SOIL PROFILE AND WATER TABLE FLUX OF CHANCHAGA IRRIGATION SCHEME MINNA, NIGER STATE

BY

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PGD/AGRIC ENG/2003/174

DEPARTMENT OF AGRICULTURAL ENGINEERING,

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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SUBMITTED IN PARTIAL FULFILLMENT OF THE

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DEPARTMENT OF AGRICULTURAL ENGINEERING,

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March 2005

CERTIFICATION

This is to certify that this project was carried out by Ogunmakinwa Akinloye Dickson in the Department of Agricultural Engineering, Federal University of Technology, Minna.

_______________________ _______________________

Engr. N. A Egharevba Date

Project Supervisor

_______________________ 4-07-05

Engr. (Dr.) D. Adgidzi Date
H.O.D

DEDICATION

I wish to dedicate this project to the Almighty God and my beloved wife Mrs. Adunola Ogunmakinwa.

ACKNOWLEDGEMENT

I sincerely wish to express my profound gratitude to God Almighty for His enabling grace through the lord Jesus Christ for this academic attainment.

My appreciation also goes to my Project Supervisor. Engr. Dr. N.A. Egharevba who through patience and fatherly support made this work a good success. I thank him for his guidance and valuable time he has committed to make this project a reality.

My deep gratitude is due especially to the Head of Agric Engineering Department, FUT Minna Engr. Dr. D. Adgidzi for the encouragement and good governance display in our time.

In the same vein I thank my course coordinator Dr. Z. D. Osunde and all other lecturers for their encouragement and impartation of knowledge which cannot be quantified.

Thanks to my boss in the department of Dams and Reservoirs Operation, Federal Ministry of Water Resources, Abuja for their propelling encouragement till the end of this programme.

My warm and profound gratitude goes to my beloved wife Mrs. Adunuola Ogunmakinwa who has always been in support of every good step I take, and finally my children Oluwadusin and Oluwatobi for their cooperation throughout the programme.

ABSTRACT

The project is all about the soil profile and water table flux in Chanchaga irrigation scheme, Minna, Niger state. The topographical survey of the project area was conducted, the project site was divided into four different blocks viz: upper slope, middle slope, capillary fringe and valley bottom (Block A,B,C,D). The soil physical properties determined includes bulk density ranges from 1.36 and 1.75 and moisture content ranges from 18.5% and 30.86%. The colour of various soil profile horizons were obtained. The soil texture using hydrometer method was determined and the soil is pre-dominantly sandy clay loamy and sandy loamy and clay. The clay tends to increase as you go down the profile while sandy soil tends to diminish while you go down profile. The chemical properties of the soil which includes Organic matter ranges from 1 to 1.17 and PH values ranges from 4.2 to 5.5. From the readings obtained from the observation well in each block the water table fluctuation is affected by the nature of the soil and the slope of the area under study.

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CHAPTER ONE

1.0 INTRODUCTION

For agricultural development soil-water-plant relation have been the most important factor that determine crop production. The success or failure of a particular cropping system may well depend on the water management programmed. Water must be available in the soil to replenish the lost by evaporation from the soil and transpiration of the crop throughout the season The soil must be able to provide water as it is needed if maximum yield is to be obtained. To increase productivity, the distribution of water within the soil profile and the proportion that retain in the root zone for the plant to utilize appears to be more crucial limitation than the total rainfall.

For any irrigation development and its sustenance, soil properties and water requirement should be determined. Chanchaga is one of the major irrigation schemes in the Niger state. Its was development in 1975 by the state government. The idea was conceived because series of survey and investigation report indicated the suitability of the land for the establishment of an irrigation scheme. Source of water for this scheme is river chanchaga.

The irrigation water is supplied to supplement the water available from rainfall and contribution to soil moisture from ground water. The moisture content of the area is a function of soil properties down the soil profile, holding capacity and water table.

Measurement of water level with the aid of piezometer were used to analyze the ground water with respect to its storage and the water table fluctuation was determined .The direction of flow can be obtained from the water table or Piezometric surface contour maps

Water moves in a soil from one point to another ,if the water at the fist point has higher energy status than the water at the second level. This may be compared to water moving through a pipe from a point of high pressure toward a point of lower pressure , The rapidity of movement depends on the size of the energy difference and on the soil characteristic .

1.1 Research Project Location

The research was conducted at chanchaga irrigation scheme Niger sate, Nigerian. Chanchaga irrigation scheme is located between latitude 9° 34'-9° 37'N and longitude latitude 9° 34'-9° 37'E and situated at chanchaga Village at the out skirt of Minna the capital of

Niger state , the village is about 10 km on Minna –Suleja road .The total field area is 12 ha, The slope of the agricultural field is 2%

1.2 Geology / Parent Material

Niger state is generally underlain by three Principal rock units as follows:

- Crystalline basement complex
- Cretaceous sediments and
- Alluvial deposit

The above rock units have different characteristic and water bearing potentials. About 60 %of Niger state underlain by crystalline basement complex rock and chanchaga irrigation scheme has fallen within this area .Crystalline basement rock have been broadly divided in to three grouped namely;

- Marginalize gneisses
- Quartzite and schist
- Granite rocks

Out of the three group above chanchaga irrigation is characterized by quartzite's and schist secondary processes like deformation, weathering etc has given crystalline basement complex rock some degree of porosity and permeability and can therefore be regarded as aquifer .

Messrs Green Field limited (1995) has identified two main aquifer The two main aquifer unit are .

a) The weathered unconsolidated material or the overburden or the residual soil.

b) Partly weathered and fractured basement, which is normally formed below (a) above.

Viable aquifer unit in the basement complex are found within the fracture basement . Aquifer potential for the weathered unconsolidated material or the overburden depends on its thickness. This implies that ground water occurrences in the basement rock is either in pockets or basin; this depend on type of deformation that might have occurred at that particular site. The geology formation of the scheme has high potential of ground water therefore hole- water could be available here to supplement river water for irrigation

1.3 Topography.

As the topography of the project area is relatively flat, there was little or no land formation in the course of construction of canal network system and hence the adoption of surface system of irrigation water stays long on flat and leveled land ; thus has a longer opportunity time than on sloping land where there is rapidly run off .

1.4 Climatic Condition

The climatic of the project area is essentially the same type of the middle belt of Nigerian with high temperature and humidity during most part of the year. This favours growths of various species of vegetables in chanchaga irrigation scheme in the dry season. But with rainfall ranging between 1047.3 – 1491.7 mm, rice being grown in the raining season always give a high yield in view of its semi – aquatic nature and hence its higher water requirement than most other crops .

The project area lies in the portion of Niger state where normal annual rainfall ranging between 1047.3 – 1491.7 mm. Rain normally occurs between April to October. The peak rainfall is recorded in August or September.

Temperature

The hottest periods are in the month of March and April.

The sunshine record of the area indicates that Nov and Dec have highest he mean value for the past ten year.

Relative Humidity:

The Relative humidity all the year run but generally it raises to 80% and above in the past ten years and as low as 18%,

1.5 PROJECT JUSTIFICATION

The justifications of this project are enumerated below:

- Farmer can be advised on irrigation period
- The soil profile description gives the properties of the soil in relation to agriculture
- It helps farmers to have knowledge of types of crop to grow in the project site
- It also gives the direction of ground water flow with respect of slope

1.6 AIMS AND OBJECTIVES

The project is aimed at:

1 Description of the soil profile in chanchaga irrigation scheme.

2 Study the direction of ground water flow

3 Study fluctuation of water table

4 To establish relationship between soil and water movement

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 SOIL CLASSIFICATION

A soil classification system is an arrangement of different soils into groups having similar properties. The purpose is to make it possible to estimate soil properties or capabilities by association with soils of the same class whose properties are known, and provide the Engineer with an accurate method of description. However, there are so many different combinations of these properties in any natural soil deposit that any universal system of classification seems impractical. Instead the groups of classes are based on those properties which are most important in that particular phase of engineering for which the classification was developed.

Textural classification group soil by their grain size characterizes. The gravel and larger sizes are regarded and the particles finer than 2 mm diameter are divided into three groups; and size and clays.

The soils are then grouped by the percentage of each of these three components.

Textural classification was developed by agricultural Engineer who found that grain sizes was an indication of the workability of top soils. A number of different textural classification scheme have been employed in engineering work. [Robert. J. 1993]

2.2 SOIL IDENTIFICATION BY COLOUR

Colour is not very important physical properties in itself, it is an identification of more important properties. For example, yellow and red indicate that a soil has undergone severe weathering. A dark greenish brown is often an indication of organic matter. A change in colour encountered during excavation often mean a different soil stratum with different properties has been uncovered. Colour is usually the easiest property of a soil for personnel untrained in soil mechanics to identify, therefore a practical method of describing a certain soil by colour is described usually with the aid of the Munsel colour charts. [George B 1970]

2.3 AUGER BORING

The soil Auger is the simplest equipment for making a shallow hole in the ground and securing samples of the soil material in a much loosened condition. Several different styles are available.

