



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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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

Tanzanian economy is dominated by smallholder agriculture accounting for more than 90% of rural employment with food crop production dominating the agriculture economy. Rice is the second most important cereal crop in Tanzania after maize and the majority of rice farmers depend on it both for food and cash (Bucheyeki et al., 2011; RLDC, 2011). Tanzania rank second as a largest producer of rice in Southern Africa after Madagascar with production level of 818,000 tons produced from 681,000 ha (USDA world rice statistics, 2007).

Like in other food crop production, most of the rice production in Tanzania is undertaken by small scale farming. Small scale rice farming is characterized by many small holder farmers, cultivating small farms (0.5 to 10 acres), whereby rain fed accounts for 71% and traditional irrigation accounts for 29% of rice grown in Tanzania (RLDC, 2011). These small scale farmers use no or low inputs.

The major constraints facing the rice production sector includes erratic weather condition and declining land productivity due to application of poor technology, inaccessibility of improved seeds, 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⁻¹. These yields are lower than yield in the developed countries which hikes to over 10 t ha⁻¹ in some seasons (Bucheyeki et al., 2011).

To increase rice productivity under small scale farming, identification of gaps between what is recommended for adequate rice production and what is practiced by small scale farmers is required.

Most of the current recommendations in soil fertility management in rice fields are blanket. This is not helpful in extension services because as matter of fact, soils are variable and need different packages for their improvements in order to intensify rice production. Therefore, a survey at a somehow detailed scale is important to have area specific recommendations.

This report therefore presents:

- a) Review of current fertilizer and soil management recommendations for rice in the study area;
- b) Current rice farming practices and their effect on soil fertility depletion in the study area; and
- c) Site specific soil fertility status and recommendation of measures to be taken in order to improve rice productivity.

2. MATERIALS AND METHODS

2.1 DESCRIPTION OF THE STUDY AREA

This study was conducted in rice farming valleys of Kilombero and Wami-Dakawa in Morogoro region (Fig 1).

Most part of the Kilombero district lies along the Kilombero valley which is part of Rufiji Basin. Kilombero valley extends from east to southwest from below the Udzungwa Mountain. The climate of Kilombero is considered tropical sub humid, with annual rainfall between 1200 to 1400 mm falling between Dec and June. The valley has a bimodal rainfall, short rains fall in November to January and long rains start in March to June (URT, 2008). The annual average temperature in Kilombero ranges between 26°C and 32°C in November.

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 and 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 check list with questions regarding the fertilizer recommendations currently used for rice production and soil management practices. Review of various publications on fertilizer recommendations was also consulted.

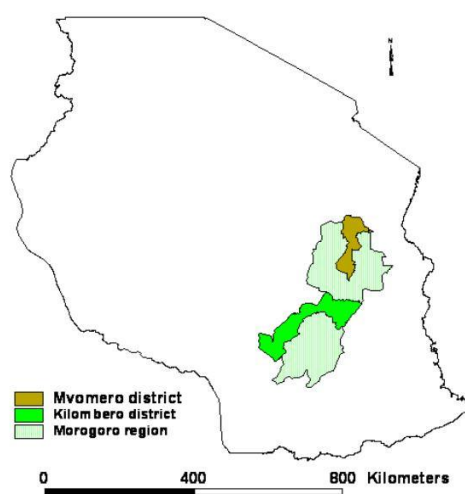


Figure 1: Location of Kilombero and Mvomero Districts in Tanzania

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 interview 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 five sites 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 before the field exercise. Mapping units were established in this stage and later 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 and way points were taken to follow 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 1 kg was taken and put in a sample bag. This was followed by appropriate labeling of the sample.

The samples were transported to SUA soil lab and air dried in the glass house ready for physical and chemical analyses.

2.2.5 Soil laboratory analysis

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

Soil texture was determined by hydrometer method using calgon (5%) as a dispersing agent (NSS, 1990). The soil pH was determined potentiometrically in water at the ratio of 1:2.5 soil-water as described by McLean (1982) while electrical conductivity (EC) was determined by conductivity meter in a 1:2.5 soil-water suspension following a method by Rhoades (1982). Organic carbon was determined by the Walkley and Black wet oxidation method as outlined by Nelson and Sommers (1982). The total nitrogen in the soil samples was determined by Kjeldahl method (Bremner and Mulvaney, 1982) while the available N (Nitrate-N) was determined following a procedure by Okalebo (1993). Available phosphorus was extracted by Bray-I method (Bray and Kurtz, 1945) for soils with pH 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_{soil}) and exchangeable bases were determined by saturating soil with neutral 1M NH₄OAc (ammonium acetate) and the adsorbed NH₄⁺ were displaced using 1M KCl and then determined by Kjeldahl distillation method for the estimation of CEC of the soil. The exchangeable bases (Ca²⁺, Mg²⁺, Na⁺, K⁺) 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 estimation of rate of fertilizer to apply was based on use of high yielding varieties, which are recommended in rice intensification and 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

