EFFECT OF CROP WATER INTAKE ON WATER TABLE DEPTH A CASE STUDY OF CHANCHAGA IRRIGATION SCHEME

BY

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BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGENEERING FEDERAL UNEVERSITY OF TECHNOLOGY, MINNA

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DECLARATION

I hereby declare that this Project is a record of a research word that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any University of Institution. Information derived from personal communications, published and unpublished works of others were duly referenced in the text.

Sunday Uyehe

22 /11/2008

Date

DEDICATION

This project is dedicated to God Almighty, to my family in loving memory of my late mother Mrs. Bridget Andrew Uyehe, may her gentle soul rest in perfect peace amen. Also I dedicate this project work to my department, Agricultural and Bioresources Engineering' Federal University of technology minna.

CERTIFICATION

This is to certify that this project was carried out by Sunday Uyche in the Department of Agricultural and Bioresources Engineering, Federal University of Technology, Minna

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My unlimited thanks go to God Almighty for his grace, blessing, wisdom, strength, and courage. Throughout the period of this project and my academic pursue in general. And which has been a trend of success to my life. Apparently I wish to express my gratitude to my supervisor in person of Eng. John Jiya Musa for his positive suggestion and contribution to the success of this project. I also wish to extend a vote of thanks to the department, Agricultural and Bioresources Engineering for all the contribution given to me to the achievement of this goal. Finally I wish to thank my family for the tremendous support given to me throughout my academic race.

ABSTRACT

At the Chanchaga irrigation scheme, Crop water intake was carried out by determining and monitoring water table depth fluctuation. The study includes installing three piezometric pipes in the field at 50m distance apart. Water level where measured at 8 to 12days interval to determine their fluctuations. The soil physical properties determine include moisture content, bulk density, porosity, available soil moisture holding capacity, and infiltration rate of the soil. At the depth of 0-30cm the moisture content was11.00, bulk density was 1.49g/cm^3, porosity was -12.10pores available soil moisture holding capacity was 74.01; at the depth of 30-60cm the moisture content was 8.84, the bulk density was 1.60g/cm^3, porosity was -9.60pores, available soil moisture holding capacity was 48.44; at the depth of 60-80cm the moisture content was 8.23, bulk density was1.58g/cm^3, porosity was -9.00pores, available soil moisture holding capacity was 26.73; while at 80-100cm the moisture content was 8.47, bulk density was 1.57g/cm^3, porosity was -8.30pores, available soil moisture holding capacity was 26.13 The ground water fluctuation at the project site shows that the water level in well Band C were within the effective root zone i.e. below 100cm. For shallow and moderately rooted crops. The water level in the three wells indicate that area surrounding well A should be drained during the month of August and September to reduce the water logging effect at that period but alternatively high water required crops like rice and sugar Cain (sacharum 024 and 0260) should be grown in the area. While around well B and C irrigation is required slightly for October and fully for the rest of the dry season.

TABLE OF CONTENT

List of Tables

List of Figures

CHAPTER ONE

1.0 Introduction

Water is next to air in importance, for both human and plant existence. Plants require a constant supply of water to maintain growth. It has been estimated that during months of October to March rain ceases to fall. And in order to maintain continuous crop production to meet the food need of the country or society. There is a need to meet the crop water requirement. Therefore, irrigation becomes a necessity.

Irrigation is an old practice, as old as civilization. The importance of water in agriculture has been realized from time immemorial. (Smriti1999) state that no grain is ever produced without water, but too much water tends to spoil grain. Consequently creating room for drainage construction to solve problem of excess water. A technical and scientific water management is essential for the control of water within the soil and irrigation time.

1.1 General Background

Irrigation is defined as the artificial application of water to moist the soil for the purpose of crop production. (Egharevgba 2002). In many areas of the world the amount and timing of rainfall are not adequate to meet the moisture requirement of crops and irrigation essential to raise crop necessary to meet the need of food and fiber. Irrigation is use to support plant growth and development being limited by water shortage. Irrigation should be seen as a husbandry aid, the need for irrigation, depends on the available water at the root zone and the effect of water stress on the plant's stage of growth. Crop respond at a particular stage of growth when the use of irrigation during periods of rainfall deficiency is likely to show economic benefits, and water stress.

1.2 Underground Water

This is the water beneath the soil or ground surface where the void spaces are substantially filled with the water table. Its upward movement (Capillarity) from the water table into the root zone can be a major source of water for plant growth.

Water which is a carrier of nutrient in soluble from is needed in adequate volume for the successful growth of crops. To increase productivity, study of the possible relationship between surface drainage and ground water becomes important, since the distribution of water within the soil profile and the proportion of water remaining in the root zone for plant utilization appears to be of critical limitation than the total amount of rainfall.

Therefore, in such an environment, an understanding of the use of water is very important to formulate a management strategy, to monitor the water level fluctuation and to make more efficient use of the limited seasonal rainfall (Michael 2000).

1.3 Underground Water Movement

When drainage water moves downward and out of the soil, it encounters a zone in which the pores are saturated with water. Often, this saturated zone lies above a layer of impermeable rock or clay. The upper surface of this zone of saturation is called the water table and water within the saturated zone is called ground water. Water table is commonly 1 – 10m below the soil surface. The unsaturated zone above the water table is the vadose zone. Vadose zone include unsaturated materials underlying the soil profile and so considered deeper than the soil itself. In some cases, the saturated zone may be high to include, the lower soil horizons, with the vadose zone confined to the upper soil horrizone (Brady 1999)

On the other hand, if ground water is too close or near to the surface, the lands ability to produce most crop becomes almost impossible. Therefore, a water table within the lower portion of the root zone may supply substantial amount of water thereby reducing the cost of irrigation. Ground water can be removed through pumping for domestic and irrigational uses. Water saturated soil make upland plant and forest species difficult if not impossible. Prolonged saturation also makes it difficult to carry out farm operation as tractor and other equipment used for planting, tillage and harvest operation.