The most effective land Auger is the pose hole, Auger, consisting of two curve blades that retain the soil as it cut. These are available in sizes from 2 to 6 inches in diameter.

Small earth Auger are generally fitted with handles, so that they can be turned by hand and extensions can be added to the handle so that depths as great as 30 ft can be reached.

Soil Auger have the advantages of obtaining a dry hole until water table is reached and of providing easy visual recognition off changes in soil composition on the other hand they are difficult to use in soft clays and coarse gravel and impossible to use in most soils below the water table. Hand Auger are seldom economical when boring deeper than 20 ft. [George B 1970]

2.4 MOISTURE CONTENT

[Brian 1978] The moisture content of soil is determined as follows: A suitable container with lid needs to be available for sample.

First, the container is weighed (M_1), complete with lid, after ensuring that it is absolutely dry and clean. The appropriate weight of wet soil is then placed in the container in a lose state. The lid is securely fixed and the container, complete with lid and wet soil, is then weighed again (M_2). The lid is then removed and contents is dried at a temperature of about of 105-110^{o}c, usually for a period of 24hrs.

It is important to note that some soils may be susceptible to fundamental change if they are dried at a temperature of 105^{0} to 110^{o}c example are organic soils and soils with a significant grypsum content. With such soils lower drying temperatures must be used and the period of frying may have to be prolonged. A record of any such changes must be noted on the corresponding result sheet.

The drying time of 24hrs may be reduced when it is proven that weight recorded at four hour intervals do not differ by more than 0.1% of the original mass of the wet sample.

When the drying period is complete, the lid is replaced and weighed container and any soil (M_3) after having been allowed to cool naturally.

The moisture content is then calculated using the definition of moisture content.

$$M = \frac{\text{Mass of water}}{\text{Mass of solid matter}}$$

$$M = \frac{M_2 - M_3}{M_3 - M_1} \times 100\%$$

Where M = moisture content

M_1 = mass of condiment + lid

M_2 = mass of container + lid + wet soil

M_3 =mass of container + lid + dry soil

2.5 Bulk Density

Bulk density is defined as the ratio of the mass of dried particles to the total volume of soil (including particles and spaces). He observed that the bulk density of a soil depends on how the soil is arranged, the proportionality of individual soil. Which classify the soil and how compacted the soil is. And that a soil of low bulk density is highly expected in a land to be irrigated, because it facilitate water holding capacity and hydraulic conductivity of the soil.

Accordingly the bulk density of most soil ranges from 1.0g/cm^3 for clay and 1.8g/cm^3 of sand furthermore, when bulk density is medium to fine textured subsoil exceeds 1.7g/cm^3, the hydraulic conductivity value become so low that drainage becomes difficult.

In a similar development, it was observed that soil that are loosed and porous will have low weight per unit volume (bulk density) and those that are more compacted will have high value. Since particles of sandy soil generally tend to lie in close contact, such soil have highs bulk densities. The low organic matter, content of soil further encourages this. On the other hand the particles of the finer surface soil such as silt loams, clay loam and clay ordinary do not rest so close together. This result from the fact that these surface soil are comparatively well granulated a condition encouraged by there relatively high organic matter content. Granulation encourage a fluffy, porous condition, which result in low bulk density values.

Consequently, the bulk density of a well granulated silt loam surface soil is sure to be lower than that of a representative sandy loams. Bulk density values.

Consequently, the bulk density of a well granulated silt loam surface soil is sure to be lower than that of a representative sandy loam. Bulk densities of clay, clay loam and silt loam surface soils normally may range from 1.00g/cm^3 high as 1.60g / cm^3 depending on their condition. While a range of 1.20g/cm^3 to 1-80g / cm^3 may be found in sand and sandy loam[Denis Bence 1985].

2.6 WATER TABLE SURVEY

Water table surveys provide valuable information on the drainage conditions in the area. Water table levels reflect the prevailing balance between the different ground water recharge/discharge components. When the water table is permanently or seasonally too close to the soil surface, control ground water system may be required.

In water table surveys interest is primarily in long term, seasonal variations (Short term fluctuations after rain or irrigation may be studied separately, usually in connection with the functioning of a drainage system). The seasonal trends in the water table levels are often closely related to the rainfall or irrigations. At a few selected key sites on key dates (selections made on the basis of previous detailed studies on the ground water table trend.[Eghavevba 2000]

2.7 Observation well

Observation wells are to either measure the static water level in the hole or to measure the pressure of the water at a given point in an aquifer. Depth of observation well should be below the lowest expected water level.

There are so many types of materials that could be used for casing (e.g. thin metal, standard pipe, abettors, bitumen impregnated pipe and plastic pipe i.e. PVC), but PVC is often used because of it's availability and is less expensive. Casing should be perforated and the perforations should be large enough for water to enter but small enough to prevent soil material from entering the casing.

Generally, perforations should be between 2.5 – 5 cm in diameter and cased with an economic sell screen. The casing should extend to 30 – 50 cm above ground surface so that it will be visible from distance. The extended portion of the pipe could be painted either yellow or orange or some colour that contrast with the natural surroundings to make it easy to locate for measurement and for farmer to see the casing in cultivated field. When the casing is not protected by fence or similar permanent structure, a painted 10 cm by 120 cm wooden post or painted steel post could be installed near the casing with hole number painted or stamped on the post. The casing should be capped to prevent rocks or sticks from being dropped down that casing.

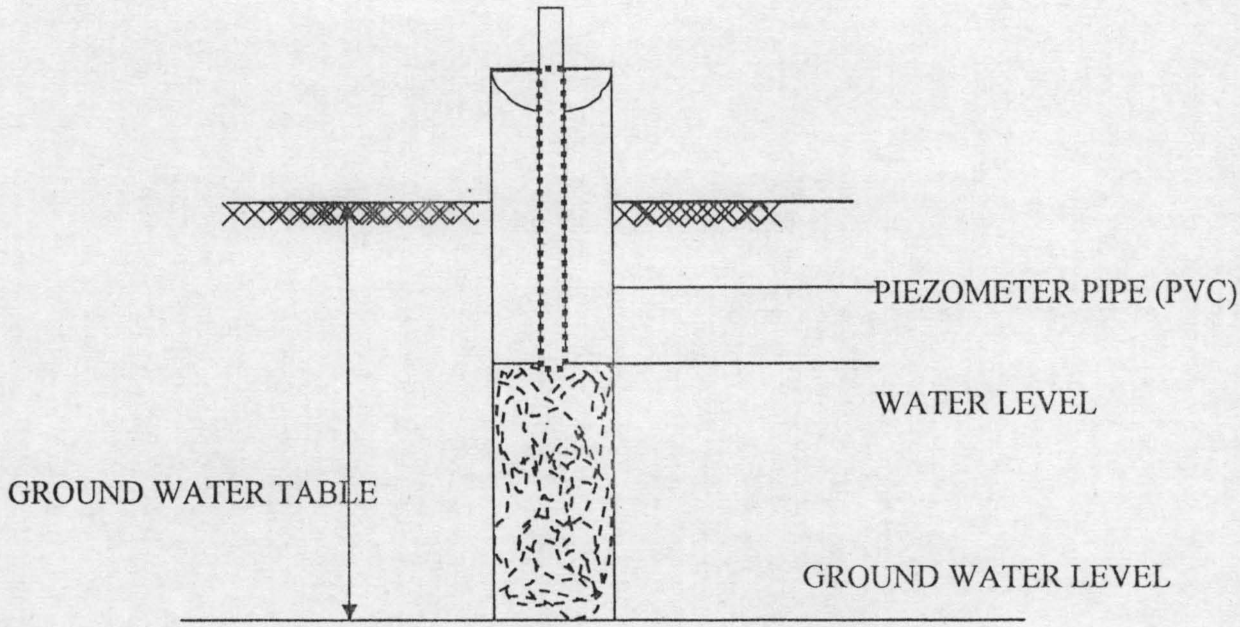

Fig 1 TYPICAL OBSERVATION WELL

2.8 Records of Observation Wells

A permanent record should be made of all observation wells. This record should include such items as the location and depth of wells, diameter, perforated length of the casing installed, elevation of natural ground surface at top of the well and measurement of the depth of water.

