjingu rock phosphate (MPR) 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 pH.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Mlimba A	<b>Kitete area, Mlimba A village</b>						
<b>Latitude</b>	-8.81269							
<b>Longitude</b>	35.90201							
<b>Sampling unit</b>	KITE_I	<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)	4.8	Very strongly acidic	Phosphorus (ppm)	13.25	Medium	Boron (ppm)	1.41	Satisfactory
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.26	Medium	Copper (ppm)	3.70	High
CEC (cmol(+)/kg)	23	Medium	Sulfate sulfur (ppm)	5.86	Deficient	Manganese (ppm)	44.24	High
Organic carbon (%)	2.69	High	Calcium (cmol(+)/kg)	3.76	Medium	Zinc (ppm)	1.26	High
Total nitrogen (%)	0.24	Medium	Magnesium (cmol(+)/kg)	2.02	High	Iron (ppm)	185.81	High
Nitrate N (ppm)	44.80	Low	Sodium (cmol(+)/kg)	0.49	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Mwembeni	<b>Miembeni, Miembeni village</b>						
<b>Latitude</b>	-8.80104							
<b>Longitude</b>	35.83558							
<b>Sampling unit</b>	MIE_1	<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)	5.5	Strongly acidic	Phosphorus (ppm)	10.53	Medium	Boron (ppm)	1.92	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.12	Low	Copper (ppm)	3.51	High
CEC (cmol(+)/kg)	10	Low	Sulfate sulfur (ppm)	7.98	Marginal	Manganese (ppm)	44.24	High
Organic carbon (%)	1.17	Low	Calcium (cmol(+)/kg)	1.22	Sufficient	Zinc (ppm)	0.39	Low
Total nitrogen (%)	0.07	Very low	Magnesium (cmol(+)/kg)	0.73	Sufficient	Iron (ppm)	58.26	High
Nitrate N (ppm)	42.00	Low	Sodium (cmol(+)/kg)	0.34	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be avoided. Application of farm yard manure where available is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended as basal application at planting. Minjingu rock phosphate fertilizers can be applied in this area as the low pH will help in its solubilization and the phosphate rock will gradually raise the pH.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Potassium:* 45 kg K/ha is recommended at planting.
- *Zinc:* 2 kg Zn/ha is recommended as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label to achieve 0.18 kg Zn/ha per season.

<b>Village name:</b>	Ngalimila	<b>Kikove area, Ngalimila village</b>						
<b>Latitude</b>	-8.97283							
<b>Longitude</b>	35.91496							
<b>Sampling unit</b>	KIK_I	<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)	4.5	Very strongly acidic	Phosphorus (ppm)	14.04	Medium	Boron (ppm)	2.13	Satisfactory
Ec (mS/cm)	0.16	Salt free	Potassium (cmol(+)/kg)	0.33	Medium	Copper (ppm)	0.87	High
CEC (cmol(+)/kg)	25	High	Sulfate sulfur (ppm)	5.40	Deficient	Manganese (ppm)	177.58	High
Organic carbon (%)	2.37	Medium	Calcium (cmol(+)/kg)	2.72	Medium	Zinc (ppm)	1.34	High
Total nitrogen (%)	0.22	Medium	Magnesium (cmol(+)/kg)	1.47	Medium	Iron (ppm)	282.58	High
Nitrate N (ppm)	71.40	Low	Sodium (cmol(+)/kg)	0.46	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential for Al toxicity. The amount of lime required will be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 80 to 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application, as basal application at planting. 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 pH.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, as basal or top dressing.

<b>Village name:</b>	Utengule	<b>Mafisa area, Utengule village</b>						
<b>Latitude</b>	-8.95768							
<b>Longitude</b>	35.84980							
<b>Sampling unit</b>	MAF_I	<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)	4.9	Very strongly acidic	Phosphorus (ppm)	20.50	High	Boron (ppm)	0.83	Sufficient
Ec (mS/cm)	0.12	Salt free	Potassium (cmol(+)/kg)	0.30	Medium	Copper (ppm)	2.94	High
CEC (cmol(+)/kg)	21	Medium	Sulfate sulfur (ppm)	7.74	Marginal	Manganese (ppm)	116.97	High
Organic carbon (%)	2.39	Medium	Calcium (cmol(+)/kg)	3.76	Medium	Zinc (ppm)	2.28	High
Total nitrogen (%)	0.18	Low	Magnesium (cmol(+)/kg)	2.32	High	Iron (ppm)	253.55	High
Nitrate N (ppm)	42.00	Low	Sodium (cmol(+)/kg)	0.45	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Sulfur:** 4 kg S/ha is recommended, as basal or top dressing

<b>Village name:</b>	Ngalimila	<b><i>Ipugasa area, Ngalimila village</i></b>						
<b>Latitude</b>	-8.92304							
<b>Longitude</b>	35.90882							
<b>Sampling unit</b>	IPU_I	<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)	5.1	Strongly acidic	Phosphorus (ppm)	23.33	High	Boron (ppm)	1.59	Satisfactory
Ec (mS/cm)	0.12	Salt free	Potassium (cmol(+)/kg)	0.43	High	Copper (ppm)	2.00	High
CEC (cmol(+)/kg)	25	High	Sulfate sulfur (ppm)	16.19	Sufficient	Manganese (ppm)	93.03	High
Organic carbon (%)	7.40	Very high	Calcium (cmol(+)/kg)	1.67	Sufficient	Zinc (ppm)	0.83	Medium
Total nitrogen (%)	0.33	Medium	Magnesium (cmol(+)/kg)	0.97	Medium	Iron (ppm)	118.06	High
Nitrate N (ppm)	47.60	Low	Sodium (cmol(+)/kg)	0.44	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential for Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. Minjingu rock phosphate fertilizers will more suitable in this area as the low pH will help in its solubilization and will gradually raise the pH.
- **Potassium:** 15 kg K/ha is recommended at planting.

<b>Village name:</b>	Ngalimila	<b><i>Ipugasa2 area, Ngalimila village</i></b>						
<b>Latitude</b>	-8.91012							
<b>Longitude</b>	35.91321							
<b>Sampling unit</b>	IPU_2	<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)	5.0	Very strongly acidic	Phosphorus (ppm)	25.60	High	Boron (ppm)	1.23	Medium
Ec (mS/cm)	0.10	Salt free	Potassium (cmol(+)/kg)	0.30	Medium	Copper (ppm)	2.94	High
CEC (cmol(+)/kg)	20	Medium	Sulfate sulfur (ppm)	5.40	Deficient	Manganese (ppm)	56.36	High
Organic carbon (%)	2.63	High	Calcium (cmol(+)/kg)	2.87	Medium	Zinc (ppm)	1.05	High
Total nitrogen (%)	0.18	Low	Magnesium (cmol(+)/kg)	1.60	Medium	Iron (ppm)	127.74	High
Nitrate N (ppm)	46.20	Low	Sodium (cmol(+)/kg)	0.46	Medium			

### Parameters to address in this site:

- *Soil pH*: Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen*: 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus*: 10 kg P/ha is recommended as basal application at planting. 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 soil pH.
- *Potassium*: 15 kg K/ha is recommended at planting.
- *Sulfur*: 4 kg S/ha is recommended, either basal along with P and K application or top dressing with N fertilizer.

<b>Village name:</b>	Ngalimila	<b>Hiari ya Moyo area, Ngalimila village</b>						
<b>Latitude</b>	-8.94343							
<b>Longitude</b>	35.88071							
<b>Sampling unit</b>	HIA_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)	5.0	Very strongly acidic	Phosphorus (ppm)	16.88	Medium	Boron (ppm)	2.38	Satisfactory
Ec (mS/cm)	0.10	Salt free	Potassium (cmol(+)/kg)	0.31	Medium	Copper (ppm)	3.70	High
CEC (cmol(+)/kg)	21	Medium	Sulfate sulfur (ppm)	5.86	Deficient	Manganese (ppm)	80.61	High
Organic carbon (%)	2.36	Medium	Calcium (cmol(+)/kg)	2.87	Medium	Zinc (ppm)	1.12	High
Total nitrogen (%)	0.20	Low	Magnesium (cmol(+)/kg)	1.26	Medium	Iron (ppm)	166.45	High
Nitrate N (ppm)	56.00	Low	Sodium (cmol(+)/kg)	0.46	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0, an adequate range for flooded rice and also to prevent potential Al toxicity. The amount of lime required will be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended as basal application at planting. 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.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Sulfur:** 4 kg S/ha is recommended, either basal or top dressing.

<b>Village name:</b>	Kalengakelu	<b><i>Ihumwa area, Kalengakelu village</i></b>						
<b>Latitude</b>	-8.74772							
<b>Longitude</b>	35.84304							
<b>Sampling unit</b>	IHU_I	<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)	5	Very strongly acidic	Phosphorus (ppm)	12.69	Medium	Boron (ppm)	1.55	Satisfactory
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.41	High	Copper (ppm)	2.19	High
CEC (cmol(+)/kg)	18	Medium	Sulfate sulfur (ppm)	27.92	Sufficient	Manganese (ppm)	200	High
Org. carbon (%)	2.08	Medium	Calcium (cmol(+)/kg)	3.31	Medium	Zinc (ppm)	2.35	High
Total nitrogen (%)	0.24	Medium	Magnesium (cmol(+)/kg)	2.04	High	Iron (ppm)	301.94	High
Nitrate N (ppm)	47.6	Low	Sodium (cmol(+)/kg)	0.47	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.

<b>Village name:</b>	Kalengakelu	<b>Kikolokoto area, Kalengakelu village</b>						
<b>Latitude</b>	-8.73569							
<b>Longitude</b>	35.87793							
<b>Sampling unit</b>	KIKO_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)	4.9	Very strongly acidic	Phosphorus (ppm)	14.84	Medium	Boron (ppm)	1.16	Medium
Ec (mS/cm)	0.09	Salt free	Potassium (cmol(+)/kg)	0.27	Medium	Copper (ppm)	2.19	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	41.52	Sufficient	Manganese (ppm)	77.58	Medium
Org. carbon (%)	1.85	Medium	Calcium (cmol(+)/kg)	2.27	Medium	Zinc (ppm)	0.9	High
Total nitrogen (%)	0.15	Low	Magnesium (cmol(+)/kg)	1.15	Medium	Iron (ppm)	60	High
Nitrate N (ppm)	75.6	Low	Sodium (cmol(+)/kg)	0.35	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 80 - 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 40 kg K/ha is recommended at planting.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b>Makilika area, Kalengakelu village</b>						
<b>Latitude</b>	-8.78347							
<b>Longitude</b>	35.91466							
<b>Sampling unit</b>	MAKI_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)	5.1	Strongly acidic	Phosphorus (ppm)	3.06	Low	Boron (ppm)	1.05	Medium
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.38	Medium	Copper (ppm)	2.75	High
CEC (cmol(+)/kg)	34	High	Sulfate sulfur (ppm)	30.73	Sufficient	Manganese (ppm)	13.52	High
Organic carbon (%)	7.4	Very high	Calcium (cmol(+)/kg)	2.27	Medium	Zinc (ppm)	0.54	Low
Total nitrogen (%)	0.47	Medium	Magnesium (cmol(+)/kg)	0.68	Medium	Iron (ppm)	50.32	High
Nitrate N (ppm)	53.2	Low	Sodium (cmol(+)/kg)	0.62	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b>Mtakuja area, Kalengakelu village</b>						
<b>Latitude</b>	-8.76128							
<b>Longitude</b>	35.8994							
<b>Sampling unit</b>	MTA_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)	5.2	Strongly acidic	Phosphorus (ppm)	10.31	Medium	Boron (ppm)	1.19	Medium
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.14	Low	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	11	Low	Sulfate sulfur (ppm)	33.55	Sufficient	Manganese (ppm)	26.06	High
Organic carbon (%)	0.95	Low	Calcium (cmol(+)/kg)	1.22	Low	Zinc (ppm)	0.32	Low
Total nitrogen (%)	0.09	Very low	Magnesium (cmol(+)/kg)	0.62	Low	Iron (ppm)	80.52	High
Nitrate N (ppm)	46.2	Low	Sodium (cmol(+)/kg)	0.36	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b>Mtakuja2 area, Kalengakelu village</b>						
<b>Latitude</b>	-8.76258							
<b>Longitude</b>	35.87862							
<b>Sampling unit</b>	MTA_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)	5.5	Strongly acidic	Phosphorus (ppm)	8.5	Medium	Boron (ppm)	0.65	Sufficient
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.07	Low	Copper (ppm)	3.51	High
CEC (cmol(+)/kg)	11	Low	Sulfate sulfur (ppm)	19.94	Sufficient	Manganese (ppm)	15.64	High
Organic carbon (%)	0.73	Low	Calcium (cmol(+)/kg)	1.07	Low	Zinc (ppm)	0.32	Low
Total nitrogen (%)	0.06	Very low	Magnesium (cmol(+)/kg)	0.62	Low	Iron (ppm)	62.13	High
Nitrate N (ppm)	50.4	Low	Sodium (cmol(+)/kg)	0.32	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 70 kg K/ha is recommended at planting.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b>Titu area, Kalengakelu village</b>						
<b>Latitude</b>	-8.75911							
<b>Longitude</b>	35.90876							
<b>Sampling unit</b>	TIT_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)	5.2	Strongly acidic	Phosphorus (ppm)	13.93	Medium	Boron (ppm)	0.65	Sufficient
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.11	Low	Copper (ppm)	1.06	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	20.88	Sufficient	Manganese (ppm)	71.52	High
Organic carbon (%)	1.24	Low	Calcium (cmol(+)/kg)	2.27	Medium	Zinc (ppm)	0.61	Medium
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	1.06	Medium	Iron (ppm)	127.74	High
Nitrate N (ppm)	46.2	Low	Sodium (cmol(+)/kg)	0.4	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 70 kg K/ha is recommended at planting.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b><i>Uuga area, Kalengakelu village</i></b>						
<b>Latitude</b>	-8.72703							
<b>Longitude</b>	35.89565							
<b>Sampling unit</b>	UGA_I	<b><i>Clay loam</i></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)	5	Very strongly acidic	Phosphorus (ppm)	17.67	Medium	Boron (ppm)	0.29	Low
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.3	Medium	Copper (ppm)	1.06	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	22.7	Sufficient	Manganese (ppm)	83.64	High
Organic carbon (%)	1.91	Medium	Calcium (cmol(+)/kg)	2.42	Medium	Zinc (ppm)	0.54	Low
Total nitrogen (%)	0.15	Low	Magnesium (cmol(+)/kg)	1.17	Medium	Iron (ppm)	98.71	High
Nitrate N (ppm)	49	Low	Sodium (cmol(+)/kg)	0.43	Medium			

### **Parameters to address in this site:**

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Boron:** 0.25kgB/ha is recommended, as either basal or foliar application.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kalengakelu	<b>Yeriko area, Kalengakelu village</b>						
<b>Latitude</b>	-8.74767							
<b>Longitude</b>	35.83251							
<b>Sampling unit</b>	YER_I	<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)	5.1	Strongly acidic	Phosphorus (ppm)	24.92	High	Boron (ppm)	1.85	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.31	Medium	Copper (ppm)	3.7	High
CEC (cmol(+)/kg)	17	Medium	Sulfate sulfur (ppm)	9.62	Marginal	Manganese (ppm)	98.79	High
Organic carbon (%)	2.41	Medium	Calcium (cmol(+)/kg)	4.21	High	Zinc (ppm)	2.14	High
Total nitrogen (%)	0.15	Low	Magnesium (cmol(+)/kg)	2.19	High	Iron (ppm)	311.6	High
Nitrate N (ppm)	82.6	Low	Sodium (cmol(+)/kg)	0.4	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 80 - 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either basal or top dressing.