1.4 Objectives

- To determine the water table depth and moisture content of the Chanchaga Irrigation Scheme
- To determine the rate of water fluctuation
- To determine the water table depth and crop water requirement
- To determine suitable crops at various water table depth.

1.5 Justification of the Objectives

In many African countries and Nigeria in particular our farmers do not have full knowledge and information on water requirement of our major agricultural crops. Let alone knowing the impact of water table to crop yield. This poor information makes it difficult to meet crop yield adequately. Because in Nigeria many farm consist of mix cropping while the crop water requirement differs. Thus there is an important need for relevant and sustained studies on estimating crop yield response to water table depth. It is only with such information and data that engineers can plan and design effective irrigation system at minimum cost and help in planning for next cropping season. With adequate irrigation practice the following can be achieve

- To provide crop insurance against short duration drought
- To control soil temperature by cooling including the atmosphere thereby making more favorable environment for plant growth.
- To soften tillage pans and clods.

1.6 Nature of the Problem

The problem of inadequate water supply, lack of data on crop water need, water table depth and their relationship to crop yield and irrigation have continued to pose major problem in agriculture production in most developing countries. And these may be as a result of lack of development of available water resource, irrigation criteria and lack of available relevant study that should provide such information.

Consequently, agricultural production in the country has continue to be limited to single rainfall cropping season even in areas where available water resources can easily be harvested for multiple cropping

1.7 Scope of Study

By the determination of the water table depth at the Chanchaga Irrigation Scheme will enable the farmers know the crop water requirement, irrigation time and drainage time. Consequently increasing the yield.

Estimating the infiltration rate and moisture content of the soil is very important to formulate a management strategy to monitor the water level fluctuation and to make more efficient use of the seasonal limited rainfall and water bodies

CHAPTER TWO

2.0 Literature Review

2.1 Water need of Plant

Water availability is one of the main controls that determine crop growth. Plants require water for two main reasons; to maintain growth and to supply nutrients. Water deficiency under extreme conditions leads to poor growth and wilting of the plant. Under less extreme condition growth in inhibited by lack of nutrients and by reduces assimilation of energy. Excesses of water may also occur, however, the plant obtain most of their nutrient from the soil and hence the water complete air may be suffer from lack of oxygen and related problem of anaerobes, (Richard, 2001). To help meet water requirement by plant are alternative means of water in needed.

2.1.1 Evapourtranspiration

Evapourtranspiration is the process by which plant absorb moisture from the soil through the root and give it out as vapour through the leaves into the atmosphere. (Sinha 2000) Water is extracted from the soil through the process of transpiration; this process is controlled partly by physiological factors such as the leaf size, density and orientation of the stomata.

Michael, 2000 stated that the rate of potential transpiration is a function atmospheric conditions (wind speed, relative humidity, and turbulence) and energy input from solar radiation. Transpiration results in the evaporation of water from the stomata in the plant leaves, and this create disequilibrium between the moisture status in leaf and that in the lower part of the plant. Water therefore moves through a process of mass flow towards the leaves. The effect is thereby transmitted through the membranes of the root into the soil and a related movement of water occurs through the pores surrounding the root (Sinha, 2000). Apparently if the volume of water in the soil reduces or dries up the water films within the soil become discontinuous. The rate at which mass flow take place through the pore system to the root declines. Ultimately, the demand for water by the plant ceases. This is a phase during which the transpiration rate exceeds the rate of water uptake, and the plant experience a net loss of moisture. The leaves start to dry out, and the stomata closes up. This regulates transpiration to some extent, but it does not prevent it altogether, prolonged drought therefore leads to continuous loss of strength, reduce nutrient input and diminished growth. In agriculture, one of the consequence id loss of yield, ultimately, if water is not supplied to the plant in sufficient quantities by renewed rainfall or irrigation, is that the plant wilts are dries up, (Davis and Janardhan, 2000).

2.1.2 Soil – Plant – Water Relationship

Soil – plant – water relationship relate to the properties of soil and plants that affect the movement, retention and use of water. Soil provides the room for water to be used by plants through the roots present in the same medium. Water as much and also as a career of large amount of nutrients is required in a large measure for the successful growth of crops. The rate of entry of water into the soil and its retention, movement and availability to plant roots are all physical phenomena. (Sarma, 2001)

2.1.3 Soil Texture and Structure

The relative proportion of sand, silt and clay determines the soil texture. Texture is designed by using the names of the predominant size fraction and the word "loam" whenever all three major size fractions occur in sizable proportions.(Sarma, 2000). Sandy soil is classified as coarse texture, loamy soil as medium fine, and clay soil as fine texture. All these three soil characteristics determine the rate of water movement into the soil.

Soil structure in the arrangement of individual soil particles with respect to each other into a pattern. It constitutes the nature or channel in which water will flow within the soil. However, the strength of bond, the size and shape of the structural unit differs in geographical areas.

2.1.4 Vertical Movement of Water into the Soil (Infiltration)

The vertical movement of water into the soil is called infiltration. The infiltration characteristics of the soil are one of the dominant variables in influencing irrigation. Infiltration rate is the soil characteristics determining the maximum rate at which water can enter the soil under specific conditions. The actual rate at which water is entering the soil at any given time is termed the infiltration velocity.