Measuring Devices for Depth of Water

There are several devices for measuring the depth of water in an observation well. These include weighted chalk line i.e and ordinary steel tape with suitable weight attached to the end is chalked, steel with popper attached to end of the tape, when this is lowered into the hole, a distinct "POP" can be heard when the popper meets the water surface. The other device is a graduated ruler or dipstick made of 1.27 cm thick by 2.54 cm wide hard wood is useful for measuring water levels within 2.5 m of the surface. Caution should be exercised to avoid errors in measurement process. Also electrical sounding device are available for measuring the depth of water in the well. In this study , the Dipstick method was adopted in view of its precision and low cost . (David K. 1980)

2.9 WATER MOVEMENT IN SOILS

Water will move in a soil from one point to another if the water at the first point has higher energy status than the water at the second level. This may be compared to water moving through a pipe from a point of high pressure toward a point of lower pressure. In saturated soils, the pressure is less than atmospheric and the energy has a negative value compared to our zero point.

Water entering a dry soil is held at a small function of a bar of suction at the surface layer. It is held at higher suction in the zone below the welting point and water moves down in response to the energy difference. We have already pointed out that suction is a negative pressure, so a low suction value indicates a higher energy status than a high suction value. The rapidity of movement depend on the soil characteristic. Darcy's law is commonly used to express the relationship

V = k SA – SB/d

Where V = velocity of flow (cm/day)

S_A = Suction at A (cm H_20)

S_B = Suction at B (Cm H_20)

d = distance between A + B (Cm)

K = Hydraulic Conductivity or Conductivity coefficient

Since Sa and S_B are both really negative values (Cm /day), the numerator becomes positive when S_B is numerically greater than S_A .the value of K in unsaturated soils changes as the suction changes.

As soil moisture content decreases and suction values increases in numerical size, the value of K decreases.

2.10 VERTICAL DISTRIBUTION OF GROUND WATER

The subsurface occurrence of ground waters may be divided into zone of aeration and Saturation. The zone of aeration consists of interstices occupied partially by water and particularly air. In the zone of saturation all interstices are filled with water under hydrostatic pressure.

On most of the land masses of the earth, a single zone of aeration over lies a single zone of saturation and extends upward to the ground surface.

In the zone of aeration, vadose water occurs. This general zone may be further sub divided into soil water zone, the intermediate vadose zone, and the capillary zone.

The saturated zone extends from the upper surface of saturation down to underlying impermeable rock. In the absence of overlying impermeable strata, the water table, or phreatic surface, forms the upper surface of the zone of saturation. This is defined as the surface of the zone of atmospheric pressure and appears as the level at which water stands in a well penetrating the aquifer. Actually, a saturation extend slightly above the water table due to capillary attraction; however, water is held here at less than atmospheric pressure. Water occurring in the zone of saturation is commonly referred to simply as ground water, but the term phreatic water is also employed (David K 1980)

2.11 GROUND WATER MOVEMENT.

Ground water in its natural state is invariably moving. This movement is governed by establishing hydraulic principles. The flow througjh aquifers, most of which are natural porous media, can be expressed by what is know as Darcy's law hydraulic conductivity which is a measure of the permeability of the media, is an important constant in the flow equation. Determination of hydraulic conductivity can be made buy several laboratory or field techniques application of Darcy's law enable ground water flow rates and direction to be evaluated

2.12 SOIL CHEMICAL PROPERTIES

SOIL PH

The value of soil PH in water indicates that the soil is more acidic than alkaline. The source of acidity in the soil could be hydrogen ions from the permanent charge on the soil mineral resources, since the organic matter, which is usually another source of soil. Tendency for some of the soils to become further acidic when fertilizer use is indiscriminate is thus high. [Rhoades 1982]

CHAPTER THREE

3.0 METHODOLOGY

The reconnaissance investigation of the project area was carried out during which the physical features and their position were observed. The topographic feature was noted to determine elevation of the land and to know the direction of slope. After that locations of observation well were determined and sample was collected for analysis. The geological data of the project area was also collected.

3.1 TOPOGRAPHIC SURVEY

The topographical map of the area is very necessary in order to determine the elevation of the land, direction and degree of slopes, existing feature on site, irrigation canals (mains and sub-mains). With the help of the contour map the area is divided into blocks that is A, B, C, D and from each block observation well was sunk. The topographic map shows that detail network of the irrigation canals.

3.2. COLLECTION OF SAMPLES AND INSTALLATION OF PEIZOMETER

Using topographic plan of the project area and canals/channels network of the site was divided into four blocks namely A, B, C, D form each block an observation well was established and distance between them were noted.

Soil sample were been collected with the aid of hand Auger. The sample were been collected at 30 cm down the profile to a depth of 1.2m. That is four samples from each pit were collected for analysis. After boring PVC pipes of 4.5 cm diameter were installed in each well to the depth of each boring and 0.5 m above the ground

Before installation, the pipes were perforated spirally, this extended from the bottom of each pipe to 0 .5 m up the length of the pipe. The diameter of each perforation is 3.2 mm; this is to ensure that only water seeps into the pipe and not silt or any other foreign materials.

The head of the PVC pipe is covered to guard against unwanted deposits and the bottom of the pipe is sealed with end cup to curtail silt, sand or any other foreign material from going into the pipe. The readings were taken every 5 days. A calibrated wooden stick was used in taking measurement;

3.3 DETERMINATION OF MOISTURE CONTENT

All the samples were labelled and taken to lab for moisture content determination. Different container was available for various samples.

Firstly the tin container was weighed as M1 after ensuring that it was absolutely dry and clean. Appropriate weight of wet soil is then placed in the container in a loose state and it was weighed M2. the tin was kept in an oven and dried at a temperature of about 105 ^{0} for a period of 24 hrs. When the drying period was completed, the dry sample was removed and weighed as M3 after having be allowed to cool naturally. The moisture content was then calculated using the definition of moisture content

M = mass of water

Mass of solid mater.

M = M2 – M3

M3 – M1

Where M = Moisture Content

M1 = Mass of Container

M2 = Mass of Container + Wet Soil

M3 = Mass of Container + Dry soil

3.4 TEXTURAL CLASSIFICATION

This was determined using the hydrometer method. The sample was collected and dried, it was then sieved using a standard test sieves, 4.75 m, 2.36 mm, 1.18 mm, 69 mm, 42 sum, 150 um, 75 um and receiver 50 g of air dry sample was weighed in a beaker and kept aside. 50 g of calgon (Sodium hexameta phophare) was weighed and diluted in one litre of a clean water and stirred thoroughly. 50 ml of the diluted Calgon was measured mixed with 51 g Samples already in the beaker and stirred. The experiment was then left for 24 hours.

After 24 hrs, the soil suspension was stirred for ten minutes and the suspension was transferred from beaker to glass cylinder and water was added until it reached 100 ml.

Then the top of the cylinder was covered with palm and inverted several times until soil was in suspension. The glass cylinder was then placed in a flat surface and time was noted. Soil hydrometer was placed into the suspension, until hydrometer reading was recorded after 40 Sec. The hydrometer reading (H1 and T1), the suspension was left to stand for 3 hrs before the second reading was taken (H2 and T2). The first reading measured the percentage of total clay in suspension. The second reading measured the percentage of sand in suspension.

The formula used was obtained from Sukanbi T.A (1979), selected method for soil and plant analysis (Gbomola publisher, Ibadan)

For Clay formula 100 – (H1 + 0.36 (T1 – 20 0C) – 2.012

For Sand [H2 + 0.36 (T2 – 20 0 C) – 2.012

For Silt 100 – (% Sand + % Clay)

The particle size analysis by hydrometer method gave percentage of clay, sand and silts of the sample taken from the project site.

The percentages of the soil particles got from the above were plotted on the textural triangle and name of the texture was read off.

3.5 BULK DENSITY

The bulk density is an important soil physical property considering its influence on water holding capacity.

The sample was collected using an open can of milk, weighed and the volume is also is also noted

$$\text{Bulk density} = \frac{\text{Weight of sample}}{\text{Volume of sample}}$$

3.6 SOIL CHEMICAL PROPERTIES

SOIL PH

General procedure for soil pH (2.5:1 H_2O)

1. Add 50 ml deionised water to 20 ± 0.1 g soil.
2. Stir the mixture for 10 minutes, allow to stand for 30 min, stir again for 2 min.
3. Measure the pH of the soil suspension.
4. Allow to settle for 1 hr then measure the conductivity of the supernatant liquid for samples with an EC > 1.0 mS/cm consider saturated paste extract analysis.