Nutrient depletion rate studies in Kilombero and Wami valleys are so far not documented. However, other studies by Sanchez et al (1997) and Lynam et al (1998) show that over decades, small-scale farmers have removed large quantities of nutrients from their soils without using sufficient quantities of manure or fertilizer to replenish the soil. 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 fertilizers use in Tanzania was introduced in 1956 by the British American Tobacco Company (BAT) and limited to cash crops: tobacco, coffee and cotton in Northern and Lake Zones. The use of such fertilizers in food crops did not start until 1980s, which was introduced through the Kilimo/FAO Fertilizer program. The first fertilizer recommendations in Tanzania were those by Samki and Harrop (1984), which were released after the Kilimo/FAO fertilizer program in Tanzania. The currently available fertilizer recommendations in Tanzania were released in 1993 (Mowo et al., 1993), after review of recommendations by Samki and Harrop (1984). 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

The fertilizer recommendation for rice in Kilombero based on the Kilimo/FAO project trials in three sites in Kilombero district (Ifakara-Lumemo, Ifakara Secondary school, and Ifakara TAC). According to Mkangwa (1984), the fertilizer recommendations for Kilombero valley in areas with light-textured soils is 60 kg N ha⁻¹ and 25kg P ha⁻¹ while in heavy clay soils is 60 to 90 kg N ha⁻¹ and 20 kg P ha⁻¹.

The fertilizer recommendations for rice in light-textured soils of Wami valley were 120 kg N ha⁻¹ and 10 kg P ha⁻¹ (Mkangwa, 1993). These recommendations were based on fertilizer trials conducted at Dakawa.

However, taking into consideration the economics of fertilizer use, the fertilizer recommendations was revised to blanket rate of 40 kg N ha⁻¹ and 10 kg P ha⁻¹ 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). Low rate of P in these recommendations was due to lack of rice response to P, hence low amount of P was recommended to replenish the P removal by crops.

In 1997, Scalgia made new recommendations for rice production in Kilombero and Wami valley where 60 kg N ha⁻¹ (equivalent to 1 bag urea per acre) and 0 kg P ha⁻¹ was recommended. This fertilizer recommendations of 60 kg N ha⁻¹ 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 only in extension services in all these areas. More emphasis on N fertilizer was partly because of lack of consistent response of P fertilizer in rice in trials and demonstration plots at that time (Scalgia, 1997). Thus it was recommended that P fertilizers need has to be determined for specific areas before application.

From this study, it is evident that the available fertilizer recommendations are too old and too generalized, hence need to be reviewed due to changes of farming practices, rice varieties used, and duration of cultivation in order to achieve rice intensification. The review of these formal recommendations is inevitable as the deficiencies of additional nutrients other than N and P are likely to be observed, and hence response to fertilizers with those nutrients will be expected.

During this study it was also 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⁻¹ 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.

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 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 down slopes. 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. The earth bunds not only harvest rainwater and increase soil moisture retention, but also help to retain fertilizers applied in the field and shield from being washed away by floods or runoff. With respect to tillage, a case study by Scalgia (1997) demonstrated that cultivation by tractors enhance more paddy rice yields than hand hoe. However, we think this can be true only for soils with relatively deep surface soils in Kilombero. Observations in Kilombero show that disc plough are responsible for bringing up relatively nutrient-poor sub surface soils and mix 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 time 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 by 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 easily leaks through the deep sandy soil layer.

Information on rice yield decline over time in Kilombero and Wami valleys are not documented. However, due to continuous opening up of new fields and shifting to new lands from upper slopes to downslopes, the decline might not be that obvious. A document 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.

Under the current rice area expansion practices, forecasting the future situation in the Kilombero and Wami valleys, rice cultivation may not be sustainable. This is because paddy fields have already reached the floodplains of the Kilombero and Wami Rivers and there is no or little additional land suitable for rice cultivation. Moreover, 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 land by slashing using nyengo, followed by burning residues biomass either after piling them on some spots or after spreading them on the farm area. Of recently (about 2 years ago) farmers started using pre-planting herbicide (roundup) before burning and cultivation. In 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 interfere with nutrient re-cycling for sustainable production.

3.2.2 Tillage practices

Tillage is done by using hand hoes, power tillers, oxen ploughs, and tractors. Cultivation by tractor ploughs the soil deeper than oxen plough and hand hoe. In most of the valleys in Mlimba area, some areas of Mang'ula, some parts of Mngeta, Mofu, and Mbingu, the top soils are shallow, 10-15-cm deep or less, 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 lower 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

Small scale 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 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 few days if rainfall frequencies is low even if receive heavy rainfall per storm. In other areas with heavy clays example in some parts of Dakawa (Luhindo, Vidunda A and B, Lumanda, Mpapa, and Makutule-Milama) water stands in the fields for longer time, but rice suffer more from water stress due to tendency of heavy clays to hold water strongly such that water 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 washing away of dissolved nutrients from applied fertilizers which will reduce response of fertilizers. Also lack of water control will contribute to nutrient losses from 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, and thus reducing risks of crop failure and preserve 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 includes *mbawa mbili*, Zambia, India, *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 are more adapted to their environment than the improved varieties. However, most of these local varieties are late maturing, and low yielding than the improved ones. Most of the high yielding improved varieties have high nutrient demand than the local varieties. The use of these improved varieties without application of fertilizers will further contribute to depletion of nutrients other than N and P.