2.1.5 Measurement of Infiltration

Three methods of estimating infiltration characteristics of soil for the design of irrigation system of determination of crop water use.

a. The use cylinder infiltometers,

b. Measurement of subsidence of free water in a large basin, and

c. Estimation of accumulated infiltration from the water front advance data.

The use of cylinder infiltometer is most common.

Infiltration characteristics of soil may be determine by producing water in a metal cylinder installed on the field surface and observing the rate at which water level is lowered in the cylinder, (Yadar, 2003).

2.1.6 Soil Moisture Retention

The moisture content of a sample of soil is usually defined as the amount of water lost when dried at certain temperature, expressed either as the weight of water per unit weight of dry soil (dry basis) or as the volume of water per unit volume of bulk soil (wet basis). Although useful, the information is not a clear indication of the availability of water for plant growth. The differences exist because the water retention characteristics may be different for different soils, (Yadar, 2003).

2.1.7 Measurement of Soil Moisture

Soil moisture measurements are important in the suitable scheduling of irrigations and estimating the amount of water to apply in each irrigation. Measurement of changes in soil moisture storage with time is important in estimating evapourtranspiration. The percentage moisture content o a soil can be expressed as;

$$\text{Percentage moisture content} = \left(\frac{\text{weight of wet soil} - \text{weight of oven dry soil}}{\text{weight of wet soil}} x100\right)$$

Apparently moisture content can be calculated by expressing it as percentage of dry weight as given below black (1965).

$$Md = \left[\left(\frac{Ww - Wd}{Wd}\right) x\ 100\right] \qquad 2.1$$

Where Ww = wet weight of soil

Wd = dry weight of soil

Md = moisture content expressed as percentage of dry weight

$$Mv = (Md\ x\ As) \qquad 2.2$$

Where Mv = available moisture holding capacity

As = apparent specific gravity of soil

As = weight of a given volume of soil / weight of an equal volume of Water

$$d = \left[\left(\frac{Mv}{100}\right) xD\right] \qquad 2.3$$

Where d = available water of plants

D = depth of soil

Equating equation (2.2) and (2.3)

$$D = \left[\left(\frac{Md}{100}\right) xAs\ xD\right] \qquad 2.4$$

2.1.8 Bulk Density

The dry bulk density of soil is defined as the rate of the mass of dried particles to the total volume of soil (including particles and pores)

$$D = \left(\frac{Ms}{Vt}\right) = \left[\frac{Ms}{(Vs+Va+Vw)}\right] \qquad 2.5$$

Where Ms = mass of dried soil (Kg)

Vt = total volume (m^3)

Va = volume of air (m^3)

Vs = volume of water (m^3)

The term dry bulk density and apparent specific gravity often use synonymously where as the term specific gravity denotes a dimensionless quantity, bulk density is expressed in grams per cm or mass per unit volume, the two terms have equal numerical values.

Total (wet) bulk density is the mass of moist soil per unit volume.

$$Dbt = \left(\frac{Mt}{Vt}\right) = \left[\left(\frac{Ms+Mw}{Vs+Va+Vw}\right)\right] \qquad 2.6$$

Where Mt = total mass of soil (Kg)

Vt = total volume of soil (m^3)

(Michael 2000)

2.1.9 Movement of water and termination

Water intake is the movement of irrigation water from the soil surface into and through the soil. It is an expression of several factors, including infiltration and percolation.

2.2.0 Percolation: - Is the downward movement of water through saturated or nearly saturated soil in response to the force of gravity. It occurs when water is under pressure. Percolation rate is synonymous with infiltration rate with qualitative provision of saturated or near saturated condition.

2.2.1 Interflow: - Is the lateral seepage of water in a relatively pervious soil above a loss previous layer. Such water usually reappears on the surface of the soil at a lower elevation.

2.2.2 Seepage: - Is the infiltration (vertically) downward and lateral movement of water into soil or substrate from a source of supply such a s a reservoir or irrigation canal.

2.2.3 Permeable: - It is the characteristics of a pervious medium relating to the readiness with which it transmit fluids. Low permeable of subsoil is the major reason for under drainage. Clay loam and silt clays when wetted become almost impermeable as the clay swells and the crack closes.

2.2.4 Water table

Water table is defined as that level in the earth crust where all the voids in the rocks and soil are filled with water, and water is allowed to flow freely (Egharevgba 2006).

Water table marks the top of the saturated zone which fluctuate over the season normally being much higher in the raining season. In wetlands the water table is very near the soil surface and the land is not suitable for cultivation until the water table of the whole area is lowered. Where water flows down the soil profile and is impeded by an impermeable layer such as saturated clay or silt clay, a perched water table is formed water from above cannot drain through the impermeable barrier and so a saturated zone builds up over it. (Emerson, 2003)

2.2.5 Drainage

Drainage is the removal of excess water from the soil profile. As this water leaves the macrospore of the soil, air replaces. This air that takes its place enables gaseous exchange to continue. Horticultural soils should return to at least 10 percent air capacity in the top half meter within one day of being saturated. Some soils, notably those over chalk or gravel, are naturally free draining but many have underlying materials which are impermeable or only slowly permeable to water. In such cases artificial drainage sometimes referred to as filed drainage or under drainage is put in to carry away the excess water. This helps the soil to reach its field capacity rapidly but does not reduce it moisture holding capacity. (Sinha, 2000). Well drained soils are those which are rarely saturated within the upper 900mm except during or immediately after heavy rain. Uniform brown red, or yellow colours indicate on aerobic soil i.e. a soil in which oxygen is available. Improper top 600mm for several months each year. These soils tend to have less bright colours then well drained soil. Grayish or ochreous colour are distinct at 450mm giving a characteristics rusty mottled appearance. Poorly – drained soils are saturated within the upper 600mm for at least half year and are predominantly grey (Yadar, 2003).