<b>Village name:</b>	Jaribu	<b>Kichangani area, Jaribu village</b>						
<b>Latitude</b>	-8.84886							
<b>Longitude</b>	35.87614							
<b>Sampling unit</b>	KICH_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)	4.9	Very strongly acidic	Phosphorus (ppm)	52.27	High	Boron (ppm)	2.18	Satisfactory
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.36	Medium	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	30	High	Sulfate sulfur (ppm)	10.24	Marginal	Manganese (ppm)	31.09	High
Organic carbon (%)	2.54	High	Calcium (cmol(+)/kg)	1.62	Sufficient	Zinc (ppm)	1.26	High
Total nitrogen (%)	0.4	Medium	Magnesium (cmol(+)/kg)	0.91	Medium	Iron (ppm)	137.42	High
Nitrate N (ppm)	46.2	Low	Sodium (cmol(+)/kg)	0.33	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Chisano	<b>Chisano area, Chisano village</b>						
<b>Latitude</b>	-8.67225							
<b>Longitude</b>	35.88488							
<b>Sampling unit</b>	CHIS_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)	4.9	Very strongly acidic	Phosphorus (ppm)	76.10	High	Boron (ppm)	6.61	High
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.22	Medium	Copper (ppm)	0.87	High
CEC (cmol(+)/kg)	15	Medium	Sulfate sulfur (ppm)	4.85	Deficient	Manganese (ppm)	41.21	High
Organic carbon (%)	2.14	Medium	Calcium (cmol(+)/kg)	2.10	Medium	Zinc (ppm)	1.99	High
Total nitrogen (%)	0.12	Low	Magnesium (cmol(+)/kg)	1.44	Medium	Iron (ppm)	243.87	High
Nitrate N (ppm)	32.20	Low	Sodium (cmol(+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended, as basal or top dressing.

<b>Village name:</b>	Merera	<b>Msita area, Merera village</b>						
<b>Latitude</b>	-8.59408							
<b>Longitude</b>	36.04648							
<b>Sampling unit</b>	MSIT_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)	25.01	High	Boron (ppm)	3.08	Satisfactory
Ec (mS/cm)	0.14	Salt free	Potassium (cmol(+)/kg)	0.33	Medium	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	14	Medium	Sulfate sulfur (ppm)	6.47	Marginal	Manganese (ppm)	71.52	High
Organic carbon (%)	2.08	Medium	Calcium (cmol(+)/kg)	2.29	Medium	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.20	Low	Magnesium (cmol(+)/kg)	1.01	Medium	Iron (ppm)	243.87	High
Nitrate N (ppm)	51.00	Low	Sodium (cmol(+)/kg)	0.28	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Sulfur:** 4 kg S/ha is recommended, either basal or top dressing.

<b>Village name:</b>	Merera	<b>Merera area, Merera village</b>						
<b>Latitude</b>	-8.54413							
<b>Longitude</b>	35.99470							
<b>Sampling unit</b>	MER_I	<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)	4.4	Extremely acidic	Phosphorus (ppm)	5.10	Low	Boron (ppm)	4.76	Satisfactory
Ec (mS/cm)	0.19	Salt free	Potassium (cmol(+)/kg)	0.46	High	Copper (ppm)	1.25	High
CEC (cmol(+)/kg)	20	Medium	Sulfate sulfur (ppm)	10.24	Marginal	Manganese (ppm)	41.21	High
Organic carbon (%)	4.58	Very high	Calcium (cmol(+)/kg)	1.81	Sufficient	Zinc (ppm)	0.61	Medium
Total nitrogen (%)	0.37	Medium	Magnesium (cmol(+)/kg)	0.63	Sufficient	Iron (ppm)	69.68	High
Nitrate N (ppm)	42.20	Low	Sodium (cmol(+)/kg)	0.33	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 25 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Chita	<b>Darajani area, Chita village</b>						
<b>Latitude</b>	-8.54414							
<b>Longitude</b>	35.99468							
<b>Sampling unit</b>	MER_2	<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)	4.5	Very strongly acidic	Phosphorus (ppm)	26.67	High	Boron (ppm)	2.97	Satisfactory
Ec (mS/cm)	0.18	Salt free	Potassium (cmol(+)/kg)	0.28	Medium	Copper (ppm)	2.19	High
CEC (cmol(+)/kg)	20	Medium	Sulfate sulfur (ppm)	15.63	Sufficient	Manganese (ppm)	38.18	High
Organic carbon (%)	3.63	Very high	Calcium (cmol(+)/kg)	1.62	Low	Zinc (ppm)	0.54	Low
Total nitrogen (%)	0.27	Medium	Magnesium (cmol(+)/kg)	0.63	Low	Iron (ppm)	118.06	High
Nitrate N (ppm)	77.00	Low	Sodium (cmol(+)/kg)	0.33	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 80 – 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Zinc:* 2 kg Zn/ha is recommended as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application should be as per manufacturer instructions on the label.

<b>Village name:</b>	Chita	<b>Chita area, Chita village</b>						
<b>Latitude</b>	-8.52054							
<b>Longitude</b>	35.96006							
<b>Sampling unit</b>	CHIT_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)	4.7	Very strongly acidic	Phosphorus (ppm)	28.09	High	Boron (ppm)	2.62	Satisfactory
Ec (mS/cm)	0.10	Salt free	Potassium (cmol(+)/kg)	0.20	Low	Copper (ppm)	0.30	Sufficient
CEC (cmol(+)/kg)	8	Low	Sulfate sulfur (ppm)	8.62	Marginal	Manganese (ppm)	16.97	High
Organic carbon (%)	1.36	Medium	Calcium (cmol(+)/kg)	1.42	Sufficient	Zinc (ppm)	2.21	High
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	1.18	Medium	Iron (ppm)	118.06	High
Nitrate N (ppm)	39.20	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Cation exchange capacity:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be avoided. Application of farm yard manure is recommended
- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either as basal or top dressing.

<b>Village name:</b>	Chita	<b>Chita2 area, Chita village</b>						
<b>Latitude</b>	-8.52160							
<b>Longitude</b>	35.95342							
<b>Sampling unit</b>	CHIT_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)	5.1	Strongly acidic	Phosphorus (ppm)	52.39	High	Boron (ppm)	1.10	Medium
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.44	High	Copper (ppm)	1.25	High
CEC (cmol(+)/kg)	21	Medium	Sulfate sulfur (ppm)	1.08	Deficient	Manganese (ppm)	10.79	High
Organic carbon (%)	2.98	High	Calcium (cmol(+)/kg)	1.81	Sufficient	Zinc (ppm)	1.12	High
Total nitrogen (%)	0.19	Low	Magnesium (cmol(+)/kg)	1.25	Medium	Iron (ppm)	118.06	High
Nitrate N (ppm)	47.60	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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:** 10 kg S/ha is recommended, either basal or top dressing.

<b>Village name:</b>	Ikule	<b>Kiwalani area, Ikule village</b>						
<b>Latitude</b>	-8.43381							
<b>Longitude</b>	36.06135							
<b>Sampling unit</b>	KIWA_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)	12.33	Medium	Boron (ppm)	3.42	Satisfactory
Ec (mS/cm)	0.14	Salt free	Potassium (cmol(+)/kg)	0.23	Medium	Copper (ppm)	0.68	High
CEC (cmol(+)/kg)	24	Medium	Sulfate sulfur (ppm)	6.47	Marginal	Manganese (ppm)	5.03	High
Organic carbon (%)	4.70	Very high	Calcium (cmol(+)/kg)	1.13	Sufficient	Zinc (ppm)	1.55	High
Total nitrogen (%)	0.44	Medium	Magnesium (cmol(+)/kg)	0.72	Sufficient	Iron (ppm)	40.65	High
Nitrate N (ppm)	50.40	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. Minjingu rock phosphate fertilizers will be more suitable in this area as the low pH will help in its solubilization, and will gradually raise the soil pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Ikule	<b><i>Irungusha area, Ikule village</i></b>						
<b>Latitude</b>	-8.42449							
<b>Longitude</b>	36.02816							
<b>Sampling unit</b>	ILU_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)	4.8	Very strongly acidic	Phosphorus (ppm)	49.43	High	Boron (ppm)	3.69	Satisfactory
Ec (mS/cm)	0.10	Salt free	Potassium (cmol(+)/kg)	0.20	Low	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	18	Medium	Sulfate sulfur (ppm)	25.33	Sufficient	Manganese (ppm)	17.15	High
Organic carbon (%)	2.76	High	Calcium (cmol(+)/kg)	1.13	Sufficient	Zinc (ppm)	0.61	Medium
Total nitrogen (%)	0.26	Medium	Magnesium (cmol(+)/kg)	0.67	Sufficient	Iron (ppm)	60.00	High
Nitrate N (ppm)	51.00	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 40 kg K/ha is recommended at planting
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Alternatively, foliar fertilization can be done to achieve 0.18 kg Zn/ha per season. Appropriate concentration per foliar application is as per manufacture instructions on the label.

<b>Village name:</b>	Mkangawalo	<b>Mlimani Paki area, Mkangawalo village</b>						
<b>Latitude</b>	-8.38807							
<b>Longitude</b>	36.07231							
<b>Sampling unit</b>	MLIM_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)	5.2	Strongly acidic	Phosphorus (ppm)	46.70	High	Boron (ppm)	2.43	Satisfactory
Ec (mS/cm)	0.10	Salt free	Potassium (cmol(+)/kg)	0.54	High	Copper (ppm)	1.06	High
CEC (cmol(+)/kg)	17	Medium	Sulfate sulfur (ppm)	11.32	Marginal	Manganese (ppm)	12.91	High
Organic carbon (%)	2.54	High	Calcium (cmol(+)/kg)	1.81	Sufficient	Zinc (ppm)	1.12	High
Total nitrogen (%)	0.27	Medium	Magnesium (cmol(+)/kg)	1.03	Medium	Iron (ppm)	69.68	High
Nitrate N (ppm)	32.20	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Sulfur:** 4 kg S/ha is recommended, basal or top dressing application.

<b>Village name:</b>	Mkangawalo	<b>Mgudeni area, Mkangawalo village</b>						
<b>Latitude</b>	-8.41657							
<b>Longitude</b>	36.14323							
<b>Sampling unit</b>	MGUD_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)	5.0	Very strongly acidic	Phosphorus (ppm)	80.61	High	Boron (ppm)	1.84	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.44	High	Copper (ppm)	3.51	High
CEC (cmol(+)/kg)	17	Medium	Sulfate sulfur (ppm)	22.10	Sufficient	Manganese (ppm)	23.03	High
Organic carbon (%)	1.34	Medium	Calcium (cmol(+)/kg)	1.33	Sufficient	Zinc (ppm)	0.83	Medium
Total nitrogen (%)	0.10	Low	Magnesium (cmol(+)/kg)	1.16	Medium	Iron (ppm)	253.55	High
Nitrate N (ppm)	37.80	Low	Sodium (cmol(+)/kg)	0.18	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Mkangawalo	<b>Mgudeni2 area, Mkangawalo village</b>						
<b>Latitude</b>	-8.42846							
<b>Longitude</b>	36.14930							
<b>Sampling unit</b>	MGUD_2	<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)	4.9	Very strongly acidic	Phosphorus (ppm)	58.92	High	Boron (ppm)	0.78	Sufficient
Ec (mS/cm)	0.14	Salt free	Potassium (cmol(+)/kg)	0.34	Medium	Copper (ppm)	4.83	High
CEC (cmol(+)/kg)	26	High	Sulfate sulfur (ppm)	6.47	Marginal	Manganese (ppm)	13.94	High
Organic carbon (%)	3.48	High	Calcium (cmol(+)/kg)	2.29	Medium	Zinc (ppm)	0.83	Medium
Total nitrogen (%)	0.20	Low	Magnesium (cmol(+)/kg)	1.96	Medium	Iron (ppm)	214.84	High
Nitrate N (ppm)	61.60	Low	Sodium (cmol(+)/kg)	0.48	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either basal or top dressing.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Mkangawalo	<b>Mgudeni3 area, Mkangawalo village</b>						
<b>Latitude</b>	-8.45012							
<b>Longitude</b>	36.16849							
<b>Sampling unit</b>	MGU_1	<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)	4.9	Very strongly acidic	Phosphorus (ppm)	10.55	Medium	Boron (ppm)	1.46	Medium
Ec (mS/cm)	0.12	Salt free	Potassium (cmol(+)/kg)	0.49	High	Copper (ppm)	2.75	High
CEC (cmol(+)/kg)	31	High	Sulfate sulfur (ppm)	14.55	Sufficient	Manganese (ppm)	13.94	High
Organic carbon (%)	5.77	Very high	Calcium (cmol(+)/kg)	1.81	Sufficient	Zinc (ppm)	1.55	High
Total nitrogen (%)	0.46	Medium	Magnesium (cmol(+)/kg)	1.18	Medium	Iron (ppm)	156.77	High
Nitrate N (ppm)	63.00	Low	Sodium (cmol(+)/kg)	0.56	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.

