# Determination of Surface and Ground Water Quality of the Chanchaga Irrigation Scheme Niger State - Nigeria

By

BABANGIDA SALIHU DALHA
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# APPROVAL PAGE

This project have been read and approved by the undersigned as having met the requirement for presentation of project by the Department of Agricultural Engineering, Federal University of Technology Minna.

ENGR. (DR.) EGHAREVBA ______________________________
PROJECT SUPERVISOR

ENGR. (DR.) D. ADGIDZI ______________________________
HEAD OF DEPARTMENT

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BABANGIDA S. DALHA

# DEDICATION

Dedicated to my mother and members of my family whose increased love brighten my days.

## ABSTRACT

This work present the analysis of surface and ground water quality of Chanchaga irrigation schem. With a view to determining the suitability of the water for irrigation purpose. Physio-chemical and bacteriological parameter like PH, electrical conductivity, magnesium, calcium, chloride, boron, E. Coli, Faecal Coliforms were examined. The result of the analysis showed that the surface samples (SF1, SF2) and ground water samples (GWS1, GWS2) have tolerable salt levels, generally low conductivity. Except the surface water samples have high bacteriological contaminant during the raining season.

The water is therefore suitable for dry season irrigation farming.

CHAPTER ONE

## 1.0 GENERAL BACKGROUND OF THE STUDY

There is no doubt that water is an important natural resource of any country. The role of water in agriculture, industries and domestic activities cannot be over estimated. Therefore water is regarded as life and that no water no life.

The most important sources of surface water for irrigation is normally from the rivers. Therefore this made it necessary to assess the quality of the water before use for irrigation purposes. The quality of the water is of primary important in irrigation. For any successful irrigation agriculture, therefore adequate sources and quality of water must be provided. It is not every water that is good for irrigation. The quality of irrigation water, depends on the amount of suspended sediment in the water. To this end, the study is designed to analyse the quality of River Chanchaga for dry season farming.

## 1.1 DESCRIPTION OF PROJECT LOCATION

Chanchaga irrigation scheme is located at Chanchaga Village at the outskirt of Minna metropolis the capital of Niger State. River Chanchaga has been the main source of water for the irrigation scheme for dry season farming. The scheme was established in 1975 but become fully functional in the year 1978.

The scheme has a total area of twelve hectares. Out of this wild flooding system is adopted for eight hectares, and four hectares designed for gravity system using main canal and field channels (NDAKO 1998).

## 1.2 CLIMATE OF THE PROJECT AREA

The area has two distinct seasons of wet and dry. The wet season commences around the month of April with its peak about the month of August. The dry season sets in as the raining season gradually withdraws, about the month of October. The temperatures being usually very high, hence resulting in high evapotransporation.

## 1.3 AIMS AND OBJECTIVES OF THE STUDY

The aims and objectives of this study are:

1. To analyse the quality of River Chanchaga for dry season farming in Chanchaga irrigation scheme.
2. To examine the factors influencing water quality
3. To estimate the quantities of carbonates, bicarbonates, chlorides, electrical conductivity, PH, calcium and potassium contents in River Chanchaga.

## 1.4 SCOPE OF STUDY

The scope of this project is to:

1. Identify the sources and quality of water available for irrigation purpose in Chanchaga irrigation scheme.
2. Analysis of the water to ascertain its quality for man, animals and irrigation purposes.

In an ideal situation, the analysis of the river water is supposed to be carried on a daily or weekly basis for effective monitoring. But due to much financial involvement and time constraints, the number of the sample analysis has been limited to two, one for a month, for the duration of two months (January and February) which falls within the dry season period.

CHAPTER TWO

## 2.0 LITERATURE REVIEW

To successfully carry out this study, a theoretical frame work becomes necessary. In order to explore the view point of scholars in respect of irrigation water, bearing in mind the main focus of the research work. An analysis of the water quality of River Chanchaga and its suitability for use in the Chanchaga irrigation scheme.

## 2.1 IRRIGATION DEFINITION

Water and its quality has been a subject of research and discussion by soil and water engineers for many years. Therefore it is not surprising when we consider the role of water in many sectors of human endeavour. One of the area in which water is mostly used is irrigation. Irrigation has been generally defined as the application of water to the soil for the purpose of supplying the moisture essential for plant growth. It is the application of water to the soil for the following purposes:

(i) To add water to soil to supply the moisture essential for plant growth.

(ii) To provide crop insurance against short duration of draught

(iii) To cool the soil and atmosphere thereby making more favourable environment for plant growth.

(iv) To reduce the hazard of frost

(v) To wash out or dilute salt in the soil

(vi) To reduce the hazard of piping.

## 2.2 SOURCES OF IRRIGATION WATER

Sources of irrigation water to bring about plant growth can be classified as surface and ground water sources.

Michael (1978) maintained that the main sources of surface water is precipitation in the form of rainfall or snowfall which runs from precipitation drains through streams and rivers and collect in surface depression forming tanks or ponds which serve as reservoirs. This can then be diverted through canal system for irrigation.

Mazumda (1983) further maintained ground water being naturally filtered, is generally superior to surface water except in certain situation where the salt content is very high.

## 2.3 QUALITY OF IRRIGATION WATER

Water quality refers to the degree of perfection of particular water based on the context of consideration. The quality of irrigation water according to Schwab (1966), depend on the amount of suspended sediments and chemical constituents in the water and that the effect of sediment is influenced by the nature of the material and soil condition of the irrigated area. Textural composition and fertility may be improved if sediment is deposited on the sandy soil. On the other hand, where sediment is derived from eroded areas, soil fertility or permeability may decrease.

Sedimentation in canals or ditches may be serious, resulting in higher maintenance cost. Normally ground water or water from reservoirs does not contain enough water or water trouble in irrigation water. It has been observed that sediment is the most important pollutant from agricultural land that get into streams and reservoirs causing eutroplication in lakes and increasing the cause of treatment for domestic and municipal supplies. Soil particles indicates an erosion loss and carry attached many chemicals ions such as phosphorous and potassium.

Schwab (1966) and Michael (1978) pointed out that chemical properties of water effect its suitability for many uses. According to them, the most important characteristics of irrigation water are:

a) Total concentration of soluble salts
b) Proportion of Sodium to other cations
c) Concentration of potentially toxic elements
d) Bicarbonate concentration of calcium, phosphorus and magnesium.
e) Total soluble salt as shown by electrical conductivity of water express (EC) million per centimeters.