Saturated paste extract conductivity

The electroconductivity measurement identifies suits, which are potentially saline. The electroconductivity of the saturated paste extract is measured to determine the level of salinity

REAGENTS AND STANDARDS

1. Dissolve 0.7456 g of-KCl in-1000 ml water: 1.412 mS/cm at 25'C.
2. Dissolve 7.456 g of KCl.in 1000 ml water: 12.900 mS/cm at 25*C

Procedure

1. Weigh about 300 ± 25g soil into a plastic container.
2. Add water to the soil with stirring until it is nearly saturated
3. Allow the mixture to stand covered for several hours to permit the soil to imbibe eth water, and then add more water to achieve a uniformly saturated soil water paste. At this point the soil paste glistens as it reflects light, flows slightly when the container is tipped. Slides freely and cleanly off a spatula and consolidates easily by tapping or jarring the container after a trench is formed in the paste with the slide of a spatula.
4. after mixing, allow the sample to stand (preferably overnight, but at least 4Hrs), and then recheck the criteria for saturation. Free water should not collect on the soil surface, nor should the paste stiffen markedly of lose its glisten. if the paste is too wet, additional dry soil to the paste mixture.
5. Transfer to a Buckner filter funnel fitted with highly retentive filter paper. Apply vacuum, and collect the filtrate if the initial filtrate is turbid and refiltered.
6. Measure the conductivity of the filtrate against that of the standards

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

The result of both physical and chemical properties of the soil samples collected from the project site were analyzed below

Physical Properties of the Soil

The result of composition analysis of various sample collected down the profile up to 120cm deep are tabulated in table 4.i. When measured on the textural triangle, it fits into sandyloam, sandy clay loam and clay loam.

From the colour chart, description of various samples by the colour are described in fig 2 with the aid of colour distribution chart.

Table 4.1: TEXTURAL CLASSIFICATION OF SOIL AT DIFFERENT DEPTH OF SOIL

Sample No	Depth	Sand %	Silt%	Clay%	Colour	Remark
TPA_1	0 – 30	70.8	18.0	11.2	Dark Brown	S L
TPA_2	30 – 60	64.5	11.4	24.1	Yellowish Brownish	SCL
TPA_3	60-90	63.1	10.2	26.7	Dark Brown	SCL
TPA_4	90- 120	64.3	12.5	23.2	Dark Brown	SCL
TPB_1	10-30	50.2	31.0	18.8	Yellowish Brown	L
TPB_2	30-60	30.9	37.5	31.6	Dark Yellow	CL
TPB_3	60-90	70.3	9.8	19.9	Yellowish Brown	SL
TPB_4	90-120	65.40	13.45	21.15	Dark Grayish Brown	SCL
TPC_1	0-30	68.11	10.28	22.61	Yellowish Brown	SC
TPC_2	30-60	71.65	S14.10	14.85	Brownish Yellow	SL
TPC_3	60-90	68.70	11.00	20.30	Brown	SL
TPC_4	90-120	65.60	13.45	20.95	Yellow Brown	LS
TPD_1	0-30	79.2	08.6	12.20	Grayish Brown	LS
TPD_2	30-60	74.1	12.8	13.10	Grayish Brown	SL
TPD_3	60-90	75.6	13.45	10.95	Reddish Brown	SL
TPD_4	90-120	72.1	8.9	19.10	Brownish Yellow	SL

N.B

T_P – Trail Pit

SCL – Sandy Clay Loam

L – Loam

SL – Sandy Loam

DESCRIPTION OF SOIL ACCORDING TO COLOUR

DISTRIBUTION CHART

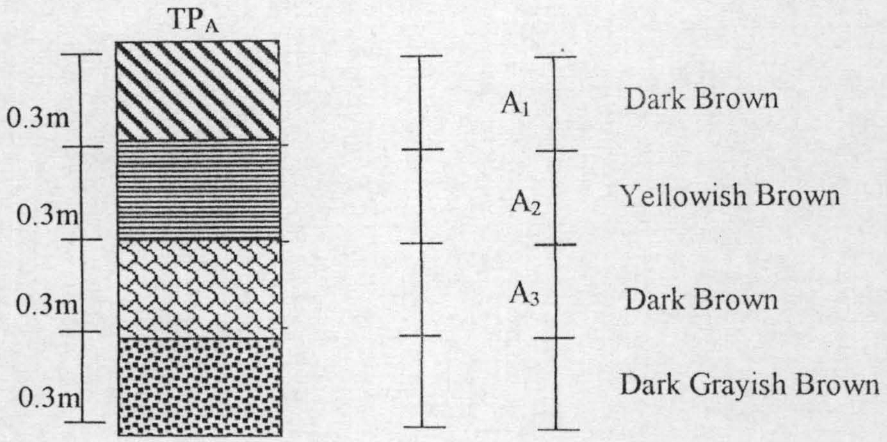

Fig 2.1 Trial pit 1

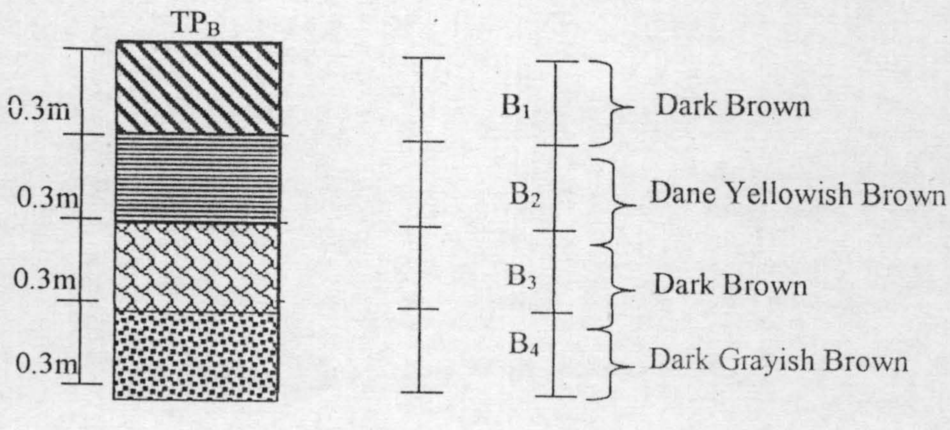

Fig 2.2 Trial pit 2

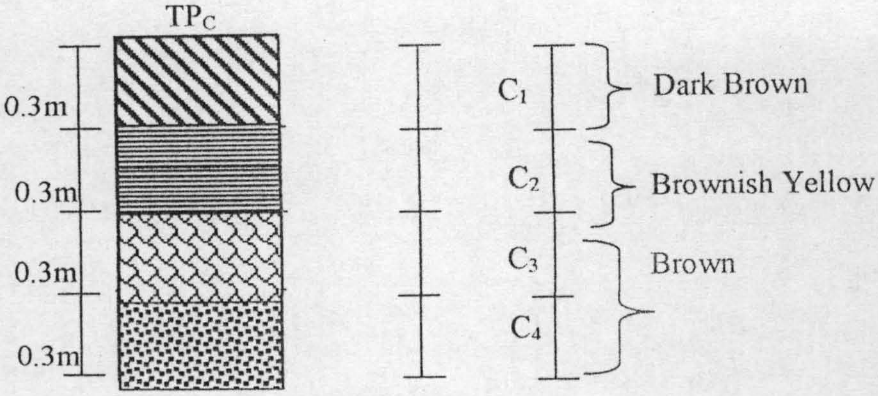

Fig 2.3 Trial pit 3

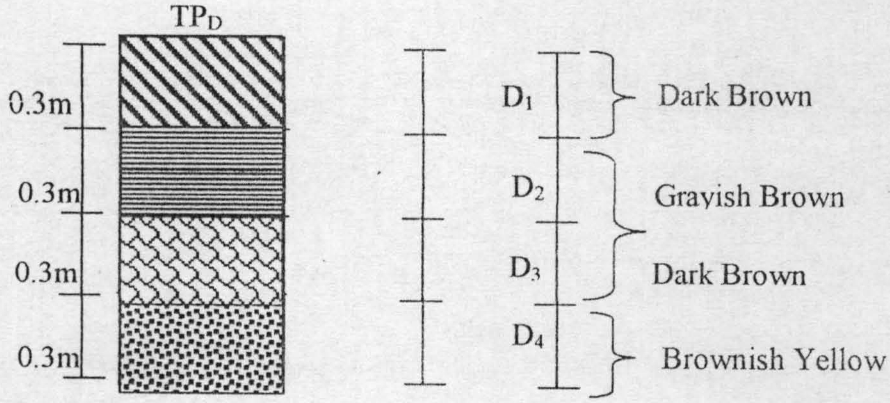

Fig 2.4 Trial pit 4

MOISTURE CONTENT & BULK DENSITY

The result obtained from the soil moisture content analysis was presented in table 4.2. The moisture content increases down the profile except in few occasions. For example, from block A, for soil depth of 0-30cm the mean moisture content is 23.01%, 30-60cm is 27.1%, 60-90cm is 31.1% and 90-120 is 32.2%. The reason for increase down profile is as a result of less aeration and less microbic activities and evaporation. The mean soil moisture ranges from 28.36 and 30.05. The mean moisture content is highest at the valley bottom.

The bulk density analysis can be found in table 4.2. The bulk density of the soil varies from depth to depth. The bulk density ranges from 1.36 and 1.75, which is acceptable because bulk density of clay and sand are 1.0g/cm^3 and 1.8gcm^3 respectively, then that of silty – clay loam should fall within the range. The bulk density decreases in value as you go down the profile, because the lower horizons have not been tempered with during cultivation while the surface soils have been affected by cultivation. Bulk density is affected by two factors: fixture and mineral composition of the soils.

