Assessment of Some Heavy Metal Concentrations And Their Environmental Implications In Some Parts of Dass L.G.A of Bauchi State

Mbap Gwakchan

01/11369/1

April 2009

ASSESSEMENT OF SOME HEAVY METAL CONCENTRATIONS AND THEIR ENVIRONMENTAL IMPLICATIONS IN SOME PARTS OF DASS LOCAL GOVERNMENT AREA OF BAUCHI STATE

BY

MBAP GWAKCHAN
01/11369/1

A THESIS SUBMITTED TO THE APPLIED GEOLOGY PROGRAMME ABUBAKAR TAFAWA BALEWA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF BACHELOR OF TECHNOLOGY (B. TECH)(HONS) IN APPLIED GEOLOGY

APRIL, 2009

ABSTRACT

The study was carried out to analysis the concentration and environmental implications of the following heavy metals: Cadnium (Cd), Iron (Fe), Copper (Cu), lead (Pb) in Dass Local Govemment area of Bauchi State. The results obtained from the analysis were compared with the WHO recommended standard for water samples and average concentration in an undisturbed soil sample as compiled by Rose et al, (1979) for soil samples. Water samples as compared with WHO standard showed that the concentration of the following heavy metals in drinking water samples are high Cd, pb, Fe and detrimental to the health of the inhabitants while that for Cu is very low. For soil samples the result obtained shown that the concentrations of all the elements were low compared to the concentration in an undisturbed soil sample.

DECLARATION

I hereby declare that this thesis is entirely written by me and is solely my research work. This work has never been presented completely or in part in any previous application for the Award of a Bachelor's Degree. References made to published and unpublished literatures have been duly and properly acknowledged.

MARY G. .... 28/10/2010 ....

Name and Signature Date

This declaration is confirmed by

.... 28th-10-2010 ....

for Mr. Dieter A. Bassi Date

CERTIFICATION

This thesis entitled "Assessment of the concentration of some heavy metals and its environmental implications in parts of Dass Local Government Area of Bauchi State" by Mbap Gwakchan, meets the regulations governing the Award of Bachelor of Technology (B. Tech) Degree of the Abubakar Tafawa Balewa University, Bauchi, Nigeria and is approved for its contribution to the knowledge and literary presentation.

____________________ 28th - 10 - 2010

for Mr. Dieter .A. Bassi

Supervisor

Date

____________________ 28th - 10 - 2010

Mallam A.S. Maigari

for Programme Coordinator

Date

____________________ ____________________

Prof. M.S. Sessey

Date

____________________ ____________________

External Examiner

Date

DEDICATION

This work is dedicated first to the Almighty God for his mercies and protection over my life.

Also to my beloved parents Prof. & Mrs Mbap and to my siblings Nanfe and Cyrus may God bless you all.

ACKNOWLDGEMENT

I am greatly indebted to my supervisor, Mr D.A. Bassi, for his patience. kindness, advice throughout the period of this research work, by being available, providing useful materials and taking pains to read and make useful corrections in the project. I am very grateful Sir.

Special gratitude goes to my distinguished lectures in Geology programme: The programme Coordinator; Mallam A.S. Maigari, Prof E.F.C Dike, Prof. D.M. Orazulike, Dr N.K. Samaila, Dr M.B. Abubakar, Mallam Ahmed Isa Haruna, Mr D.A. Bassi, Mr Timothy Bata, Mallam .A. Tukur and Mallam Isa Tahir thank you for the knowledge impacted in me all these years may the Lord Almighty bless you richly.

My special thanks goes to my colleagues: Lumi Gwamis, Victor Olie, Danjuma (comrade), Samaila Dio, Daniel Adukwu Anas Mohammed Tukur Rufai who have contributed to my success throughout my journey in school. May God bless you all.

I would also want to appreciate my wonderful cousins; Julfa Mirimolit, Nanyi Mirimolit, Nanmua Fildan, Sunday Durven my friend and brother, Sir vongs (my friend) and Gomar Peter Arbe (my bossom friend) for their support and encouragement during the journey.

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CHAPTER ONE

1.1 INTRODUCTION

Heavy metals are elements having atomic weight of between 63.546 and 200.590 (Kennish, 1992) and a specific gravity greater than 4.0 (Connell et al, 1984) living organisms require trace amounts of some heavy metals, including cobalt, copper, iron, manganese, molybdenum, vanadium, strontium and zinc. Excessive levels of essential elements (metals) however, can be detrimental to the organism.

Metals such as lead (Pb), cadmium, (Cd), mercury (Hg), arsenic (As) Barium (Ba) and chromium health (Cr). Trace metals such as lead and cadmium will interfere with the essential nutrients of similar appearance, such as cadmium(Ca^{2+}) and Zinc(Zn^{2+}) .

However, the important point to note is that whatever the amount of heavy metal presence in a media such as soil and water it is the dosage that is critical. Even essential element, if taken in excessive amounts cause ill health as examplified by debilitating diseases such as chronic adverse health effects of the respiratory system and dermatologic (Viessman and Hammer, 1985) as a result of the abundance of chromium ion in drinking water.

Ground water and surface waters are among most important media that act as a bridge between rock and soil geochemistry and human physiology. Edmunds and Smedhey (1996) have pointed out that in addition to anthropogenic sources, the natural baseline geochemistry of groundwater's resulting from interaction with rocks also creates widespread health and acceptability problems in many parts of the main causes for the enhancement of such health problems, particularly among developing countries of the tropics, is the installation of deep boreholes in rural water supplies. It has been observed that such well sittings have been made in places where specific geochemical conditions have led to excessive concentration of toxic or undesirable heavy and trace metals such As, Cr, Fe, Mn, Sb and Al (Dissomayake, 1991, Edmund and Smedley, 1996; Apambare et al, 1997).

Soils are derived from the weathering of rocks (parent materials) and functions as filter for ground water. The soils provide for specific forms of life both directly for plants and indirectly for human beings and animals indirectly through crops.

A case study in Sri lanka showed the effect of excessive accumulation and leaching of elements under tropical conditions caused by the continuous chemical leaching of the parent materials (rocks). The soil happen to be very poor in nutrients causing diminished plant growth and yield. As shown by Brooks et al (1974, 1977), some of the plants tolerate excessive quantities of elements such as nickel and many of them are classified as accumulation plants. While the effect of element inbalances are more clearly seen in plants due to the direct relationship between soil geochemistry and plant physiology, that for human is more complex.

It is with this regard that the concentration of some heavy metals in some parts of Dass town is studied to know its environmental implication on the area.

1.2 AIMS AND OBJECTIVE

The study aims at ensuring the following:

(i) A graduating student is capable of carrying out a research work on a particularly area of study to fulfill one of the pre – requisites for the award of B. Tech in applied Geology.

(ii) Assessing the concentration of some heavy metals in ground water and soil in some parts of Dass Local Government Area of Bauchi state.

The aim of the study will be achieved by: -

(a) Collecting water samples from boreholes and hand-dug wells and analyzing for possible contamination.

(b) Collecting soil samples at depth of 10 – 20cm with the aid of a hand-auger and analyze the concentration of some heavy metals in them.

1.3 LOCATION ,EXTENT , AND ACCESSIBILITY

The study area lies within the coordinates of longitude $10^0$04', $9^0$57' and lat 9^0 29',$9^0$35 The area covers the following localities: - Wandi, Bondot, Dot, Anguwar Abuja, Bakassi and Anguwan Sarki, all located in Dass Local Government Area of Bauchi State and easily accessible, with tarred and untarred roads thus, making it easy both during the dry and rainy season for carrying out the work successfully.

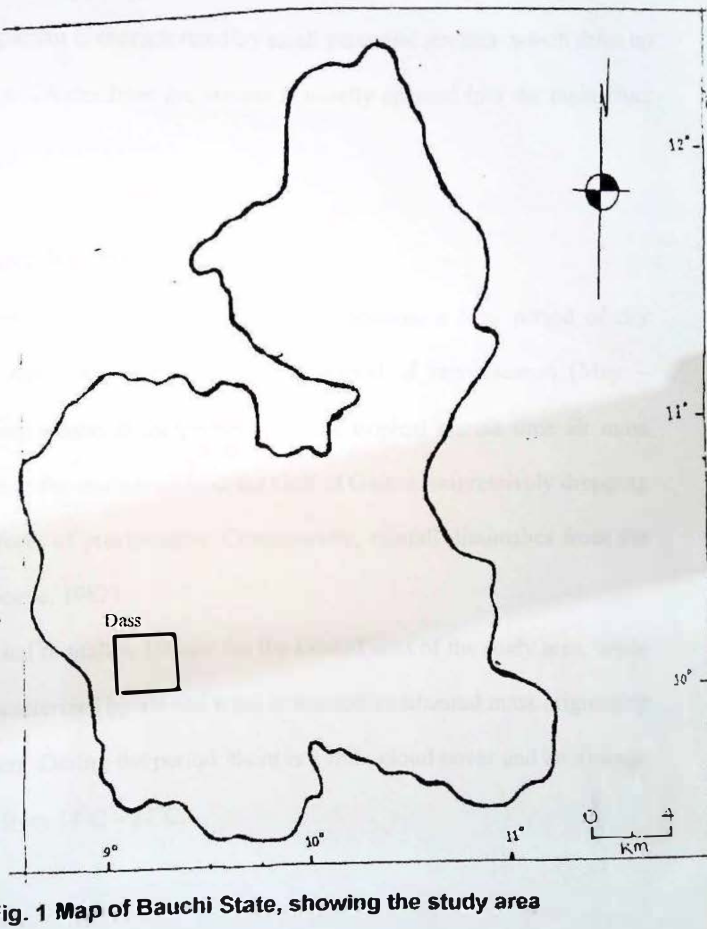


Fig. 1 Map of Bauchi State, showing the study area

1.4 RELIEF AND DRAINAGE

The relief of the study area is characterized by low lying hills in some parts and moderately elevated hills in some areas.

The drainage pattern is characterized by small perennial streams which dries up during the dry season .Water from the steams is usually channel into the main river channel.

1.5 CLIMATE AND VEGETATION

The study area is characterized by two main seasons, a long period of dry season (October – April) and a relatively short period of rainy season (May – September). The rainy season is the period when the tropical marine time air mass travels northwards over the study area from the Golf of Guinea progressively dropping its moisture in the form of precipitation. Consequently, rainfall diminishes from the south to the north (Ijoeye, 1982).

The mean annual rainfall is 150mm for the located sites of the study area, while the dry season is characterized by air and wind or tropical continental mass originating from the Sahara desert. During the period, there is a little cloud cover and an average temperature varying from $14^{0}C - 32^{0}C$.

1.6 SETTLEMENT AND LANDUSE

Most of the settlements in the study area are scattered with Bundot, Kagadama and Dot as major settlements whereas, minor settlements include, Wandi, Anguwan sarki,Angwan Abuja and Bakassi. Most of the settlements are on plains and lowland areas and it seems the availability of water supply and fertile lands for farming enhances the location of the settlement.