The relationship between conductivity and part per million of soluble salts indicates the proportion of sodium hazard of the water is indicated by Sodium Adsorption ratio (SAR)

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

Where:- $Na^+$, $Ca^{++}$ and $Mg^{++}$ represent the concentration in milliequivalent per litre of the respective ions.

Schwab position was strengthened by Gayer (1977) who reported that for a successful design and utilization of any irrigation scheme cognisance should be given to the prospective quality of the source of irrigation water. Similarly, Mazumba (1983) reported that the quality of irrigation is judged by both total concentration of ions and the individual ions present, and that the major cations in water are calcium ($Ca^{++}$), Sodium ($Na^+$), potassium ($K^+$), Iron (Fe) and boron (B); while the anions include carbonate ($Co_3^-$), bicarbonate ($HCo_3^-$), chloride ($Cl^-$), sulphate ($SO_4^-$), phosphate, Nitrate and Nitrites.

Also, in a related development Michael (1978) stressed the effect of sediment in irrigation water and warned that salt deposits can harm the operation of an irrigation scheme by causing frequency of canal maintenance and blocking of pipe and water ways.

## 2.4 CHARACTERISTICS OF WATER

Characteristics of water are classified as physical, chemical and biological.

### 2.4.1 Physical Characteristics of Water

Tebbut, (1977) stated that the physical properties of water in many cases can relatively be measured with ease and that some may be readily observed even by a layman. He further discussed the physical properties of water as follows:

a) Temperature: Temperature is important for its effects on other properties. For example speeding up of chemical reactions, reductions in solubility of gases, amplification of tastes and odour.

b) Taste and Odour: Due to dissolved impurities, often organic in nature, for example, phenol and chlorophenol, those properties are subjective properties which are difficult to measure.

c) Colour: Even pure water is not colourless. It has a pale green-blue tint in large volumes. It is necessary to differentiate between true colour due to materials in solution and apparent colour due to suspended matter. Natural yellow colour in water from upland catchment is due to organic acids which are not in any way harmful, being similar to tanaic acid from tea.

d) Turbidity: The presence of colloidal solids gives liquid a cloudy appearance which is aesthetically un-attractive and may be harmful. turbidity may be due to clay and silt particles, discharges of sewage or industrial wastes, or to the presence of large number of micro-organisms.

e) Solids: Solids may be present in suspension and/or in solution and may be divided into organic matter and in-organic matter.

f) Electrical Conductivity:

The conductivity of a solution depends on the quantity of dissolved salts present and for dilute solutions it is approximately proportional to the total dissolved solids (TDS) content.

$$K = \frac{\text{Conductivity (seimens/meter)}}{\text{TDS (In Mg per litre)}}$$

Knowing the value of K for a particular water, the measurement of conductivity provides rapid indication of total dissolved solids. He also mentioned other characteristics as Radioactivity, Density and Viscosity.

### 2.4.2 **Chemical Characteristics**

Tebbut (1977) identified the chemical properties of waters as follows:

a) PH:- The degree of alkalinity or acidity of a sample is measured on the PH scale which actually measures the concentration of hydrogen ions present.

$$H_2O = H^+ + OH^-$$

$$PH = -Log_{10} (H^+)$$

Since only about $10^{-7}$ molar concentration of $(H^+)$ and $(OH^-)$ are present at equilibrium, water concentration may be taken as unity. Many chemical reactions are controlled by pH and biological activity is usually restricted for a fairly narrow pH range of 6 to 8.

b) Oxidation - Reduction Potentials (ORP):-

In any system undergoing oxidation, there is a continual change in the ratio between the materials in the reduced form and those of the oxidised form.

c) Alkalinity: This is due to the presence of carbonates $(CO_3)$, bicarbonates $(HCO_3)$, or hydroxide (OH) ion. Most of the alkalinity in water is due to $HCO_3$ produced by the reaction of ground water or limestone.

$$\underset{\text{(insoluble)}}{CaCO_3} + H_2O + \underset{\text{(from soil Bacteria)}}{CO_2} \text{ --- } \underset{\text{(Soluble)}}{Ca(HCO_3)_2}$$

Alkalinity is useful in water and wastes in that it provides buffering to resist change in pH. It is normally divided into caustic alkalinity above pH 8.2 and total alkalinity above pH 4.5. Alkalinity can exist down to pH 4.5 because of the fact that bicarbonates are not completely neutralized until this pH is reached. the amount of alkalinity present is expressed in terms of $CaCo_3$.

d) Acidity: Most natural water and domestic sewage are buttered by $Co_2$ - $HCo_3$ system. Carbonic acid is not fully neutralised until pH 8.2 and will not depress pH below 4.5. This $Co_2$ acidity is in the pH range of 8.2 to 4.5. Mineral acidity occurs below pH 4.5. Acidity is also expressed in terms of $CaCo_3$.

e) Hardness: This is a property of water which prevent lather formation with soap, and it produces scale in hot water system. It is due mainly to metallic ions Ca and Mg. Though Iron (Fe) and Tin (Sr) are also responsible, the metals are usually associated with $HCo_3$, $So_4$, Cl and Na. If high concentration of Na and K salts are present, the non carbonate hardness may be negative since salts could form alkalinity without producing hardness.

f) Dissolved Oxygen:

Oxygen is a most important element in water quality control. Its presence is essential to maintain the higher forms of biological life and the effect of waste discharge on a river is largely determined by the oxygen balance of the system.

g) Oxygen Demand:

Organic components are generally unstable and may be oxidised biologically or chemically to stable, relatively inert end product such as $Co_2$, $No_3$ and $H_2O$.

h) Nitrogen: Is an important element in biological system. Biological treatment of wastes can only proceed in the presence of sufficient Nitrogen.

i) Chlorides: Chlorides are responsible for brackish taste in water and is an indicator of sewage pollution because of the chloride content of urine.

Note that, there are many other specialised chemical characteristics that may be assessed when dealing with industrial waste waters. Example; Toxic metals, cyanide, phenol, oils and grease etc.

### 2.4.3 Biological Characteristics

Almost all organic wastes contain large number of micro-organisms, hence biological water analysis provides a most sensitive quality parameter tebbut (1977).