Another problem faced with water saturated poorly aerated soil condition is that during construction the muddy low bearing condition of saturated soil make it very difficult to operate machines. Houses built on poorly drained soil may suffer on uneven settlement and flooded basement during wet period. Similarly rise of water into road beds. Also can lead to water logging in areas where infiltration rate is very low. It is important to role that if ground water is too near or close alternatively too much or less in the soil profile, the lands' ability to economically produce most crops becomes almost nil (Ojha 2003)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Site Description

The Chanchaga irrigation scheme is sited at Chanchaga Local Government of Minna, Niger State, Nigeria. The scheme is located between latitude 9°34' - 9°37'N and longitude 6°36' - 6°39'E, (Ndako 2004). The scheme gets its irrigation water at the Chanchaga River along the farm. Crops grown in the farm include spinach, Okoro, pepper, Alfalfa, pumpkins and Sugarcane. During the dry season, irrigation becomes a necessary means of supplying was to the farm. A surface system of irrigation is usually employed.

3.2 Climatic Condition

According to information and data collected from the Minna metrological centre 2008 Niger State is characterized with alternating amount of high and low temperature, rainfall, wind speed, evaporation rate and relative humidity. Tab 3.0 shows some climatic data of Niger State. From January to October

Table 3.0: Weather Report Forecast 2008

Temperature 9h to 9h next day		Rainfall amount (mm)	Wind anemometer 9h to 9h next day (Km)	Piche evaporation 9h to 9h next day	Relative humidity 12.noon	Sunshine hour
Max.	Min.					

(°C)	(°C)				
January					
33.7	20.5	0.0	214.5	15.9	19
February					
37.2	23.5	0.0	1279.5	14.5	25
March					
38.2	25.4	0.4	113.2	13.0	35
April					
36.0	24.4	73.1	107.8	6.6	50
May					
32.8	24.4	156.3	72.3	3.7	64
June					
30.3	22.8	123.9	689.2	2.9	71
July					
29.5	22.3	3140	58.0	2.2	75
August					
28.2	21.9	310.1	45.3	1.6	80
September					
30.0	21.9	330.2	39.7	2.0	72
October					
31.7	22.5	115.1	25.4	2.4	66

Figure 3.0

3.3 Infiltration rate Methodology

Materials use in carrying out the practical are a 30cm by 30cm metal ring cylinder, and another 30 by 60cm metal ring cylinder, meter rule, stop watch, and 50 liter of water. Plot for the experiment were leveled by removing grasses and debris at the soil surfaces without altering the soil structure. The 30cm by 30cm ring was place on the soil at the scheme where the infiltration rate is to be determined and gently hammered into the soil until a 25cm height is reached. Likewise the 30cm by 60cm ring. During the installation of the second ring care was taken to ensure eccentricity of the smaller ring in the bigger ring. The both rings were 25cm, before commencing the experiment. After the installation a fifty liter of water was by the side to ensure water supply. Firstly the water was poured into the bigger cylinder and simultaneously into the smaller ring to a height of 20cm and the stop watch initially at zero reading was set started. This implies that 20cm was used as the reference point each reading was taken after every 2 minutes on the stop watch with a corresponding decrease of the water level in the inner ring as noticed on the meter rule. For every 2minutes the reading on the stop watch and meter rule was taken until a saturation point is reach where the soil no longer absorb the water