<b>Village name:</b>	Mkangawalo	<b>Kidete area, Mkangawalo village</b>						
<b>Latitude</b>	-8.36573							
<b>Longitude</b>	36.06660							
<b>Sampling unit</b>	KIDE_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)	5.2	Strongly acidic	Phosphorus (ppm)	64.49	High	Boron (ppm)	3.36	Satisfactory
Ec (mS/cm)	0.14	Salt free	Potassium (cmol(+)/kg)	0.47	High	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	29	High	Sulfate sulfur (ppm)	7.55	Marginal	Manganese (ppm)	20.79	High
Organic carbon (%)	2.89	High	Calcium (cmol(+)/kg)	2.87	Medium	Zinc (ppm)	0.83	Medium
Total nitrogen (%)	0.25	Medium	Magnesium (cmol(+)/kg)	1.03	Medium	Iron (ppm)	30.97	High
Nitrate N (ppm)	42.00	Low	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Mngeta	<i>Isago area, Mngeta village</i>						
<b>Latitude</b>	-8.35130							
<b>Longitude</b>	36.13032							
<b>Sampling unit</b>	ISAG_I	<i>Sandy clay loam</i>						
<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)	4.9	Very strongly acidic	Phosphorus (ppm)	9.49	Medium	Boron (ppm)	4.31	Satisfactory
Ec (mS/cm)	0.08	Salt free	Potassium (cmol(+)/kg)	0.38	Medium	Copper (ppm)	2.57	High
CEC (cmol(+)/kg)	37	High	Sulfate sulfur (ppm)	10.24	Marginal	Manganese (ppm)	22.61	High
Organic carbon (%)	6.25	Very high	Calcium (cmol(+)/kg)	1.33	Sufficient	Zinc (ppm)	0.54	Low
Total nitrogen (%)	0.51	High	Magnesium (cmol(+)/kg)	0.52	Sufficient	Iron (ppm)	71.81	High
Nitrate N (ppm)	56.00	Low	Sodium (cmol(+)/kg)	0.29	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required will be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Lukolongo	<b>Mpande area, Lukolongo village</b>						
<b>Latitude</b>	-8.40162							
<b>Longitude</b>	36.24326							
<b>Sampling unit</b>	MPAN_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)	12.44	Medium	Boron (ppm)	1.68	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.10	Low	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	17.79	Sufficient	Manganese (ppm)	13.94	High
Organic carbon (%)	1.67	Medium	Calcium (cmol(+)/kg)	4.12	High	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	2.90	High	Iron (ppm)	166.45	High
Nitrate N (ppm)	30.80	Low	Sodium (cmol(+)/kg)	0.28	Sufficient			

### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 70 kg K/ha is recommended at planting.

<b>Village name:</b>	Lukolongo	<b>Mdibule area, Lukolongo village</b>						
<b>Latitude</b>	-8.36624							
<b>Longitude</b>	36.17824							
<b>Sampling unit</b>	MDIB_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)	4.3	Extremely acidic	Phosphorus (ppm)	29.28	High	Boron (ppm)	2.91	Satisfactory
Ec (mS/cm)	0.12	Salt free	Potassium (cmol(+)/kg)	0.23	Medium	Copper (ppm)	1.06	High
CEC (cmol(+)/kg)	18	Medium	Sulfate sulfur (ppm)	10.24	Marginal	Manganese (ppm)	11.39	High
Organic carbon (%)	2.73	High	Calcium (cmol(+)/kg)	0.75	Sufficient	Zinc (ppm)	0.97	Medium
Total nitrogen (%)	0.27	Medium	Magnesium (cmol(+)/kg)	0.52	Sufficient	Iron (ppm)	127.74	High
Nitrate N (ppm)	50.40	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 40 kg K/ha is recommended at planting.
- **Sulfur:** 4 kg S/ha is recommended, either basal or top dressing application.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Lukolongo	<b>Mdibule2 area, Lukolongo village</b>						
<b>Latitude</b>	-8.37334							
<b>Longitude</b>	36.18868							
<b>Sampling unit</b>	MDIB_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)	9.24	Medium	Boron (ppm)	3.88	Satisfactory
Ec (mS/cm)	0.22	Salt free	Potassium (cmol(+)/kg)	0.31	Medium	Copper (ppm)	1.62	High
CEC (cmol(+)/kg)	28	High	Sulfate sulfur (ppm)	16.17	Sufficient	Manganese (ppm)	11.70	High
Organic carbon (%)	4.73	Very high	Calcium (cmol(+)/kg)	1.04	Sufficient	Zinc (ppm)	0.97	Medium
Total nitrogen (%)	0.43	Medium	Magnesium (cmol(+)/kg)	0.53	Sufficient	Iron (ppm)	108.39	High
Nitrate N (ppm)	67.20	Low	Sodium (cmol(+)/kg)	0.26	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 80 - 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 15 kg K/ha is recommended at planting.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Lukolongo	<b>Mbasa area, Lukolongo village</b>						
<b>Latitude</b>	-8.35051							
<b>Longitude</b>	36.16039							
<b>Sampling unit</b>	MBAS_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)	4.5	Very strongly acidic	Phosphorus (ppm)	63.30	High	Boron (ppm)	0.78	Sufficient
Ec (mS/cm)	0.21	Salt free	Potassium (cmol(+)/kg)	0.25	Low	Copper (ppm)	1.62	High
CEC (cmol(+)/kg)	14	Medium	Sulfate sulfur (ppm)	24.26	Sufficient	Manganese (ppm)	15.64	High
Organic carbon (%)	3.15	High	Calcium (cmol(+)/kg)	1.23	Sufficient	Zinc (ppm)	1.12	High
Total nitrogen (%)	0.32	Medium	Magnesium (cmol(+)/kg)	0.36	Sufficient	Iron (ppm)	60.00	High
Nitrate N (ppm)	42.00	Low	Sodium (cmol(+)/kg)	0.30	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 40 kg K/ha is recommended at planting.

<b>Village name:</b>	Mchombe	<b>Nyaudidi area, Mchombe village</b>						
<b>Latitude</b>	-8.30364							
<b>Longitude</b>	36.17594							
<b>Sampling unit</b>	NYAU_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)	5.3	Strongly Acidic	Phosphorus (Ppm)	7.71	Medium	Boron (Ppm)	1.62	Satisfactory
Ec (mS/cm)	0.04	Salt Free	Potassium (Cmol+)/Kg)	0.40	High	Copper (Ppm)	5.02	High
CEC (cmol+)/kg)	34	High	Sulfate Sulfur (Ppm)	11.86	Marginal	Manganese (Ppm)	22.00	High
Organic carbon (%)	5.45	Very High	Calcium (Cmol+)/Kg)	4.88	High	Zinc (Ppm)	1.55	High
Total nitrogen (%)	0.53	High	Magnesium (Cmol+)/Kg)	3.21	High	Iron (Ppm)	166.45	High
Nitrate N (ppm)	44.80	Low	Sodium (Cmol+)/Kg)	0.47	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Mchombe	<b>Nakaguru area, Mchombe village</b>						
<b>Latitude</b>	-8.30939							
<b>Longitude</b>	36.15807							
<b>Sampling unit</b>	NAKAG_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)	5.4	Strongly acidic	Phosphorus (ppm)	33.31	High	Boron (ppm)	0.28	Low
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.27	Medium	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	10	Low	Sulfate sulfur (ppm)	9.70	Marginal	Manganese (ppm)	9.27	High
Organic carbon (%)	1.25	Low	Calcium (cmol(+)/kg)	1.62	Sufficient	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.10	Low	Magnesium (cmol(+)/kg)	1.81	Medium	Iron (ppm)	224.52	High
Nitrate N (ppm)	33.60	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either basal or top dressing application.
- *Boron:* 0.25 kg B/ha is recommended, either basal or foliar application.

<b>Village name:</b>	Njage	<b>Njage irrigation scheme, Njage village</b>						
<b>Latitude</b>	-8.24338							
<b>Longitude</b>	36.17992							
<b>Sampling unit</b>	NJAG_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)	5.1	Strongly acidic	Phosphorus (ppm)	25.61	High	Boron (ppm)	4.70	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.16	Low	Copper (ppm)	5.02	High
CEC (cmol(+)/kg)	19	Medium	Sulfate sulfur (ppm)	8.62	Marginal	Manganese (ppm)	35.94	High
Organic carbon (%)	3.03	High	Calcium (cmol(+)/kg)	3.15	Medium	Zinc (ppm)	1.92	High
Total nitrogen (%)	0.26	Medium	Magnesium (cmol(+)/kg)	1.56	Medium	Iron (ppm)	34.29	High
Nitrate N (ppm)	42.00	Low	Sodium (cmol(+)/kg)	0.22	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 40 kg K/ha is recommended at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Njage	<b>Makangagani area, Njage village</b>						
<b>Latitude</b>	-8.25565							
<b>Longitude</b>	36.18557							
<b>Sampling unit</b>	MAKA_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 (ppm)	27.38	High	Boron (ppm)	3.02	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.16	Low	Copper (ppm)	2.97	High
CEC (cmol(+)/kg)	11	Low	Sulfate sulfur (ppm)	4.85	Deficient	Manganese (ppm)	26.06	High
Organic carbon (%)	1.48	Medium	Calcium (cmol(+)/kg)	1.42	Sufficient	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	1.08	Medium	Iron (ppm)	253.55	High
Nitrate N (ppm)	32.20	Low	Sodium (cmol(+)/kg)	0.18	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Njage	<b>King'ulung'ulu area, Njage village</b>						
<b>Latitude</b>	-8.26290							
<b>Longitude</b>	36.18451							
<b>Sampling unit</b>	KING_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)	5.4	Strongly acidic	Phosphorus (ppm)	76.82	High	Boron (ppm)	1.96	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.30	Medium	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	13.48	Sufficient	Manganese (ppm)	23.03	High
Organic carbon (%)	2.25	Medium	Calcium (cmol(+)/kg)	3.92	Medium	Zinc (ppm)	2.28	High
Total nitrogen (%)	0.14	Low	Magnesium (cmol(+)/kg)	1.98	Medium	Iron (ppm)	234.19	High
Nitrate N (ppm)	33.60	Low	Sodium (cmol(+)/kg)	0.26	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 15 kg K/ha is recommended at planting.

<b>Village name:</b>	Njage	<b>Mkongomtale area, Njage village</b>						
<b>Latitude</b>	-8.24571							
<b>Longitude</b>	36.19587							
<b>Sampling unit</b>	MKON_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)	9.72	Medium	Boron (ppm)	2.8	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.18	Low	Copper (ppm)	2.75	High
CEC (cmol(+)/kg)	16	Medium	Sulfate sulfur (ppm)	5.39	Deficient	Manganese (ppm)	71.52	High
Organic carbon (%)	1.06	Low	Calcium (cmol(+)/kg)	1.62	Sufficient	Zinc (ppm)	1.34	High
Total nitrogen (%)	0.09	Very low	Magnesium (cmol(+)/kg)	1.29	Medium	Iron (ppm)	166.45	High
Nitrate N (ppm)	33.6	Low	Sodium (cmol(+)/kg)	0.25	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Njage	<b>Makangagani2 area, Njage village</b>						
<b>Latitude</b>	-8.25533							
<b>Longitude</b>	36.18145							
<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)	5.0	Very strongly acidic	Phosphorus (ppm)	23.35	High	Boron (ppm)	3.25	Satisfactory
Ec (mS/cm)	0.05	Salt free	Potassium (cmol(+)/kg)	0.12	Low	Copper (ppm)	4.83	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	14.01	Sufficient	Manganese (ppm)	26.06	High
Organic carbon (%)	2.5	Medium	Calcium (cmol(+)/kg)	2.53	Medium	Zinc (ppm)	1.34	High
Total nitrogen (%)	0.21	Medium	Magnesium (cmol(+)/kg)	1.82	Medium	Iron (ppm)	282.58	High
Nitrate N (ppm)	30.8	Low	Sodium (cmol(+)/kg)	0.3	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 45 kg K/ha is recommended at planting.

<b>Village name:</b>	Njage	<b>Kinjura area, Njage village</b>						
<b>Latitude</b>	-8.24436							
<b>Longitude</b>	36.19256							
<b>Sampling unit</b>	KINJ_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)	5.4	Strongly acidic	Phosphorus (ppm)	41.84	High	Boron (ppm)	0.62	Deficient
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.34	Medium	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	9	Low	Sulfate sulfur (ppm)	8.09	Marginal	Manganese (ppm)	15.64	High
Organic carbon (%)	1.57	Medium	Calcium (cmol(+)/kg)	3.06	Medium	Zinc (ppm)	1.26	High
Total nitrogen (%)	0.13	Low	Magnesium (cmol(+)/kg)	2.26	High	Iron (ppm)	118.06	High
Nitrate N (ppm)	32.2	Low	Sodium (cmol(+)/kg)	0.2	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Boron:* 0.25 kg B/ha is recommended, as either basal or foliar application.