TABLE 4.2 : MOISTURE CONTENT& BULK DENSITY

Sample No	Depth of Sample cm^2	Moisture Content %	Bulk Density (gcm^3)
TPA_1	0 – 30	23.05	1.65
TPA_2	30 – 60	27.1	1.57
TPA_3	60-90	31.1	1.52
TPA_4	90 – 120	32.2	1.49
TPB_1	0-30	24.95	1.54
TPB_2	30-60	28.9	1.36
TPB_3	60-90	30.35	1.47
TPB_4	90-120	30.86	1.38
TPC_1	0-30	18.5	1.75
TPC_2	30-60	19.55	1.43
TPC_3	60-90	21.3	1.48
TPC_4	90-120	19.75	1.37
TPD_1	0-30	29.7	1.50
TPD_2	30-60	30.1	1.41
TPD_3	60-90	30.85	1.42
TPD_4	90-120	29.55	1.47

4.2 SOIL CHEMICAL PROPERTIES

SOIL PH

The PH values range between 4.2 and 5.5. The values of soil PH in water indicates that the soil is more acidic than alkaline though the acididty is weak. The source of acidity in the soil could be hydrogen ions from the permanent charge on the soil mineral resources. Tendency for some of the soils to become further acidic when fertilizer use is indiscriminate high.

ORGANIC MATTER.

The mean organic matter content of the soil expressed as carbon is generally low. The value ranges between 1.00 and 1.17. The general low content of organic matter could be contributed to several factors which include low erratic rainfall which permits only sparse, grassy with sometimes shrubby vegetation instead of a dense and woody vegetation; high temperature that hasten mineralization and seasonal bush fire. Hence the organic matter is subjected to diminishing or reduction.

TABLE: 4.3 ORGANIC MATTER & PH

Sample		pH	Organic Matter %
A	A_1	4.8	1.026
	A_2	5.5	1.12
	A_3	5.2	1.08
	A_4	5.3	1.10
B.	B_1	5.5	1.00
	B_2	4.4	1.079
	B_3	4.8	1.00
	B_4	5.20	1.08
C	C_1	4.8	1.09
	C_2	4.2	1.09
	C_3	4.8	1.080
	C_4	5.1	1.09
D	D_1	4.8	1.05
	D_2	5.2	1.17
	D_3	4.8	1.03
	D_4	4.8	1.12

Where pH – Hydrogen ion activity

4.3 TREND OF WATER TABLE FLUCTUATION

The direction of ground water flow can be find in fig 4 , the four wells show different types of fluctuation. The water table increases from upper slope as we go down the slope and the water table dropped low as dry season was approaching. There was an indication of movement of water down the slope (fig 3.1-3.5).

The graph also indicated the direction of water flow relative to the topography. It was discovered that non of the water table rose, this is due to the fact that the wells were observed very close to dry season (Oct-Nov) at that time no rise in the water table.

TABLE 4.5 RECORD OF OBSERVATION WELLS

		DATE OF READING IN (M)									
k	Observation	17Oct	22Oct	27Oct	2Nov	7Nov	12Nov	22Nov	22Nov	27Nov	
	1	0.65	0.55	0.45	0.41	0.35	0.28	0.17	0.05	0.00	
	2	0.73	0.68	0.60	0.53	0.48	0.35	0.22	0.16	0.09	
	3	0.83	0.75	0.68	0.57	0.50	0.48	0.30	0.20	0.11	
	4	0.85	0.78	0.70	0.61	0.55	0.50	0.32	0.25	0.13	