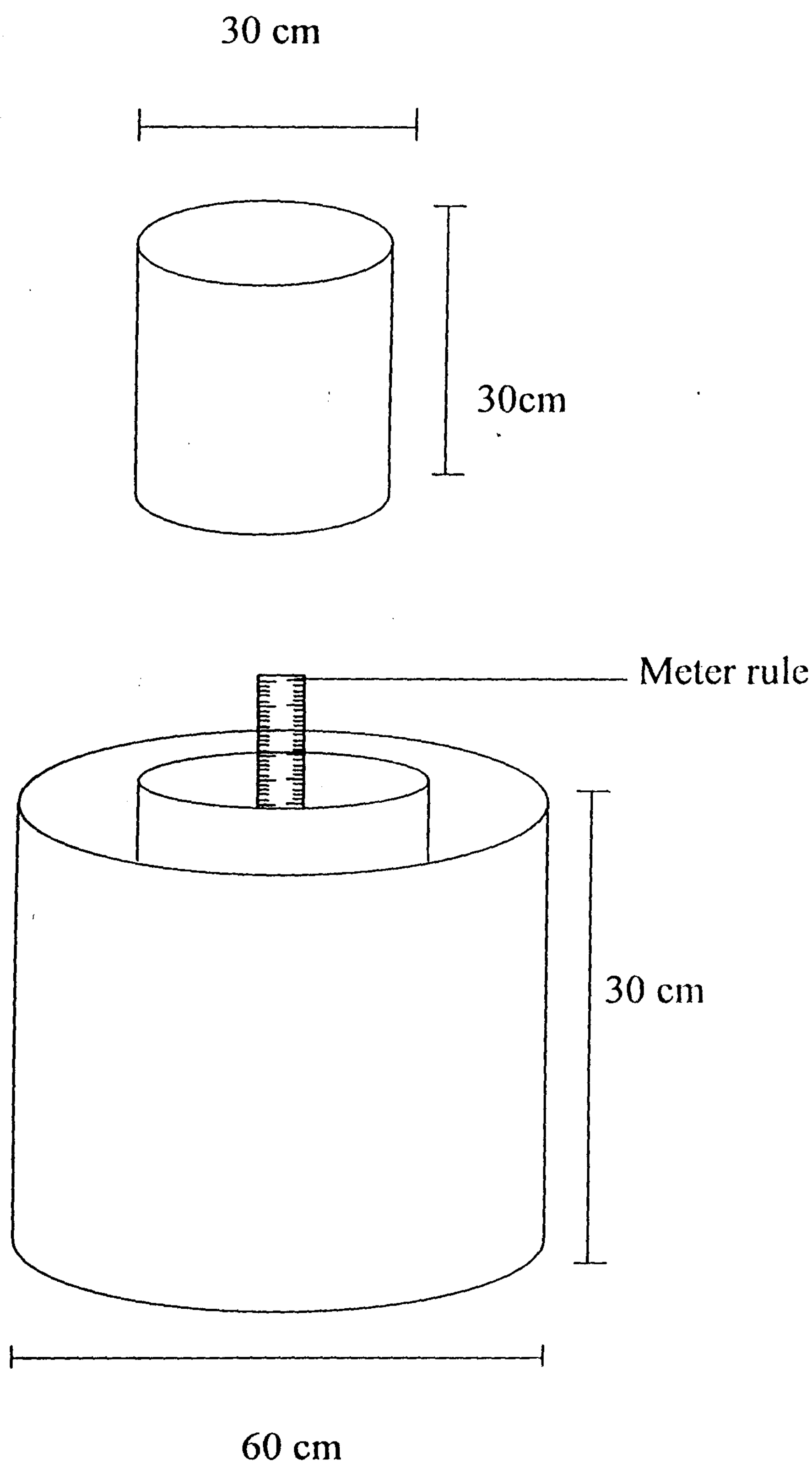


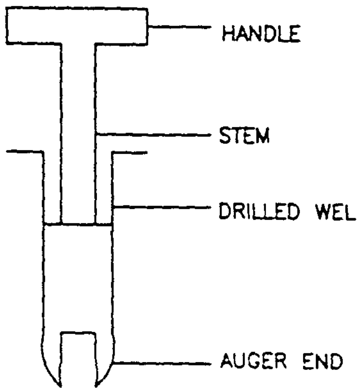
Fig 3.1 Metal Cylinder for Determining Inflation rate of the soil

3.4 Determination of Soil Moisture Content

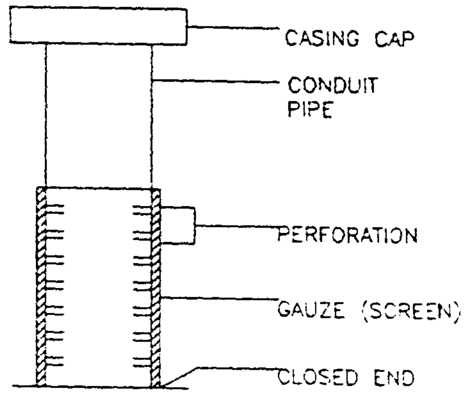
Soil sample were collected with a soil auger the samples were taken from the soil desired depth of (2-20) cm at 10 different locations. For each soil type, they collected in an aluminum container and air tight in leather bag and conveyed to the laboratory. The various containers were clearly labeled to distinguish the sample. Firstly the various can were weighed when empty and again weighed when filled with the wet soil sample. They were later put into an oven set at 105°C for 24 hours and the oven is switch off, open and the cans were removed and allow to cool. The cans together with the oven dried soil were weighed and recorded.

3.5 Determination of Water Table Depth

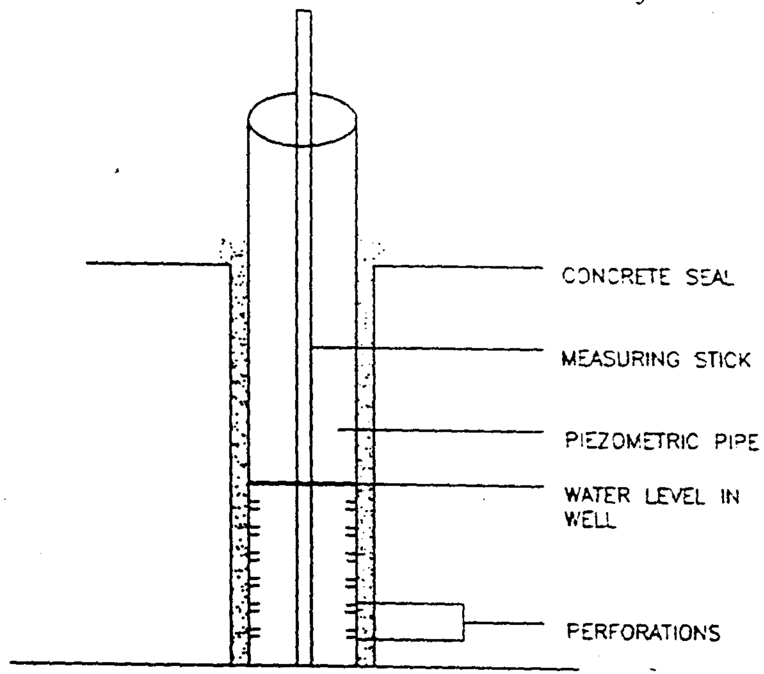
Materials used are cutlass, hand driven auger, gravels, piezometric pipe, and straight stick. A cutlass was used to clear the point of pipe installation a hand driven auger of length 1.5m and shovel diameter of 5cm was used to drill the well to 1m depth, the piezometric pipe of diameter 10.0cm and length 150cm since 100cm below ground surface is the depth of interest. They are radially perforated at 2cm apart across the depth of the pipe to allow sufficient and effective inflow of ground water in to the pipe to assume its original form and level. The pipe was buried with the perforated end below the ground surface. At the neck of the pipe on the ground surface, the clearance between the will and the pipe was sealed up using concrete mix to disallow the vertical flow of water into the well by runoff or precipitation. A straight long wooden stick was use to take the water depth measurement, by lowering the stick into the pipe, to the bottom of the pipe. And after few minutes, was removed and the water level was able to be measured, by measuring the water gauge of the stick, with a standard meter rule fig 3.2, 3.3, and 3.4 show the water table experiment.