Most farmers in both Kilombero and Wami valleys plant rice by broadcasting at varied seed rate ranging from 16 kg/acre to 48 kg/acre. Farmers broadcast rice at the seed rate of about 16 kg/acre if use ox- plough, or about 20 kg/acre if use tractor. Planting rice by broadcasting is most common 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 but aerated conditions to germinate. Broadcasting is done either by hand, or using locally designed planting-tillage or - harrowing in single operation using tractors or oxen plough. 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 planting spacing is 20 x 20 cm single rows, or 10 x 10 x 20 cm double rows, either by transplanting of seedlings or direct seeding. Rice seedlings for transplanting have to be young about 14 days after planting for effective growth and maximum tillering. If direct seeding, 2 to 3 seeds per hole are planted and have to be thinned to one seedling per hole after germination.

Transplanting of rice seedlings is practiced in areas with greater supply of water either under irrigation schemes in Njage village in Kilombero, and Mkindo, Dakawa, and Dihombo in Wami basin or in lowland wet areas of the valley like 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, 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 weeds problems in rice are 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 productions includes 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 weeds pressure 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 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, weed is still a major problem, sometimes forcing farmers to abandon the fields.

The major challenges in chemical weed control are inappropriate handling and use of herbicides. Availability of clean water for mixing of herbicides, timing of spraying, and sometimes rate 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 affect growth of rice, as it results in uniform yellowing of rice plants, and it is violation of judicious herbicide use, and hence un-sustainability of rice production. According to farmers, although post emergency spraying of low rates of roundup on rice reduces labor time for hand pulling grasses, it increases unfilled grains, hence reduced rice yields. The insect pests are control by insecticides, except for the Coleoptera, which spread RYMV; its control is difficult. Therefore to control RYMV delay planting to avoid onset of the vector and the disease is recommended. 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 severely affect rice yield. Therefore, crop protection has to be integrated in soil fertility management to increase rice yield.

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

Soil physical and chemical analysis 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 portion 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.

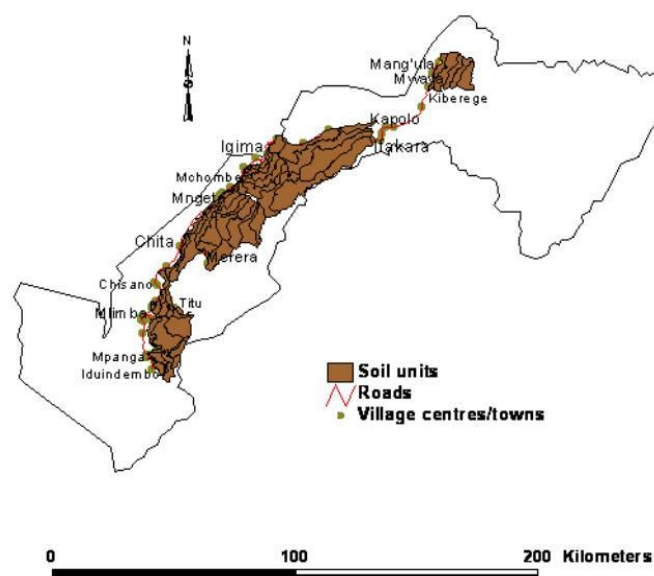


Figure 2: Location of sampling units in Kilombero District

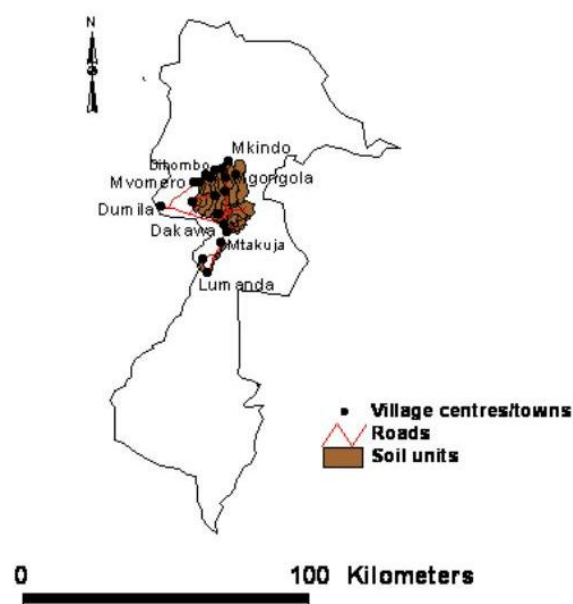


Figure 3: Location of sampling units in Mvomero District

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, and showing clear stratifications as result of cyclic deposition of alluvial materials while those in Wami have relatively deeper surface horizons which do not differ significantly in physical properties with their subsoil.

The soil colors in Kilombero varied mostly with the tillage depth. The dark and brownish color of the surface soils were observed in soils which have relatively deep surface horizons or those on which deep ploughing has not been practiced. Shallow soils where deep ploughing has been practiced showed light colors as a result of mixing up of surface and subsurface horizons. 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%. Position on slope was an important factor in deciding on the homogeneity of the sampling points. This is because, in these valleys soil texture, drainage pattern and land use were influenced by their position on slope. As mentioned earlier, soil texture varied with slope position. This is due to deposition where by coarser materials are deposited in the upper slopes and finer materials are deposited in the lower slopes. Likewise, water moves faster in the upper slopes and slows as it goes towards the lower slopes thus affecting drainage pattern.

In most parts of Kilombero and Dakawa valleys, differences in duration of the land use for rice production also follow 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 was diminishing after continuous use, these farms were abandoned or turned to upland 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.