## 2.5 SUITABILITY OF IRRIGATION WATER

The suitability of irrigation water, according to Michael (1978), can be expressed as:

$$SIW = F(QSPCD)$$

Where:-

| | | |
|---|---|---|
| Q | = | Quality of irrigation water |
| S | = | Soil type |
| P | = | Salt tolerance characteristics of the plant |
| C | = | Climate |
| D | = | Drainage characteristics of the soil |

Other factors that indirectly affect the suitability of irrigation water are:

(i) Depth of water table

(ii) Present of hard pan of lime or clay

(iii) Calcium carbonate content in the soil

(iv) Potassium nitrate ions

He further explained that, it is the actual salt concentration near the root zone which determines the suitability of an irrigation water rather than the chemical properties of the water alone.

## 2.6 EFFECT OF POOR IRRIGATION WATER

### 2.6.1 Effects on Plant:

Michael (1978) identified the effect of poor irrigation water on plant as follows:

a) Salinity Problem: This problem occurs if the total quality of salt in the irrigation water is high enough for salt to accumulate in the crop root zone to the extent that yields are affected as a result of crop having difficulty in extracting enough water from the salty soil solution and thus resulting in slow growth.

b) Toxicity Problem: This problem occurs when certain constituents such as Boron, Chloride and Sodium ions in the water are taken up by the crop and accumulated in quantity - that results in reduced yield.

c) Others: Problem like excessive regulative growth, lodging and delayed crop maturity resulting from excessive Nitrogen in the water supply, while deposits on fruits or leaves due to sprinkler irrigation with high bicarbonates water, and abnormalities indicated by an unusual pH of the irrigation water occur with sufficient frequency.

2.6.2 **Effect on Soil:**

Michael (1978), also classified poor irrigation water effect on the soil as follows:

a) Sodium Hazard: In irrigation soil, the cations present in the irrigation water as soluble salt take part in exchange reaction with the soil hence resulting in some cases in increase in sodium content of the soil which could lead to salinity.

b) Salinity Hazard: When the salt distribution of the soil solid profile becomes excessive, crop growth is deteriorated due to the nature and amount of cations and swelling characteristics.

c) Magnesium Hazard:

When magnesium is present in the irrigation water than calcium, the degree of magnesium saturation is increased. This result in the decrease in soil productivity.

d) Permeability Problem:

This problem occur when the rate of water infiltration into and through the soil is reduced by effect of specific salt sodium ($Na^+$) or lack of salts ($Co_3$ and $HCo_3$) in water to such an extent that the crop is not adequately supplied with water and yield is reduced. Crusting of seed beds, water logging of surface soil and accompanying diseases, salinity, weed, oxygen, and nutritional problems will be experienced.

## 2.7 RIVER WATER

### 2.7.1 Properties of Rivers

Most tropical rivers according to Oni (1987), are often turbid and slow moving or with critically non-existent flow with a high silt load especially in the dry season, a condition which reduces the available oxygen while heavy rains in the catchment causes high flow. This dry season condition, he further inferred, renders the dilution provided to minimal leading to undiluted effluents.

### 2.7.2 Sources of Pollution

River water pollution is most commonly associated with the discharged of effluent from sewage treatment plants, drains and factories (water house, 1982). In a related development, Oni (1987) identified soil manure and organic debris washed into streams and rivers, and drains from agricultural lands which introduce pesticides like DDT and other chlorinated hydrocarbons, as important sources of river water pollution. He further attributed some level of pollution to the increase in the use of fertilizer as a source of Nitrates in streams and rivers.

Differences in the geological formation between and within sources of water affect its quality, giving rise to variable amount of solutes in the water depending on rock type among other factors.

## 2.8 BASIC ANALYTICAL METHODS OF WATER

Simple analysis in the field of water quality control are in general, according to Tebbut (1977), based on relatively straight forward analytical principles, adding that quantitative analysis may be carried out by gravimetric, volumetric or calorimetric methods in addition to certain parameters that may be measured using special electrodes.

## 2.9 PREVIOUS WORKS ON RIVER CHANCHAGA

The researcher has intensify to find out whether any work was done by other people previously on the quality of River Chanchaga water for use in dry season farming. To his knowledge there was none.

## 2.10 PRESENT INVESTIGATION

This analysis seeks to measure the amount of carbonates, chlorides, potassium, sodium, calcium the electrical conductivity and pH of the river and use results to estimate the various hazard that might be associated with the water. Figures 2.1, 2.2 and 2.3 respectively show the Bicarbonate content, percentage exchangeable sodium and electrical conductivity of River Chanchaga water as reported by writer (2002).

CHAPTER THREE

# METHOD OF SAMPLING AND ANALYSIS

## 3.1 SAMPLE COLLECTION

Water samples were collected from River Chanchaga and two wells sink within the Chanchaga irrigation scheme at the outskirts of Minna town. the samples were collected on mid January and at the beginning of February, 2002.

| MONTH | DATE | MEAN TEMPERATURE | TIME |
|---|---|---|---|
| January | 18 January 2002 | 27°C | 11.00am |
| February | 1 February 2002 | 28°C | 12.00 noon |

Table 3.1.1 shows sampling period, temperature and time.

## 3.2 METHOD OF SAMPLING

Plastics containers were used in collecting samples. The containers were initially washed thoroughly using detergent before rinsing with tap water and finally rinsing several times with distilled water. At each sample site the containers were rinsed several times with the irrigation water.

The water temperature was taken using clinical thermometer. The samples was taken approximately from the entrance into the scheme and at the intake location (ie. for the surface samples), while that of the wells was collected at the depth of 0.5m, 1.00m, 2.00m and 2.50m respectively. The samples were collected by dipping the 1.5 litres containers below the water level and the containers were tightly closed and taken to the laboratory for analysis. For each surface sample collected was clearly marked as follows:-

-Name of water body

-Location of the sampling position

-Date and time of collection

-Name of sample collector

-Temperature of the water

While that of the wells was also identified as:-

-Depth of the well

-Diameter of the well

-Method of collection

-Water level

-Yield of the well approximately

-Water temperature at the time of collection

-Name of collector

-Date of collection

## 3.3 SAMPLE PRE-TREATMENT

For the research to be able to achieve its ultimate objective, the samples collected were made to undergo pre-treatment. In this, the samples were kept in an air-conditioned room to reduce the microbial activities. The samples were then moved to laboratory for analysis.