In each of the settlements, the people engage in farming activities which include crop cultivation such as rice, maize groundnut, millet and also irrigation farming is practice during the dry season. The inhabitants also rear some animals such as goat, sheep and cattle.

1.7 PREVIOUS WORK

The Earliest ground water investigation on the area was done by the Bauchi State Agricultural Development Programme (BSADP) in partnership with water and environmental sanitation project (WATSAN) in 1986. Geophysical surveys were carried out, boreholes were drilled and the quality of water was determined to access the level of pollution of ground water in Dass town of Bauchi state.

A recent work was done in July and August of 2007 for the provision of groundwater for the inhabitants of Dass town alongside to assess the groundwater for possible contamination by WATSAN in partnership with Aqua GCM Water Borehole Drillers. Prior to the sinking of boreholes in August 2008, Geophysical surveys were carried out to delineate structures for the accumulation of ground water and subsurface conditions. Boreholes were sank at depths were weathered Basement rocks occur (WATSAN).

CHAPTER TWO

LITERATURE REVIEW

2.1 GENERAL INTRODUCTION OF BASEMENT COMPLEX ROCKS OF NIGERIA

Nigeria lies within the Pan – African mobile belt to the east of the west African Craton and subsequently was affected by the Pan – African Orogeny (600 ± 150 ma). The Cratons are believed to have suffered Orogenic deformation and metamorphism since the Lower to Middle Proterozoic times. About 80% of the Nigerian surface area of 2,225,000km^2 is occupied by rocks of the Basement Complex. The younger Granites occupies less than 5% while the sedimentary rocks occupy about 45% of the remaining surface area. The Basement complex is intruded by the Mesozoic calcalkaline Younger Granite ring complexes and is uncomformably overlain by Cretaceous and Younger sediments (Macleoad et al, 1971).

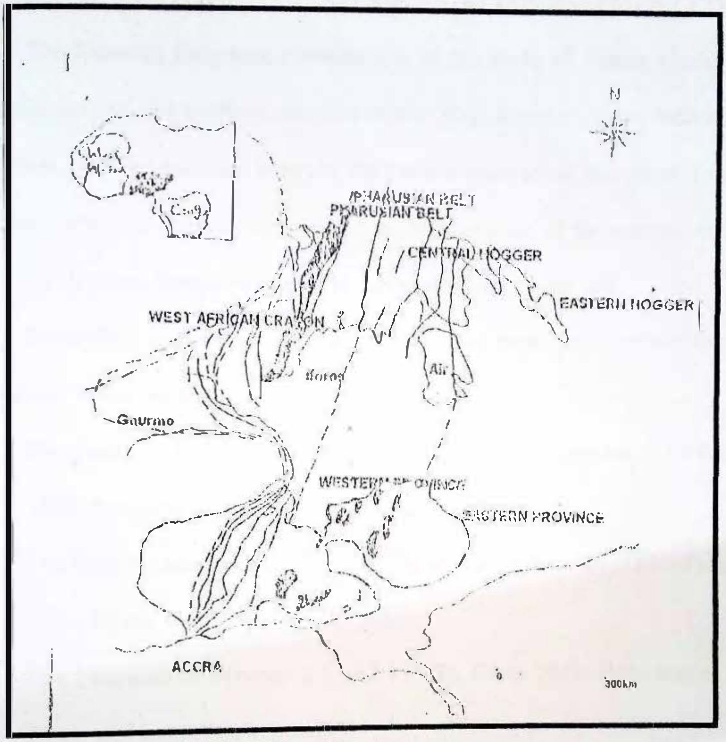


FIG 2 : Generalized Geological map of Pan- African Belt of East of West African Craton.

Source: (Modified From Caby et al., 1981)

Legend
Africa
Craton
Nigeria
Nigerian Basement
Schist Belt

2.2 REVIEW OF THE GEOLOGY OF NIGERIAN BASEMENT COMPLEX

The Nigerian Basement complex lies to the south of Tuareg shield. Evidence from the eastern and northern margins of the West African Craton indicates that the processes involved collision between the passive continental margin of Tuareg shield (600ma), which is believed to have led to the activation of the internal region of the belt. The Nigerian Basement lies in the reactivated part of the belt.

Generally, four events can be said to have been dated within the Nigerian Basement. These include;

(i) The Early Archean crustal growth (3.5 Ga) and metamorphism at 3.0 Ga (Dada, 1989; Bruger et al, 1994).

(ii) The Late Archean event between 2.5 and 2.8 Ga (oversby, 1975; Pidgeon et al, 1976; Ogezi, 1977; Dada et al 1993).

(iii) The Eburnean at between 2.1 and 1.9 Ga, Grant 1970; Rahaman et al, 1983, Annor and Lance lot, in press).

(iv) The widespread reworking during the Pan African (2600ma) (Van Breman et al, 1977; Tuboson et al, 1984; e.t.c)

Three broad lithological groups are distinguished within the Nigerian Basement complex they are:

(a) A poly - metamorphic migmatite–gneiss complex composed of largely migmatites and gneisses of various compositions and amphibolites meta- sedimentary rocks represented by median to high – grade calcareous, politic and quartzitic rocks which occurs within the migmatites and gneisses. These are described as "Ancient metasediments" (Oyawoye, 1972). The migmatite – gneisis is considered to be the Basement sensu-stricto with ages varying from Liberian (2800 ± 150 ma) respectively.

(b) Lower grade metasediments dominated by schists which form narrow belts in the western half of Nigeria. They are believed to be relicts of a supracrustal cover infolded into the migmatites and unmigmatized to slightly migmatites schists (Rahaman et al; 1976). They are refered to as the "Younger Metasediments"on the schist belt. The schist are intruded by pan African gratitoids which trend N-S.

(c) The Older (Pan African) granites are syn-tectonic to late tectonic granitic rocks, which cuts across the schist belt. The granitoid include rocks varying in composition form granite to tonalities and charnokites with smaller bodies of syenite and gabbros. (Falconer, 1911). The granitoids have yielded radiometric ages in the range of 500-700 Ma, which lie within the Pan- African age spectrum. These Pan- African granitoids are called older granites of Nigeria to aid in distinguishing them from the Mesozoic tin bearing granite complexes of central Nigeria which are referred to as the younger granites (Falconer, 1911). Radiometric dating that indicated that the Nigerian Basement is polycyclic (Ajibade et al, 1988)

Initial sedimentary rocks may have been subjected to four thermotectonic and orogenic episodes (as mentioned above) during which the rocks were metamorphosed and reactivated by subsequent events. These events took place during the Liberian (2800 ± 200Ma) accompanied by the Eburnean Orogeny

(1100+200Ma), This was followed by Kibaran Orogeny (1100 ± 2 00Ma) and then by the Pan- African (600 ± 150Ma), with the Pan African being the only Orogeny that affected most parts of Africa.

The obvious effects of the Pan-African Orogeny in Nigerian are the emplacement of large volumes of granitoids and the resetting of mineral ages in virtually all the rock types in the Basement (Turner, 1983).

The schist belts include fine to coarse grained clastic pelitic schists, phyllites banded iron formation (BIF), carbonate rocks and amphibolites (Tonner, 1983). The schist belts are elongate and generally trend N-S, NESE and NNE-SSW. The initiation of the sedimentary processes leading to the deposition of the schist belts began earlier than the Pan African Orogeny through recent field studies, structural and geochemical evidence indicate that part of the sediments may have formed in Kibaran times

(1100± 200Ma) (Ogezi, 1977, Ajibade etal 1988).

The Older Pan African granite series include rocks intruded during the Pan African Orogenic cycle (600±150Ma). They are generally high-level intrusive and anatexis has played an important role (Fitches et al, 1988), rock types ranges from coarse-grained muscovite to biotite granites. Granitization culminated in the intrusion of diverse and widespread suites of syn-late tectonic granites, granodiorite and syenite

(Fitches et al, 1985)

Structures and structural relationships in different parts of the Nigerian Basement have been discussed by many workers including Ogezi (1977), Woakes (1987), Rahaman et al, (1988). Several folding and many sets of fractures, joints, veins, pegmatites and aplite dykes have been recorded. Other structures include foliation and faults. Regionally, the most prominent structural trends are the north-south planer structures with relics of E-W, NE-SN and NW-SE structures.

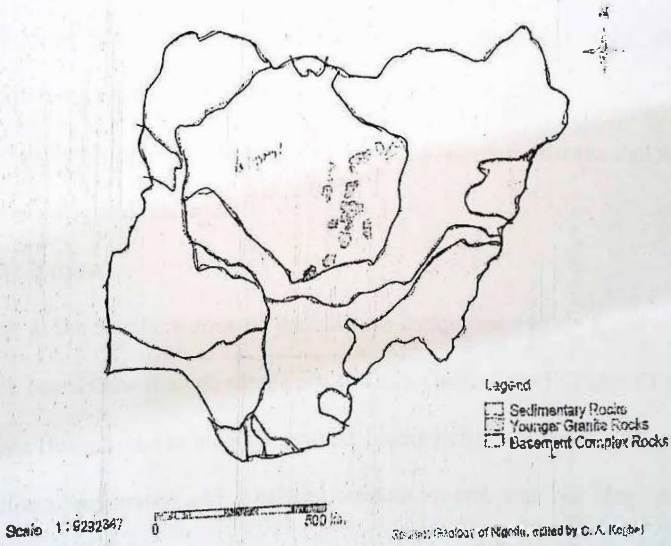


FIG 3 Generalized Geological Map of Nigeria

2.3 GEOLOGY OF BAUCHI (BASEMENT ROCKS)

Bauchi and its surrounding are situated on the Basement complex of Nigerian, made up of crystalline rocks. The complex consist almost of granites, diorites, bauchites, migmatites and greisscs.

The oldest rock of the area, the gneisses and older meta-sediments believed to be Birrimean in age (Oyawoye,1970 and MC Curry, 1976). Through the processes of metamorphism, migmatization and granitization that took place during at least two techtono- metamorphic cycles, the rocks were largely converted into migmatites and gneisses with some relics of the original gneisses (MC Curry 1976). These plutonic intrusions form what are now known as older granites.

The volcanic rocks which intruded some parts of Nigerian after the Pan African Orogeny slightly affected this area.

i. Granite gneisss

The rock occur at the Southern zone of Bauchi state comprising eastern n and western parts of Bauchi Local Government, some parts of Dass, Ganjuwa and Tafawa Balewa. They are mainly fine grained to medium grained, biotite rich granitic rocks. In general, they have uniform appearance and relatively constant in composition. They are also composed of white plagioclase, some microcline quartz and fairly abundant biotite. Hornblende is also present in varying amounts. The rocks are finely foliated. The foliation is expressed principally by sub-parallel arrangements of biotite.

(ii) Migmatites

The migmatites cover almost the entire part of the southern parts of the state. The areas include Liman Katagum, Dajin Kardam, Baraza and north of Dass town others include Tijlai ad Gumau in Toro.

Migmatites are variable in texture form medium to coarse grained and they represent a high grade metamorphose series with excellent banding. Generally, the migmatites are foliated with flakes of biotite defining general trend: In some cases as could be the bands on an outcrop of Tirwun north of Bauchi town, the bands are completely folded giving rise to plygnastic structure which is an indication of plastic flow.