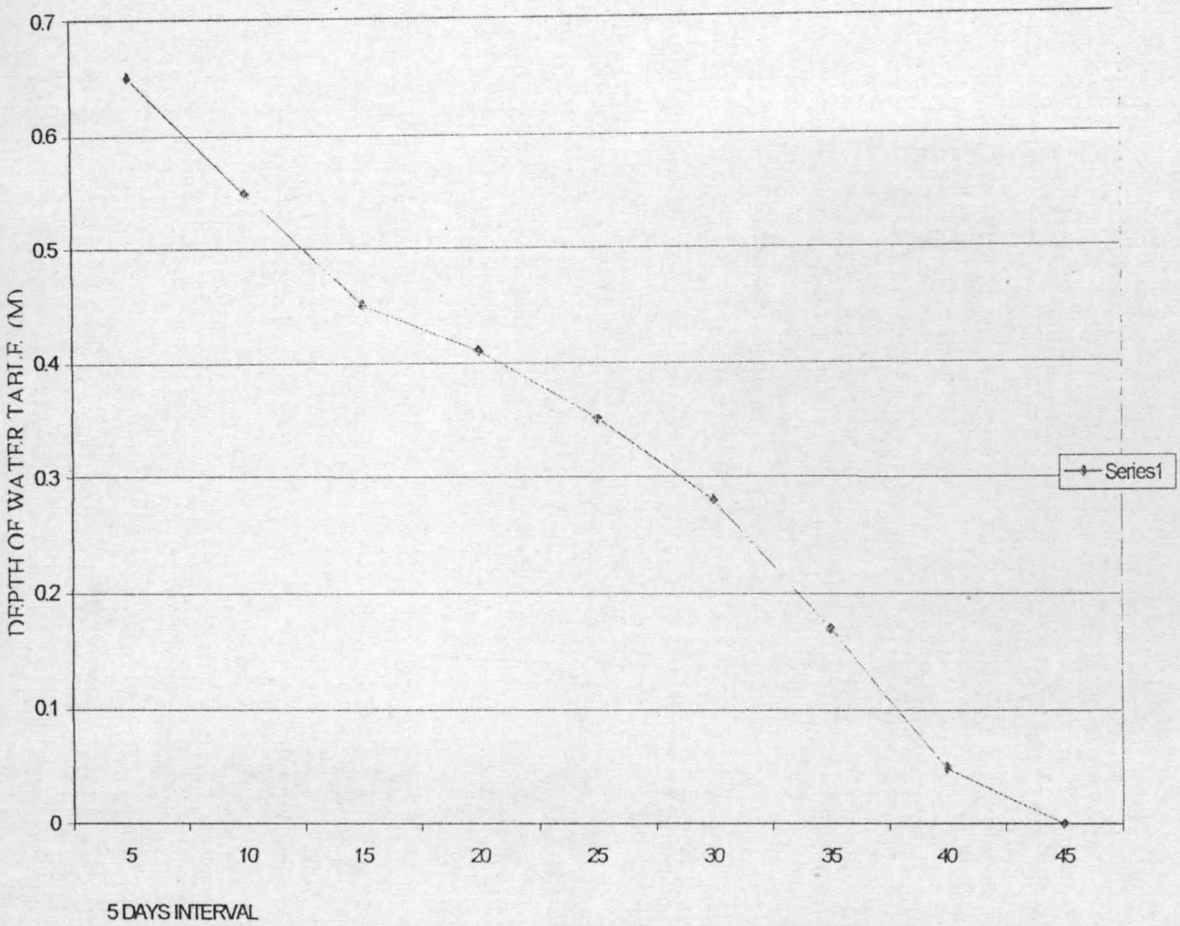

Fig. 3.1 Profile of observation well I

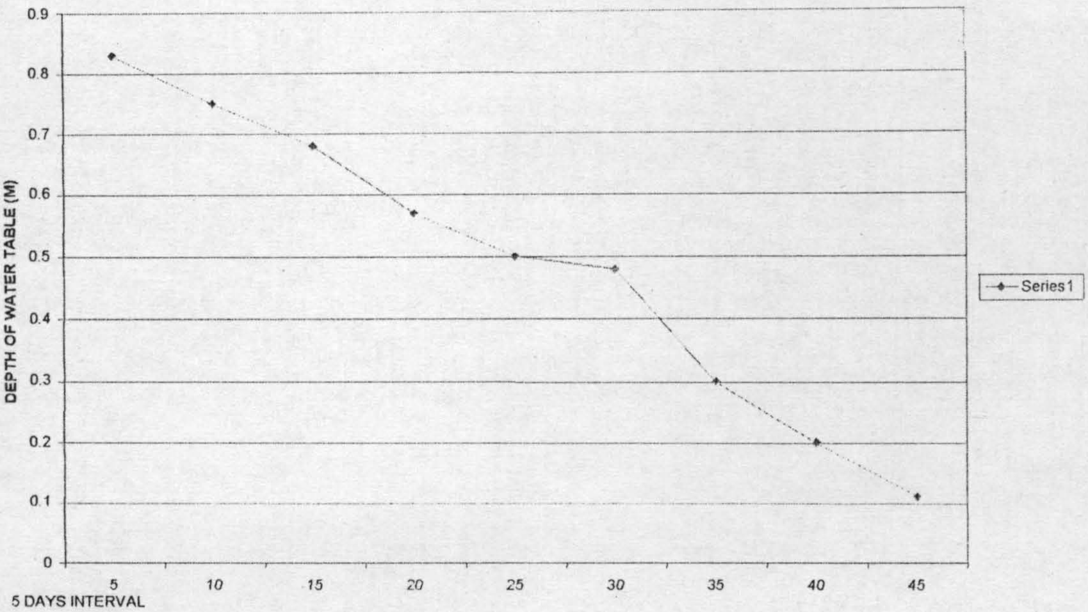

Fig. 3.2 Profile of observation well II

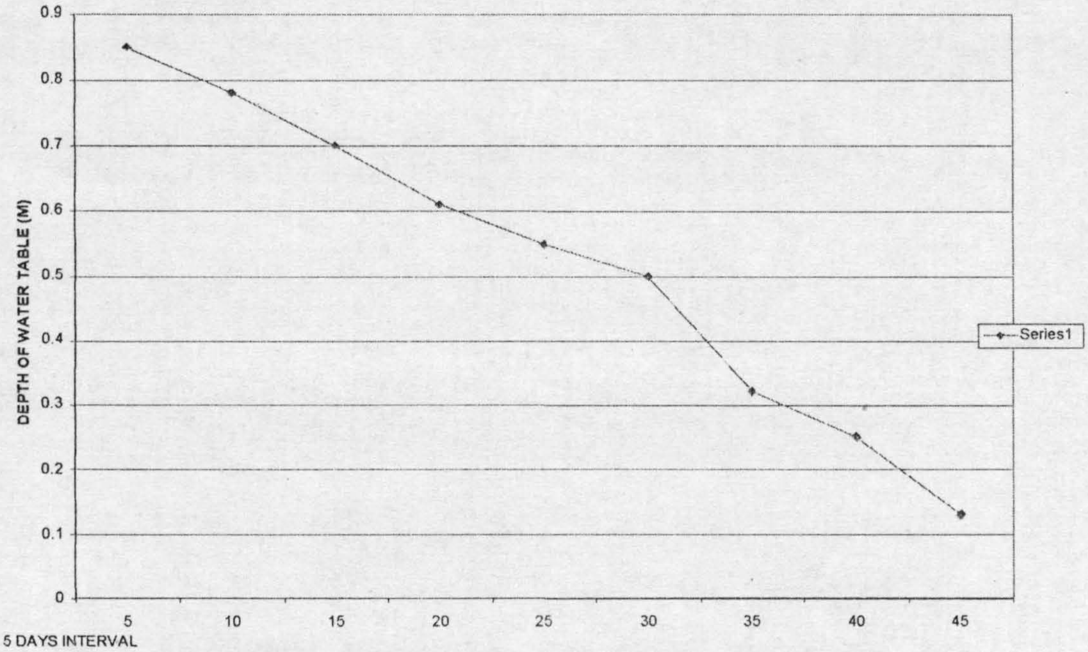

Fig. 3.3 Profile of observation well III

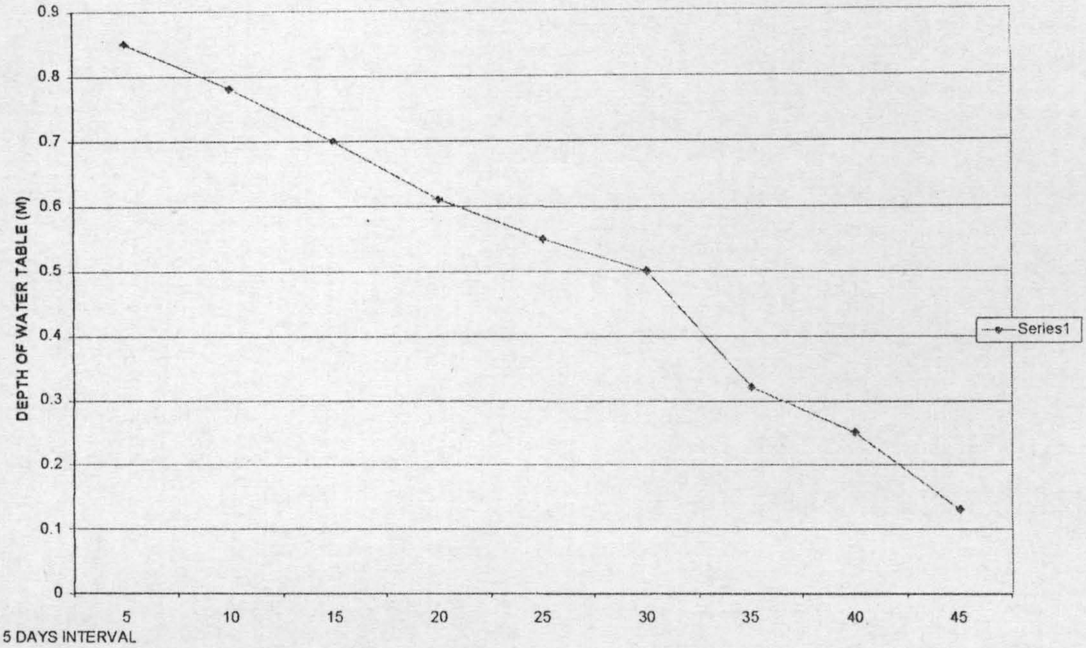

Fig. 3.4 Profile of observation well IV

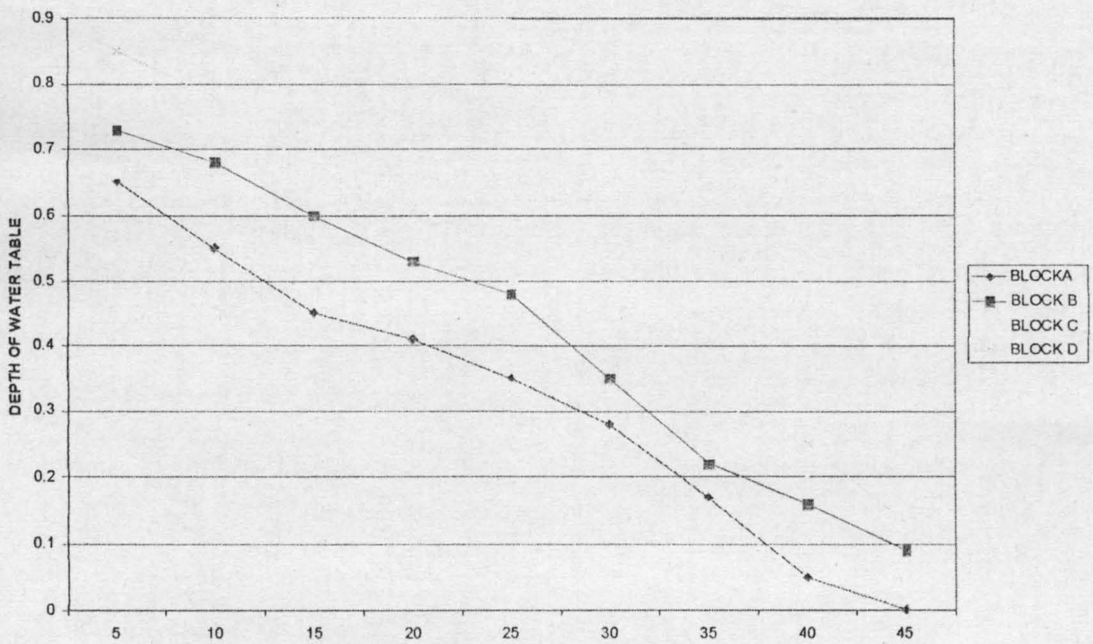

Fig.3.5 Profile of observation well I - V

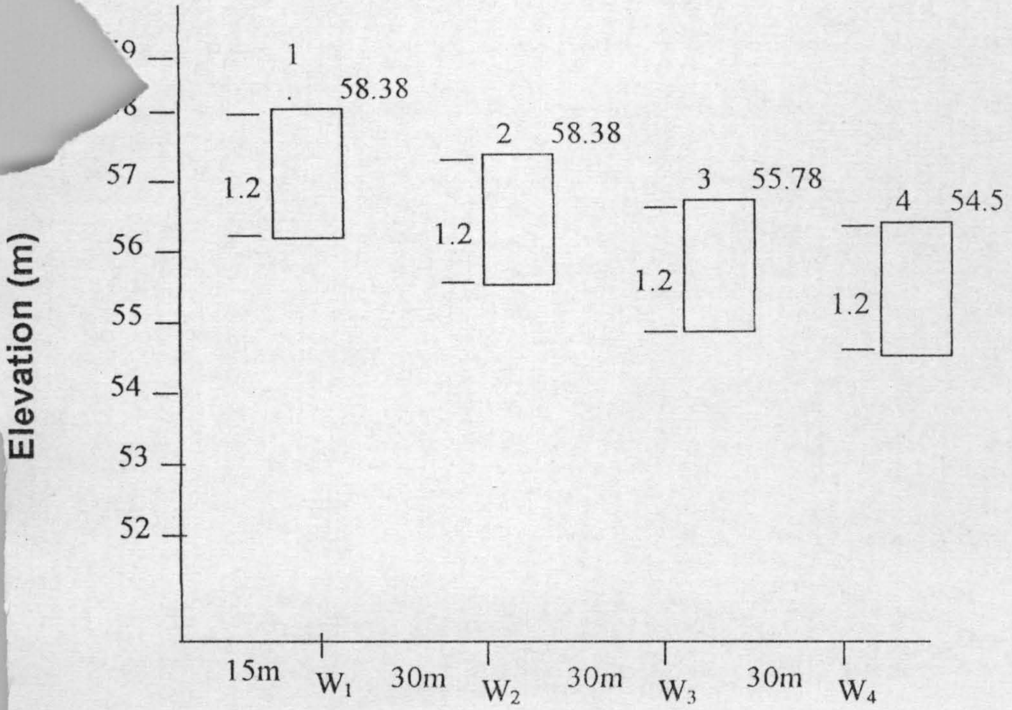

Fig 4 RELATIVE POSITION OF THE OBSERVATION WELLS

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

From geological map, chanchaga is characterized by crystalline basement complex rocks which broadly divides in to inginative gnesses quartzite and granite rocks.

The Studies where conducted to characterize and classify the soil profile .The texture ranges from sand loam ,loam and sand clays loam, The percentage fraction of total sand to silt indicate that the profile is dominated with sand.

The Observation well curve indicated that the water moved gently from upper slope down to valley bottom. The Change in the trend could be attributed to the fact that a number of factors which include climate, topography, soil type and their extent as well as tillage operations interact to influence the hydrological processes such as the underground water table dynamics . The water table fluctuation is affected by the nature of the soil and the slope of the area under study.

The studies enable any researcher or farmer that may want to engage in irrigation in chanchaga to have knowledge of the soil characteristic of the soil in relation to Agriculture. It also help to known

e schedule of irrigation.

5.2 Recommendation

In view of the studies, irrigation activities should commence from late October if cash crops one to be grown in the project area.

Irrigation should commence on upper slope because it is Indicated from the study that water table dropped faster as you go up the slope. There was an indication from the analysis that organic matter content is very low therefore to improve the land, fertilizer may be applied .

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APPENDIX 1

INTERPRETATION OF COLOUR OF THE SOILS ACCORDING TO THERE DEPTH (CM).

S/NO	Hue, Value & Chrome	Soil Colour Name
1	10YR 4 / 3	Dark Brown
2	10YR 5 / 4	Yellow Brown
3	10YR 3 /6	Dark yellowish Brown
4	10YR 5 / 8	Yellowish Brown
5	10YR 4/ 6	Dark Yellowish Brown