HAND DRIVEN AUGER USED TO DRILL OUT WELL
Fig 3.2



CROSS SECTION OF CONSTRUCTED PIEZOMETRIC PIPE
Fig 3.3



CROSS SECTION OF PIEZOMETRIC INSTALLATION

CHAPTER FOUR

4.0 Result and Conclusion

Table 4.1 Some agricultural crops and their root depth

Shallow rooted crops (60cm)	Moderately rooted crops (80cm)	Deep rooted (100cm)	Very deep rooted (120cm)
Rice	Wheat	Maize	Sugar cane
Potato	Tobacco	Cotton	Citrus
Cauliflower	Castrol	Sorghum	Coffee
Cabbage	Ground nut	Soya bean	Grape vine
Onion	Carrot	Tomato	Lucerne

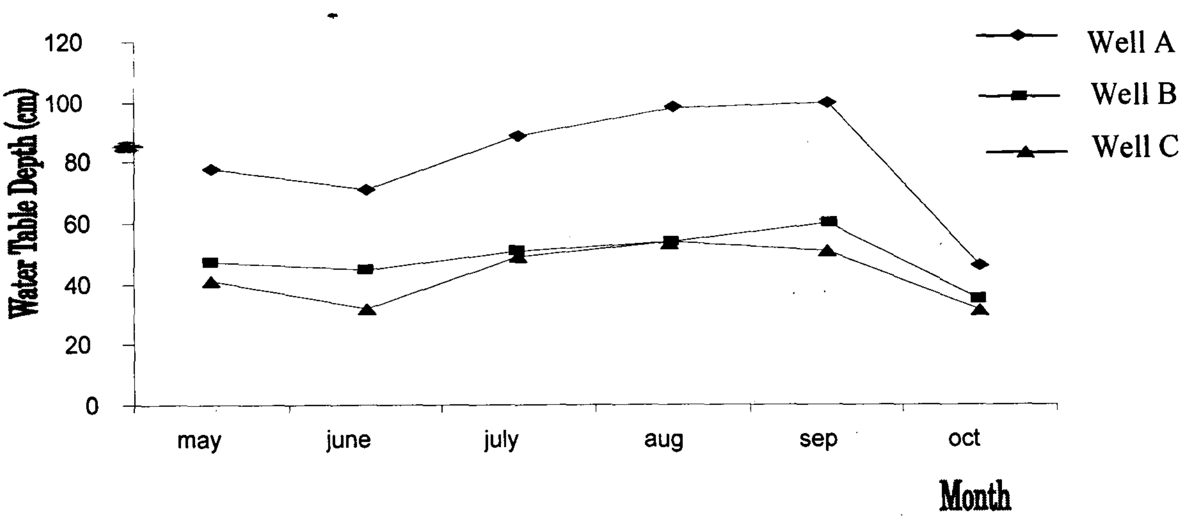


Fig 4.1 showing various well depth.

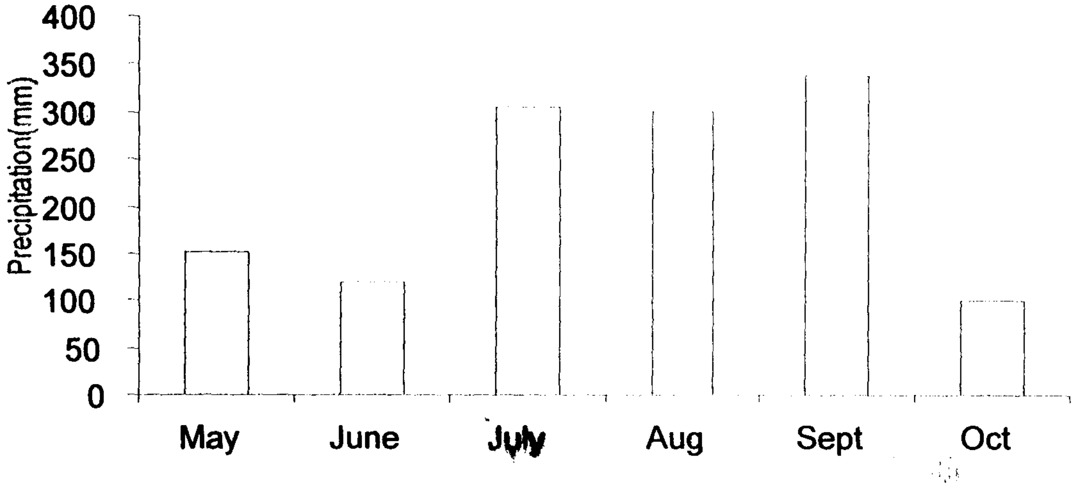


Fig 4.2 showing precipitation rate at various month.