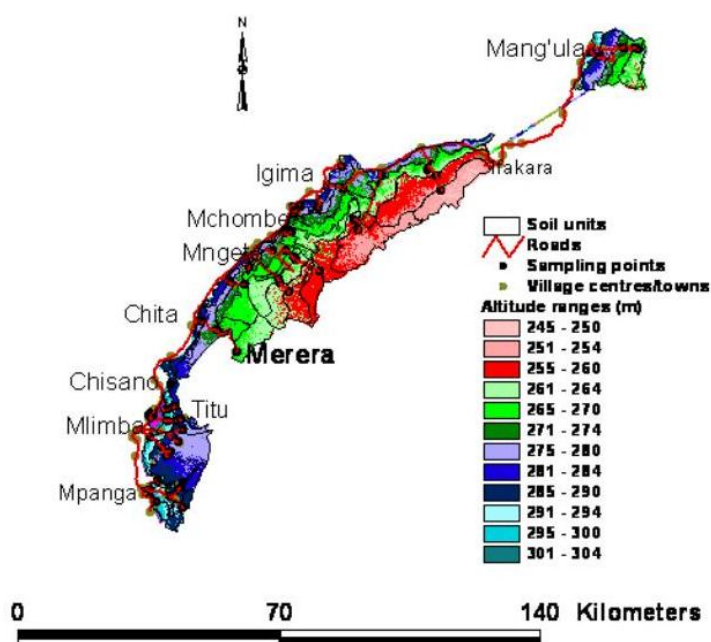


Figure 4: Position of Kilombero sampling units in relation to altitude ranges

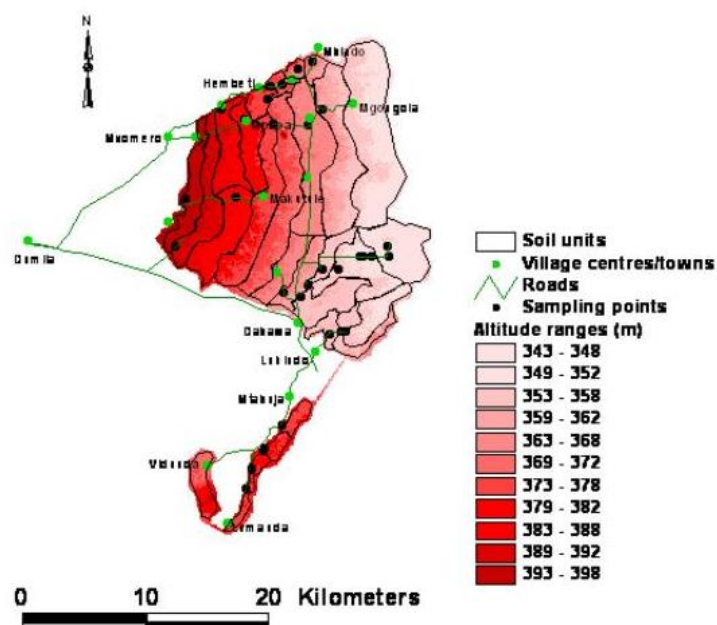


Figure 5: Position of Wami sampling units in relation to altitude ranges

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

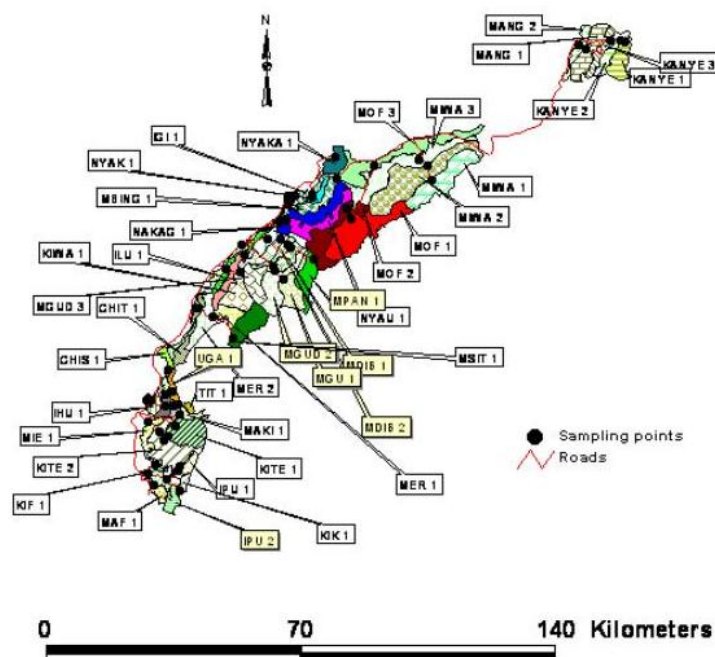


Figure 6: Sampling areas and points in Kilombero valley

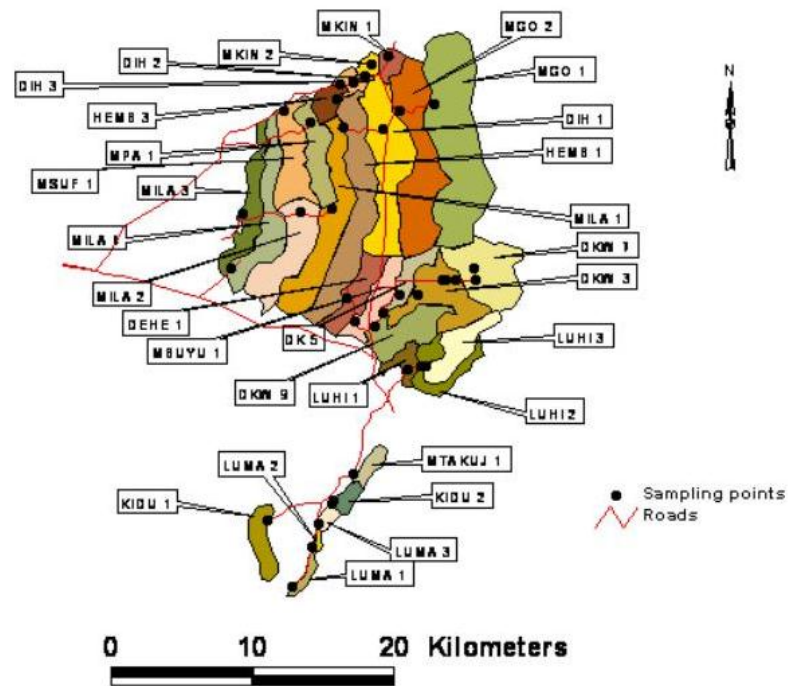


Figure 7: Sampling areas and points in Wami Valley

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

Village name:	Mpanga	Kifungwa area, Mpanga village						
Latitude	-8.92917							
Longitude	35.83654							
Sampling unit	KIF_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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 CaCO₃ 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.

Village name:	Mpanga	Mfiliga area, Mpanga village						
Latitude	-8.90734							
Longitude	35.85331							
Sampling unit	MFI_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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 CaCO₃ 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

Village name:	Mwembeni	Ipopoo area, Miembeni village						
Latitude	-8.83718							
Longitude	35.88480							
Sampling unit	KITE_3	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mwembeni	Kitete area, Mwembeni village						
Latitude	-8.82626							
Longitude	35.86425							
Sampling unit	KITE_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mlimba A	Kitete area, Mlimba A village						
Latitude	-8.81269							
Longitude	35.90201							
Sampling unit	KITE_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mwembeni	Miembeni, Miembeni village						
Latitude	-8.80104							
Longitude	35.83558							
Sampling unit	MIE_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Ngalimila	Kikove area, Ngalimila village						
Latitude	-8.97283							
Longitude	35.91496							
Sampling unit	KIK_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Utengule	Mafisa area, Utengule village						
Latitude	-8.95768							
Longitude	35.84980							
Sampling unit	MAF_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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