## 3.4 METHOD OF ANALYSIS

The main aim of conducting the analysis was to ascertain the suitability of both samples for the existing irrigation scheme. In the analysis of the samples, emphasis was more on the important parameters that are capable of affecting the quality of any irrigation water world over. Those parameters analysed includes:

- Determination of pH (Determines the degree of acidity or alkalinity of the water samples. Where pH 1-6.9 is considered acidic, pH 7 neutral and above pH 7 is referred as alkaline.

- Determination of Total Dissolved Solids (TDS)

- To know the proportion calcium ($Ca^{2+}$), Magnesium ($Mg^{2+}$) Sodium ($Na^{+}$) and Chloride ($Cl^{-}$).

- $HCo_3$ (Bicarbonate) concentration

- Tests was also conducted to determine the level of these micro elements: Iron ($Fe^{2+}$), Manganese ($Mn^{2+}$) and Boron ($Br^{-}$).

The analysis was conducted within two (2) days.

The above parameters determination was accomplished by the use of a multi parameter spectrophotometer.

## 3.5 PROCEDURE OF OPERATION

12V DC adaptor was plugged into the outlet to ON the meter by means of ON/OFF button.

The meter will first perform an LCD self diagnostic test by displaying a full set of figures. Then it will show a scrolling C100 message.

When the LCD displays "__________", the meter is ready. On the secondary LCD "P1" will appear to inform that the first parameter measurement procedure can be performed.

Press the program "t" and program key to select the desired parameter.

After which the measurement procedure for each parameter was then adopted.

Note that, the test measurement procedures are the same except that different types of reagents are required for each parameter determination.

## 3.6 DETERMINATION OF ELECTRICAL CONDUCTIVITY AND TEMPERATURE

Material used here are:

Reagents: Deionized water, potassium chloride

Apparatus: Thermometer, conductivity meter, and beakers

Procedure: Standard solution (potassium chloride) was placed in a water bath and the temperature of calibrated standard solution has equilibrated, the electrodes was placed in the solution and left for 5-10 minutes. The conductivity was set to 0-2000 microsiemens and adjust to 1413 microsiemens. The instrument was set to the cell contents and the sample was then read. The conductivity meter automatically displays the readings.

## 3.7 SULPHATE, DETERMINATION AND CORRECTION FOR THE HARDNESS OF THE WATER

These are determined by using lovibond mini kit, a modified form of the tablet count method.

## 3.8 BACTERIOLOGICAL EXAMINATION

This test is done to determine organisms which are called coliform and most sensitive is E. Coli which is found in water and their presence indicates contamination by faeces.

## 3.9 YIELD ESTIMATION OF THE UNDERGROUND WATER

The yield of the two wells sink was known through the adoption of direct field method of measurement.

**Apparatus used are:**

20 litres bucket, plastic cup and a wrist watch.

**Procedure:**

After digging the wells the water that was initially reached was removed from the wells completely. After which the wells were allowed to yield for 30 minutes. During the period 4 x 20 litres bucket are removed.

# CHAPTER FOUR

## DATA ANALYSIS

### 4.1 **Result and Discussion**.

The results of the test carried out are presented in Table 4.1a

And 4.1b for surface and ground water respectively.

| Month | Surface Water Sample (SFS) | PH | EC Umbos cm | Ca2+ Mg/I | Mg2+ Mg | Na+ Mg/I | K+ Mg/I | HCO3 Mg/I | CL Mg/I | Br Mg/I |
|---|---|---|---|---|---|---|---|---|---|---|
| January | SFS1 | 7.0 | 12 | 8.6 | 3 | 6.7 | 2.5 | 0 | 27 | 0.0 |
| February | | 6.9 | 12 | 8.3 | 3.6 | 6.0 | 2.6 | 0 | 27 | 0.0 |
| January | SFS2 | 7.1 | 11.5 | 8.6 | 3.2 | 7.2 | 2.5 | 0 | 27 | 0.0 |
| February | | 7.0 | 11.8 | 8.0 | 4.1 | 5.3 | 2.81 | 0 | 28 | 0.0 |

Table 4.1a shows the laboratory results of surface water analysis of River Chanchaga

| Month | Ground Water Sample (GWS) | Dept. In meters | PH | EC Umbos cm | Ca2+ Mg/I | Mg2+ Mg | Na+ Mg/I | K+ Mg/I | HCO3 Mg/I | CL Mg/I | Br Mg/I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $GWS_1$ | 2.5 | 6.8 | 21.2 | 20 | 5.6 | 3.7 | 2.2 | 0 | 96 | 0.13 |
| February | $GWS_1$ | 2.5 | 6.5 | 18.32 | 20 | 4.3 | 3.5 | 2.2 | 0 | 95 | 0.18 |
| January | $GWS_2$ | 1.0 | 6.3 | 27.5 | 57 | 8.99 | 2.8 | 1.8 | 0 | 72 | 0.01 |
| February | $GWS_2$ | 2.0 | 6.1 | 31.3 | 55 | 7.8 | 2.8 | 1.8 | 0 | 71 | 0.04 |

Table 4.1b shows the laboratory results of Ground analysis of Chanchaga irrigation Scheme.

4.11 PH Value

The water is neutral in mid January and early February for the surface sample while that of ground water samples was acidic.

However if the ground water is to be used as a source of irrigation water in the scheme, there is the need for the use of lime fertilizer to reduce. The acid content after prolong irrigation in the scheme.

### 4.1.2 Electrical Conductivity (EC) Umhos/cm

This is the ability of water to conduct electricity and is expressed in umhos/cm. EC and salt concentration are proportion to one another. Therefore since the electrical conductivity of both samples lies within 0-100 umhos/cm, the water from the river and wells within the scheme can be used for irrigation with most crops as the samples have electrical conductivity with low salinity hazard.

### 4.1.3 Calcium ($Ca^{2+}$) and Magnesium ($Mg^{2+}$)

Calcium and Magnesium are some of the basic and secondary nutrient elements required for tissue formation and production of health citrus tress. Therefore when found not in sufficient quantities they must be supplemented through the use of fertilizer materials containing calcium and magnesium. the concentration of these elements are found to be within the permissible limit of less than 50mg/litres.

### 4.1.4 Chloride ($Cl^-$)

The permissible level of chloride in any is 200mg/l. Therefore as regards to level of chloride, the quality of the two water samples are okay.

4.1.5 **Potassium ($K^+$)**

This is necessary for morphological performance of any plant. From the result of the analysis, the potassium contents in both the surface samples and ground water samples was found to be desirable as is within the range of 0.2 - 55mg/litres.