The migmatite is a composite rock of hornblende bearing gneiss and granitic rock. The granitic rock is usually biotite granite alternating with the hornblende bearing gneiss .

iii **Fayalite quartz monzonite** (Bauchite)

Fayalite bearing charnokitic rocks (Bauchite): are generally restricted to areas around Dandango, Gwaskaron and Kubi. They appear as oval to sub-circular scattered outcrops of various sizes.

Fayalite quartz monzonite (Bauchite) was first described as coarse grained augite syenite by Falconer (1911), but the distinctive features of the rock were first described by Oyawoye (1985, 1961) who named them bauchite . Clear occurrence of bauchite was seen at Wombai hill, Guri and underlying Bauchi town. The occur as platy exposure with deep green colour when fresh and pinkish when weathered. The rocks are massive homogenous and unfoliated. They have few joints, out cropping as smooth rounded boulders derived from massive unfoliated rocks by spherical weathering. The mineral assemblage includes biotite, hornblende Fayalite and pyroxene. Accessory minerals found include apatite zircon and iron oxide.

iV Quartz Diorite

Quartz diorite occurs as veins and dykes within the migmatites and granites. The dykes vary in thickness from 10cm to as much as 100cm. They are generally cross-cutting the structure in the host rock, having a sharp contact with them . The quartz diorite is a medium grained melanocratic rock.

V Pegmatite

They are found cross-cutting the country rocks within the area of interest. They are divided into concordant and discordant .The concordant pegmatite are those found parallel to the pre-existing structures while discordant are those truncating the pre-existing structure in the rock.

The pegmatites are made up of coarse grained quartz and feldspar; mostly potassium feldspar with little biotite and little or no muscovite.

Vi Biotite hornblende granite

Biotite hornblende granite occurs as prominent hills with rugged surfaces. The exposure shows faint foliations, defined by small streaks of biotite hornblendes alternating with feldspars and quartz.

2.4 Younger Granite suite

The younger granites of Jurassic ages are found only in a small portion of the State. The prominent of this is found at Ningi called the Ningi-Burra Complex in Nigerian (Ike 1985). It is a large multiple ring complex, containing six over lapping centres.

2.5 Sedimentary Formations

This is only limited to the Kerri-kerri formation found in the north- eastern part of the state. The kerri-kerri formation composed of medium to coarse grained brownish sand stones, gritz, siltstones and kaolinites . The kaolinite exposure is visible in the localities of Arawa, Gwaran Mainamaji, Futuk Kirfi etc of Alkaleri and Kirfi Local Government Area.

The lacustrine chad Formation overlying the Kerri-kerri Formation is Pleistocene in age consisting of whitish silts and bands of sands, silts and clays with occasional thin lignites near the base (Rayment, 1965).

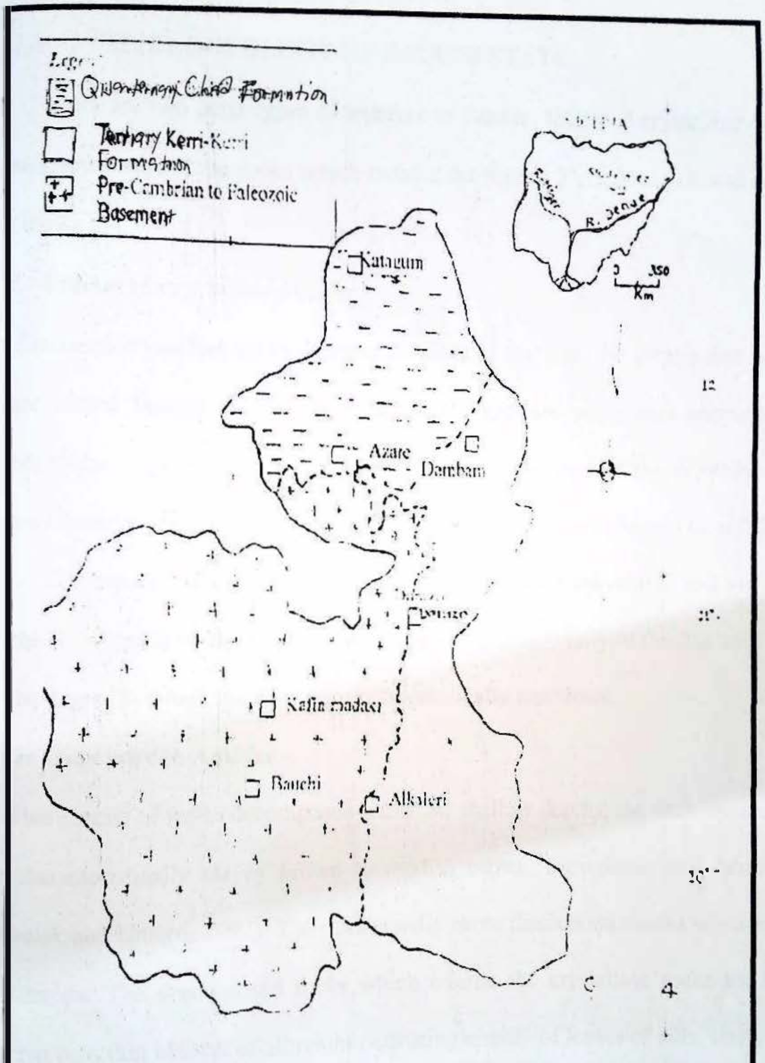


FIG 4 GEOLOGICAL MAP OF BAUCHI (ADOPTED AFTER B.S.A.D.P) (1976)

2.6 HYDROGEOLOGY OF BAUCHI STATE

There are two main types of aquifers in Bauchi, fractured crystalline rocks and weathered crystalline rocks which overlie the former K. Schoeneick and A Umaru (1992).

i. **Fractured crystalline aquifer**

Fractured crystalline rocks underlie all parts of the area, the greater part of which are buried beneath over burden materials and are sometimes encountered in boreholes or handdug wells at variable depths. Outcrops of the crystalline rocks may occur as flattish masses on the surface, in some stream channel or as hills.

The capacity of the crystalline rocks to store, allow movement and yield water chiefly depends on the extent, size, openness, and continuity of the fractures and on the degree to which the fractures are hydraulically connected.

ii The Over burden Aquifer:-

This consist of insitu decomposed rocks. At shallow depths, the decomposed rocks are characteristically clayey brown to reddish brown, ferruginous and lateritic (K. Schoelek and Umaru, 1992). The occasionally show dessication cracks when exposed at outcrops. The decomposed rocks which overlie the crystalline rocks are largely covered by a thin blanket of alluvium consisting mainly of lenses of silts, clays, sands, gravels and local interimixes of this material boulders.The materials were derived mainly from weathering of adjacent hills and reworked alluvium, they were transported by running water and deposited in lower areas and stream valleys .

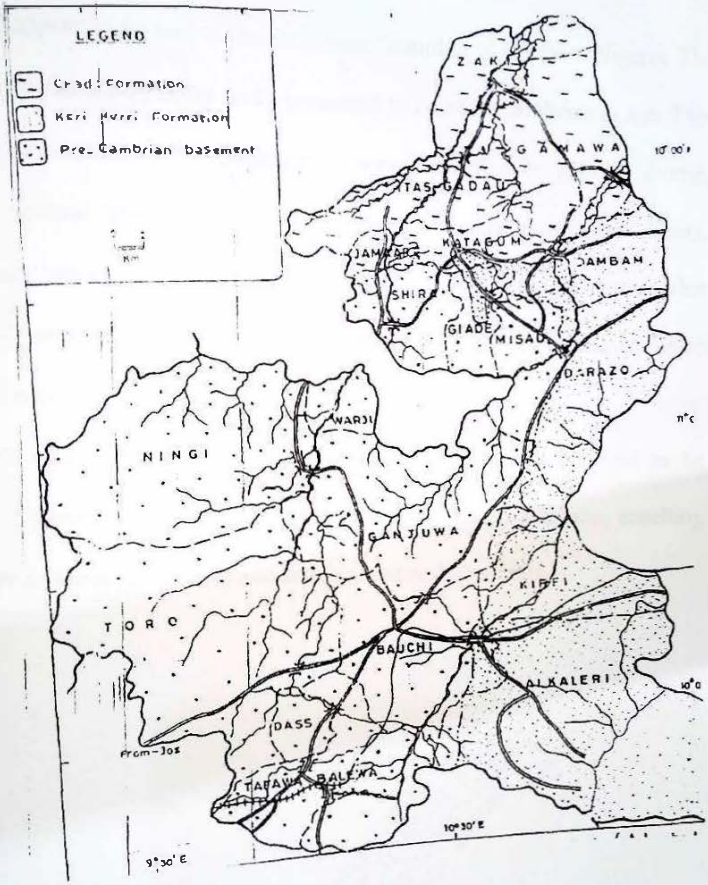


Fig. 3 Hydrogeological Map of Bauchi State (Adopted from B.S.A.D.P, 1983)

2.7 GEOLOGY OF THE STUDY AREA (DASS)

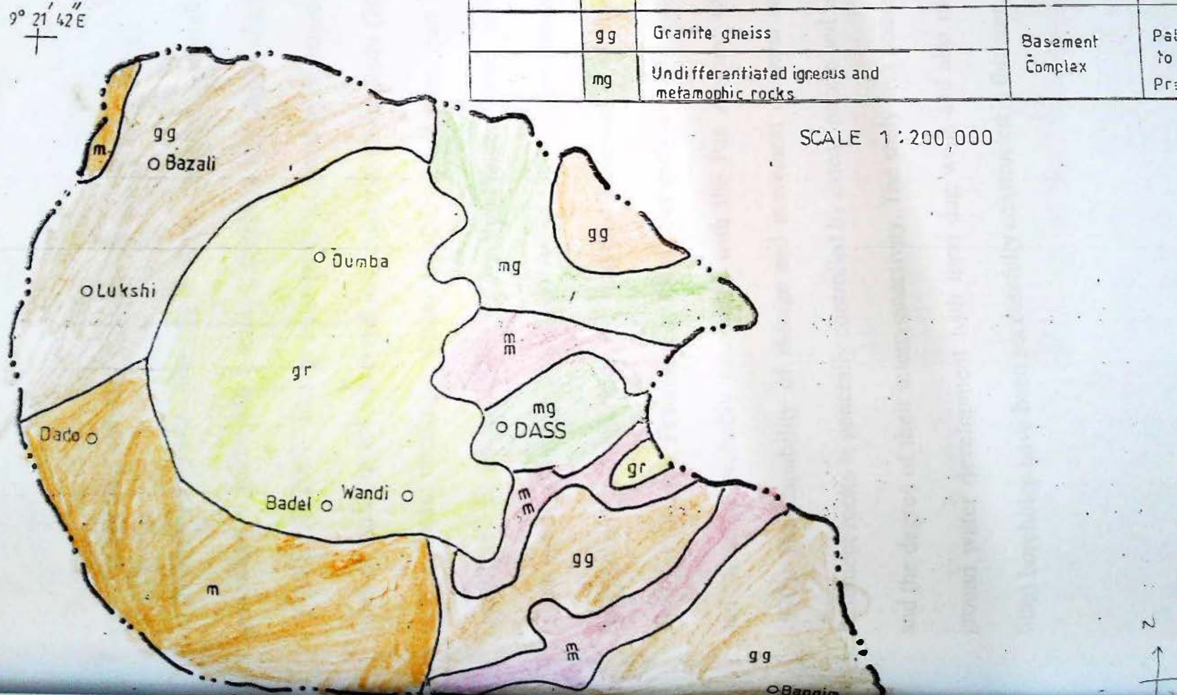
The area happens to be part of the Basement Complex of Northern Nigeria. The study area (Dass) is characterized by rocks presumed to be of Precambrian in age. This is lithologically characterized by porphyritic biotite, hornblende granite, diorite, granite, biotite granite gneiss, hornblendes diorite, quartz hyporthene diorite, migmatitic granite, migmatites and gneisses which have been one way or the other affected by the different orogenic activities that affected the area such as later intrusion of dykes and silts e.t.c (Oyawoye ,1970 and Mc. Curry ,1976).