Village name:	Ngalimila	<i>Ipugasa area, Ngalimila village</i>						
Latitude	-8.92304							
Longitude	35.90882							
Sampling unit	IPU_I	<i>Clay</i>						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Ngalimila	<i>Ipugasa2 area, Ngalimila village</i>						
Latitude	-8.91012							
Longitude	35.91321							
Sampling unit	IPU_2	<i>Clay</i>						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Ngalimila	Hiari ya Moyo area, Ngalimila village						
Latitude	-8.94343							
Longitude	35.88071							
Sampling unit	HIA_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Ihumwa area, Kalengakelu village						
Latitude	-8.74772							
Longitude	35.84304							
Sampling unit	IHU_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Kikolokoto area, Kalengakelu village						
Latitude	-8.73569							
Longitude	35.87793							
Sampling unit	KIKO_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Makilika area, Kalengakelu village						
Latitude	-8.78347							
Longitude	35.91466							
Sampling unit	MAKI_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Mtakuja area, Kalengakelu village						
Latitude	-8.76128							
Longitude	35.8994							
Sampling unit	MTA_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Mtakuja2 area, Kalengakelu village						
Latitude	-8.76258							
Longitude	35.87862							
Sampling unit	MTA_2	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Titu area, Kalengakelu village						
Latitude	-8.75911							
Longitude	35.90876							
Sampling unit	TIT_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Uuga area, Kalengakelu village						
Latitude	-8.72703							
Longitude	35.89565							
Sampling unit	UGA_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kalengakelu	Yeriko area, Kalengakelu village						
Latitude	-8.74767							
Longitude	35.83251							
Sampling unit	YER_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Jaribu	Kichangani area, Jaribu village						
Latitude	-8.84886							
Longitude	35.87614							
Sampling unit	KICH_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Chisano	Chisano area, Chisano village						
Latitude	-8.67225							
Longitude	35.88488							
Sampling unit	CHIS_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Merera	Msita area, Merera village						
Latitude	-8.59408							
Longitude	36.04648							
Sampling unit	MSIT_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Merera	Merera area, Merera village						
Latitude	-8.54413							
Longitude	35.99470							
Sampling unit	MER_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Chita	Darajani area, Chita village						
Latitude	-8.54414							
Longitude	35.99468							
Sampling unit	MER_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Chita	Chita area, Chita village						
Latitude	-8.52054							
Longitude	35.96006							
Sampling unit	CHIT_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Chita	Chita2 area, Chita village						
Latitude	-8.52160							
Longitude	35.95342							
Sampling unit	CHIT_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Ikule	Kiwalani area, Ikule village						
Latitude	-8.43381							
Longitude	36.06135							
Sampling unit	KIWA_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Ikule	Irungusha area, Ikule village						
Latitude	-8.42449							
Longitude	36.02816							
Sampling unit	ILU_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkangawalo	Mlimani Paki area, Mkangawalo village						
Latitude	-8.38807							
Longitude	36.07231							
Sampling unit	MLIM_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkangawalo	Mgudeni area, Mkangawalo village						
Latitude	-8.41657							
Longitude	36.14323							
Sampling unit	MGUD_3	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkangawalo	Mgudeni2 area, Mkangawalo village						
Latitude	-8.42846							
Longitude	36.14930							
Sampling unit	MGUD_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkangawalo	Mgudeni3 area, Mkangawalo village						
Latitude	-8.45012							
Longitude	36.16849							
Sampling unit	MGU_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkangawalo	Kidete area, Mkangawalo village						
Latitude	-8.36573							
Longitude	36.06660							
Sampling unit	KIDE_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mngeta	Isago area, Mngeta village						
Latitude	-8.35130							
Longitude	36.13032							
Sampling unit	ISAG_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Lukolongo	Mpande area, Lukolongo village						
Latitude	-8.40162							
Longitude	36.24326							
Sampling unit	MPAN_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Lukolongo	Mdibule area, Lukolongo village						
Latitude	-8.36624							
Longitude	36.17824							
Sampling unit	MDIB_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Lukolongo	Mdibule2 area, Lukolongo village						
Latitude	-8.37334							
Longitude	36.18868							
Sampling unit	MDIB_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Lukolongo	Mbasa area, Lukolongo village						
Latitude	-8.35051							
Longitude	36.16039							
Sampling unit	MBAS_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mchombe	Nyaudidi area, Mchombe village						
Latitude	-8.30364							
Longitude	36.17594							
Sampling unit	NYAU_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mchombe	Nakaguru area, Mchombe village						
Latitude	-8.30939							
Longitude	36.15807							