4.1.6 **Sodium ($Na^+$)**

Sodium is one of the undesirable elements in an irrigated soil. this is because, in its presence, nutrients can be washed out from the soils rather easily and plant cannot assimilate nutrients because of the toxicity of sodium salts.

4.1.7 **Sulphate ($SO_4^-$)**

The desirable level of sulphate in any irrigation water is given as 200mg/litres. From the results of the analysis of both samples, the maximum concentration of 14mg/litres was registered. Therefore this indicate how qualitative the water is for use in the scheme.

4.1.8 **Boron (Br)**

From the water samples the Boron contents was found to be appreciable. Since it is within the permissible limits.

4.1.9 **Total Dissolved Solid (TDS)**

The total percentage of total dissolved solids present in water may indicate how suitable is that water for irrigation purposes. When present in large quantity they purport to increase osmotic pressure of the soil solution thereby causing high soil moisture stress in the root zone which in turn may hinder the plant growth and affect crop yield.

Therefore, this implies that during this period of year, the water salinity is low. It is acceptable for irrigation. Also if these wells are to be sighted within the inland valley of the scheme, the yield level will surely improve. This will make the ground water satisfactory in terms of quantity and availability. It is also observed that the water has also low percentage of sodium. It is therefore of permissible quantity for the soils of the scheme, but precaution should be taken so that excess exchangeable sodium does not develop.

**Calculation of Sodium Adsobtion Ratio (SAR)**

The result obtained are presented in table 4.1a and 4.1b.

The calculation for SAR forevery period of the sampling is shown below:

January: $SFS_1$

Sodium ($Na^+$) - 6.7 mg/l

Calcium ($Ca^{2+}$) - 8.6 mg/l

Magnesium ($Mg^{2+}$) - 3 mg/l

$$SAR = Na^+/vCa^{2+} + mg^{2+})/2$$

$$= 6.7/v(8.6 + 3)/2$$

$$= \frac{6.7}{2.408} = 2.78 \text{ mg/l}$$

February: $SFS_1$

Sodium ($Na^+$ ) - 6.0 mg/litre

Calcium ($Ca^{2+}$) - 8.3 mg/litre

Magnesium ($Mg^{2+}$) - 3.6 mg/litre

$$SAR = Na^+/v(Ca^{2+} + Mg^{2+})/2$$

$$= 6.0/v(8.3 + 3.6)/2$$

$$= \frac{6.0}{2.439} = 2.46 \text{ mg/l}$$

January: $SFS_2$

$$SAR = Na^+/v(Ca^{2+} + Mg^{2+})/2$$
$$= 7.2/v(8.6 + 3.2)/2$$
$$= \frac{7.2}{2.428} = 2.97 \text{ mg/l}$$

February: $SFS_2$

$$SAR = Na^+/v(Ca^{2+} + Mg^{2+})/2$$
$$= 5.3/v(8.0 + 4.1)/2$$
$$= \frac{5.3}{2.459} = 2.16 \text{ mg/litres}$$

January $GWS_1$:

$$SAR = Na^+/v(Ca^{2+} + Mg^{2+})/2$$
$$= 3.7/v(20 + 5.6)/2$$
$$= \frac{3.7}{3.577} = 1.03 \text{ mg/l}$$

February $GWS_1$:

$$SAR = 3.5/v(20 + 4.3)/2$$
$$= \frac{3.5}{3.485} = 1.0 \text{ mg/l}$$

January $GWS_2$:

$$SAR = 2.8/v(57 + 8.99)/2$$
$$= \frac{2.8}{5.744} = 0.48\text{mg/l}$$

February $GWS_2$:

$$SAR = 2.8/v(55 + 7.8)/2$$
$$= \frac{2.8}{5.603} = 0.49\text{mg/l}$$

Remember:

SFS - Surface Water Sample
GWS - Ground Water Sample
SAR - Sodium Adsoption Ratio

# CHAPTER FIVE

## CONCLUSION AND RECOMMENDATION.

### 5.1 CONCLUTION.

Based on the result of the analysis carried out, the water from river Chancahga and ground water within the scheme are safe as a source for irrigation water at mid of January and mid February or dry season faming. Also judging by the level of phosphate and nitrate, which are general low, the water is good for drinking and domestic purpose.

### 5.2 RECOMMENDATIONS.

Even though the PH of the surface sample was found to be okay, but regular cheek of this parameter in our irrigation waters is very important to prevent the possibilities of acidity or alkalinity.

To create a reservoirs of adequate capacity into which both the river Chanchaga water and wells water can be pumped. From such reservoirs, the water whose quality has been found suitable for irrigation purposes can be tapped and used for irrigation in time of danger.

To acquire another farm land further down the steam of the river Chanchaga. Irrigation suitability map should be produced and should include recommendations for various type of irrigation.

The chemical analysis of the soil and water samples should be carried out periodically.

To maintain ground water facilities within the scheme, which can be used to supplement the surface reservoir.