<b>Village name:</b>	Igima	<b>Nyakidete area, Igima village</b>						
<b>Latitude</b>	-8.24750							
<b>Longitude</b>	36.24141							
<b>Sampling unit</b>	NYAK_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)	5.4	Strongly acidic	Phosphorus (ppm)	38.05	High	Boron (ppm)	3.08	Satisfactory
Ec (mS/cm)	0.06	Salt free	Potassium (cmol(+)/kg)	0.27	Medium	Copper (ppm)	3.70	High
CEC (cmol(+)/kg)	18	Medium	Sulfate sulfur (ppm)	5.39	Deficient	Manganese (ppm)	44.24	High
Organic carbon (%)	2.32	Medium	Calcium (cmol(+)/kg)	4.50	High	Zinc (ppm)	1.92	High
Total nitrogen (%)	0.16	Low	Magnesium (cmol(+)/kg)	4.56	Very high	Iron (ppm)	311.61	High
Nitrate N (ppm)	37.80	Low	Sodium (cmol(+)/kg)	0.31	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended, and can be applied as basal along with K or top dressing with N fertilizer.

<b>Village name:</b>	Igima	<b><i>Igima area, Igima village</i></b>						
<b>Latitude</b>	-8.24196							
<b>Longitude</b>	36.24178							
<b>Sampling unit</b>	IGI_1	<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)	4.6	Very strongly acidic	Phosphorus (ppm)	28.09	High	Boron (ppm)	1.96	Satisfactory
Ec (mS/cm)	0.36	Salt free	Potassium (cmol(+)/kg)	0.44	High	Copper (ppm)	2.75	High
CEC (cmol(+)/kg)	26	High	Sulfate sulfur (ppm)	11.86	Marginal	Manganese (ppm)	25.33	High
Organic carbon (%)	4.92	Very high	Calcium (cmol(+)/kg)	2.58	Medium	Zinc (ppm)	1.34	High
Total nitrogen (%)	0.48	Medium	Magnesium (cmol(+)/kg)	1.35	Medium	Iron (ppm)	205.16	High
Nitrate N (ppm)	40.60	Low	Sodium (cmol(+)/kg)	0.39	Medium			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended as basal application at planting. 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:** 4 kg S/ha is recommended, as either basal along with P or top dressing along with N fertilizer.

<b>Village name:</b>	Mbingu	<b>Chiwachiwa area, Mbingu village</b>						
<b>Latitude</b>	-8.14826							
<b>Longitude</b>	36.29556							
<b>Sampling unit</b>	NYAKA_I	<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)	5.3	Strongly acidic	Phosphorus (ppm)	25.84	High	Boron (ppm)	4.14	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.19	Low	Copper (ppm)	4.08	High
CEC (cmol(+)/kg)	22	Medium	Sulfate sulfur (ppm)	4.85	Deficient	Manganese (ppm)	135.15	High
Organic carbon (%)	3.22	High	Calcium (cmol(+)/kg)	2.77	Medium	Zinc (ppm)	1.12	High
Total nitrogen (%)	0.25	Medium	Magnesium (cmol(+)/kg)	1.74	Medium	Iron (ppm)	272.90	High
Nitrate N (ppm)	35.00	Low	Sodium (cmol(+)/kg)	0.36	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 10 kg S/ha is recommended, either basal or top dressing application.

<b>Village name:</b>	Mbingu	<b>Mbingu area, Mbingu village</b>						
<b>Latitude</b>	-8.20002							
<b>Longitude</b>	36.29897							
<b>Sampling unit</b>	MBING_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)	5.5	Strongly acidic	Phosphorus (ppm)	66.86	High	Boron (ppm)	2.23	Satisfactory
Ec (mS/cm)	0.08	Salt free	Potassium (cmol(+)/kg)	0.51	High	Copper (ppm)	2.94	High
CEC (cmol(+)/kg)	33	High	Sulfate sulfur (ppm)	13.48	Sufficient	Manganese (ppm)	53.33	High
Organic carbon (%)	4.96	Very high	Calcium (cmol(+)/kg)	5.27	High	Zinc (ppm)	1.85	High
Total nitrogen (%)	0.32	Medium	Magnesium (cmol(+)/kg)	3.58	High	Iron (ppm)	98.71	High
Nitrate N (ppm)	54.60	Low	Sodium (cmol(+)/kg)	0.30	Sufficient			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.

<b>Village name:</b>	Miwangeni	<b>Kiwalani area, Miwangani village</b>						
<b>Latitude</b>	-8.15372							
<b>Longitude</b>	36.50256							
<b>Sampling unit</b>	MIWA_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)	5.0	Very strongly acidic	Phosphorus (ppm)	52.04	High	Boron (ppm)	4.08	Satisfactory
Ec (mS/cm)	0.12	Salt free	Potassium (cmol(+)/kg)	0.45	High	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	14	Medium	Sulfate sulfur (ppm)	5.39	Deficient	Manganese (ppm)	27.45	High
Organic carbon (%)	1.48	Medium	Calcium (cmol(+)/kg)	3.06	Medium	Zinc (ppm)	2.35	High
Total nitrogen (%)	0.11	Low	Magnesium (cmol(+)/kg)	2.75	High	Iron (ppm)	156.77	High
Nitrate N (ppm)	58.80	Low	Sodium (cmol(+)/kg)	0.23	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Sulfur:** 10 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Miwangeni	<b>Mipingoni area, Miwangani village</b>						
<b>Latitude</b>	-8.16801							
<b>Longitude</b>	36.52492							
<b>Sampling unit</b>	MIWA_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)	12.56	Medium	Boron (ppm)	4.53	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.13	Low	Copper (ppm)	2.19	High
CEC (cmol(+)/kg)	6	Low	Sulfate sulfur (ppm)	10.24	Marginal	Manganese (ppm)	19.88	High
Organic carbon (%)	0.42	Very low	Calcium (cmol(+)/kg)	0.46	Sufficient	Zinc (ppm)	0.46	Low
Total nitrogen (%)	0.06	Very low	Magnesium (cmol(+)/kg)	0.66	Sufficient	Iron (ppm)	98.71	High
Nitrate N (ppm)	35.00	Low	Sodium (cmol(+)/kg)	0.27	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be avoided. Application of farm yard manure is recommended.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 45 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either basal or top dressing application.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Miwangeni	<b>Miwangani area, Miwangani village</b>						
<b>Latitude</b>	-8.20372							
<b>Longitude</b>	36.53656							
<b>Sampling unit</b>	MIWA-I	<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)	4.8	Very strongly acidic	Phosphorus (ppm)	22.05	High	Boron (ppm)	1.23	Medium
Ec (mS/cm)	0.08	Salt free	Potassium (cmol(+)/kg)	0.20	Low	Copper (ppm)	3.89	High
CEC (cmol(+)/kg)	33	High	Sulfate sulfur (ppm)	29.11	Sufficient	Manganese (ppm)	44.24	High
Organic carbon (%)	2.25	Medium	Calcium (cmol(+)/kg)	2.77	Medium	Zinc (ppm)	0.90	Medium
Total nitrogen (%)	0.22	Medium	Magnesium (cmol(+)/kg)	2.16	High	Iron (ppm)	263.23	High
Nitrate N (ppm)	39.20	Low	Sodium (cmol(+)/kg)	0.60	Medium			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label kg Zn.

<b>Village name:</b>	Mofu	<b><i>Kibasila area, Mofu village</i></b>						
<b>Latitude</b>	-8.16957							
<b>Longitude</b>	36.39228							
<b>Sampling unit</b>	MOF_3	<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)	4.5	Very strongly acidic	Phosphorus (ppm)	17.78	Medium	Boron (ppm)	3.81	Satisfactory
Ec (mS/cm)	0.11	Salt free	Potassium (cmol(+)/kg)	0.12	Low	Copper (ppm)	0.30	Sufficient
CEC (cmol(+)/kg)	7	Low	Sulfate sulfur (ppm)	29.65	Sufficient	Manganese (ppm)	35.15	High
Organic carbon (%)	1.04	Low	Calcium (cmol(+)/kg)	0.46	Sufficient	Zinc (ppm)	1.34	High
Total nitrogen (%)	0.10	Low	Magnesium (cmol(+)/kg)	0.28	Sufficient	Iron (ppm)	98.71	High
Nitrate N (ppm)	44.80	Low	Sodium (cmol(+)/kg)	0.19	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be avoided. Application of farm yard manure is recommended.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 45 kg K/ha is recommended at planting.

<b>Village name:</b>	Mofu	<b>Mnadani area, Mofu village</b>						
<b>Latitude</b>	-8.27542							
<b>Longitude</b>	36.32515							
<b>Sampling unit</b>	MOF_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)	5.4	Strongly acidic	Phosphorus (ppm)	16.36	Medium	Boron (ppm)	2.29	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.15	Low	Copper (ppm)	1.62	High
CEC (cmol(+)/kg)	13	Medium	Sulfate sulfur (ppm)	4.85	Deficient	Manganese (ppm)	16.97	High
Organic carbon (%)	1.06	Low	Calcium (cmol(+)/kg)	0.37	Sufficient	Zinc (ppm)	0.90	Medium
Total nitrogen (%)	0.08	Very low	Magnesium (cmol(+)/kg)	0.50	Sufficient	Iron (ppm)	156.77	High
Nitrate N (ppm)	28.00	Low	Sodium (cmol(+)/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting.
- *Potassium:* 40 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended, either basal or top dressing.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used.

<b>Village name:</b>	Mofu	<i>Mofu area, Mofu village</i>						
<b>Latitude</b>	-8.30260							
<b>Longitude</b>	36.33608							
<b>Sampling unit</b>	MOF_I	<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)	4.8	Very strongly acidic	Phosphorus (ppm)	35.44	High	Boron (ppm)	2.97	Satisfactory
Ec (mS/cm)	0.25	Salt free	Potassium (cmol(+)/kg)	0.58	High	Copper (ppm)	3.51	High
CEC (cmol(+)/kg)	27	High	Sulfate sulfur (ppm)	24.80	Sufficient	Manganese (ppm)	20.00	High
Organic carbon (%)	2.95	High	Calcium (cmol(+)/kg)	2.77	Medium	Zinc (ppm)	1.63	High
Total nitrogen (%)	0.36	Medium	Magnesium (cmol(+)/kg)	1.38	Medium	Iron (ppm)	224.42	High
Nitrate N (ppm)	35.00	Low	Sodium (cmol(+)/kg)	0.29	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent potential Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.

<b>Village name:</b>	Kanyenja	<b>Kanyenja area, Kanyenja village</b>						
<b>Latitude</b>	-7.86381							
<b>Longitude</b>	37.01160							
<b>Sampling unit</b>	KANYE_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)	4.9	Very strongly acidic	Phosphorus (ppm)	19.79	Medium	Boron (ppm)	4.48	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.08	Low	Copper (ppm)	0.49	Medium
CEC (cmol(+)/kg)	7	Low	Sulfate sulfur (ppm)	5.39	Deficient	Manganese (ppm)	17.75	High
Organic carbon (%)	0.61	Low	Calcium (cmol(+)/kg)	1.04	Sufficient	Zinc (ppm)	0.46	Low
Total nitrogen (%)	0.06	Very low	Magnesium (cmol(+)/kg)	0.50	Sufficient	Iron (ppm)	40.65	High
Nitrate N (ppm)	32.20	Low	Sodium (cmol(+)/kg)	0.15	Sufficient			

### Parameters to address in this site:

- **Soil pH:** Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 70 kg K/ha is recommended at planting.
- **Sulfur:** 10 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kanyenja	<b>Kanyenja2 area, Kanyenja village</b>						
<b>Latitude</b>	-7.85910							
<b>Longitude</b>	36.99960							
<b>Sampling unit</b>	KANYE_2	<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)	5.5	Strongly acidic	Phosphorus (ppm)	11.61	Medium	Boron (ppm)	2.02	Satisfactory
Ec (mS/cm)	0.01	Salt free	Potassium (cmol(+)/kg)	0.16	Low	Copper (ppm)	5.21	High
CEC (cmol(+)/kg)	20	Medium	Sulfate sulfur (ppm)	3.77	Deficient	Manganese (ppm)	47.27	High
Organic carbon (%)	2.59	High	Calcium (cmol(+)/kg)	2.29	Medium	Zinc (ppm)	0.97	Medium
Total nitrogen (%)	0.20	Low	Magnesium (cmol(+)/kg)	1.69	Medium	Iron (ppm)	253.55	High
Nitrate N (ppm)	47.60	Low	Sodium (cmol(+)/kg)	0.30	Sufficient			

### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- **Potassium:** 40 kg K/ha is recommended at planting
- **Sulfur:** 10 kg S/ha is recommended. Single dose, basal or top dressing
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Kanyenja	<b><i>Msalise area, Kanyenja village</i></b>						
<b>Latitude</b>	-7.85958							
<b>Longitude</b>	36.97335							
<b>Sampling unit</b>	KANYE_3	<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)	5.2	Strongly acidic	Phosphorus (ppm)	13.04	Medium	Boron (ppm)	3.30	Satisfactory
Ec (mS/cm)	0.02	Salt free	Potassium (cmol(+)/kg)	0.19	Low	Copper (ppm)	3.70	High
CEC (cmol(+)/kg)	29	High	Sulfate sulfur (ppm)	6.47	Marginal	Manganese (ppm)	28.67	High
Organic carbon (%)	1.63	Medium	Calcium (cmol(+)/kg)	2.67	Medium	Zinc (ppm)	1.41	High
Total nitrogen (%)	0.10	Low	Magnesium (cmol(+)/kg)	2.03	High	Iron (ppm)	214.84	High
Nitrate N (ppm)	39.20	Low	Sodium (cmol(+)/kg)	0.26	Sufficient			

### Parameters to address in this site:

- *Soil pH*: Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen*: 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus*: 20 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium*: 40 kg K/ha is recommended at planting.
- *Sulfur*: 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Mang'ula	<b>Mgudeni area, Mang'ula village</b>						
<b>Latitude</b>	-7.87102							
<b>Longitude</b>	36.89559							
<b>Sampling unit</b>	MANG_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)	5.0	Very strongly acidic	Phosphorus (ppm)	93.29	High	Boron (ppm)	1.90	Satisfactory
Ec (mS/cm)	0.07	Salt free	Potassium (cmol(+)/kg)	0.29	Medium	Copper (ppm)	2.57	High
CEC (cmol(+)/kg)	19	Medium	Sulfate sulfur (ppm)	13.48	Sufficient	Manganese (ppm)	16.97	High
Organic carbon (%)	2.69	High	Calcium (cmol(+)/kg)	2.77	Medium	Zinc (ppm)	1.26	High
Total nitrogen (%)	0.16	Low	Magnesium (cmol(+)/kg)	1.82	Medium	Iron (ppm)	263.23	High
Nitrate N (ppm)	35.00	Low	Sodium (cmol(+)/kg)	0.29	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Potassium:* 15 kg K/ha is recommended at planting.