Sampling unit	NAKAG_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	Njage irrigation scheme, Njage village						
Latitude	-8.24338							
Longitude	36.17992							
Sampling unit	NJAG_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	Makangagani area, Njage village						
Latitude	-8.25565							
Longitude	36.18557							
Sampling unit	MAKA_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	King'ulung'ulu area, Njage village						
Latitude	-8.26290							
Longitude	36.18451							
Sampling unit	KING_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	Mkongomtale area, Njage village						
Latitude	-8.24571							
Longitude	36.19587							
Sampling unit	MKON_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	Makangagani2 area, Njage village						
Latitude	-8.25533							
Longitude	36.18145							
Sampling unit	MAKA_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Njage	Kinjura area, Njage village						
Latitude	-8.24436							
Longitude	36.19256							
Sampling unit	KINJ_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Igima	Nyakidete area, Igima village						
Latitude	-8.24750							
Longitude	36.24141							
Sampling unit	NYAK_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Igima	Igima area, Igima village						
Latitude	-8.24196							
Longitude	36.24178							
Sampling unit	IGI_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mbingu	Chiwachiwa area, Mbingu village						
Latitude	-8.14826							
Longitude	36.29556							
Sampling unit	NYAKA_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mbingu	Mbingu area, Mbingu village						
Latitude	-8.20002							
Longitude	36.29897							
Sampling unit	MBING_I	Clay loam						
Soil texture	CL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Miwangeni	Kiwalani area, Miwangani village						
Latitude	-8.15372							
Longitude	36.50256							
Sampling unit	MIWA_3	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Miwangeni	Mipingoni area, Miwangani village						
Latitude	-8.16801							
Longitude	36.52492							
Sampling unit	MIWA_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Miwangeni	Miwangani area, Miwangani village						
Latitude	-8.20372							
Longitude	36.53656							
Sampling unit	MIWA-I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mofu	Kibasila area, Mofu village						
Latitude	-8.16957							
Longitude	36.39228							
Sampling unit	MOF_3	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mofu	Mnadani area, Mofu village						
Latitude	-8.27542							
Longitude	36.32515							
Sampling unit	MOF_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mofu	Mofu area, Mofu village						
Latitude	-8.30260							
Longitude	36.33608							
Sampling unit	MOF_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kanyenja	Kanyenja area, Kanyenja village						
Latitude	-7.86381							
Longitude	37.01160							
Sampling unit	KANYE_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kanyenja	Kanyenja2 area, Kanyenja village						
Latitude	-7.85910							
Longitude	36.99960							
Sampling unit	KANYE_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Kanyenja	Msalise area, Kanyenja village						
Latitude	-7.85958							
Longitude	36.97335							
Sampling unit	KANYE_3	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mang'ula	Mgudeni area, Mang'ula village						
Latitude	-7.87102							
Longitude	36.89559							
Sampling unit	MANG_2	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mang'ula	Mgudeni2 area, Mang'ula village						
Latitude	-7.88256							
Longitude	36.91341							
Sampling unit	MANG_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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

Village name:	Mkindo	Mgongola area, Mkindo village						
Latitude	-6.53494							
Longitude	37.51307							
Sampling unit	MGO_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkindo	Mgongola2 area, Mkindo village						
Latitude	-6.45044							
Longitude	37.56111							
Sampling unit	MGO_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkindo	Mkindo irrigation scheme no. 2, Mkindo village						
Latitude	-6.58761							
Longitude	37.48852							
Sampling unit	MKIN_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Mkindo	Mkindo irrigation scheme no. 1, Mkindo village						
Latitude	-6.56180							
Longitude	37.50027							
Sampling unit	MKIN_2	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dihombo	Dihombo area, Dihombo village						
Latitude	-6.29850							
Longitude	37.54527							
Sampling unit	DIH_I	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dihombo	Dihombo2 area, Dihombo village						
Latitude	-6.26435							
Longitude	37.53392							
Sampling unit	DIH_2	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dihombo	Dihombo3 area, Dihombo village						
Latitude	-6.26940							
Longitude	37.52701							
Sampling unit	DIH_3	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Hembeti	Mpapa area, Hembeti village						
Latitude	-6.40277							
Longitude	37.56724							
Sampling unit	HEMB_I	Sandy Clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Hembeti	Irrigation scheme, Hembeti village						
Latitude	-6.27007							
Longitude	37.51867							
Sampling unit	HEMB_2	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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 ₄ _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.