The oldest rock of the study area are the gneisses and are believed to be Birnnean in age (Shemang and Umaru, 1994) overlain by recent alluvium, resulting from the weather and erosion of hills and decomposed rock materials.

GEOLOGY MAP OF DASS L.G.A SHOWING THE STUDY AREA. ADOPTED FROM BAUCHI STATE MINISTRY OF LAND AND SURVEY (2002).

	SYMB	LITHOLOGY	FORMATION	AGE
	m	Migmatite, Migmatite gneiss banded gneiss.	Basement Complex	Palaeozoic to Pre-Cambrian
	mm	Older Alluvium		Neogene
	gr	Coarse foliated granite	Older Granite Suite	Palaeozoic
	gg	Granite gneiss	Basement Complex	Palaeozoic to Pre-Cambrian
	mg	Undifferentiated igneous and metamophic rocks		

SCALE 1 : 200,000



2.8 HYDROGEOLOGY OF THE STUDY AREA

Hydrogeologically, the study area comprises generally of medium high percentage of joints and fractures, except in few places which are lowly fractured (WATSAN, 2007) like in most parts covered by Basement complex two main types of aquifers are observed in the course of the study (BSADP, 1986). There include those occurring within weathered basement, part overlying the hand crystalline bedrock and in fractured/fault zones of the fresh rocks. Characteristically, the weathered Basement is clayey brown to reddish brown ferrogenized and lateritic. The fractured Basement crystalline rock underlies the whole of the area. Fracturing in the area of study is mainly due to jointing, faulting and shearing probably associated with the Pan African Orogeny (Oyawoye, 1970). The capability of storage and movement of water within the crystalline Basement rocks is generally controlled by extent, pattern and size of these fractures and the degree of their interconnectivity. The study area possess great potential for ground water development with hand dug wells and also mechanized and hand fitted boreholes have been successfully constructed in this area.

CHAPTER THREE

SAMPLING METHODS, PREPARATION AND MATERIALS

3.1 METHODOLOGY

The study involved field work, which was carried out in two phases:

The first phase was the field reconnaissance survey that was done to establish the following:

i. To identify the media to be used for the study.

ii. To mark sample point locations.

The second phase was the main detailed survey which was carried out on November, 2008. During this process, samples were collected with the aid of the Global Positioning System(GPS), the sample locations were marked on the field map, descriptions of locations and samples were made and recorded on the field note-book.

3.2 FIELD WORK

The detailed survey was carried out in Dass town of Bauchi State where soil and water were the media sampled for this study. A total of seventeen samples were collected consisting of nine water samples and eight soil samples.

3.2.1 SOIL SAMPLING

Soil samples were collected at depth of 10-20cm using a hand auger. The samples were collected prior to the rainy season and the soil was too hard for sampling. However, with the aid of the hand auger and a hoe, the required soil horizon was sampled.

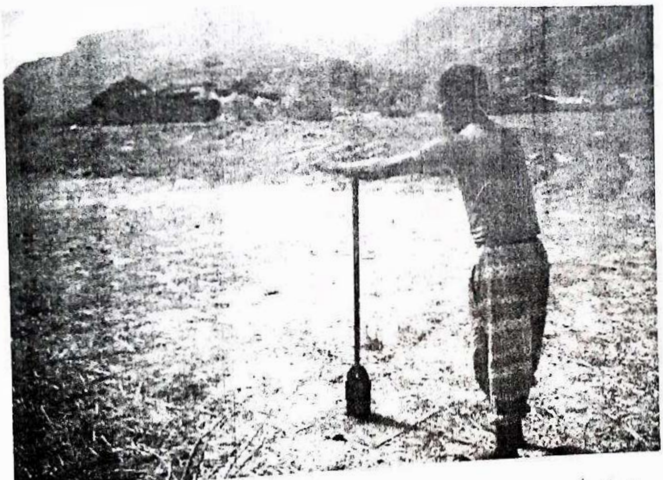


PLATE I AT WANDI IN DASS LGA

3.2.2 WATER SAMPLING

Water samples were collected from handdug wells and boreholes. These were collected in clean plastic containers and acidified by adding few drops of nitric acid (HNO_3). This was to keep the metals in suspension. However, before collecting the water samples in the containers, these containers were properly rinsed three to four times with the water sampled. With the aid of a pH meter, the pH and temperatures of the water samples were measured on the spot of collection. The coordinates of the water sample locations were obtained, marked on the field map and recorded in the field note-book. Description of these locations were also made and recorded in the field notebook.

AT WANDI IN DASS LGA

PLATE 2

3.3 LABORATORY WORK

The laboratory work was done in the chemistry laboratory of the Chemistry programme of Abubakar Tafawa Balewa University, Bauchi

The laboratory work was done in two stages:

Stage1: the sample preparation, which comprised of drying, crushing, sieving and digestion of samples.

Stage 2: the analysis of sample using the Atomic Absorption spectrometer (AAS).

3.3.1 SOIL SAMPLE PREPARATION

The soil samples were dried to remove moisture, then the dried sample were crushed in an agate mortar. After crushing each sample, the pestle and mortar were cleaned and dried thoroughly to avoid contamination before crushing another sample, 80 mesh fraction was used to sieve the dried samples. The sieve too was also cleaned thoroughly before proceeding to sieve another sample to prevent contamination by the other samples . Sieved samples were stored in new clean- labeled polythene bags. After the operation mentioned above, the soil samples were then ready for chemical analysis by AAS.

3.3.2 WATER SAMPLE PREPARATION

The AAS method was used in this study for the analysis. Samples that are not in solution such as soil samples are brought to that state before analysis, for this reason water does not require any special preparation.

3.3.3 SAMPLE DIGESTION

Analysis using AAS require samples to be put to solution. In this regard, solid related samples (soils were brought to solution before analysis). Below is the procedure for digestion.

i. From the sieve solid (soil) samples, 2.0g was weighed.

ii. The weighted sample was poured into a beaker.

iii. 100ml nitric acid (HNO_3) was added (at 4:1).

iv. 25ml of Hydrochloric acid (HCL) at ratio 4:1.

v. The solution was heated and allowed to boil for 30-45 minutes.

vi. The boiled sample was remove from the heat source and allowed to cool.

viii. The filtrate was then diluted to 100ml with distilled water.

After these procedures above, the soil samples were then ready for analysis by the AAS.

3.4 METHOD OF ANALYSIS

The entire sample collected for this study was analyzed by the use of Atomic Absorption spectrometer (AAS) specifically the buck scientific VGP 210 model was used.

3.4.1 ANALYSIS OF SAMPLES

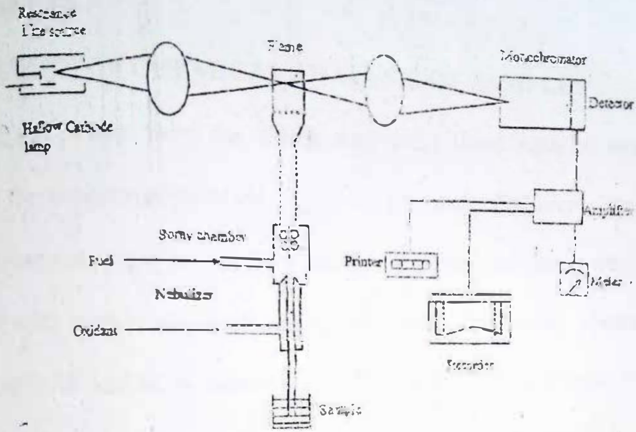
Each sample was brought to solution. This is aspirated by means of flame (mixture of air and acetylene at 200°c). The high temperature will reduce the droplet into atomic form that is the elements in solution are now in vapour and therefore is neutral or unbounded state that is said to be the ground state. The sample in vapour is illuminated by a light source called the Hallow cathode Lamp (HCL). This is also called the resonance line source. The anode of this lamp is made up of the same material to be analyzed. For example, if analysis is to determined the concentration of cadnium (Cd), a Cd HCL is used so that the Cd atoms in the vapour will absorb radiation form Cd HCL. This radiation is isolated by means of the monochromator. Its intensity is now reduced because of its absorption in the flame, which can be measured by the detector . Distilled water was used to standardize the instrument after every sample was analyzed.

3.4.2 THE ATOMIC ABSORPTION SPECTROMETER

Atomic absorption spectrometer operates on the principles that atoms in a flame at ground state will absorb the same wave length (A) of light that it will emit if excited. This is based on kirch Hoff's law, which states that an atom at a lower temperature absorbs these radiations, which it will itself emit at higher temperatures. The extent of absorptions depends upon the amount of elements in flame.

The samples is brought into solution. This is aspirated by means of a mixture of air and acetylene at about 2000^{0}C for higher temperature, the flame is made up of nitrous oxide (N_2O) and acetylene in this case temperatures approximately 8000^{0}C.

The sample in vapour is illuminated by a light source, Hollow Cathode Lamp (HCL). This is called the resonance line source. The anode of this lamp (HCL) is made up of the same material to be analyzed. The radiation is isolated by means of monochromator. Its intensity is now reduced because of its absorption in the flame which can now be measured by the detector.



Schematic Diagram of the Atomic Absorption Spectrometer

(AAS, Rose et al., 1979)

Fig 7 . Schematic Diagram of Atomic Absorbtion Spectrometer (AAS Rose et al , 1979)

CHAPTER FOUR

4.0 RESULTS

4.1 RESULTS OF CHEMICAL ANALYSIS OF SAMPLES

Soil and water were the media analyzed. These samples were analyzed to determine the concentration of the following elements Cadmium, lead, copper, and iron. The study attempts to identify the concentrations of these metals which will be compared with certain standards set by some heath regulatory agencies such as the WHO, NAFDAF and SON, excesses or deficiencies of some of these metals may have adverse effects on the inhabitants of the area.