<b>Village name:</b>	Mang'ula	<b>Mgudeni2 area, Mang'ula village</b>						
<b>Latitude</b>	-7.88256							
<b>Longitude</b>	36.91341							
<b>Sampling unit</b>	MANG_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)	5.2	Strongly acidic	Phosphorus (ppm)	19.91	Medium	Boron (ppm)	3.42	Satisfactory
Ec (mS/cm)	0.03	Salt free	Potassium (cmol(+)/kg)	0.22	Medium	Copper (ppm)	1.43	High
CEC (cmol(+)/kg)	10	Low	Sulfate sulfur (ppm)	27.49	Sufficient	Manganese (ppm)	13.94	High
Organic carbon (%)	1.48	Medium	Calcium (cmol(+)/kg)	1.62	Sufficient	Zinc (ppm)	1.99	High
Total nitrogen (%)	0.12	Low	Magnesium (cmol(+)/kg)	1.66	Medium	Iron (ppm)	176.13	High
Nitrate N (ppm)	37.80	Low	Sodium (cmol(+)/kg)	0.24	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The correct amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be avoided. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage. . Ammonium N or slow release nitrate-N fertilizers are recommended for flooded rice to avoid N losses due to de-nitrification.
- *Phosphorus:* 10 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Potassium:* 40 kg K/ha is recommended at planting.

### 3.5 SITE SPECIFIC SOIL TEST RESULTS AND RECOMMENDATIONS FOR SOIL FERTILITY MANAGEMENT IN WAMI VALLEY

<b>Village name:</b>	Mkindo	<i>Mgongola area, Mkindo village</i>						
<b>Latitude</b>	-6.53494							
<b>Longitude</b>	37.51307							
<b>Sampling unit</b>	MGO_1	<i>Sandy loam</i>						
<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)	5.5	Strongly acidic	Phosphorus (mg/kg)	2.91	Low	Boron (ppm)	1.63	Satisfactory
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	0.66	High	Copper (ppm)	4.44	High
CEC (cmol(+)/kg)	24.2	Medium	Sulphate-s (ppm)	17	Sufficient	Zinc (ppm)	0.83	Medium
Organic carbon (%)	1.40	Medium	Ca (cmolc/kg)	6.88	Very high	Manganese (ppm)	34.53	High
Total nitrogen (%)	0.12	Low	Mg (cmolc/kg)	7.56	Very high	Iron (ppm)	215.29	High
Nitrate N (ppm)	42.0	Low	Na (cmolc/kg)	0.35	Medium			

#### Parameters to address in this site:

- *Nitrogen*: 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus*: 35 kg P/ha is recommended, as basal application at planting.

<b>Village name:</b>	Mkindo	<b>Mgongola2 area, Mkindo village</b>						
<b>Latitude</b>	-6.45044							
<b>Longitude</b>	37.56111							
<b>Sampling unit</b>	MGO_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)	5.7	Medium Acidic	Phosphorus (Mg/Kg)	1.04	Low	Boron (Ppm)	0.76	Sufficient
Ec (mS/cm)	0.04	Salt Free	K (Cmolc/Kg)	0.29	Medium	Copper (Ppm)	1.28	High
CEC (cmol(+)/kg)	11.2	Low	Sulphate-S (Ppm)	2.83	Deficient	Zinc (Ppm)	0.04	Low
Organic carbon (%)	0.78	Low	Ca (Cmolc/Kg)	3.62	Medium	Manganese (Ppm)	45.85	High
Total nitrogen (%)	0.07	Very Low	Mg (Cmolc/Kg)	3.12	High	Iron (Ppm)	65.85	High
Nitrate N (ppm)	36.4	Low	Na (Cmolc/Kg)	0.43	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 10 kg S/ha is recommended. Single dose, basal or top dressing
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Mkindo	<b>Mkindo irrigation scheme no. 2, Mkindo village</b>						
<b>Latitude</b>	-6.58761							
<b>Longitude</b>	37.48852							
<b>Sampling unit</b>	MKIN_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)	5.0	Strongly acidic	Phosphorus (mg/kg)	2.18	Low	Boron (ppm)	2.2	Satisfactory
Ec (mS/cm)	0.08	Salt free	K (cmolc/kg)	0.86	High	Copper (ppm)	3.65	High
CEC (cmol(+)/kg)	17.60	Medium	Sulphate-s (ppm)	20.3	Sufficient	Zinc (ppm)	1.42	High
Organic carbon (%)	2.67	High	Ca (cmolc/kg)	3.23	Medium	Manganese (ppm)	102.45	High
Total nitrogen (%)	0.24	Medium	Mg (cmolc/kg)	2.57	High	Iron (ppm)	603.53	High
Nitrate N (ppm)	29.40	Low	Na (cmolc/kg)	0.30	Sufficient			

#### **Parameters to address in this site:**

- *Nitrogen*: 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus*: 35 kg P/ha is recommended, as basal application at planting.

<b>Village name:</b>	Mkindo	<b>Mkindo irrigation scheme no. 1, Mkindo village</b>						
<b>Latitude</b>	-6.56180							
<b>Longitude</b>	37.50027							
<b>Sampling unit</b>	MKIN_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)	5.4	Strongly acidic	Phosphorus (mg/kg)	10.48	Medium	Boron (ppm)	1.73	Satisfactory
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	0.37	Medium	Copper (ppm)	5.54	High
CEC (cmol(+)/kg)	22.2	Medium	Sulphate-s (ppm)	10.39	Marginal	Zinc (ppm)	1.29	High
Organic carbon (%)	1.95	Low	Ca (cmolc/kg)	7.27	Very high	Manganese (ppm)	164.72	High
Total nitrogen (%)	0.18	Low	Mg (cmolc/kg)	4.15	Very high	Iron (ppm)	480	High
Nitrate N (ppm)	36.4	Low	Na (cmolc/kg)	0.4	Medium			

#### **Parameters to address in this site:**

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Dihombo	<b>Dihombo area, Dihombo village</b>						
<b>Latitude</b>	-6.29850							
<b>Longitude</b>	37.54527							
<b>Sampling unit</b>	DIH_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)	1.97	Low	Boron (ppm)	0.90	Sufficient
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	0.44	High	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	20.4	Medium	Sulphate-s (ppm)	15.11	Sufficient	Zinc (ppm)	0.17	Low
Organic carbon (%)	1.17	Low	Ca (cmolc/kg)	6.50	Very high	Manganese(ppm)	17.55	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	6.14	Very high	Iron (ppm)	70.06	High
Nitrate N (ppm)	25.2	Low	Na (cmolc/kg)	0.59	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting. 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 pH.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dihombo	<b>Dihombo2 area, Dihombo village</b>						
<b>Latitude</b>	-6.26435							
<b>Longitude</b>	37.53392							
<b>Sampling unit</b>	DIH_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)	1.56	Low	Boron (ppm)	1.83	Satisfactory
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	0.39	Medium	Copper (ppm)	4.44	High
CEC (cmol(+)/kg)	22.6	Medium	Sulphate-s (ppm)	12.28	Marginal	Zinc (ppm)	1.23	High
Organic carbon (%)	2.40	Medium	Ca (cmolc/kg)	6.12	Very high	Manganese (ppm)	195.85	High
Total nitrogen (%)	0.19	Low	Mg (cmolc/kg)	4.45	Very high	Iron (ppm)	453.53	High
Nitrate N (ppm)	37.8	Low	Na (cmolc/kg)	0.26	Sufficient			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.

<b>Village name:</b>	Dihombo	<b><i>Dihombo3 area, Dihombo village</i></b>						
<b>Latitude</b>	-6.26940							
<b>Longitude</b>	37.52701							
<b>Sampling unit</b>	DIH_3	<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)	5.9	Medium acidic	Phosphorus (mg/kg)	46.29	High	Boron (ppm)	1.73	Satisfactory
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	1.58	High	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	13.6	Medium	So4_s (ppm)	16.05	Sufficient	Zinc (ppm)	1.03	High
Organic carbon (%)	1.40	Medium	Ca (cmolc/kg)	4.96	High	Manganese (ppm)	28.87	High
Total nitrogen (%)	0.13	Low	Mg (cmolc/kg)	2.25	High	Iron (ppm)	74.12	High
Nitrate N (ppm)	36.4	Low	Na (cmolc/kg)	0.16	Sufficient			

**Parameters to address in this site:**

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.

<b>Village name:</b>	Hembeti	<b>Mpapa area, Hembeti village</b>						
<b>Latitude</b>	-6.40277							
<b>Longitude</b>	37.56724							
<b>Sampling unit</b>	HEMB_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)	8.30	Medium	Boron (ppm)	1.20	Medium
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	0.75	High	Copper (ppm)	2.86	High
CEC (cmol(+)/kg)	20.6	Medium	So4_s (ppm)	14.16	Sufficient	Zinc (ppm)	0.90	Medium
Organic carbon (%)	1.62	Medium	Ca (cmolc/kg)	7.27	Very high	Manganese (ppm)	17.55	High
Total nitrogen (%)	0.13	Low	Mg (cmolc/kg)	6.47	Very high	Iron (ppm)	109.41	High
Nitrate N (ppm)	60.2	Low	Na (cmolc/kg)	0.28	Sufficient			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Hembeti	<b>Irrigation scheme, Hembeti village</b>						
<b>Latitude</b>	-6.27007							
<b>Longitude</b>	37.51867							
<b>Sampling unit</b>	HEMB_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)	4.9	Very strong acid	Phosphorus (mg/kg)	3.53	Low	Boron (ppm)	1.46	Satisfactory
Ec (mS/cm)	0.03	Salt free	K (cmolc/kg)	0.26	Medium	Copper (ppm)	1.28	High
CEC (cmol(+)/kg)	9.4	Low	SO <sub>4</sub> _S (ppm)	9.44	Marginal	Zinc (ppm)	1.03	Medium
Organic carbon (%)	1.52	Medium	Ca (cmolc/kg)	1.69	Sufficient	Manganese (ppm)	76.98	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	0.99	Medium	Iron (ppm)	303.50	High
Nitrate N (ppm)	64.4	Low	Na (cmolc/kg)	0.17	Sufficient			

### Parameters to address in this site:

- *Soil pH:* Liming is recommended to raise the pH to between 5.5 and 6.0 in order to prevent Al toxicity. The amount of lime required can be known after determination of exchangeable acidity and lime requirement.
- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Hembeti	<b>Hembeti area, Hembeti village</b>						
<b>Latitude</b>	-6.39372							
<b>Longitude</b>	37.60427							
<b>Sampling unit</b>	HEMB_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)	6.7	Neutral	Phosphorus (mg/kg)	23.38	High	Boron (ppm)	1.56	Satisfactory
Ec (mS/cm)	0.45	Salt free	K (cmolc/kg)	0.50	High	Copper (ppm)	2.86	High
CEC (cmol(+)/kg)	21.4	Medium	So4_s (ppm)	9.91	Marginal	Zinc (ppm)	0.70	Medium
Organic carbon (%)	1.38	Medium	Ca (cmolc/kg)	6.31	Very high	Manganese (ppm)	60.00	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	8.79	Very high	Iron (ppm)	109.41	High
Nitrate N (ppm)	50.4	Low	Na (cmolc/kg)	4.67	Very high			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 10 - 20 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dehere area, Dakawa village</b>						
<b>Latitude</b>	-6.40455							
<b>Longitude</b>	37.52295							
<b>Sampling unit</b>	DEHE_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)	5.9	Medium acidic	Phosphorus (mg/kg)	1.35	Low	Boron (ppm)	0.65	Sufficient
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	0.36	Medium	Copper (ppm)	2.23	High
CEC (cmol(+)/kg)	10.8	Low	So4_s (ppm)	12.28	Marginal	Zinc (ppm)	0.04	Low
Organic carbon (%)	0.39	Very low	Ca (cmolc/kg)	3.62	Medium	Manganese (ppm)	37.36	High
Total nitrogen (%)	0.05	Very low	Mg (cmolc/kg)	3.39	High	Iron (ppm)	91.76	High
Nitrate N (ppm)	42.0	Low	Na (cmolc/kg)	0.58	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Potassium:* 15 kg K/ha is recommended at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label kg Zn.