Village name:	Hembeti	Hembeti area, Hembeti village						
Latitude	-6.39372							
Longitude	37.60427							
Sampling unit	HEMB_3	Sandy clay Loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dehere area, Dakawa village						
Latitude	-6.40455							
Longitude	37.52295							
Sampling unit	DEHE_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Mbuyuni area, Dakawa village						
Latitude	-6.53494							
Longitude	37.51307							
Sampling unit	MBUYU_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Mbuyuni area, Dakawa village						
Latitude	-6.40282							
Longitude	37.55568							
Sampling unit	DK_5	Sandy clay Loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 14						
Latitude	-6.40277							
Longitude	37.56724							
Sampling unit	DKW_4	Sandy clay Loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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 ₄ _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 (FeS₂)] 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.

Village name:	Dakawa	Dakawa irrigation scheme, block 2 I						
Latitude	-6.3933 I							
Longitude	37.59 I 75							
Sampling unit	DKW_I	Sandy clay Loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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 ₄ _S (ppm)	3.3 I	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 (FeS₂)] 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.

Village name:	Dakawa	Dakawa irrigation scheme, block 2I_b						
Latitude	-6.39339							
Longitude	37.58544							
Sampling unit	DKW_2	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 17						
Latitude	-6.39331							
Longitude	37.59175							
Sampling unit	DKW_3	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 25						
Latitude	-6.39372							
Longitude	37.60427							
Sampling unit	DKW_6	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 20						
Latitude	-6.39339							
Longitude	37.58544							
Sampling unit	DKW_7	Sandy Clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 9-I						
Latitude	-6.41479							
Longitude	37.54579							
Sampling unit	DKW_8	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Dakawa	Dakawa irrigation scheme, block 9-I_b						
Latitude	-6.39363							
Longitude	37.58353							
Sampling unit	DKW_9	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Kidunda B area, Luhindo village						
Latitude	-6.38642							
Longitude	37.60351							
Sampling unit	KIDU_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Kidunda A area, Luhindo village						
Latitude	-6.53287							
Longitude	37.51461							
Sampling unit	KIDU_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Kidunda area, Luhindo village						
Latitude	-6.53494							
Longitude	37.51307							
Sampling unit	KIDU_3	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Mtakuja area, Luhindo village						
Latitude	-6.28248							
Longitude	37.57781							
Sampling unit	MTAKUJ_I	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Luhindo area, Luhindo village						
Latitude	-6.42248							
Longitude	37.54069							
Sampling unit	LUHI_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Luhindo2 area, Luhindo village						
Latitude	-6.29755							
Longitude	37.52033							
Sampling unit	LUHI_2	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Luhindo3 area, Luhindo village						
Latitude	-6.27007							
Longitude	37.51867							
Sampling unit	LUHI_3	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Lumanda area, Luhindo village						
Latitude	-6.27966							
Longitude	37.51688							
Sampling unit	LUMA_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Lumanda2 area, Luhindo village						
Latitude	-6.54498							
Longitude	37.47216							
Sampling unit	LUMA_2	Sandy clay loam						
Soil texture	SCL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Luhindo	Lumanda3 area, Luhindo village						
Latitude	-6.53287							
Longitude	37.51461							
Sampling unit	LUMA_3	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Milama	Makutule area, Milama village						
Latitude	-6.44768							
Longitude	37.57331							
Sampling unit	MILA_I	Sandy loam						
Soil texture	SL							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Milama	Makutule2 area, Milama village						
Latitude	-6.44768							
Longitude	37.57331							
Sampling unit	MILA_2	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Milama	Mgegani valley, Milama village						
Latitude	-6.58761							
Longitude	37.48852							
Sampling unit	MILA_3	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Milama	Subiria area, Milama village						
Latitude	-6.44798							
Longitude	37.57014							
Sampling unit	MILA _4	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Msufini	Mpapa area, Misufini village						
Latitude	-6.54728							
Longitude	37.50466							
Sampling unit	MPA_I	Sandy clay						
Soil texture	SC							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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.