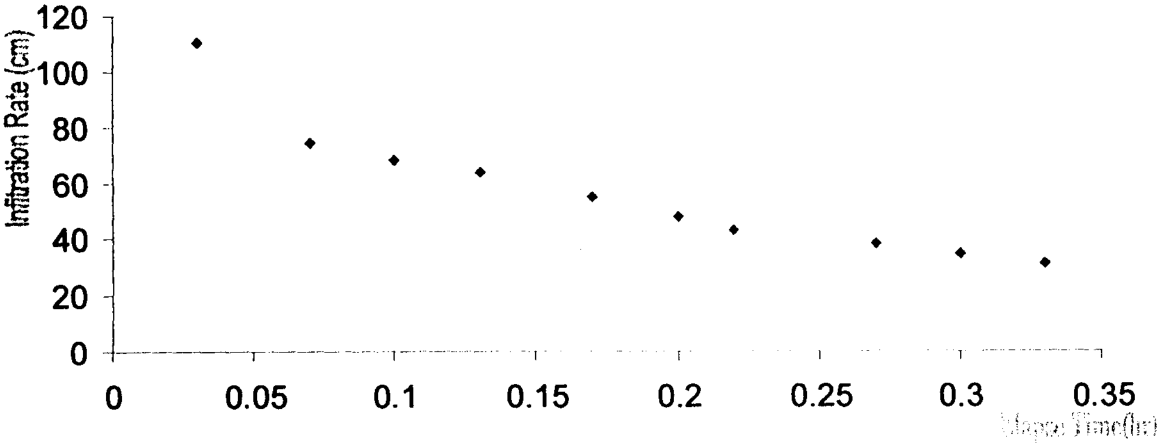


Fig 4.3 showing infiltration rate against time.

Table 4.2 Showing The result obtained from the infiltration practical

Serial number	Elapse time (hr)	Elapse time (cm)	Initial reading (cm)	Infiltration (cm)	Cumulative Infiltration (cm)	Infiltration rate (cm)
1	2	0.03	0.00	3.30	3.30	110
2	4	0.07	3.30	1.90	5.20	74
3	6	0.10	1.90	1.80	7.00	70
4	8	0.13	1.80	1.80	8.80	68
5	10	0.17	1.80	1.60	10.40	61
6	12	0.20	1.60	1.20	11.60	58
7	14	0.23	1.20	1.50	13.10	57
8	16	0.27	1.50	1.40	14.50	54
9	18	0.30	1.40	1.10	15.60	52
10	20	0.33	1.10	1.10	16.70	51

From the result obtained in table 4.1 shows that infiltration rate reduces with time. This is as a result of soil type in layer of soil profile.For infiltration rate to be adequate or fluent. Soil compacity, should be loosen, to enable the water flow freely between the voids. In addition it help crop root to penetrate easily. From the calculation of porosity in table 4.2 shows clearly that porosity also decreases at increase in soil depth. In addition the result as shown in figure 4.20 shows that infiltration decrease with time and stopped at saturation. At this stage, the water begins to accumulate at the top of the soil. Unless it is drained off, or evaporated, and this depend on the volume of the surface water.

Table 4.3 Showing the Results of moisture and bulk density

Depth (9cm)	Weight of wet soil (g)	Weight of oven dry soil (g)	Moisture content in dry base (%)	Moisture content in wet bases (%)	Wet bulk density (g/cm^3)	Dry bulk density (g/cm^3)	Available holding capacity	Available moisture holding capacity in crop root zone	Porosity (%)
0-20	322.70	255.74	26.18	20.75	1.78	1.41	36.91		-26.24
	304.55	270.82	12.45	11.08	1.68	1.50	18.68		-12.00
	303.24	269.88	12.36	11.00	1.67	1.49	18.42		-12.10
20-40	302.10	269.90	11.93	10.65	1.67	1.49	17.78	74.01	-12.10
	290.3	262.9	10.42	9.44	1.60	1.45	15.55		-10.35

	5	4							
	289.73	264.11	9.70	8.84	1.60	1.45	15.11		-9.60
40-60	288.45	263.51	9.47	8.65	1.59	1.45	13.73	48.44	-9.70
	286.26	262.69	8.97	8.23	1.58	1.45	13.00		-9.00
60-80	286.03	262.13	9.12	8.36	1.58	1.45	13.22	26.73	-9.00
	285.18	261.88	8.90	8.47	1.57	1.45	12.91		-8.30
								26.13	

Table 4.3

4.3 Analysis of moisture content

From the result obtained in table 4.2 as carried out at the chanchaga irrigation scheme site, and laboratory work. Shows clearly that moisture content was higher at the upper part of the slope, and this could be as a result of the pounding effect of depressed storage of precipitation. Consequently the low moisture content recorded at the lower part of the slope could be as a result of the seasonal stream channel situated at the bottom of the slope. At both upper and lower part of slope, the moisture content decreases with increases in depth until 60cm depth. The moisture content at that level starts to increase, which may be as a result of capillary rise.

It is observed also, that wet bulk density, moisture content in wet base, available moisture holding capacity, and porosity decreases with increase in soil depth.