<b>Village name:</b>	Dakawa	<b>Mbuyuni area, Dakawa village</b>						
<b>Latitude</b>	-6.53494							
<b>Longitude</b>	37.51307							
<b>Sampling unit</b>	MBUYU_I	<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)	6.4	Slightly acidic	Phosphorus (mg/kg)	2.69	Low	Boron (ppm)	0.73	Sufficient
Ec (mS/cm)	0.06	Salt free	K (cmolc/kg)	0.63	High	Copper (ppm)	1.91	High
CEC (cmol(+)/kg)	24.2	Medium	So4_s (ppm)	8.97	Marginal	Zinc (ppm)	0.17	Low
Organic carbon (%)	0.94	Low	Ca (cmolc/kg)	8.42	Very high	Manganese (ppm)	31.7	High
Total nitrogen (%)	0.08	Very low	Mg (cmolc/kg)	8.84	Very high	Iron (ppm)	46.24	High
Nitrate N (ppm)	28.0	Low	Na (cmolc/kg)	0.89	High			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the kg Zn.

<b>Village name:</b>	Dakawa	<b>Mbuyuni area, Dakawa village</b>						
<b>Latitude</b>	-6.40282							
<b>Longitude</b>	37.55568							
<b>Sampling unit</b>	DK_5	<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)	11.94	Medium	Boron (ppm)	0.10	Low
Ec (mS/cm)	0.08	Salt free	K (cmolc/kg)	0.73	High	Copper (ppm)	1.28	High
CEC (cmol(+)/kg)	15.8	Medium	So4_s (ppm)	7.55	Marginal	Zinc (ppm)	0.63	Medium
Organic carbon (%)	0.78	Low	Ca (cmolc/kg)	5.78	High	Manganese (ppm)	57.17	High
Total nitrogen (%)	0.08	Very low	Mg (cmolc/kg)	4.67	Very high	Iron (ppm)	65.65	High
Nitrate N (ppm)	57.4	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. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Boron:* 0.25kgB/ha is recommended, as either basal or foliar application.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 14</b>						
<b>Latitude</b>	-6.40277							
<b>Longitude</b>	37.56724							
<b>Sampling unit</b>	DKW_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)	7.95	Moderate alkaline	Phosphorus (mg/kg)	4.44	low	Boron (ppm)	0.86	sufficient
Ec (mS/cm)	0.16	Salt free	K (cmolc/kg)	0.59	high	Copper (ppm)	0.96	High
CEC (cmol(+)/kg)	21.8	medium	SO <sub>4</sub> _S (ppm)	11.33	marginal	Zinc (ppm)	0.63	Low
Organic carbon (%)	0.51	Medium	Ca (cmolc/kg)	15.15	very high	Manganese (ppm)	12	High
Total nitrogen (%)	0.66	High	Mg (cmolc/kg)	6.71	very high	Iron (ppm)	3.88	Medium
Nitrate N (ppm)	44.8	low	Na (cmolc/kg)	0.28	sufficient			

### Parameters to address in this site:

- **Alkalinity:** To manage the alkalinity acidifying minerals [elemental S, pyrite (FeS<sub>2</sub>)] or organic amendments (wood chips, sawdust) may help to lower soil pH. However, the rate to be applied and its response to change in pH in this area needs to be investigated.
- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 2 I</b>						
<b>Latitude</b>	-6.3933 I							
<b>Longitude</b>	37.59175							
<b>Sampling unit</b>	DKW_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)	7.8	Mildly alkaline	Phosphorus (mg/kg)	10.36	Adequate	Boron (ppm)	2.00	Satisfactory
Ec (mS/cm)	0.22	Salt free	K (cmolc/kg)	0.79	High	Copper (ppm)	2.86	High
CEC (cmol(+)/kg)	23.2	Medium	SO <sub>4</sub> _S (ppm)	3.31	Deficient	Zinc (ppm)	0.37	Low
Organic carbon (%)	0.92	Low	Ca (cmolc/kg)	13.23	Very high	Manganese (ppm)	31.70	High
Total nitrogen (%)	0.07	Very low	Mg (cmolc/kg)	7.70	Very high	Iron (ppm)	36.53	High
Nitrate N (ppm)	37.8	Low	Na (cmolc/kg)	0.43	Medium			

### Parameters to address in this site:

- **Alkalinity:** To manage the alkalinity acidifying minerals [elemental S, pyrite (FeS<sub>2</sub>)] or organic amendments (wood chips, sawdust) may help to lower soil pH. However, the rate to be applied and its response to change in pH in this area needs to be investigated.
- **Cation exchange capacity and soil organic matter:** Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 20 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 10 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 21_b</b>						
<b>Latitude</b>	-6.39339							
<b>Longitude</b>	37.58544							
<b>Sampling unit</b>	DKW_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	Medium acidic	Phosphorus (mg/kg)	3.54	Low	Boron (ppm)	1.7	Satisfactory
Ec (ms/cm)	0.11	Salt free	K (cmolc/kg)	0.73	High	Copper (ppm)	2.86	High
CEC (cmol(+)/kg)	29.4	High	Sulphate-S (ppm)	14.16	Sufficient	Zinc (ppm)	0.37	Low
Organic carbon (%)	0.83	Low	Ca (cmolc/kg)	11.31	Very high	Manganese (ppm)	65.66	High
Total nitrogen (%)	0.07	Low	Mg (cmolc/kg)	9.63	Very high	Iron (ppm)	51.53	High
Nitrate N (ppm)	44.8	Low	Na (cmolc/kg)	0.55	High			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 17</b>						
<b>Latitude</b>	-6.39331							
<b>Longitude</b>	37.59175							
<b>Sampling unit</b>	DKW_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)	6.2	Slightly acidic	Phosphorus (mg/kg)	1.56	Low	Boron (ppm)	1.60	Satisfactory
Ec (mS/cm)	0.08	Salt free	K (cmolc/kg)	0.84	High	Copper (ppm)	3.49	High
CEC (cmol(+)/kg)	34.0	High	So4_s (ppm)	14.16	Sufficient	Zinc (ppm)	0.83	Medium
Organic carbon (%)	1.50	Medium	Ca (cmolc/kg)	13.23	Very high	Manganese (ppm)	122.26	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	11.76	Very high	Iron (ppm)	82.94	High
Nitrate N (ppm)	35.0	Low	Na (cmolc/kg)	0.48	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 25</b>						
<b>Latitude</b>	-6.39372							
<b>Longitude</b>	37.60427							
<b>Sampling unit</b>	DKW_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 (mg/kg)	4.44	Low	Boron (ppm)	0.73	sufficient
Ec (mS/cm)	0.09	Salt free	K (cmolc/kg)	0.71	High	Copper (ppm)	2.07	High
CEC (cmol(+)/kg)	22.0	Medium	Sulphate-S (ppm)	7.04	marginal	Zinc (ppm)	0.04	Low
Organic carbon (%)	0.90	Low	Ca (cmolc/kg)	9.58	Very high	Manganese (ppm)	37.36	High
Total nitrogen (%)	0.08	Low	Mg (cmolc/kg)	6.31	Very high	Iron (ppm)	39.18	High
Nitrate N (ppm)	46.2	Low	Na (cmolc/kg)	0.30	sufficient			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 20</b>						
<b>Latitude</b>	-6.39339							
<b>Longitude</b>	37.58544							
<b>Sampling unit</b>	DKW_7	<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)	0.88	Low	Boron (ppm)	2.77	Satisfactory
Ec (mS/cm)	0.10	Salt free	K (cmolc/kg)	0.59	High	Copper (ppm)	2.54	High
CEC (cmol(+)/kg)	30.8	High	So4_s (ppm)	0.47	Deficient	Zinc (ppm)	0.11	Low
Organic carbon (%)	0.84	Low	Ca (cmolc/kg)	10.92	Very high	Manganese (ppm)	48.68	High
Total nitrogen (%)	0.06	Very low	Mg (cmolc/kg)	11.24	Very high	Iron (ppm)	51.53	High
Nitrate N (ppm)	36.4	Low	Na (cmolc/kg)	0.72	High			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 20 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 9-1</b>						
<b>Latitude</b>	-6.41479							
<b>Longitude</b>	37.54579							
<b>Sampling unit</b>	DKW_8	<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)	16.81	Medium	Boron (ppm)	1.7	Medium
Ec (mS/cm)	0.07	Salt free	K (cmolc/kg)	0.90	High	Copper (ppm)	2.54	High
CEC (cmol(+)/kg)	16.2	Medium	So4_s (ppm)	10.39	Marginal	Zinc (ppm)	0.76	Low
Organic carbon (%)	1.40	Medium	Ca (cmolc/kg)	6.31	High	Manganese (ppm)	48.68	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	4.51	Very high	Iron (ppm)	135.88	High
Nitrate N (ppm)	49.0	Low	Na (cmolc/kg)	0.22	Sufficient			

### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Dakawa	<b>Dakawa irrigation scheme, block 9-1_b</b>						
<b>Latitude</b>	-6.39363							
<b>Longitude</b>	37.58353							
<b>Sampling unit</b>	DKW_9	<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)	5.8	Medium acidic	Phosphorus (mg/kg)	1.76	Low	Boron (ppm)	1.63	Satisfactory
Ec (mS/cm)	0.12	Salt free	K (cmolc/kg)	1.37	High	Copper (ppm)	5.54	High
CEC (cmol(+)/kg)	27.0	High	So4_s (ppm)	20.77	Sufficient	Zinc (ppm)	0.44	Low
Organic carbon (%)	1.66	Medium	Ca (cmolc/kg)	9.77	Very high	Manganese (ppm)	108.11	High
Total nitrogen (%)	0.13	Low	Mg (cmolc/kg)	7.42	Very high	Iron (ppm)	180.00	High
Nitrate N (ppm)	67.2	Low	Na (cmolc/kg)	0.35	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 80 – 100 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Kidunda B area, Luhindo village</b>						
<b>Latitude</b>	-6.38642							
<b>Longitude</b>	37.60351							
<b>Sampling unit</b>	KIDU_I	<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)	6.4	Slightly acidic	Phosphorus (mg/kg)	3.94	Low	Boron (ppm)	2.16	Satisfactory
Ec (mS/cm)	0.13	Salt free	K (cmolc/kg)	1.48	High	Copper (ppm)	3.81	High
CEC (cmol(+)/kg)	46.2	Very high	So4_s (ppm)	17.94	Sufficient	Zinc (ppm)	0.37	Low
Organic carbon (%)	1.15	Low	Ca (cmolc/kg)	19.00	Very high	Manganese (ppm)	48.68	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	17.37	Very high	Iron (ppm)	82.41	High
Nitrate N (ppm)	29.4	Low	Na (cmolc/kg)	0.80	High			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Kidunda A area, Luhindo village</b>						
<b>Latitude</b>	-6.53287							
<b>Longitude</b>	37.51461							
<b>Sampling unit</b>	KIDU_2	<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	Phosphorus (mg/kg)	1.78	Low	Boron (ppm)	3.03	Satisfactory
Ec (mS/cm)	0.19	Salt free	K (cmolc/kg)	0.78	High	Copper (ppm)	0.96	High
CEC (cmol(+)/kg)	41.0	Very high	So4_s (ppm)	12.28	Marginal	Zinc (ppm)	0.11	Low
Organic carbon (%)	0.66	Low	Ca (cmolc/kg)	16.31	Very high	Manganese (ppm)	6.23	High
Total nitrogen (%)	0.05	Very low	Mg (cmolc/kg)	16.52	Very high	Iron (ppm)	33.00	High
Nitrate N (ppm)	25.2	Low	Na (cmolc/kg)	1.08	High			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Kidunda area, Luhindo village</b>						
<b>Latitude</b>	-6.53494							
<b>Longitude</b>	37.51307							
<b>Sampling unit</b>	KIDU_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	Phosphorus (mg/kg)	3.54	Low	Boron (ppm)	1.33	Medium
Ec (mS/cm)	0.14	Salt free	K (cmolc/kg)	0.64	High	Copper (ppm)	0.81	High
CEC (cmol(+)/kg)	39.8	High	So4_s (ppm)	25.97	Sufficient	Zinc (ppm)	0.11	Low
Organic carbon (%)	0.70	Low	Ca (cmolc/kg)	14.77	Very high	Manganese (ppm)	9.06	High
Total nitrogen (%)	0.04	Low	Mg (cmolc/kg)	14.48	Very high	Iron (ppm)	19.76	High
Nitrate N (ppm)	40.6	Low	Na (cmolc/kg)	1.14	High			

### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Mtakuja area, Luhindo village</b>						
<b>Latitude</b>	-6.28248							
<b>Longitude</b>	37.57781							
<b>Sampling unit</b>	MTAKUJ_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)	5.9	Medium acidic	Phosphorus (mg/kg)	3.63	Low	Boron (ppm)	0.43	Low
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	0.40	High	Copper (ppm)	0.81	High
CEC (cmol(+)/kg)	16.0	Medium	Sulphate-s (ppm)	6.14	Marginal	Zinc (ppm)	0.11	Low
Organic carbon (%)	0.78	Low	Ca (cmolc/kg)	5.73	High	Manganese (ppm)	51.51	High
Total nitrogen (%)	0.07	Very low	Mg (cmolc/kg)	4.23	Very high	Iron (ppm)	109.41	High
Nitrate N (ppm)	40.6	Low	Na (cmolc/kg)	0.39	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Boron:** 0.25kgB/ha is recommended, as either basal or foliar application.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Luhindo area, Luhindo village</b>						
<b>Latitude</b>	-6.42248							
<b>Longitude</b>	37.54069							
<b>Sampling unit</b>	LUHI_I	<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 (mg/kg)	0.62	Low	Boron (ppm)	1.12	Medium
Ec (mS/cm)	0.07	Salt free	K (cmolc/kg)	1.58	High	Copper (ppm)	1.28	High
CEC (cmol(+)/kg)	36.0	High	Sulphate-s (ppm)	15.58	Sufficient	Zinc (ppm)	0.17	Low
Organic carbon (%)	0.98	Low	Ca (cmolc/kg)	12.27	Very high	Manganese (ppm)	74.15	High
Total nitrogen (%)	0.06	Very low	Mg (cmolc/kg)	14.48	Very high	Iron (ppm)	46.24	High
Nitrate N (ppm)	29.4	Low	Na (cmolc/kg)	0.94	High			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended, either basal or top dressing application.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Luhindo2 area, Luhindo village</b>						
<b>Latitude</b>	-6.29755							
<b>Longitude</b>	37.52033							
<b>Sampling unit</b>	LUHI_2	<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)	6.4	Slightly acidic	Phosphorus (mg/kg)	0.83	Low	Boron (ppm)	0.7	Sufficient
Ec (mS/cm)	0.07	Salt free	K (cmolc/kg)	1.79	High	Copper (ppm)	1.28	High
CEC (cmol(+)/kg)	42.4	Very high	Sulphate-s (ppm)	22.66	Sufficient	Zinc (ppm)	0.37	Low
Organic carbon (%)	1.17	Low	Ca (cmolc/kg)	16.69	Very high	Manganese (ppm)	34.53	High
Total nitrogen (%)	0.09	Very low	Mg (cmolc/kg)	18.49	Very high	Iron (ppm)	59.17	High
Nitrate N (ppm)	33.6	Low	Na (cmolc/kg)	0.65	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 2 kg Zn /ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Luhindo3 area, Luhindo village</b>						
<b>Latitude</b>	-6.27007							
<b>Longitude</b>	37.51867							
<b>Sampling unit</b>	LUHI_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)	6.0	Medium acidic	Phosphorus (mg/kg)	0.62	Low	Boron (ppm)	0.38	Low
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	1.48	High	Copper (ppm)	2.38	High
CEC (cmol(+)/kg)	46.8	Very high	Sulphate-s (ppm)	14.16	Sufficient	Zinc (ppm)	0.44	Low
Organic carbon (%)	0.84	Low	Ca (cmolc/kg)	15.35	Very high	Manganese (ppm)	57.17	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	17.21	Very high	Iron (ppm)	100.57	High
Nitrate N (ppm)	37.8	Low	Na (cmolc/kg)	0.49	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Boron:** 0.25kgB/ha is recommended, as either basal or foliar application.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Lumanda area, Luhindo village</b>						
<b>Latitude</b>	-6.27966							
<b>Longitude</b>	37.51688							
<b>Sampling unit</b>	LUMA_I	<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)	5.6	Medium acidic	Phosphorus (mg/kg)	1.04	Low	Boron (ppm)	1.9	Satisfactory
Ec (mS/cm)	0.03	Salt free	K (cmolc/kg)	0.49	High	Copper (ppm)	2.7	High
CEC (cmol(+)/kg)	32.0	High	Sulphate-s (ppm)	12.28	Marginal	Zinc (ppm)	0.37	Low
Organic carbon (%)	1.56	Medium	Ca (cmolc/kg)	11.31	Very high	Manganese (ppm)	45.85	High
Total nitrogen (%)	0.13	Low	Mg (cmolc/kg)	8.57	Very high	Iron (ppm)	250.59	High
Nitrate N (ppm)	30.8	Low	Na (cmolc/kg)	0.7	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Lumanda2 area, Luhindo village</b>						
<b>Latitude</b>	-6.54498							
<b>Longitude</b>	37.47216							
<b>Sampling unit</b>	LUMA_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)	3.11	Low	Boron (ppm)	1.10	Medium
Ec (mS/cm)	0.04	Salt free	K (cmolc/kg)	0.46	High	Copper (ppm)	1.28	High
CEC (cmol(+)/kg)	17.4	Medium	Sulphate-s (ppm)	11.80	Marginal	Zinc (ppm)	0.50	Low
Organic carbon (%)	0.60	Very low	Ca (cmolc/kg)	5.92	High	Manganese (ppm)	43.02	High
Total nitrogen (%)	0.09	Very low	Mg (cmolc/kg)	5.52	Very high	Iron (ppm)	100.59	High
Nitrate N (ppm)	35.0	Low	Na (cmolc/kg)	0.44	Medium			

#### **Parameters to address in this site:**

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Sulfur:** 4 kg S/ha is recommended. Single dose, basal or top dressing.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Luhindo	<b>Lumanda3 area, Luhindo village</b>						
<b>Latitude</b>	-6.53287							
<b>Longitude</b>	37.51461							
<b>Sampling unit</b>	LUMA_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)	6.9	Neutral	Phosphorus (mg/kg)	4.14	Low	Boron (ppm)	2.16	Satisfactory
Ec (mS/cm)	0.08	Salt free	K (cmolc/kg)	0.75	High	Copper (ppm)	0.96	High
CEC (cmol(+)/kg)	37.8	High	Sulphate-s (ppm)	18.41	Sufficient	Zinc (ppm)	0.04	Low
Organic carbon (%)	0.57	Very low	Ca (cmolc/kg)	6.31	Very high	Manganese (ppm)	11.89	High
Total nitrogen (%)	0.04	Very low	Mg (cmolc/kg)	14.24	Very high	Iron (ppm)	25.94	High
Nitrate N (ppm)	28.0	Low	Na (cmolc/kg)	0.73	High			

#### Parameters to address in this site:

- **Nitrogen:** 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Zinc:** 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Milama	<b>Makutule area, Milama village</b>						
<b>Latitude</b>	-6.44768							
<b>Longitude</b>	37.57331							
<b>Sampling unit</b>	MILA_1	<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 (mg/kg)	17.0	Medium	Boron (ppm)	1.0	Medium
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	0.56	High	Copper (ppm)	0.65	High
CEC (cmol(+)/kg)	8.8	Low	Sulphate-s (ppm)	7.55	Marginal	Zinc (ppm)	0.24	Low
Organic carbon (%)	0.88	Low	Ca (cmolc/kg)	4.00	Medium	Manganese (ppm)	34.53	High
Total nitrogen (%)	0.06	Very low	Mg (cmolc/kg)	1.71	Medium	Iron (ppm)	26.82	High
Nitrate N (ppm)	37.8	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. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Milama	<b>Makutule2 area, Milama village</b>						
<b>Latitude</b>	-6.44768							
<b>Longitude</b>	37.57331							
<b>Sampling unit</b>	MILA_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)	5.9	Medium Acidic	Phosphorus (Mg/Kg)	3.94	Low	Boron (Ppm)	1.47	Medium
Ec (mS/cm)	0.04	Salt Free	K (Cmolc/Kg)	0.77	High	Copper (Ppm)	2.54	High
CEC (cmol(+)/kg)	17.8	Medium	Sulphate-S (Ppm)	9.91	Marginal	Zinc (Ppm)	0.37	Low
Organic carbon (%)	1.07	Low	Ca (Cmolc/Kg)	6.31	Very High	Manganese (Ppm)	14.72	High
Total nitrogen (%)	0.10	Low	Mg (Cmolc/Kg)	6.06	Very High	Iron (Ppm)	73.59	High
Nitrate N (ppm)	28.0	Low	Na (Cmolc/Kg)	0.48	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 25 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Milama	<b>Mgegani valley, Milama village</b>						
<b>Latitude</b>	-6.58761							
<b>Longitude</b>	37.48852							
<b>Sampling unit</b>	MILA_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)	5.9	Medium acidic	Phosphorus (mg/kg)	7.16	Medium	Boron (ppm)	1.67	Satisfactory
Ec (mS/cm)	0.05	Salt free	K (cmolc/kg)	1.06	High	Copper (ppm)	3.02	High
CEC (cmol(+)/kg)	21.8	Medium	Sulphate-s (ppm)	8.03	Marginal	Zinc (ppm)	0.44	Low
Organic carbon (%)	1.17	Low	Ca (cmolc/kg)	8.42	Very high	Manganese (ppm)	43.02	High
Total nitrogen (%)	0.10	Low	Mg (cmolc/kg)	6.61	Very high	Iron (ppm)	88.59	High
Nitrate N (ppm)	39.2	Low	Na (cmolc/kg)	0.35	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 20 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing
- *Zinc:* 2 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Milama	<b>Subiria area, Milama village</b>						
<b>Latitude</b>	-6.44798							
<b>Longitude</b>	37.57014							
<b>Sampling unit</b>	MILA_4	<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)	6.95	Low	Boron (ppm)	2.03	Satisfactory
Ec (mS/cm)	0.07	Salt free	K (cmolc/kg)	0.7	High	Copper (ppm)	2.23	High
CEC (cmol(+)/kg)	19.8	Medium	Sulphate-s (ppm)	9.91	Marginal	Zinc (ppm)	0.63	Medium
Organic carbon (%)	1.46	Low	Ca (cmolc/kg)	7.85	Very high	Manganese (ppm)	17.55	High
Total nitrogen (%)	0.11	Low	Mg (cmolc/kg)	6.31	Very high	Iron (ppm)	101.82	High
Nitrate N (ppm)	26.6	Low	Na (cmolc/kg)	0.46	Medium			

### Parameters to address in this site:

- *Cation exchange capacity and soil organic matter:* Incorporation of crop residues during land preparation is recommended. Burning as a method of land clearing should be stopped. Application of farm yard manure is recommended.
- *Nitrogen:* 120 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- *Phosphorus:* 35 kg P/ha is recommended, as basal application at planting.
- *Sulfur:* 4 kg S/ha is recommended. Single dose, basal or top dressing.
- *Zinc:* 1 kg Zn/ha is recommended, as basal application at planting. Foliar fertilization to achieve 0.18 kg Zn/ha per season can also be used. Appropriate concentration per foliar application is as per manufacturer instruction on the label.

<b>Village name:</b>	Msufini	<b>Mpapa area, Misufini village</b>						
<b>Latitude</b>	-6.54728							
<b>Longitude</b>	37.50466							
<b>Sampling unit</b>	MPA_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)	6.2	Slightly acidic	Phosphorus (mg/kg)	18.06	Medium	Boron (ppm)	0.56	Low
Ec (mS/cm)	0.10	Salt free	K (cmolc/kg)	0.82	High	Copper (ppm)	3.14	High
CEC (cmol(+)/kg)	27.4	High	Sulphate-s (ppm)	14.64	Sufficient	Zinc (ppm)	1.29	High
Organic carbon (%)	2.69	High	Ca (cmolc/kg)	9.38	Very high	Manganese (ppm)	37.36	High
Total nitrogen (%)	0.18	Low	Mg (cmolc/kg)	7.94	Very high	Iron (ppm)	100.59	High
Nitrate N (ppm)	50.4	Low	Na (cmolc/kg)	0.51	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 10 kg P/ha is recommended, as basal application at planting.
- **Boron:** 0.25kgB/ha is recommended as either basal or foliar application.

<b>Village name:</b>	Msufini	<b>Mpapa2 area, Misufini village</b>						
<b>Latitude</b>	-6.41964							
<b>Longitude</b>	37.52782							
<b>Sampling unit</b>	MSUF_I	<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)	5.30	Strongly acidic	Phosphorus (mg/kg)	2.07	Low	Boron (ppm)	0.36	Low
Ec (mS/cm)	0.08	Salt free	K (cmolc/kg)	0.44	High	Copper (ppm)	7.59	High
CEC (cmol(+)/kg)	29.8	High	Sulphate-s (ppm)	20.3	Sufficient	Zinc (ppm)	2.35	High
Organic carbon (%)	2.96	High	Ca (cmolc/kg)	10.15	Very high	Manganese (ppm)	178.87	High
Total nitrogen (%)	0.25	Medium	Mg (cmolc/kg)	8.79	Very high	Iron (ppm)	409.41	High
Nitrate N (ppm)	46.2	Low	Na (cmolc/kg)	0.47	Medium			

#### Parameters to address in this site:

- **Nitrogen:** 110 kg N/ha is recommended. Apply 50% of N 2 weeks after transplanting and the rest at floral initiation stage.
- **Phosphorus:** 35 kg P/ha is recommended, as basal application at planting.
- **Boron:** 0.25 kg B/ha is recommended, as either basal or foliar application.

## 4. CONCLUSION AND RECOMMENDATION

This study has revealed the following:

- Formal documented fertilizer recommendations for rice are outdated, not area specific and focus on two major nutrients (Nitrogen and Phosphorus). Therefore, these recommendations need to be updated, area specific and expand the coverage to more macro and micro-nutrients. To achieve that, soil testing services and fertilizer trials should be carried out at appropriate time intervals.
- During this study it was observed that the rate of adoption of the fertilizer recommendations is very low, and limited in few areas where there are irrigation schemes. In addition, in areas where fertilizers are used, farmers use higher fertilizer rates than the recommended rates such as 120 kg N ha<sup>-1</sup> in Mkindo and Dakawa irrigation schemes. In the rest of areas, farmers do not use any fertilizers and are not aware of the fertilizer recommendations in their areas. Rice production without use of fertilizers results in greater nutrient mining. Preliminarily we suggest interventions to educate these farmers on the importance of replenishing the nutrients. We also suggest fertilizer trials to consider other than N and P.
- This study also revealed that some rice farming practices such as burning of crop residues, deep tillage in shallow surface soils that bring up a less fertile subsurface horizon, lack of water control techniques and nutrient mining due to non-use of fertilizer lead to depletion of soil fertility in the rice producing areas.
- There is a spatial variation in soil properties which have influence on their productivity and management. The following conclusion and recommendation are made on the studied soil properties:
  - It was noted that texture and drainage varied from the upper slopes to the lower slopes, with lower slopes having better properties for rice production. The determined soil texture range from sandy loam to clayey, which are not limiting rice production. However due to cyclic depositions of fluvial materials and tillage of shallow surface soils underlying sandy subsurface soils, the soil textures may change with time.
  - The CEC values in both Kilombero and Wami valleys range from low to high with most of the areas having medium to high values. Therefore most of the areas can hold the nutrient cations and make them available to the crops both under rain fed and irrigation. Proper crop residue management and use of organic fertilizers are recommended to improve CEC in areas where the values are low.