Village name:	Msufini	Mpapa2 area, Misufini village						
Latitude	-6.41964							
Longitude	37.52782							
Sampling unit	MSUF_I	Clay						
Soil texture	C							
Parameter	Values	Interpretation	Parameter	Values	Interpretation	Parameter	Values	Interpretation
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⁻¹ 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 are having extremely to very strongly acidic conditions (pH of 4.3 – 5), most of the areas have the pH values which do not directly interfere with rice productivity. Lime requirement 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 are a measure of soil salinity were found to be optimum in both Kilombero and Wami valleys indicating no salt problems in studied soils. The exchangeable sodium percent (ESP) for all studied Kilombero soils are 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 are generally medium while in Wami are 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 part of the area. P fertilizers are therefore recommended.
- Exchangeable K levels are low in some areas in Kilombero necessitating K fertilization. Most part 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 studied Kilombero soils but none in Wami. Mg supplement is recommended in deficient areas.
- Soil sulfur levels are sufficient in most of both 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 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 and a small portion have values that can 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 estimated basing 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 and thus lowers 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 those of 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

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 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 recommended 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 available P. In Wami valley the available P values are low in most sites except in Blocks 14 and 21 of Dakawa irrigation scheme, Hembeti, Dihombo, Mpapa, Makutule, Mkindo Irrigation scheme which are medium and parts of Dihombo and Hembeti villages which have high available P.

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 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 combination 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 to test its adequate and economical rate to be applied 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 soils. 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 and therefore recommend on the 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 I: KEY INFORMANTS FOR REVIEW OF CURRENT FERTILIZER RECOMMENDATIONS AND AGRONOMIC PRACTICES

S/n	Name	Designation	Institution/Village	District
1	Prof. Semoka JMR	Researcher	SUA	
2	Mr. Thomas Kakema	Researcher	Dakawa Agricultural Research Institute	Mvomero
3	Mr. Didas R. Kimaro	Researcher	Dakawa Agricultural Research Institute	Mvomero
4	Mr. G. Mnguu	Extension Staff	Ifakara, DALDO	Kilombero
5	Mr. Mwaisumo	Extension Staff	Mchombe, Kilombero	Kilombero
6	Mr. Kisunjulu	Extension Staff	Mlimba, Kilombero	Kilombero
7	Mr. Swai	Extension Staff	Mkindo, Mvomero	Mvomero
8	Ms Margret	Extension staff	Misufini, Mvomero	Mvomero
9	Miss Neema Mkanga	Extension staff	Mkindo, Mvomero	Mvomero
10	Mr. Ramadhani Rajabu	Farmer	Mkindo, Mvomero	Mvomero
11	Mr. Joseph Chapa	Farmer	Miwangani, Kilombero	Kilombero
12	Mr. Frank Kilumbi	Farmer	Kalengakelu, Kilombero	Kilombero
13	Mr. Krispin Mwaaliga	Farmer	Ngalimila, Kilombero	Kilombero
14	Mh.Ernest Malinanga	Farmer	Mpanga, Kilombero	Kilombero
15	Mr. Maulid Kasonga	Farmer	Ngalimila, Kilombero	Kilombero
16	Mr. Rite	Farmer	Igima, Kilombero	Kilombero
17	Mr. Kazwila	Farmer	Mofu, Kilombero	Kilombero
18	Mr. Ally Msoffe	Farmer	Dakawa, Mvomero	Mvomero
19	Mrs. Mariam Mahono	Farmer	Lumanda, Mvomero	Mvomero
20	Mr. John Ndalul	Farmer	Luhindo, Mvomero	Mvomero
21	Mr. Kessy	Farmer	Dihombo, Mvomero	Mvomero
22	Mr. Musa Hamisi Tinya	Farmer	Milama, Mvomero	Mvomero

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. Farm preparations: How is the land prepared?			
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)			
II. Planting/Sowing method			
Broadcast (amount of seeds per area			
Planting in rows (line spacing)			
Direct seeding vs. transplanting			
Rice varieties planted			
III. Soil water management			
How is water controlled? (e.g. With majaruba/or any other means			
Is rice irrigated or rain-fed?			
Runoff management			
IV. Weeds management			
Herbicides used (Yes/No)			
Type of herbicides used			
Use of hand hoes			
Time of weeding	(refer stage of crops or weed population density and growth stage or days/week after planting)		
V. Crop protection			
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			
VI. Harvesting and post harvesting			
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

Name of District		Name of Village	
Date of survey		Name of Key informant	
<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>			
a) What is the current recommendation rate for N fertilizers:			
Urea (bags/acre (ha)?)			
CAN (bags/acre (ha)?)			
SA (bags/acre (ha)?)			
Manure			
b) What is the current recommendation rate for P fertilizers:			
DAP (46% P ₂ O ₅) _ (bags/acre (ha)?)			
TSP (46% P ₂ O ₅) _ (bags/acre (ha)?)			
Minjingu P (29% P ₂ O ₅) _ (bags/acre (ha)?)			
Minjingu mazao (20% P ₂ O ₅) _ (bags/acre (ha)?)			
c) Other fertilizers (name type of fertilizer and their recommended rates)			
<i>III. Source of fertilizer recommendations</i>			
What is the source of current recommendations rates:			
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
A. Land preparation	
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
B. Tillage	
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
C. Puddling	
Hand hoes	Njage, Mkindo, Dakawa irrigation scheme, Dehere
Power tillers	In irrigation schemes
D. Soil fertility Management	
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
E. Seed selection	
Local seeds:	
Super	All
India	All
Kisegesy	Ngalimila
Mbwawa mbili	All
Zambia	All
Improved seeds:	
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.
F. Planting practices:	
Broadcasting	All
Direct seeding (in rows)	Non
Transplanting (in rows at recommended spacing)	Njage, Mkindo, Dehere
Transplanting randomly	Njage, Lumanda, Dehere
G. Weeding	
Herbicide use	
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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