The samples were analyzed using the Atomic Absorption spectrometry (AAS) buck scientific model and the results obtained are shown in tables 1 and 2

4.2 SOIL SAMPLE RESULTS

Eight soil samples were collected and these were denoted as S_1, S2, S_3, S_4, S_5, S_7, S_8 which were collected form area near farmlands. Table 1 below shows the result of chemical analyses of soil samples.

ble 1 .Results of Chemical Analysis of Soil Samples (mg/l).

SAMPLE POINT	Cadnium	Copper	Lead	Iron
S1	0.0318	0.38	0.031	0.180
S2	0.0171	0.82	0.008	0.097
S3	0.0132	0.43	0.024	0.158
S4	0.0721	0.33	0.036	0.213
S5	0.0182	0.67	0.103	0.115
S6	0.0194	0.40	0.028	0.082
S7	0.0098	0.54	0.005	0.091
S8	0.0128	0.73	0.019	0.122
MEAN	0.0243	0.54	0.032	0.132
LCL	-3.7705	0.87	1.992	0.046
UCL	3.8191	0.21	2.056	0.218

controls were obtained from the equations below

AN(X)=$\sum X/N$

ANDARD DEVIATION= $\sqrt{\sum(X-x)^2} / \sum N$

PER CONTROL LIMIT(UCL)=MEAN+2(STANDARD DEVIATION)

WER CONTROL LIMIT(LCL)=MEAN-2(STANDARD DEVIATION)

here ,

-SUMMATION OF

-TOTAL CONCENTRATION

-TOTAL NUMBER OF SAMPLES

Table 2 Concentration for selected elements(metals) in an undisturbed Geochemical Environment compiled by Rose et al (1979)

IGNEOUS					SEDIMENTARY ROCKS		
ELEMENT	**SOIL (AV)**	**UMAFIC**	**MAFIC**	**GRAN**	**Lst**	**Sst**	**Sh**
Sb	2	0.1	0.1	0.2	0.3	1.0	1-2
As	7.5	1.0	1.5	2.1	1.1	1.2	12
Ba	300	0.4	330	840	92	170	550
Bi	0.1-0.5	1.2	0.05	0.3	-	0.3	1.0
Cd	10	-	0.2	0.1	0.035	0.0	0.3
	15	110	48	1	0.1	0.33	19
Cu	21000	42	72	12	5	10	42
Fe	11000	94300	86500	14200	3800	9800	47000
K	17	34	8300	42000	2700	10700	26600
Pb	17	1	4	18	5	10	25
Ni	36	2000	130	4.5	20	2	68
Zn	36	58	94	51	21	40	100

4.3 WATER SAMPLE RESULTS

It is now generally recognized that the quantity of groundwater Is just as important as its quality. Natural surface or ground water may contain dissolved solids as well as suspended matter. The quantity and quality of these constituents depends on geologic and environmental factors such as weathering and they are continuously changing as a result of the reaction of water with contact media and human activities.

Due to anomalous concentration of these heavy metals as a result of the activities mentioned above, the World Health Organization (WHO) has therefore, recommended permissible concentration levels for these elements. NAFDAF, SON and HPDWR have there standards which is in line with the WHO standard. Nine water samples were collected from boreholes and hand dug wells. The result for this analysis is shown in Table 2 together with their pH values.

Table 3. Results of Chemcal Analysis of Water Samples

SAMPLE LOCATION	Cu	Cd	Pb	Fe	pH
W_1	0.38	0.1194	0.043	0.413	7.1
W_2	0.85	0.0293	0.147	0.262	7.2
W_3	0.43	0.0954	0.013	0.575	7.0
W_4	0.92	0.0149	0.308	0.298	7.1
W_5	0.98	0.0023	0.115	0.365	7.0
W_6	0.40	0.0297	0.231	0.322	6.9
W_7	0.33	0.0342	0.208	0.280	6.1
W_8	0.28	0.0023	0.158	0.414	5.4
W_9	1.08	0.5782	0.097	0.076	6.6

Table 4. Water Standards for WHO in Comparism with Water Standards from some Health Regulatory Agencies

rameters	Maximum Acceptable concentration (WHO) mg/l	Maximum Allowable Standard NAFDAF	Maximum Allowable Standard NPDWR(mg/l)	USEP Maximum allowable standard (mg/l)	SON Standard (mg/l)	FDA Guide line (mg/l)
ad(Pb)	0.01 mg/l	-	0.015	0.0015	0.01	
n (Fe)	0.05-0.3mg/l	-	100	0.3	0.3	-0.01
agnesium (g)	50mg/l	30	0.3	-	-	-
dnium(C	0.003mg/l	-	0.005	0.005	0.003	0.005
tassium(	lmg/l	-	1	-	-	-
pper(Cu)	2.0mg/l	-	1.3	1.0	1.0	1.0
	-	-	-		6.5-8.5	-

WHO : World Health Organisation

NAFDAF : National Agency for Food Drug Administration and Control

USEP : United States Environmental Protection Agency

SON : Standard organization of Nigeria

FDA: Federal Drug Administration

CHAPTER FIVE

5.0 DISCUSSION OF RESULTS

From the observed result on the (Table 1) shows the concentration of Cadmium in the soil is high compared to the other metals concentration. The results in table 3 for water samples shows that the concentration of the following elements in water are above the WHO standard. The concentration of all the elements are low compared to the average concentrations in an undisturbed geochemical environment as shown in (table 2) as compiled by Rose et al, (1979).

5.1 SOIL

5.1.1 Copper

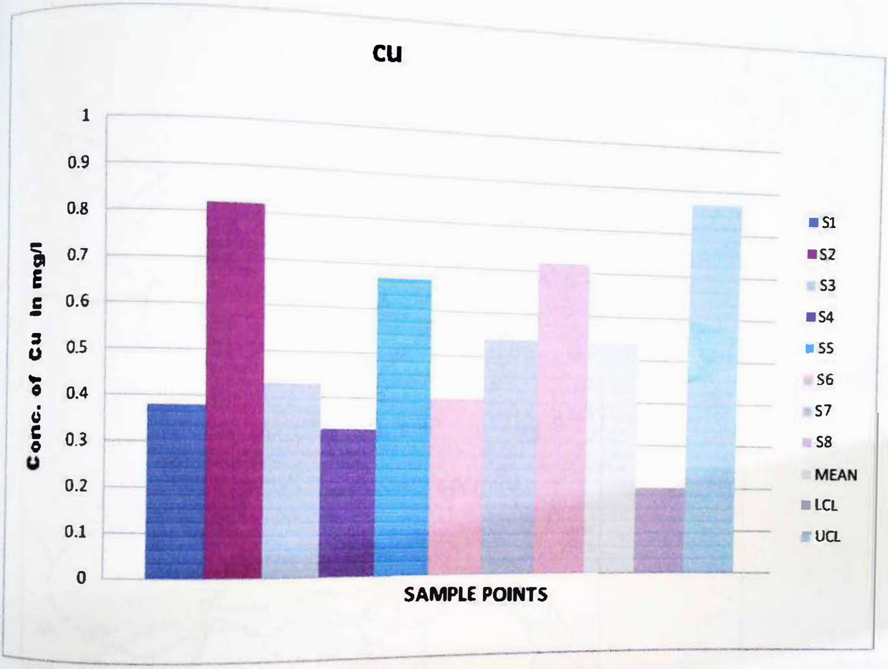


Fig 8a Histogram showing the concentration of Cu in soil samples of the study area.

The concentration values for copper in the soil samples (Table 1) ranges from 0.33-0.82mg/l. The histogram in fig 6a shows the concentration of copper in the samples in comparism with the mean (x) 0.54, the lower control limit (LCL)(0.21) and the upper control limit(UCL)(0.87). From the graph, it can be observed that all

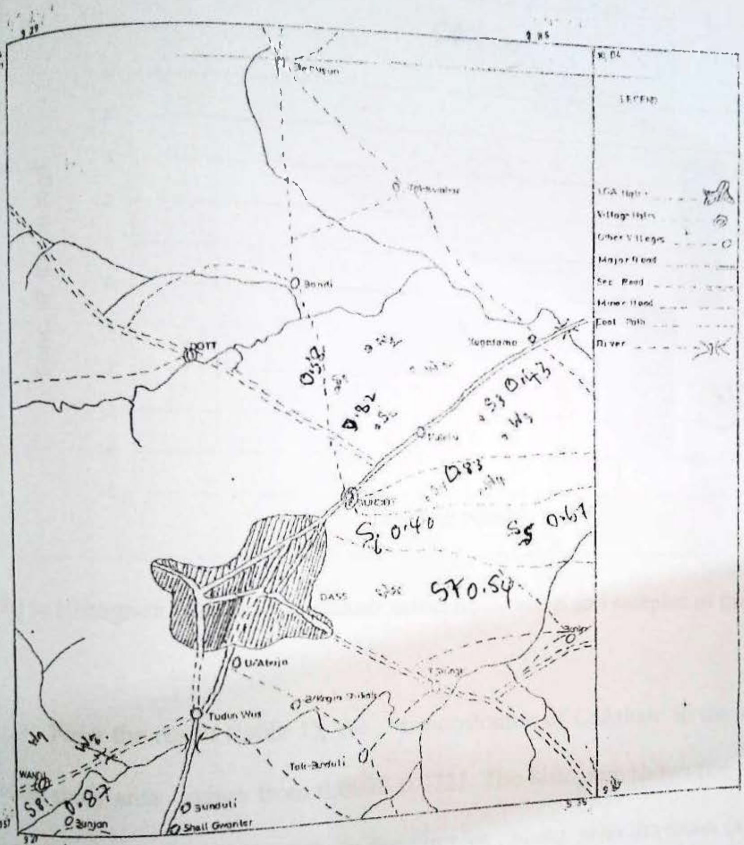


Figure 8b showing the concentrations of Cu (mg/l) in the soil samples of the study area.

5.1.2 CADNIUM

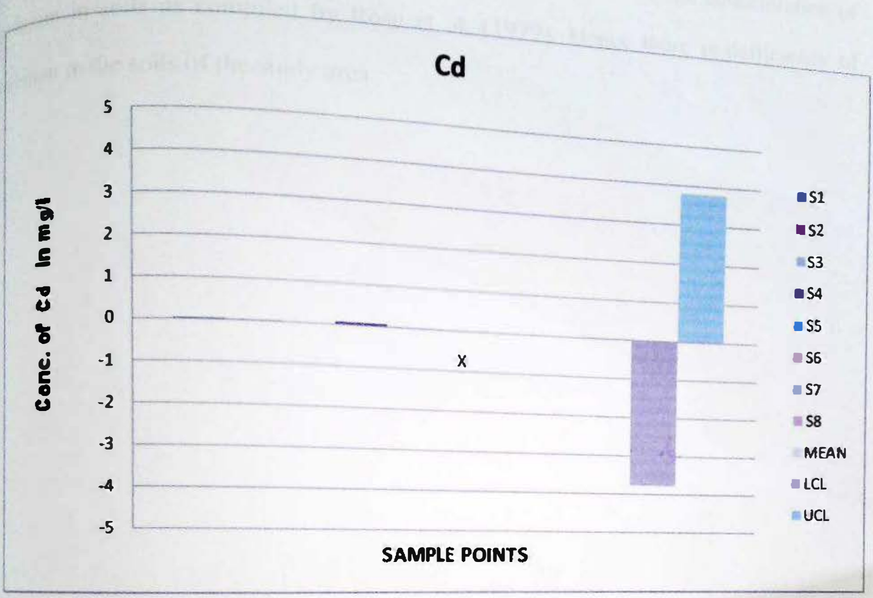


Fig 9a Histogram showing cadnium concentrations in soil samples of the study area

From the result (table 1), the concentration of Cadnium in the soils samples of the study area range from 0.0098-0.0721. The histogram shows (fig) shows the concentration of Cadnium (Cd) in the samples , along with the mean (x)(0.024), the lower control limit(LCL) (-3.7705) and the upper control limit (UCL) (3.8191) calculated for this concentratons. The concentration values for Cadnium in the study area are very low . This could be as a result of leaching of C^{2+} by water.