6	10YR 5 / 8	Yellowish Brown
7	10YR 4 / 2	Dark Grayish Brown
8	10YR 5 / 6	Yellowish Brown
9	10YR 6 / 8	Brownish Yellow
10	10YR 5 / 3	Brown
11	10YR 5 / 4	Yellow Brown
12	10YR 5 / 2	Grayish Brown
13	10YR 5 / 3	Grayish Brown
14	5YR 5 / 4	Reddish Brown
15	10YR 6 / 8	Brownish Yellow

Appendix 2

ʾata of Observation Well at Chanchaga irrigation Scheme

·servatio n Well	Location Well	Death of Observati on Well	Diameter of Well (cm)	Distance Between Well
1	Between main-cannel and Fcl	1.2m	4.5cm	Main cannal to observation is 15m
2	Between field cannal 1 and 2	1.2m	4.5cm	Observation well 1-2 is 20m
3	Between field cannal 2 & 3	1.2	4.5cm	Observation well 2-3 is 20cm
4	Between field cannall 2 and end of last block	1.2m	4.5cm	Observation well 3-4 is 30cm

Appendix 3

Determination of Moisture Content

Lock	Test	Tin no	Mass of Tin (g)	Tin + wet soil	Tin + dry soil	Mass of water	Mass of solu (g)	Moisture content (%)	Mean (%)
TP_a	A_1	A_{57}	26.90	80.65	70.51	10.14	43.61	23.54	
	A_1	B_{63}	26.38	60.01	53.80	6.21	27.42	22.6	23.05
	A_2	Z_{16}	25.05	91.35	84.19	7.16	59.14	26.1	
	A_2	Z_{13}	26.22	92.93	84.19	8.74	87.97	28.1	27.1
	A_3	24	25.83	105.73	94.50	31.23	68.67	45.5	
	A_2	A_{55}	26.77	120.80	107.33	13.47	80.56	16.72	31.1
TP_B	B_1	A_1	26.73	74.20	66.07	8.13	39.34	20.7	
	B_1	N_{39}	26.40	145.00	118.85	26.95	92.45	29.2	24.95
	B_2	A_{53}	26.25	90.80	63.71	27.09	37.46	27.2	
	B_2	A_7	26.84	154.22	124.40	29.82	97.56	30.6	28.9
	B_3	A_{43}	25.87	75.63	67.57	8.06	41.07	29.6	
	B_3	B_{93}	28.59	88.18	73.97	14.21	45.38	31.3	30.35
	B_4	A_{50}	29.64	108.86	91.06	17.8	61.42	29.0	
	B_4	A_1	26.73	74.20	66.07	8.13	39.34	20.7	30.26
TP_C	C_1	Z_1	25.81	52.66	48.3	4.36	25.66	17.0	
	C_1	A_{22}	25.98	49.44	45.51	3.91	19.53	20.0	18.5
	C_2	A_2	26.35	62.51	56.65	5.86	30.3	19.3	
	C_2	Z_{43}	28.87	52.93.	52.87	0.06	24.37	0.25	19.55
	C_3	C_{72}	25.25	58.99	52.95	6.03	27.68	22	

	C_3	M_{28}	25.55	47.21	43.51	3.7	17.96	20.6	21.3
	C_4	C_3	26.49	57.00	52.15	4.85	25.66	18.90	
	C_4	B_6	29.12	62.51	56.80	5.71	27.08	20.6	
									19.75
TP_D	D_1	A_1	25.46	110.98	11.14	19.84	65.68	30.2	
	D_1	N_{39}	26.40	145.80	118.85	26.95	92.45	26.2	29.7
	D_2	A_{53}	29.75	134.15	110.28	23.9	80.53	29.7	
	D_2	A_7	26.54	154.22	124.89	29.82	94.86	30.5	50.1
	D_3	A_{13}	24.01	103.37	84.89	18.48	16.58	30.4	
	D_3	B_{95}	28.59	88.18	73.97	14.21	45.38	31.3	30.85
	D_4	A_{52}	27.36	92.97	77.26	15.01	49.9	30.1	
	D_4	A_{50}	29.64	108.86	91.06	17.8	61.46	29.0	29.55