- The pH values for Kilombero area are all acidic. Except for parts which have extreme to very strongly acidic conditions (pH of 4.3 – 5). Most of the areas have pH values which do not directly interfere with rice productivity. Lime requirements and exchangeable acidity studies are recommended in order to be able to establish the amount of lime to be applied to raise the soil pH to around 6.0. The pH values for Wami range from strong acid to mildly alkaline. These pH values are suitable for rice production. Care should be taken not to lower them through improper use of acidifying fertilizers.
- The electrical conductivities which is a measure of soil salinity, was found to be optimum in both Kilombero and Wami valleys, indicating no salt problems in the studied soils. The exchangeable sodium percent (ESP) for all studied Kilombero soils were rated optimum. The same was observed in Wami soils except in Hembeti where the ESP was high suggesting the possibility of reducing rice yields due to high sodium content. Leaching by fresh water can help to reduce the values of exchangeable sodium.
- Soil organic carbon in Kilombero was found to range from low to high, with medium to high dominating. In Wami, the soil OC is mostly low. The efforts to increase soil OC should be emphasized by proper crop residue management (such as non-burning) and use of farm yard manure where applicable.
- Total N in Kilombero is generally medium while in Wami it is generally low. The nitrate N is low in both Kilombero and Wami soils. Application of N fertilizers is unavoidable in the process of improving rice productivity in these areas.
- The available P levels are generally medium to high in Kilombero soils and low in a small area. P fertilizers, especially those which are favored in acidic soils are recommended in Kilombero because the soils are acidic. In Wami the P levels are generally low in most parts of the area. P fertilizers are therefore recommended.
- Exchangeable K levels are low in some areas in Kilombero necessitating K fertilization. Most parts of Kilombero and all of Wami areas have adequate K.
- Exchangeable Ca levels are low in some parts of Kilombero valley. Liming is recommended for these soils to supply Ca and also increase soil pH. Some parts of Kilombero and all of Wami have adequate soil Ca levels
- Deficiency of exchangeable Mg is observed in about 50% of the studied Kilombero soils but none in Wami. Mg supplement is recommended in deficient areas.
- Soil sulfur levels are sufficient in most of Kilombero and Wami areas. A few areas show deficiency and therefore need sulfur containing fertilizers.
- The soil copper levels are adequate in most of Kilombero and all of Wami studied soils. Cu-containing foliar fertilizer application can be done to address the deficiency during cropping season.

- Manganese and iron levels are high in both the Kilombero and Wami studied soils. The toxicity levels are unlikely due to the ranges observed. However plant test need to be done to confirm this.
- Zinc deficiency is widely spread in Wami. Some few areas of Kilombero also have Zn deficiency. Zinc fertilization is recommended
- Most of the areas of Kilombero have adequate levels of boron (B). Few areas have low B and a small portion have values that can be toxic to rice. Liming can be done to reduce B toxicity by reducing its availability. In Wami areas, about 50% of the studied soils have low boron levels. Fertilizer programs to supplement boron are recommended.

As a general recommendation for type and amount of fertilizer to be applied, fertilizer trials need to be conducted in both Kilombero and Wami areas.

## 5. THE WAY FORWARD

In this report we have put site specific recommendations for fertilizer application to supplement N, P, K, S, Zn and B. These recommendations were based on site specific soil test results and documented rice nutrient removal. However, we strongly recommend further research on the following findings of the study:

### **Tillage**

Some of the soils in Kilombero valley have very shallow, (10-15 cm) relatively nutrient-rich surface soils overlying, coarse textured nutrient-low subsurface layers. Tillage to the subsurface brings up the relatively infertile soil to the surface, in turn lowering the fertility of the surface soil.

*Recommended further studies/researches*

- Further research on the extent and effect of this problem and its solutions is suggested

### **Water management**

This study revealed that except for a few irrigation schemes where soil bunds are used, the major part of Kilombero and Wami valleys produce low land rice without water control.

*Recommended further studies/researches*

- Better ways on educating the farmers on the importance of water management in rice production, need to be found and practiced.
- Researches on ways to reduce water seepage on relatively coarse textured/high infiltration soils are required, especially in the upper slopes of Kilombero valley and areas closer to the rivers.

### **Soil pH**

Soil pH in Kilombero valley varies from extremely acidic (4.3) to strongly acidic (5.5). Soils with pH below 5.5 require liming in order to raise the pH to between 5.5 and 6.0 which are favorable for lowland rice production. Kilombero soils which require liming includes all studied sites except Mpande (Lukologo village), Mbingu area (Mbingu village), Kanyenje shule (Kanyenja village), Mtakuja (Ngalimila village) and Miembeni area in Miembeni village.

Soil pH in Wami valley varies from strongly acidic (5.5) to mildly alkaline (7.3). Soils of Wami which require liming due to having pH of less than 5.5 include, Mkindo irrigation scheme (Mkindo village), Dihombo (Dihombo village), Hembeti (Hembeti village) and Misufini (Misufini village). Alkaline soils are not favorable for rice production. Soils which require a reduction of

pH to favor rice production in Wami are from the mid of Block 21 and towards the end of Block 14 in Dakawa irrigation schemes and soils from Kidunda A, in Luhindo village.

#### *Recommended further studies/researches*

- Investigation to determine lime requirement and exchangeable acidity is required to deduce, the exact amount of lime to apply to adjust the pH to be between 5.5 and 6.0 for the soils with pH below 5.5.
- Further research will also be required to test the effectiveness of locally available liming materials, time required before next lime application, effect of the liming materials on other nutrient availability, and the economic analysis of lime use under small scale farming.
- For areas with alkaline pH, we recommend to test for free carbonates so as to come up with a proper management strategy for the high soil pH. Further research is recommended to come up with relevant acidifying materials in terms of their effectiveness, their effects on changes of soil properties and nutrient availability and the economic analysis of soil acidification for rice production.

#### **Soil macronutrients (N, P, K and S)**

The study revealed low available Nitrogen in all sites of Kilombero and Wami. This indicates that application of high N rates may be needed in these soils

The study revealed low available P in Merera and Miembeni sites in Kilombero valley. Most of the sites in Kilombero have medium to high P available. In Wami valley the available P values are low in most sites except in Blocks 14 and 21 of the Dakawa irrigation scheme, Hembeti, Dihombo, Mpapa, Makutule and Mkindo Irrigation scheme which are medium and parts of Dihombo and Hembeti villages which have high P available.

In this study, K deficient soils in Kilombero valley are Miembeni, Mtakuja and Titu (Kalengakelu village), Chita village, Kiwalani and Irungusha (Ikule village), Mbasa, Mdibule, and Mpande (Lukolongo village), All sites in Njage village except King'ulung'ulu and Kinjula, Chisano village, Mgudeni, Kanyenje, and Msalise (Mang'ula). These K deficient soils constitute about 39% of all Kilombero soils studied, and about 30% of the remaining sites in Kilombero have medium exchangeable K. The medium exchangeable K may soon be deficient if K problem is not addressed. About 31% of the soils in Kilombero have high exchangeable K. In Wami soils, all sites studied have high K values except in Mkindo irrigation scheme, some parts of Mgongolwa, Dihombo and Dehere which have medium values.

The Kilombero soils deficient in S are in Kanyenje village (Mang'ula), Miwangani village, Chiwachiwa and Nyakadete (Mbingu village), Mnadani (Mofu village), Makangagani and Mkongomtali (Njage village), Chisano village, Chita village, Kitete (Miembeni village), Ngalmila village and Kifungwa (Mpanga village). In Wami, S is sufficient in all sites except in Mgongola, Dehere, middle of Block 21 and the whole of Block 20 at Dakawa irrigation scheme.

### *Recommended further studies/researches*

- The low available N in all sites studied indicates that high N rates may be needed in these soils. However, the response of high N rates needs further investigation along with other macro nutrients (P, K, and S) to determine nutrient balance. Nitrogen uptake/use efficiency is affected by the interactions with other nutrients (P and S) and therefore new higher N rates need to be tested in different combinations with P and S
- Research to investigate effects of water management on N dynamics from different N fertilizer types is also recommended, in order to maximize N utilization by rice under flooded conditions
- P fertilizer trials to test higher P rates and their respective economic returns are required, especially in Wami basin. The P fertilizer trials, just like N response trials needs to be conducted in the balanced fertilization context.
- Among the macronutrients, K requires more research attention than N and P. This is because soil K which was previously considered sufficient in most tropical soils, its deficiency is now becoming widespread in rice growing areas. Therefore, K response trials need to be conducted to test the adequate and economical rate of K to be applied in the context of balanced fertilization
- Preliminary trials in Dakawa irrigation scheme are showing response with K fertilization despite these sites being rated as having high K values by soil testing. These sites are dominated by heavy clay soils which can fix K and reduce its availability to the plants. Therefore, K fertilizer trials are also needed because the extent of K availability in these heavy clay soils is not known.
- Sulfur response trials need to be conducted, in order to test its adequate and economical rate of application in the context of balanced fertilization.

### **Micronutrients**

All sites of Kilombero and Wami have adequate to high levels of manganese, iron and copper.

The study revealed Zn deficiencies in both Kilombero and Wami valleys. About 26% of Kilombero soils studied are Zn deficient. These include Ipopoo-kitete (Miembeni village), Ipugasa (Ngalimila village), Makilika, Mtakuja, Titu and Uuga (Kalengakelu village), Merera, Merera Darajani (Merera village), Irungusha (Ikule village), Mgudeni and Kidete (Mkangawalo village), Isago (Mngeta village), Mipingoni (Miwangani village) and Kanyenje village in Mangula. In Wami, about 70% of soils are Zn deficient. These include soils from Mkindo, Mgongola, Dihombo, Hembeti, Dehere, Mbuyuni, all soils from Dakawa irrigation scheme, Kidunda A and B, Mtakuja (Luhindo), Luhindo, Lumanda, Makutule, Subiria, and Mgegani (Milama).

Boron deficiencies were found in some parts of Kilombero and Wami valleys. Boron deficient sites in Kilombero include Mafisa (Utengule village), Mtakuja, Titu and Uuga, (Kalengakelu village), Mgudeni (Mkangawalo village), Nakaguru (Mchombe village), Kinjura (Njage village). In

Chisano village, B level in soil was high, and may be toxic. Boron deficient areas in Wami are Block 14 of Dakawa irrigation scheme, Mtakuja in Luhindo village, Luhindo valley and Misufini village

*Recommended further studies/researches*

- Manganese levels greater than 150 ppm may be toxic. Plant analysis is recommended to check if the high levels of Manganese in soils of Ihumwa, Mafisa, Kikove and Kifungwa of Kilombero valley and those of Mkindo irrigation scheme and Dihombo in Wami valley are toxic for rice. This will help to get recommendations for Mn appropriate management.
- Plant tissue analysis is recommended to test if the high B levels in Chisano village are toxic for rice. The results can assist in recommendations of appropriate management.
- Fertilizer trials to test the rates of Zn and B are recommended in the context of balanced fertilization.

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# ANNEXES

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

### A. Current Rice 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 (grazing, burning, ploughed in, making soil bunds, etc.)			
Land cultivation: Using hand hoe/tractor/power tillers)			
Puddling (kuchabanga)			
<i>II. Planting/Sowing method</i>			
Broadcast (amount of seeds per area			
Planting in rows (line spacing)			
Direct seeding vs. transplanting			
Rice varieties planted			
<i>III. Soil water management</i>			
How is water controlled? (e.g. With majaruba/or any other means			
Is rice irrigated or rain-fed?			
Runoff management			
<i>IV. Weeds management</i>			
Herbicides used (Yes/No)			
Type of herbicides used			
Use of hand hoes			
Time of weeding	<i>(refer stage of crops or weed population density and growth stage or days/week after planting)</i>		
<i>V. Crop protection</i>			
Major weeds problem			
Major insects pest and how they are controlled			
Major rice diseases and how they are managed			
Birds and how they are managed			
<i>VI. Harvesting and post harvesting</i>			
How is rice harvested?			
How is threshing done?			
How is rice dried and for how long (how do they decide on seed moisture content?)			
How is the crop transported from the field to storage/homes/market			
Post-harvesting processing and grading			

## 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 rice 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 RICE FARMING PRACTICES IN KILOMBERO

Rice farming practices	Village
<i>A. Land preparation</i>	
Slashing and burning	All villages surveyed
Residue incorporation	Non
Roundup spray	Mlimba, Mchombe, Mang'ula, Dakawa
Residue for earth bunds	Njage and Mkindo irrigation schemes
<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. Puddling</i>	
Hand hoes	Njage, Mkindo, Dakawa irrigation scheme, Dehere
Power tillers	In irrigation schemes
<i>D. Soil fertility Management</i>	
Use of N fertilizers	Dakawa, Mkindo irrigation scheme
Use of P fertilizers	Dakawa, Mkindo
Use of Manure	Dakawa irrigation scheme
Nonuse of fertilizers	Most of farmers in all villages
<i>E. Seed selection</i>	
<b>Local seeds:</b>	
Super	All
India	All
Kisegesy	Ngalimila
Mbwawa mbili	All
Zambia	All
<b>Improved seeds:</b>	
SARO TXD 306	Njage, Mkindo and Dakawa irrigation schemes, a few farmers broadcast this type of seed in their Mbuga fields in Mlimba, Mngeta and Mang'ula.
IR series	Njage, Mkindo and Dakawa irrigation schemes, a few farmers broadcast this type of seed in their Mbuga fields in Mlimba, Mngeta and Mang'ula.
<i>F. Planting practices:</i>	
Broadcasting	All
Direct seeding (in rows)	Non
Transplanting (in rows at recommended spacing)	Njage, Mkindo, Dehere
Transplanting randomly	Njage, Lumanda, Dehere
<i>G. Weeding</i>	
<b>Herbicide use</b>	
2, 4 D	All villages
Roundup	Pre-planting in all villages, post-planting mixed with 2, 4 D in Mang'ula, Mlimba and some parts of Mngeta.
Hand pulling	All villages

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