The range of concentration values is lower than the average concentration of cadnium in soils as compiled by Rose et al, (1979). Hence there is defficiency of cadnium in the soils of the study area.

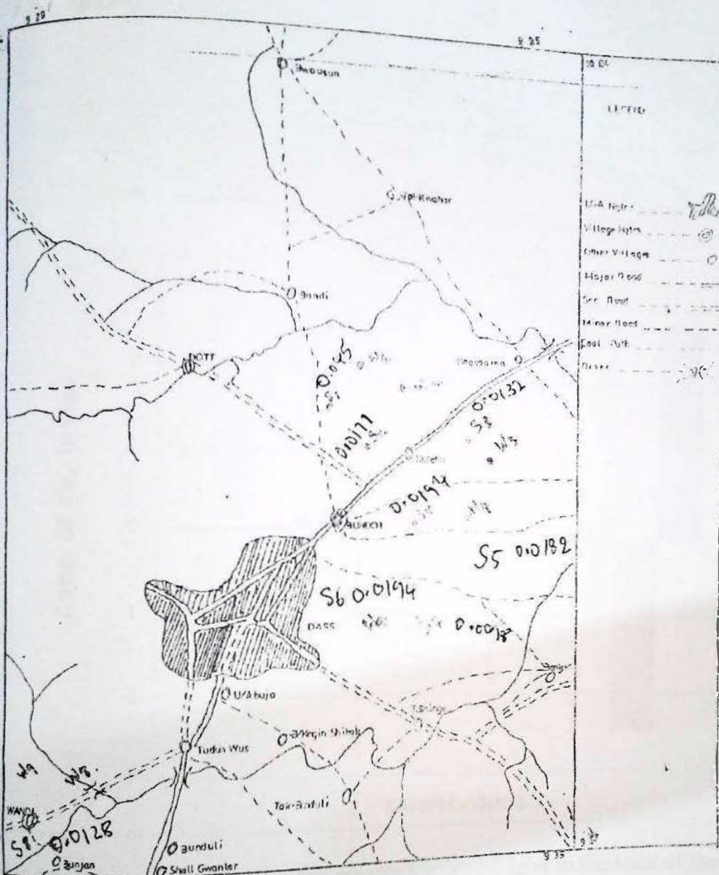


Fig 9b showing the concentration of cadium(mg/l) in the study area.

5.1.3 IRON

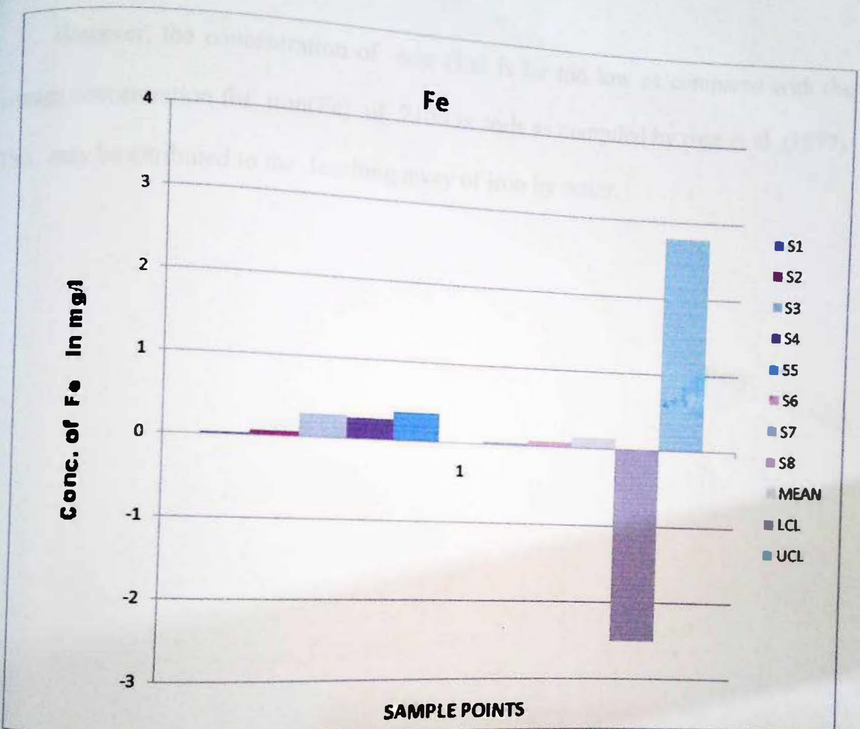
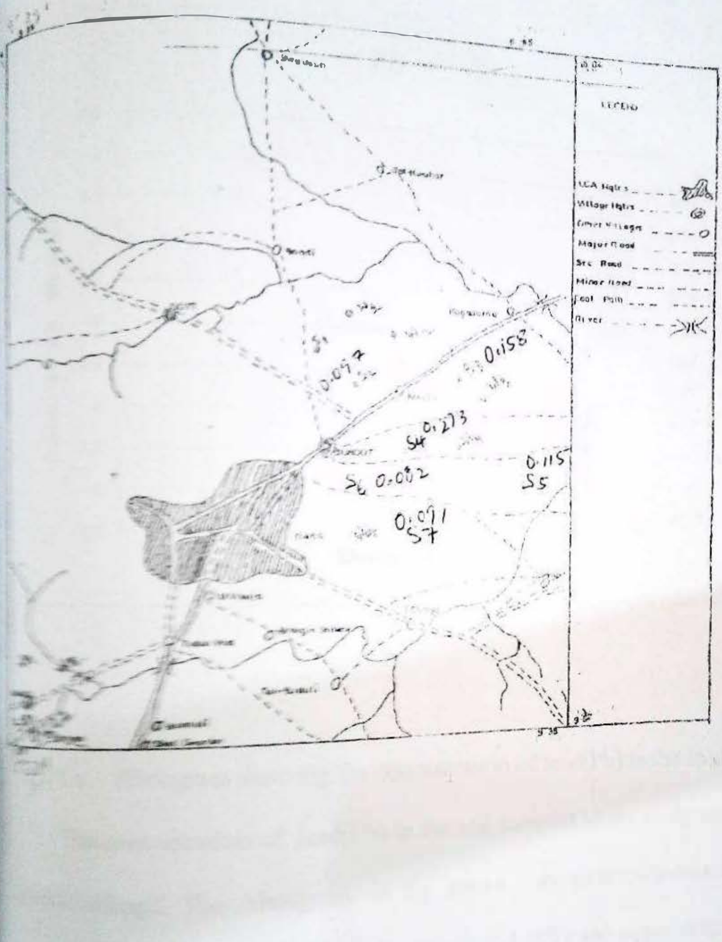


Fig 10a Histogram showing the concentration of Iron in the soils of the study area.

The results in table 1 show the concentration of iron (Fe) in the soil samples ranging from 0.008-0.360mg/l. The histogram in fig shows the mean (x=0.139), the lower control limit (LCL)=-2.507 and the upper control limit(UCL)=2.785,calculated for these concentration. The histogram shows that the highest concentration of Iron (Fe) in the study area corresponds to location S_5 with concentration 0.360mg/l

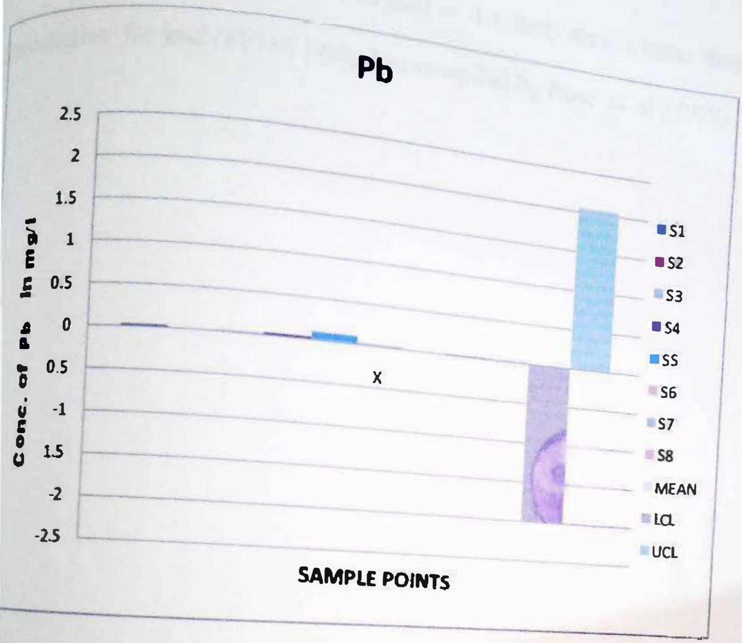
.This value is within the range of LCL-UCL calculated for Fe concentrations in the study area.

However, the concentration of iron (Fe) is far too low as compared with the average concentration for iron(Fe) of 2100 in soils as compiled by rose et al ,(1979). This may be attributed to the leaching away of iron by water.



showing the concentrations of iron (mg/l) in the study area.

5.1.4 LEAD



ll a. Histogram showing the concentration of lead(Pb) in the study area.

The concentration of lead(Pb) in the soil samples of the study area ranges from -0.103mg/l. The histogram in fig above shows the concentrations with the (x) (0.032),the lower control limit(LCL)(-1.992) and upper control limit(UCL)).The histogram shows that the highest concentration of soils of the study area onds to location S_5 (0.103) . The concentration of lead in the study area are /.

The range of concentration of lead in the study area is lower than the average concentration for lead (Pb) of 17mg/l as compiled by Rose et al ,(1979).