May		June		July		August		September		October	
12th	25th	8th	20th	10th	25th	12th	25th	12th	25th	8th	18th
70	72	76	80	88	90	99	96	100	100	52	40
44	45	47	47	49	53	54	54	62	58	38	32
30	33	39	42	48	50	54	54	52	49	32	30

A	78	71	89	98	100	46
B	47	45	51	54	60	35
C	41	32	49	54	51	31

Table 4.4 Showing Trend of Water Table Fluctuation

Trend of water table fluctuation

From the graph of figure 4.4, the three well shows the water table depth fluctuation from May to October. It is seen that well A fluctuate at 6-8cm interval from May to July and 6cm from the month of July to September, with a higher fluctuation in October due to low amount of rainfall and slope. At the month of July to September the well was pounded with water, and this could be attributed to the depression around the well which usually store precipitation water. Well B fluctuates between (1cm -12cm) depth. Well c fluctuate between depth (1cm – 16cm) depth. Both well B and C was at their peak at the month of August and September due to the high precipitation at those periods. The graph of water level in well A, B, and C. against various month as shown in figure 4.4 indicate clearly that water flow from well A to well B and C, and this is why there is much water level at well A than in well B and C. as the water flow from area of higher volume to areas of lower volume. The deflection as shown on the graph at the month of October is due to low precipitation at that month which lowers by 188.4mm and the effect is shown by the water table depth as it depreciates by 23cm at well A, 11cm, at well B and 16cm at well C.

CHAPTER FIVE

5.0 Conclusion and Recommendation

5.1 Conclusion

This study as indicated from the result obtained at various water table depth and their fluctuation in relation to precipitation, as determined at the chanchager irrigation scheme shows clearly that at well A the water level rose above average from the month of May to September. And higher at the month of August and September such that the well was pounded with water, leading to water logging around the area of well A. This effect is due to the high amount of rainfall during those period and depression storage of precipitation around the surrounding area. Therefore a drainage channel should be constructed to help remove the excess water. At well B the water level rose above average at the month of July to September which is adequate to grow most food crops like maize, sorghum, millet, tomatoes, and vegetable. And at well C, the water level is slightly above average at the month of August and early to middle month of September, this is as a result of the well being located at upland of the site area.

Apparently with piezometric pipes installed at various point in the field showing the level of water, that particular area. can help tell irrigation time when the water level falls very low and likewise drainage time when the water becomes excess.

5.1 Recommendation

Areas surrounding well A should be drained only at the month of August and September to reduce the water logging effect. A drainage pumping or a surface drainage system should be employed to correct the area. Alternatively, crops which require lots of water and can survive in much water area like sugar cain and rice should be grown around well A. at well B the water level from July to September seem adequate for most food crops, but should be supplied with water from the month of May to June to enable the land meet up with crop water requirements while full irrigation is required during the season of the remaining month of the year. Finally around well C irrigation is slightly required from the month of May to June and October, while full term irrigation is needed at the rest of the month to enable continuous irrigation. During the wet season irrigation is slightly needed around well C from May to June and October. And not the whole season. In order to reduce cost, energy and time.

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Appendix 1 weather details 2007

Month	Temperature		Rainfall amount (mm)	Wind cup anemometer 9h to 9h next day (km)	Piche evaporation 9h to9h next day	Relative humidity
	Max.(^{0}c)	Min.(^{0}c)				
January	35.7	22.8	11.2	681.3	8.7	34
February	37.5	24.6	0.0	863.1	10.3	37
March	37.6	26.2	0.0	89.6	10.1	36
April	38.4	26.0	29.9	96.3	9.7	41
May	32.0	23.7	195.0	983.5	3.6	67
June	31.5	23.4	107.7	69.9	3.0	68
July	30.1	22.5	29.7	64.3	2.1	74
August	28.5	22.2	317.1	52.5	1.4	96
September	30.1	21.9	360.5	348	1.9	74
October	31.3	22.3	172.1	43.4	2.2	68
November	33.9	20.4	0.0	94.4	9.3	30
December	34.5	20.1	0.0	131.4	12.2	19

Appendix 2 Weather details for 2006

Month	Temperature Max. (^{0}c)	Temperature Min. (^{0}c)	Rainfall amount (mm)	Wind cup anemometer 9h to 9h next day	Piche evaporation 9h to 9h next day	Relative humidity
January	35.1	20.8	0.0	1166.2	12.2	24
February	37.0	23.6	0.0	1726.1	16.3	21
March	38.4	25.7	0.0	1429.1	15.7	26
April	37.0	26.2	32.2	1424.3	8.0	54
May	33.1	24.0	151.9	1064.6	4.1	65
June	31	22.1	194.4	799.2	2.6	71
July	29.8	20.7	210.3	756.3	2.2	71
August	27.8	20.4	211.4	655.4	1.8	77
September	30.3	20.4	241.5	663.6	2.1	71
October	31.7	21.6	72.6	424.4	2.5	65
November	34.2	21.0	0.0	661.2	6.6	45
December	35.6	18.8	0.0	805.2	10.1	24

Appendix 3 Weather details for 2005

Month	Temperature 9h to 9h next day		Rainfall amount (mm)	Wind cup anemometer 9h to 9h next day	Pitch evaporation 9h to 9h next day	Relative humidity
	Max. (^{0}c)	Min. (^{0}c)				
January	33.2	919.7	0.0	1985.4	14.7	20
February	38.3	25.4	0.0	1141.3	7.0	31
March	39.4	26.4	0.0	83.7	9.9	36
April	37.6	26.1	49.1	1137.5	8.2	46
May	31.4	22.9	207.0	79.9	2.9	70
June	29.4	22.5	294.2	61.9	1.7	76
July	28.8	22.7	127.8	65.9	1.9	74
August	30.5	22.2	216.6	63.9	2.1	71
September	31.5	21.8	94.8	45.5	2.7	64
October	35.1	20.3	0.0	63.6	7.8	33
November	35	20	0.0	81.3	10.3	37
December	29.5	18	0.0	83.3	10.0	35

Plate 1 taking reading from water table depth and piezometric installatio

Plate 2 taking reading from soil filtration

Plate 3 taking reading with weight balance

Plate 4 showing soil sample in oven