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# APPENDIX

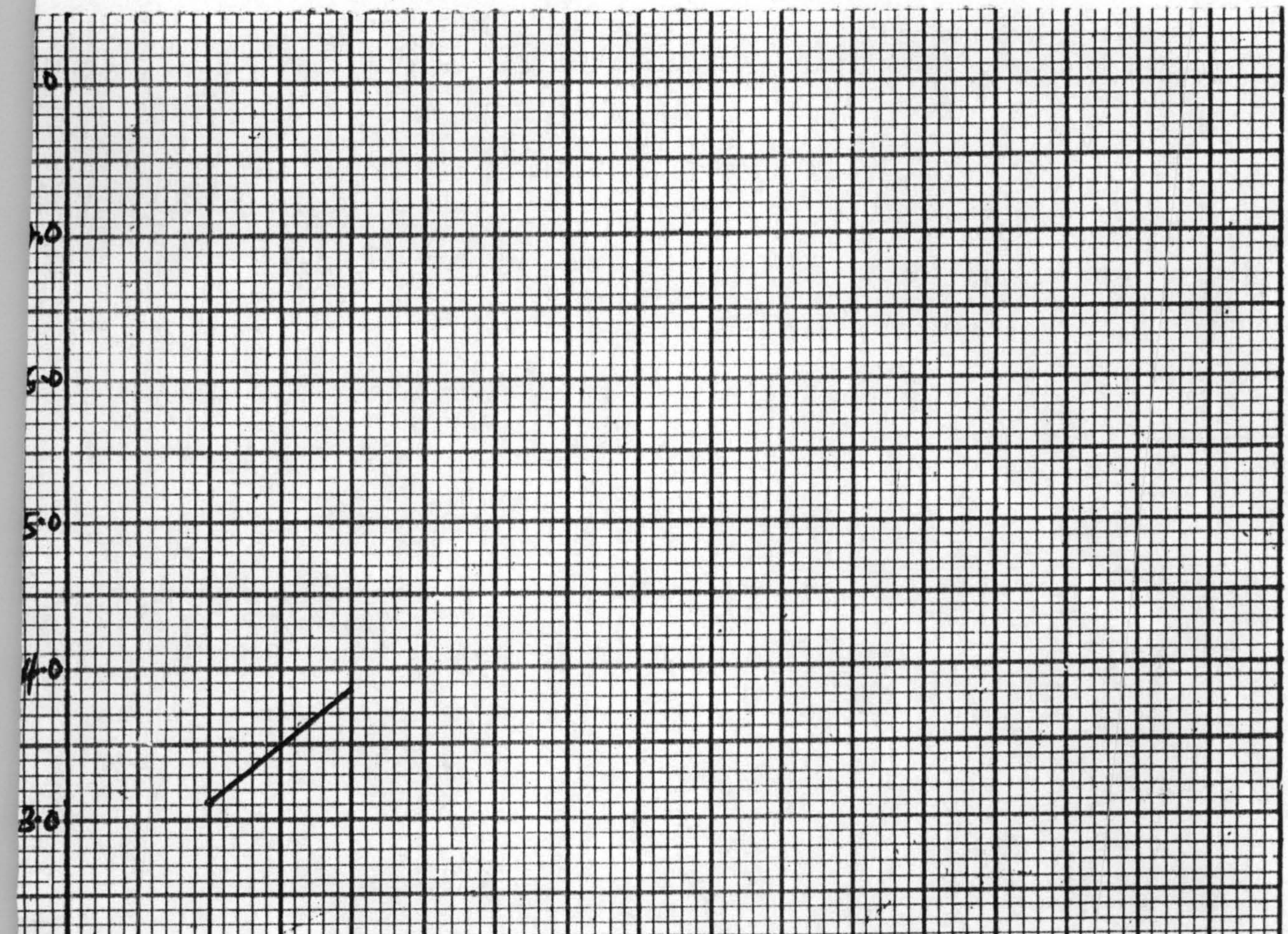


FIG. 4.19: MEAN EXCHANGEABLE MAGNESIUM PERCENTAGE IN RIVER CHANCHAGA AT CHANCHAGA IRRIGATION SCHEME

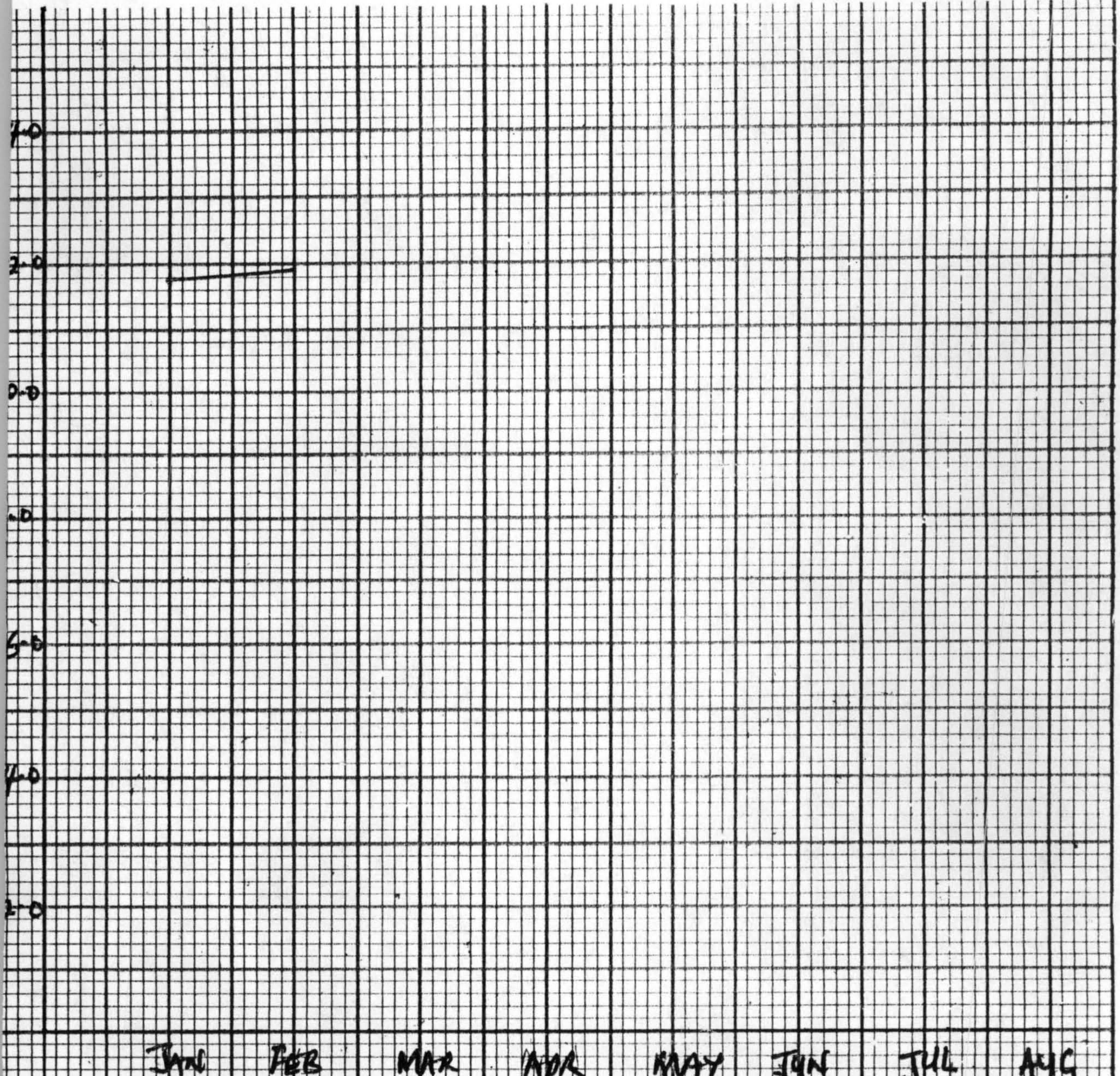


FIG. 4-12: MEAN CONCENTRATION OF SALTS IN RIVER CHANCHAGA IRRIGATION FARM LOCATION

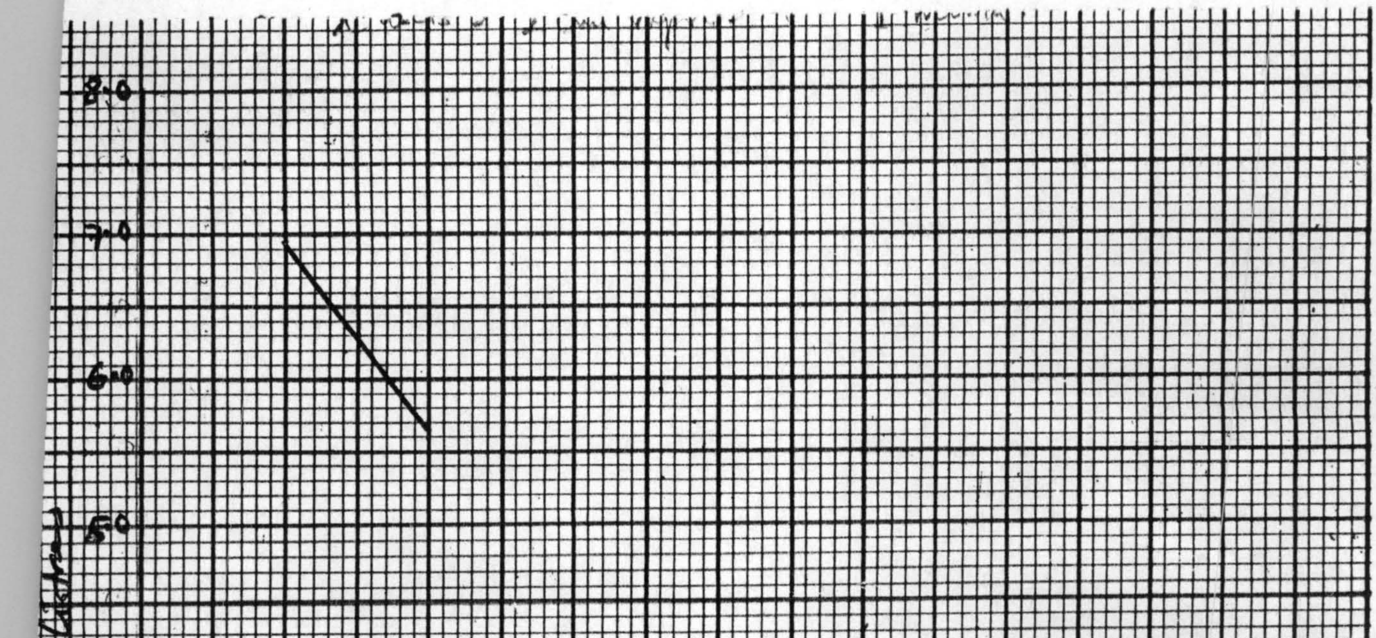


FIG. 4.10; MEAN MONTHLY EXCHANGEABLE SODIUM PERCENTAGE IN RIVER CHANCHAGA IRRIGATION SCHEME LOCATION

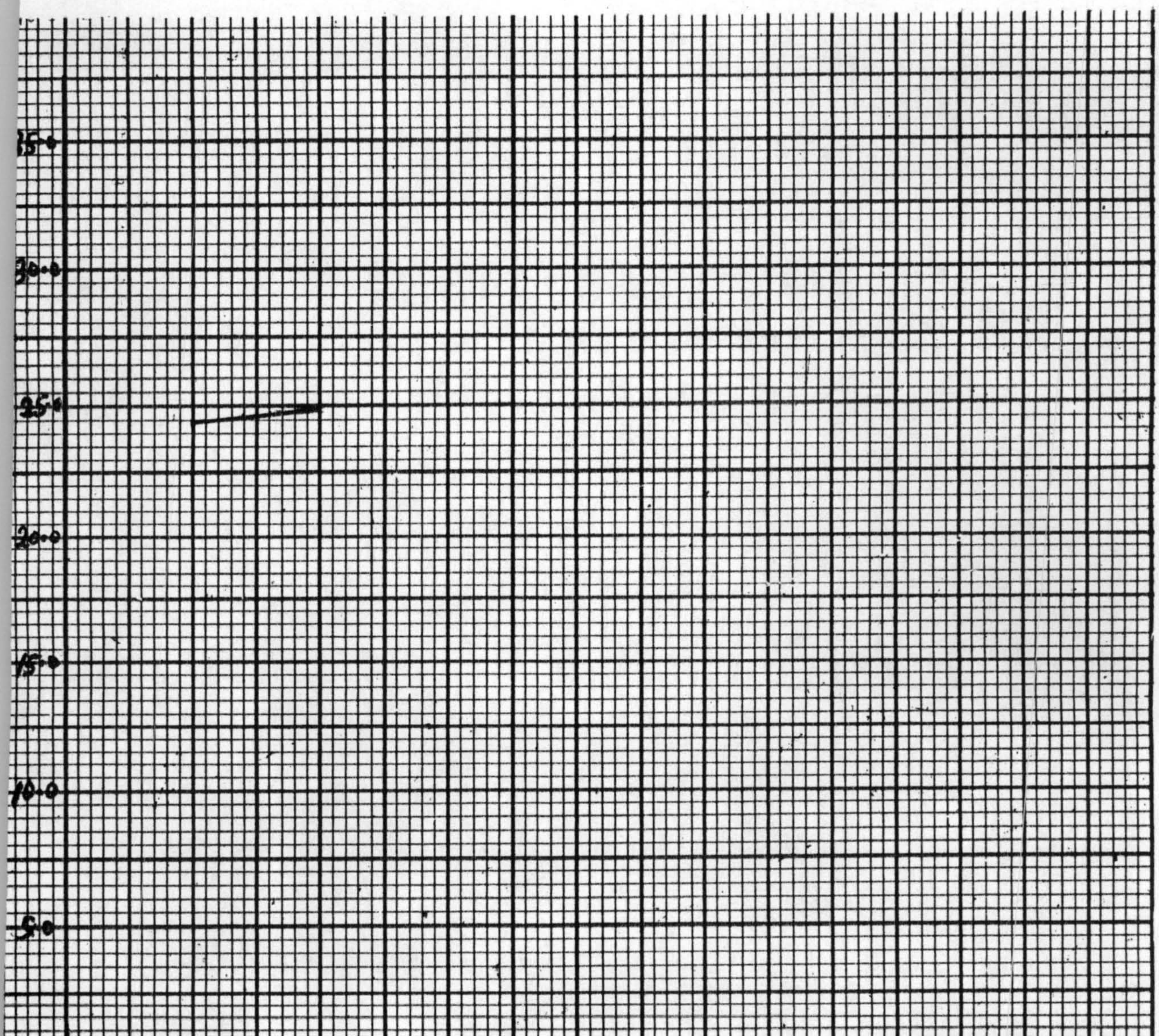