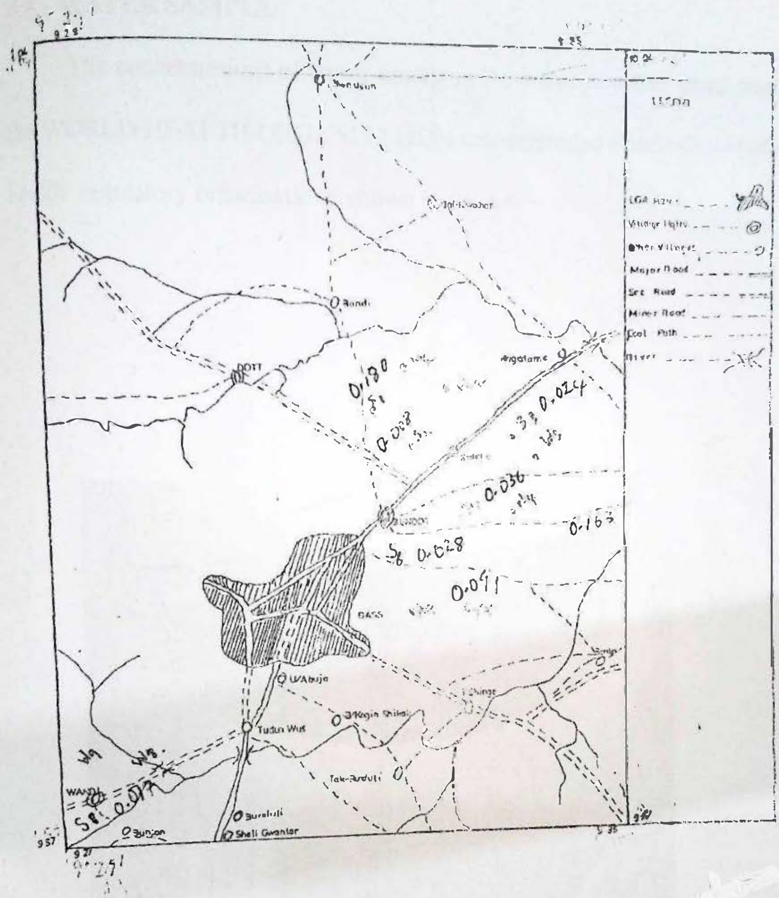


Fig 11 b showing the concentrations of Pb (mg/l) in the study area

5.2 WATER SAMPLE

The concentrations of heavy metals in the water samples were compared with the WORLD HEALTH ORGANISATION recommended standards and other national health regulatory organisations shown in table 4

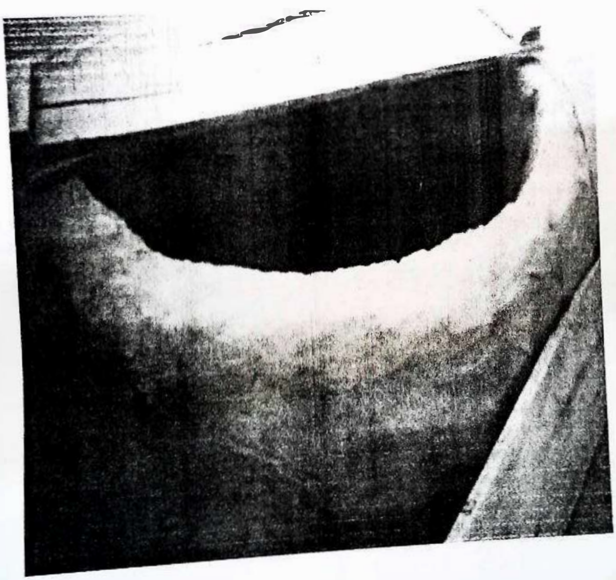


PLATE 3 where W_1 was sampled AT BUNDOT IN DASS LGA

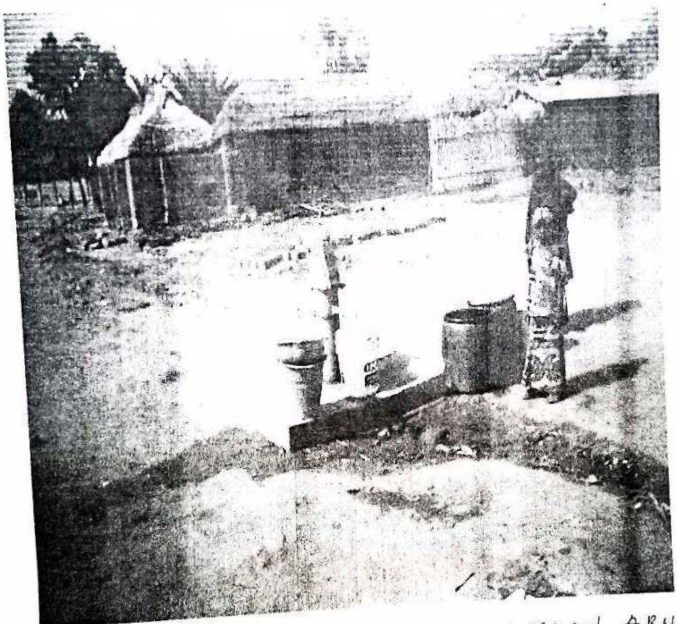


PLATE 4. Where W_8 was sampled AT ANGUWAN ABUA IN DASS LGA

5.2.1 COPPER

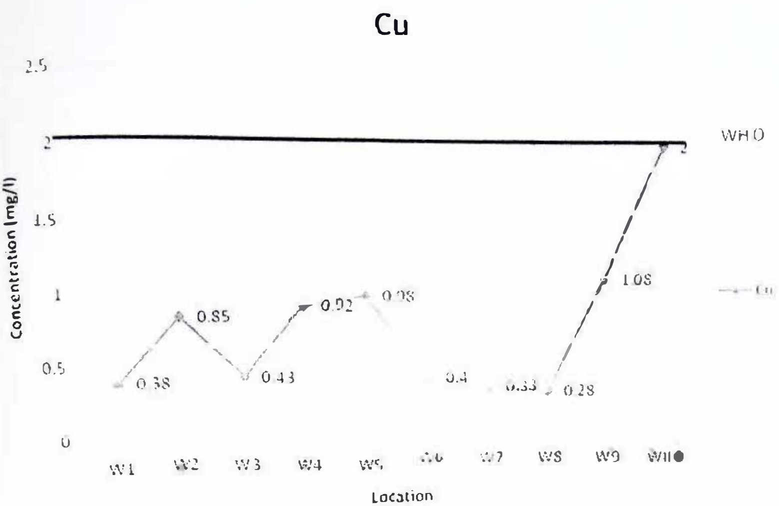


Fig 12a Graph showing the concentrations (mg/l) of Cu in water samples of the of study area.

The result of the water sample analysis (table 2) shows the concentration copper (Cu) which ranges from 0.28-1.08mg/l.

From the graph above in fig 13, the the concentration of Cu of the study area is in comparism with the World Health Organisation recommended Standard for Cu in drinking water . The copper(Cu) concentrations in the water samples are below the World Health Organisation (WHO) maximum permissible standard of 2.0mg/l.

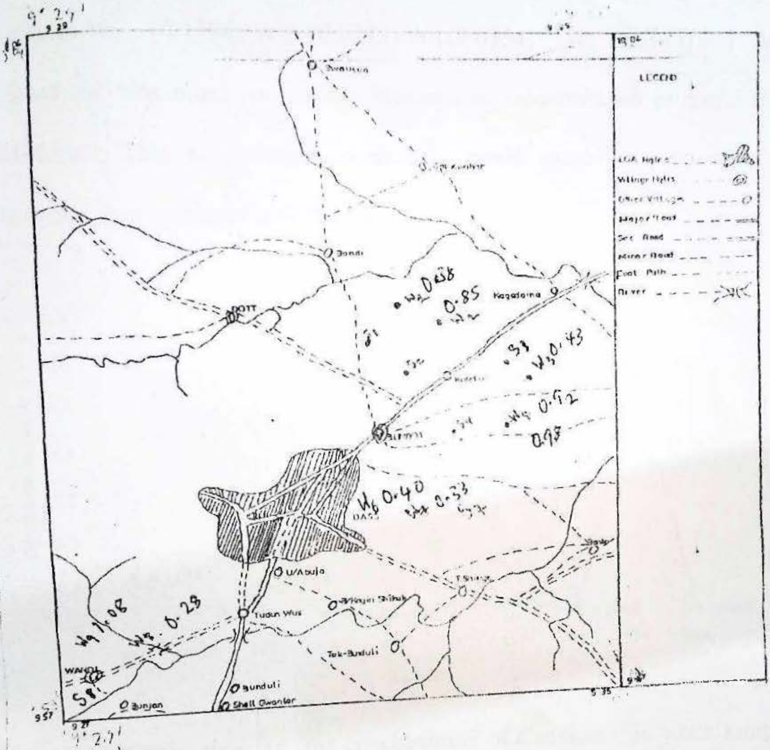


Fig 12b showing the concentrations of Cu(mg/l) in the study area.

5.2.2 CADNIUM

From the results(Table 2) ,the concentration of cadmium range from 0.0023-0.5782 mg/l . Fig shows that the concentration of cadmium in the following locations W_1 (0.1194) W_2 (0.0293) W_3(0.0954) W_4 (0.0149) and W_9 (0.5787) exceed the maximum permissible standard as recommended in drinking water of 0.003mg/l. This anomalous concentration could cause diseases such as kidney damages, lung damages ,and diarrhea.

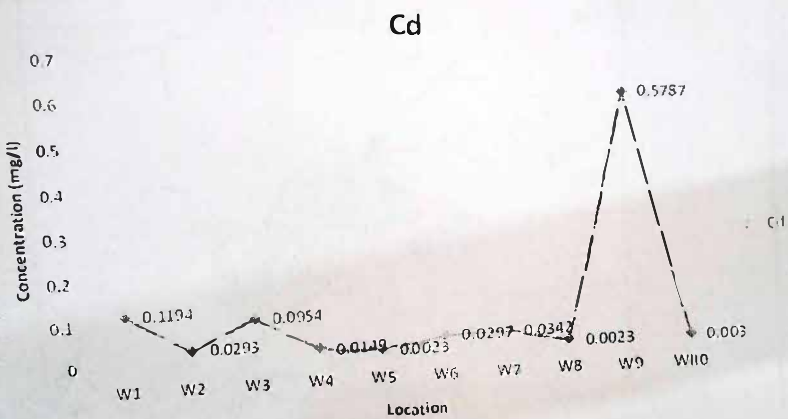


Fig 13a Graph showing the concentration of Cadnium in water samples of the study area

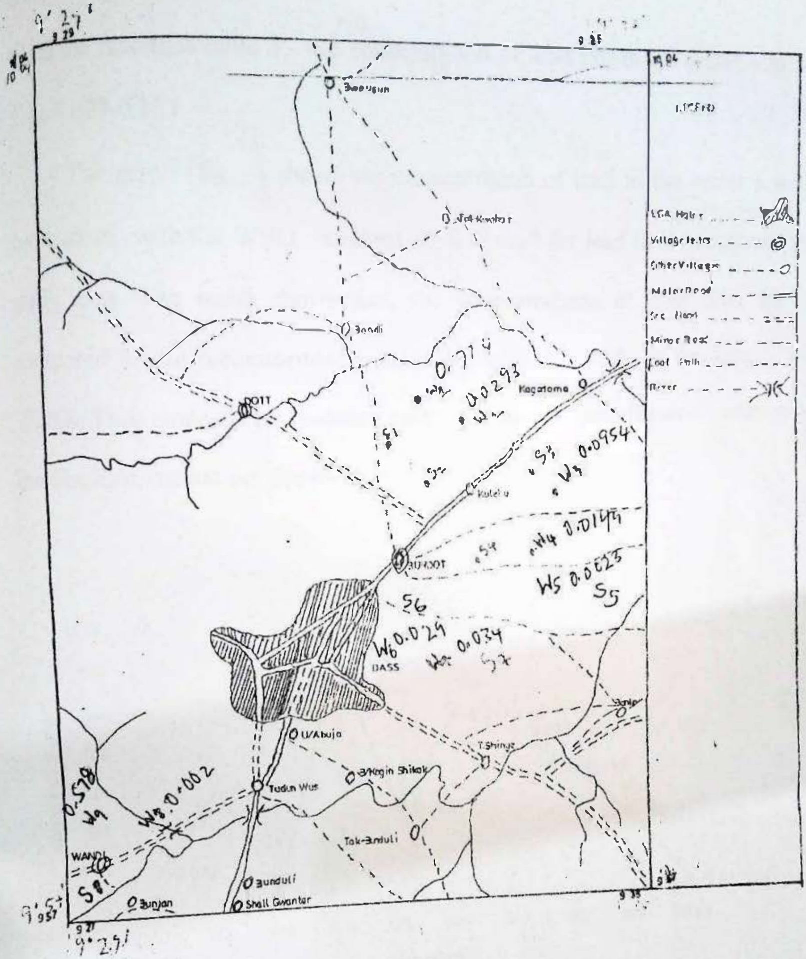


Fig 13b showing the concentrations of cadium(mg/l) in water samples of the study area.