Appendix 4

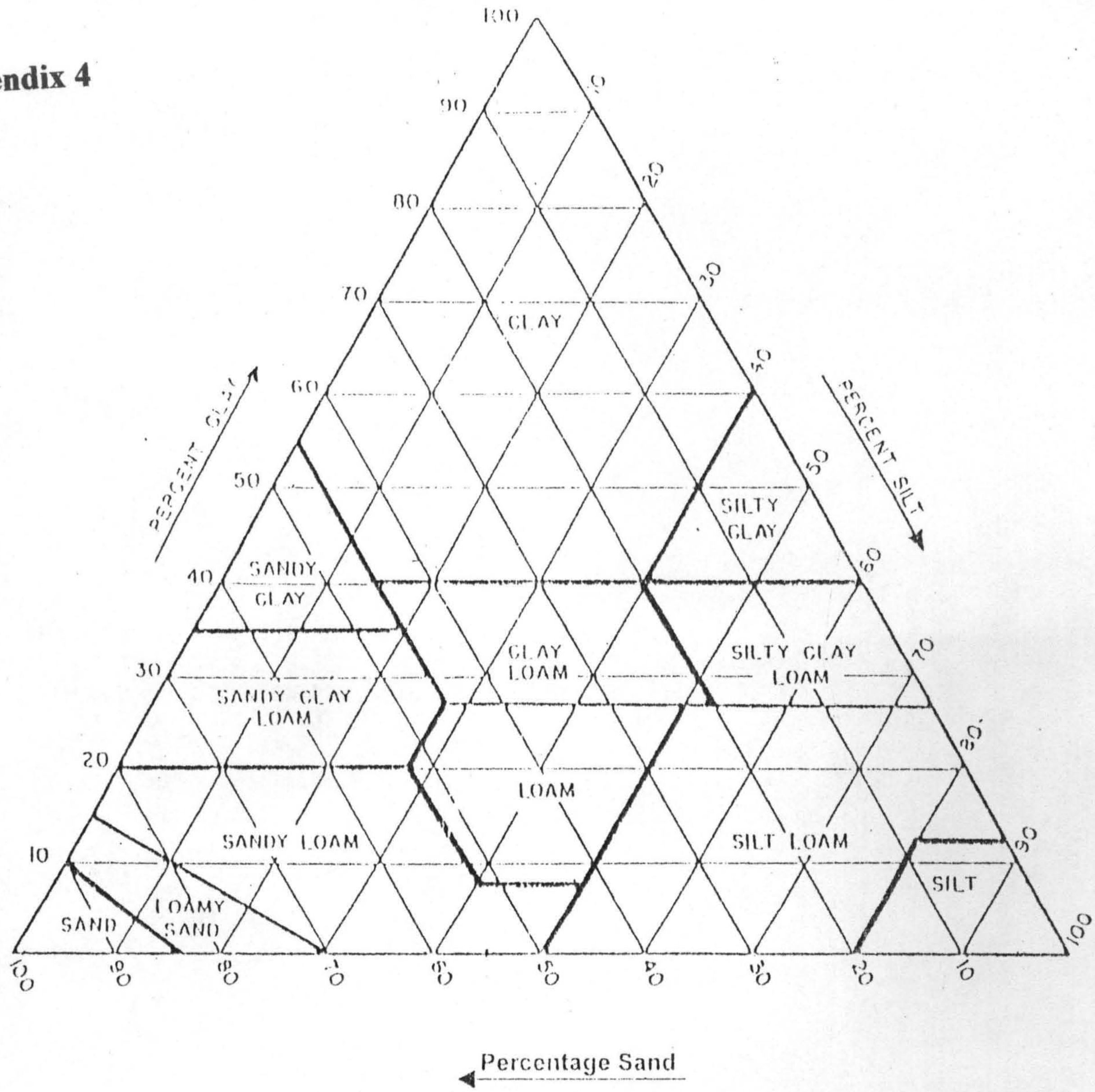
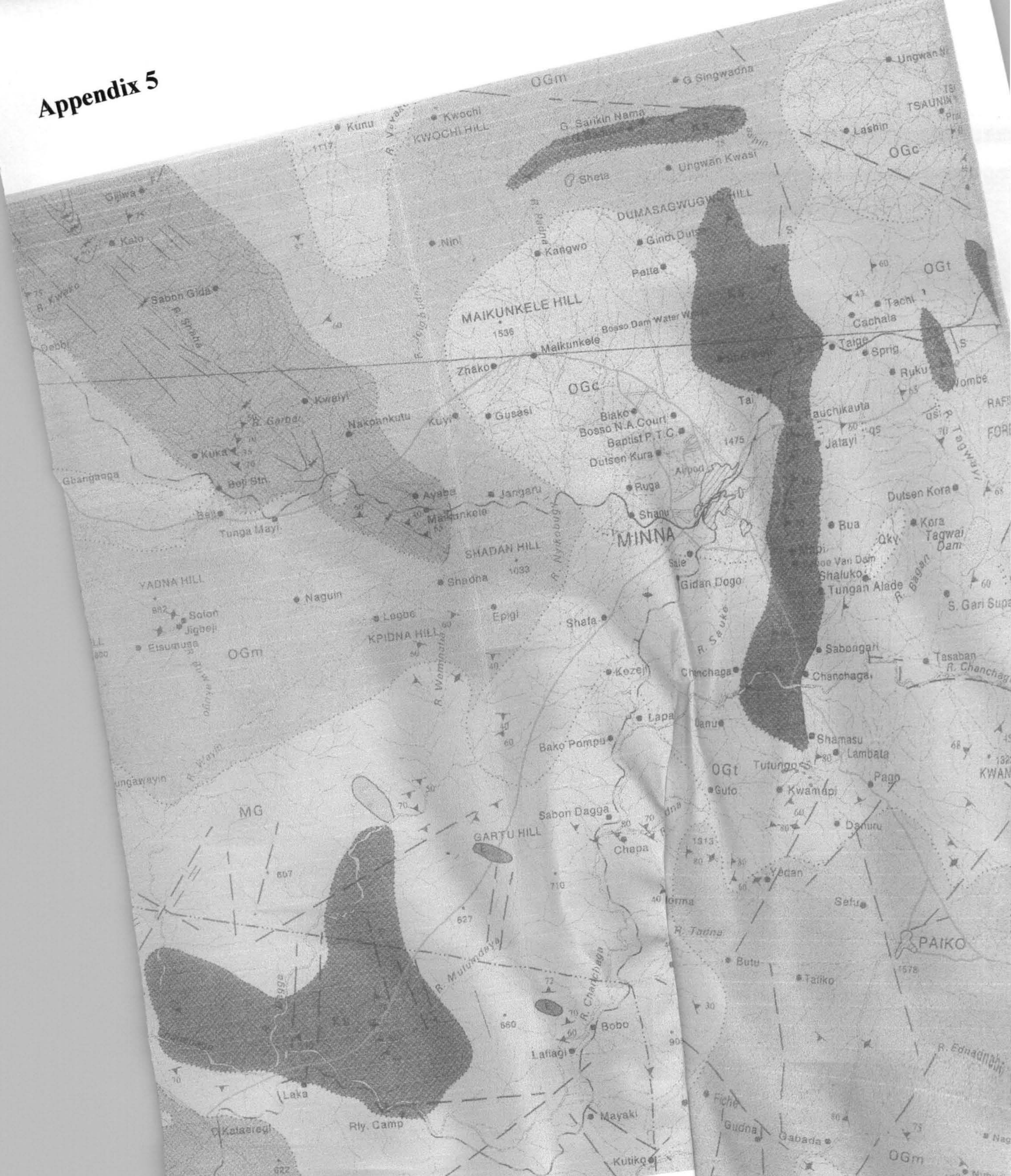


Fig. A.2: Proportions of sand, silt, and clay in the basic soil textural classes. (from U.S Department of Agriculture. Handbook 18. Soil Survey manual 503 Pp. Illus. 1951).

Appendix 5



Geological Map of Area

Appendix 6

EXPLANATION

	Alluvium		RECENT
SSl	Laterite-capped sandstone hills		CRETACEOUS
Ss	Bida sandstone		CRETACEOUS
	Coarse-grained biotite-hornblende granite	OLDER GRANITE SERIES	PAN-AFRICAN
OGp	Porphyritic coarse- to very coarse-grained biotite granite and granodiorite	OLDER GRANITE SERIES	PAN-AFRICAN
OGc	Coarse-grained biotite-muscovite granite and weakly to strongly foliated granodiorite, locally migmatitic with relics of schist	OLDER GRANITE SERIES	PAN-AFRICAN
	Medium-grained biotite and biotite-hornblende granite	OLDER GRANITE SERIES	PAN-AFRICAN
	Medium- to coarse-grained tonalites amphibolite, migmatitic in part	OLDER GRANITE SERIES	PAN-AFRICAN
Omg	Migmatitic schist and gneiss (injection migmatitic), some foliated granites, granodiorites and schists	OLDER GRANITE SERIES	PAN-AFRICAN
	Gabbro		PAN-AFRICAN
Us	USAMA SCHIST FORMATION Phyllites, mica schist, quartz schist, quartzite with interlayered amphibolite	SCHIST BELTS	PAN-AFRICAN
	BIRNIN GWARI SCHIST FORMATION Phyllites, mica schist, graphitic schist, garnet-mica schist, pebbly and cobbly schist metarhyolite and metadacite amphibolite	SCHIST BELTS	PAN-AFRICAN
qs	Qartzite and quartz schist and major quartz veins	SCHIST BELTS	PAN-AFRICAN
QKy	Quartzite with layers of quartz schist and crystalline kyanite	SCHIST BELTS	PAN-AFRICAN
	Marble	SCHIST BELTS	PAN-AFRICAN
K	KUSHAKA SCHIST FORMATION Phyllite, mica schist, quartz schist interlayered with amphibolite	SCHIST BELTS	PAN-AFRICAN
	Amphibolite	SCHIST BELTS	PAN-AFRICAN
	Talc-tremolite-actinolite schist	SCHIST BELTS	PAN-AFRICAN
	Quartz mylonite	THE ZUNGERU MYLONITES	MIGMATITIC GNEISS COMPLEX
	Mylonite gneiss and schist blastomylonite; phyllonite with intercalated amphibolite	THE ZUNGERU MYLONITES	MIGMATITIC GNEISS COMPLEX
	Mylonite, staurolite-muscovite schist	THE ZUNGERU MYLONITES	MIGMATITIC GNEISS COMPLEX
	Shear gneiss (protomylonite)	THE ZUNGERU MYLONITES	MIGMATITIC GNEISS COMPLEX