FIG. 4.1b: MEAN TOTAL CONCENTRATION OF SALT IN THE GROUND WATER FOUND WITHIN CHANCHAGA IRRIGATION SCHEME

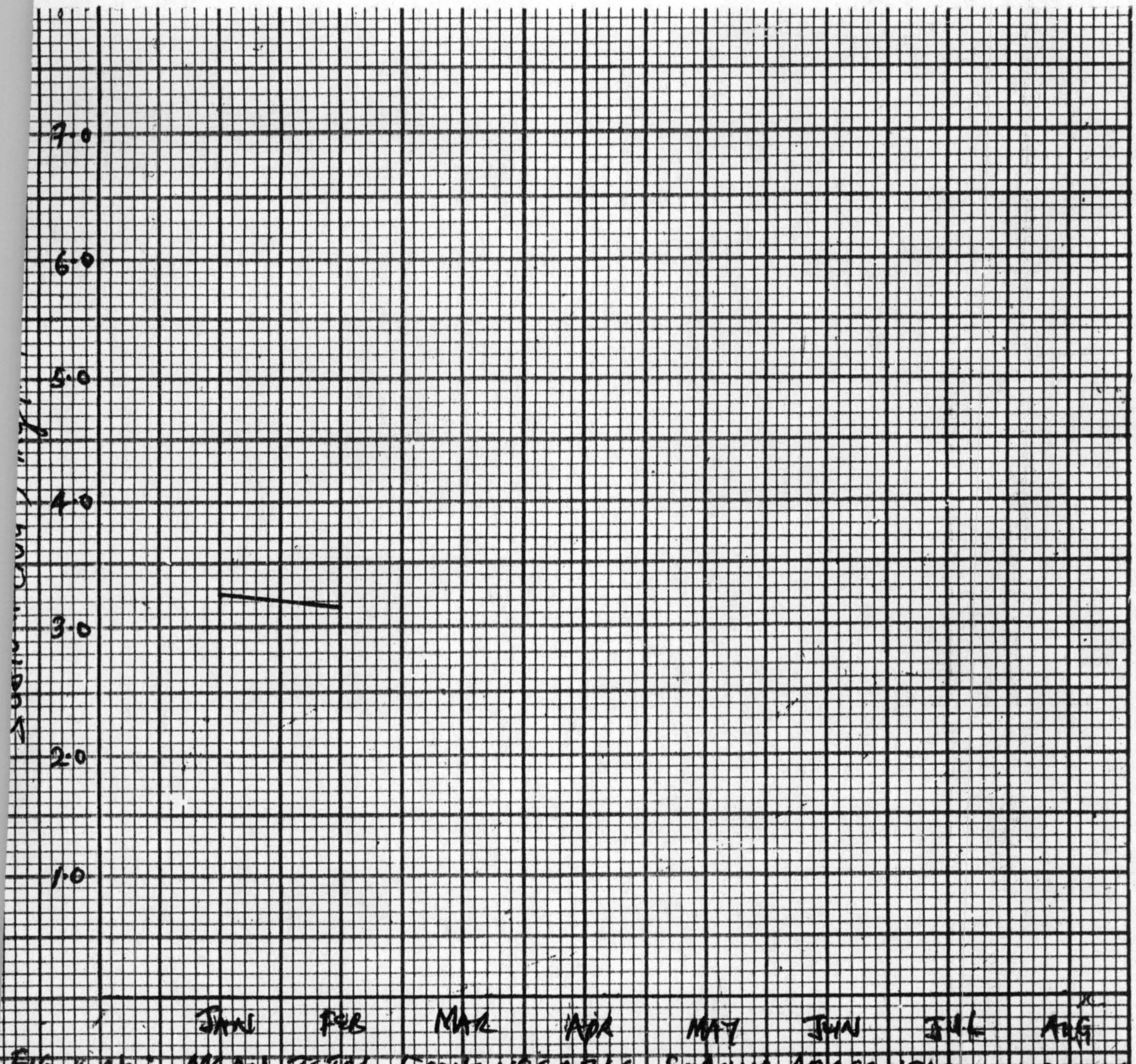


FIG. 4.16: MEAN TOTAL EXCHANGEABLE SODIUM PERCENTAGE IN GROUND WATER WITHIN CHANCHAGA IRRIGATION SCHEME

RESULT OF ANALYSIS OF RAINY SEASON SAMPLE

| Month. | Surface water sample. | pH | EC | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $HCO_3$ | Cl | Br |
|---|---|---|---|---|---|---|---|---|---|---|
| July | $SFS_1$ | 7.1 | 10.0 | 9.7 | 2.4 | 6.2 | 4.2 | 34 | 27.5 | 0.50 |
| | $SFS_2$ | 7.5 | 12.8 | 8.6 | 3.9 | 3.5 | 1.7 | 27 | 28.0 | 0.34 |

SFS (water temperature)-$SFS_1$-26.0°C

-$SFS_2$-25.4°C

| onth. | Surface water sample. | Depth in meters | pH | EC | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $HCO_3$ | Cl | Br |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ly | $GWS_1$ | 2.5 | 6.8 | 20.2 | 25 | 3.8 | 2.5 | 1.5 | 75 | 94 | 0.30 |
| | $GWS_2$ | 2.0 | 6.4 | 27.3 | 38 | 7.1 | 1.8 | 3.4 | 54 | 70 | 0.15 |

GWS (Water temperature)-$GWS_1$-29.5°C

-$GWS_2$-30°C

The sample was collected on the 14th of July, 2002.