5.2.3 LEAD

From the results in table 3 , the concentration of lead(Pb) in the water samples range from 0.005-0.103.

The graph (fig) shows the concentration of lead in the water samples in comparism with the WHO standard of 0.01mg/l for lead in drinking water of the study area .The result shows that, the concentrations of lead (Pb) are too high compared to the recommended permissible limit of lead in drinking water by WHO. This could cause diseases such as cancer, interference with vitamins D metabolism, mental development in infants.

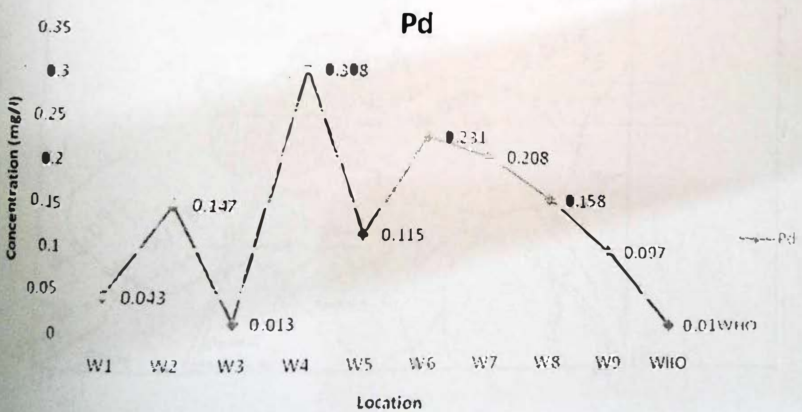


Fig 14a graph showing the concentrations(mg/l) of Lead in water samples in the study area.

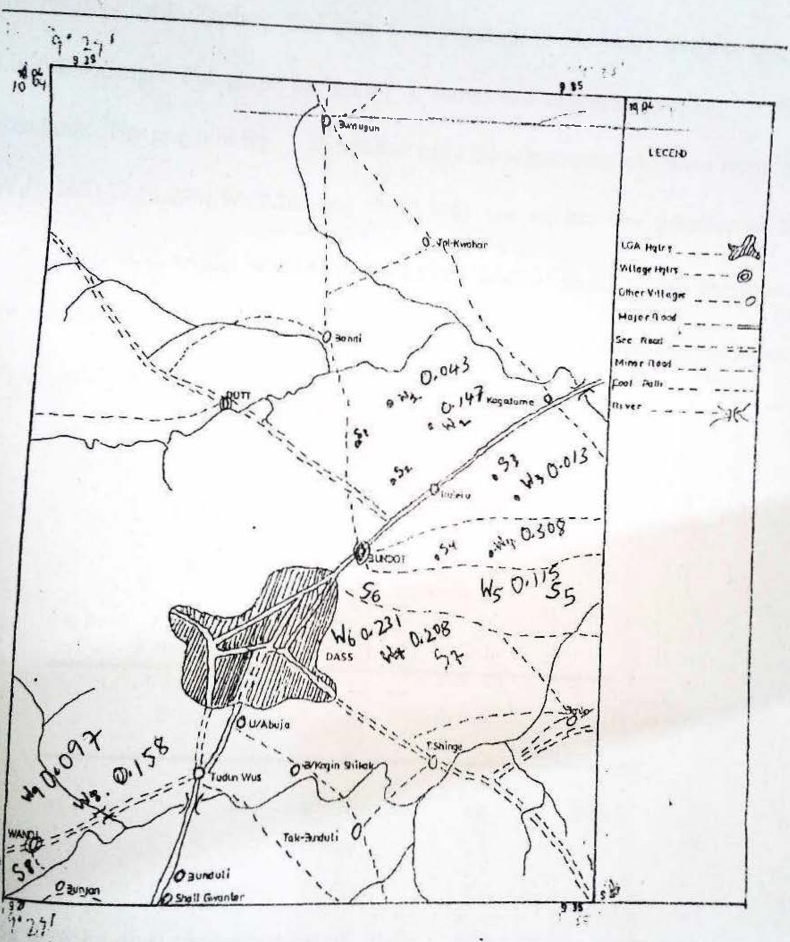


Fig 14b showing the concentration(mg/l) of lead in the water samples of the study area.

5.2.4 IRON(Fe)

The results (Table 2) show that iron concentration in the water samples ranges from 0.076-0.575mg/l. The graph in figure ( ) shows this values in comparism with WHO standards .The graph in fig shows that only the water samples gotten from locations W_2(0.263),W_4(0.298),W_7(0.28),and W_8(0.076) are within the permissive limit of WHO(0.05-0.3) while W_1(0.413),W_3(0.575), W_8(0.414) are above the permissible limit of WHO . This implies that there is high concentration of iron in locations W_1, W_3,W_5 and W_8 .

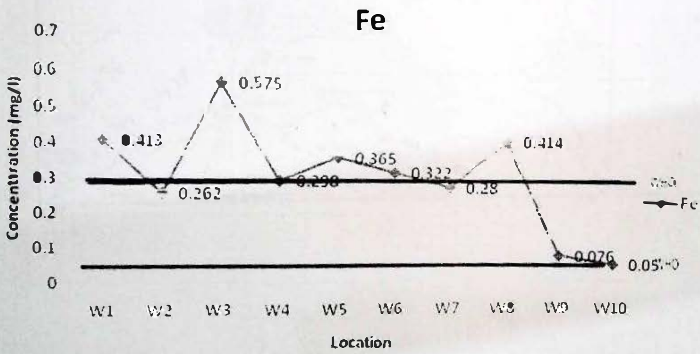


Fig 15a showing the concentration of water samples in the study area

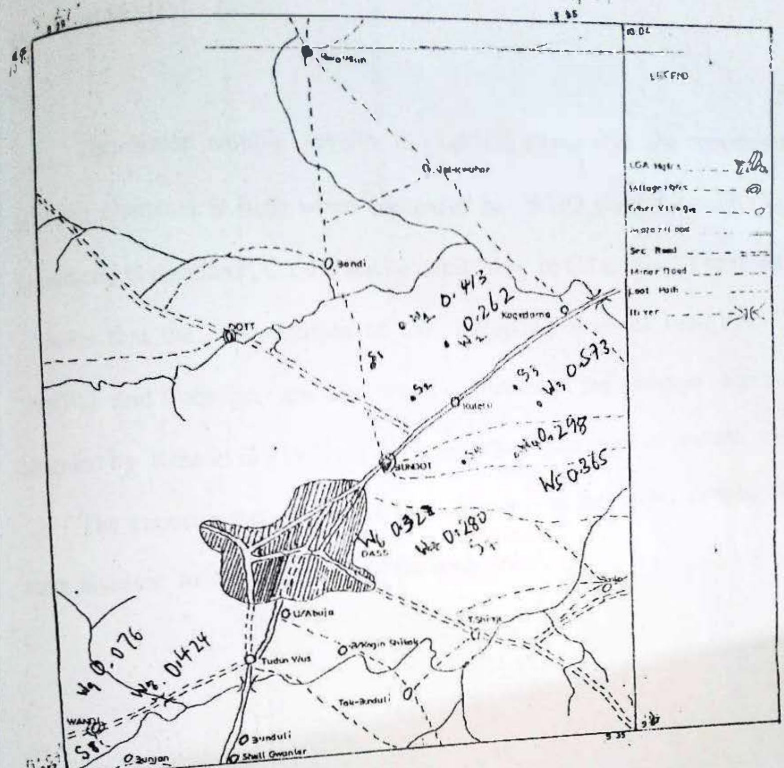


Fig 15b showing the concentration of Iron (mg/l) in water samples of the study area.

5.3 SUMMARY

The water sample results in (Table3) shows that the concentration of the following elements is high when compared to WHO (World Health Organisation) recommended standard , Cd, Pb andFe while that of Cu is low. The result in (Table 1) shows that the concentration of the following elements Lead(Pb), Copper(Cu) ,Iron(Fe) and Cadnium are low when compared to the average concentration as compiled by Rose et al ,(1979) in an undisturbed geochemical environment

The excess concentration of this elements in the water samples could cause some diseases to the inhabitants of the study area.

CHAPTER SIX

6.0 LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

6.1 LIMITATIONS

The work was carried out in Dass Local Government Area of Bauchi State to investigate the concentration of some heavy metals and their health implications on the inhabitants of the area. However, the work was could not be done thoroughly due to insufficient funding , analytical method employed for the studies happens to be the least in terms of accuracy(AAS method) compared to other analytical methods .

6.2 CONCLUSION

A Total of seven(17) Samples were obtained from both groundwater (3 boreholes and 6 hand dug wells) and soil (8 samples) to analyse the concentration of the following elements lead(Pb) , magnesium(Mg) , Potassium(K), copper (Cu) , cadmium(Cd), and iron(Fe) using the AAS method of analysis.

The result of the chemical analysis showed that :

1 There is high concentration of following:Cd,Pb,Fe elements in the water samples when compared to WHO recommended standard and that for Cu is within the WHO recommended standard.

2 All the concentration of the heavy metals in the soil samples are low when compared to the undisturbed average concentration of this elements as compiled by Rose et al ,(1979).

6.3 RECOMMENDATIONS

1 There is the need to make the existing environmental legislation more effective through appropriate enforcement . In addition , public enlightenment campaigns aim at raising the level of awareness and re-orientating the attitude of the inhabitance , in respect of environmental pollution problems are necessary.

2 Further studies should include physical, chemical and microbial investigations and isotopic compositions , as to ascertain other quality parameters and hence prescription of necessary treatment measures.

3 Further studies should also include other samples type like stream sediments ,vegetation (biological samples) to ensure a more detailed work.

4 Both water sources should be developed to supplement the existing ones.

5 Government at various levels should support research scientists and put into consideration results of research and recommendations.

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