Usmanu Danfodiyo University, Sokoto

33rd INAUGURAL LECTURE

Titled

EXPLORING THE SOIL:
From Food, Feed and Fibre Production to Environmental Conservation

Delivered by

Professor S. S. Noma
B.Sc. (UDUS); M.Sc. (U.I.); Ph.D. (UDUS)
Professor of Soil Science

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Inaugural Lecture

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In the Name of Allah, the Beneficent, the Merciful. The Creator of the World and Master of the Day of Judgement. All praises are due to Him alone. May the Peace and Blessings of Allah be upon the Noble Prophet Muhammad (PBUH), His Household, Companions and those who follow His guidance to last day. Ameen.

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Assalamu Alaikum warahmatullahi wabakatuh

1.0 Definition of Terms

1.1 Explore: to investigate, study, or analyze, look into to search and discover (about something):

to think or talk about something in order to find out more about it.

Investigating, studying, analyzing or to looking into something etc.

1.2 **Food**: substance consisting essentially of protein, carbohydrate, fat, and other nutrients used in the body of an organism to sustain growth and vital processes and to furnish energy.

1.3 **Feed**: also called animal feed, food grown or developed for livestock and poultry.

1.4 **Fibre or roughage:** is the portion of plant-derived food that cannot be completely broken down by human digestive system. It can also refer to a thin thread of a natural or artificial substance, especially one that is used to make cloth or rope.

1.5 **Environmental conservation:** is a practice that paves the way for protecting the environment and natural resources on the individual, organizational as well as governmental levels.

1.6 **Soil**: is a natural body of mineral and organic constituents, differentiated into horizons, usually unconsolidated, of variable depth, which differs among themselves as well as from the underlying parent material in morphology, physical makeup, chemical properties and composition and biological characteristics.

1.7 **Land:** is an area of the earth's surface, the characteristics of which embrace all reasonably stable, or predictably cyclic attributes of the biosphere, vertically above and below this area, including those of:

…the atmosphere;

…the soil;

…the underlying geology and associated landforms;

…the hydrology;

…the plant populations;

…the animal populations;

…the microbiological populations; and

…the results of past and present human activity,

…to the extent that these attributes exert a significant influence on present and future

uses of the land by humans.

…to the extent that these attributes exert a significant influence on present and future uses of the land by humans.

1.8 **Soil Science:** is the science dealing with soils as a natural resource on the surface of the Earth including soil formation, classification, mapping which is achieved after studying its physical, chemical and biological properties in relation to the use and management of the soils.

1.9 **Pedology:** is the study of soil as a natural body and does not focus on the soil's immediate practical use. A pedologist studies, examines and classifies soil as they occur in their natural environment.

1.10 **Edaphology:** is the study of soil from the stand point of higher plants. Edaphologists consider the various properties of soil in relation to plant production

1.0 Preamble

An inaugural lecture is an occasion of significance to every academic staff that attains the exalted position of Professor in the University. Every appointed professor takes this as an opportunity to inform colleagues, the campus community and the general public of their work to date, including current research and future plans. The dream of every Professor is to see to the presentation of his/her inaugural lecture showcasing the academic achievements to date. Although my presentation is coming a bit late as I expected to have had it before now; all the same it appears to be among the first two in my faculty.

Inaugural lectures are ceremonial occasions but academic and require a lot in terms of preparation and eventual delivery requiring several sleepless nights and stressful days. Vice Chancellor Sir, my respected senior colleagues, ladies and gentlemen It might interest you to know that today's inaugural lecture is certainly the first in my department since the establishment of this university some 45 years ago.

Vice Chancellor Sir, my presentation today will attempt to give insights in the role of Soil Science and Soil Scientists in food, feed, fibre production and environmental conservation globally and locally while updating the community and the general public on the possible contribution of soilless food production as the world populations grows geometrically approaching 10 billion.

Attempt will be made to present my modest research contributions in soil science over the past few years from soil classification, soil survey, land use planning, soil fertility and studies related to the use of various amendments in the management and rehabilitation of degraded soils.

2.0 Introduction

Although I am farmer by birth and invariably by training, little did I know of a field of study called Soil Science not until my admission into the Faculty of Agriculture in this University both by destiny and sheer coincidence after forfeiting my Joint Admission and Matriculation Board's Admission to read Bachelor of Civil Engineering at Federal University of Technology, Minna 33 years ago in line with destiny. There was hardly any mention of guidance and counseling at the time of our admission or we were simply not aware of its existence as such 90% of students with science background then had MBBS as their famous choice followed by Veterinary medicine and B.Sc. Agriculture was only an option to a few mostly those on study leave from their places of work.

Although I was comfortable while pursuing my B.Sc. Agriculture programme I did not have an idea as to what to opt for at my 400 level in terms of whether to go to Animal Science, Forestry and Fisheries, Crop/Soil Science or Agric. Economics and Extension since our degree then was General Agriculture and I knew that I could do a master's degree in any of the above options.

As God has destined it, I did my B.Sc. Project in Soil Science which gave me more interest in the area hence my choice of Soil Science at University of Ibadan in my masters and thereafter my Ph.D. in Pedology some years later.

The word "soil" is mentioned **287** times in the Quran, with different meanings; example as: clay, land, earth, or the universe with certain and very precise uses in each verse. The Quran also gave different roles of soils in human life such as creation of humans, supporting humans with essential life needs (food, feed, fiber and fuel), etc.

For example in Suratul Al-mu'minun 23: 12-16

"We created man out of the extract of clay, (23:13) then We made him into a drop of life-germ, then We placed it in a safe depository, (23:14) then We made this drop into a clot, then We made the clot into a lump, then We made the lump into bones, then We clothed the bones with flesh,[12] and then We caused it to grow into another creation. Thus Most Blessed is Allah, the Best of all those that create. (23:15) Thereafter you are destined to die, (23:16) and then on the Day of Resurrection you shall certainly be raised up".

Similarly, the word 'soil' had **112** occurrences in **12** translations in the Holy Bible. **89** times in the Old Testament and **23** times in the New Testament. All these gave me hope and confidence that I was on a right track!

Besides the general fear of B.Sc. Agriculture then which led to the Faculty referred to as ‘War College’ or later ‘Work College’ the Department of Soil Science was also one of the most feared departments to the extent that students hardly voluntarily opt to be in Soil Science. What that meant was that you are placed in the department not by choice. Some colleagues then use to say only two categories of students could voluntarily select Soil Science *‘Wanda bai sani ba sai bako’* meaning those who do not know what it entails or a stranger’. Worst still, at that time we had colleagues who used to fondly say *‘Boko sai Arna ko dan Musulmin da ya sa kanshi’* meaning Western education is for the unbelievers or Muslims that force it to themselves. In spite of the odds as Allah (SWT) will have it I have gone through all the odds. From my first research topic ‘The Effect **o**f Cement Dust on Some Soil Properties and Growth of Maize (*Zea mays).* My M.Sc. research topic was ‘Rehabilitation of degraded soils: Preliminary studies with Sokoto soils. While my Ph.D. research topic was ‘Properties, genesis and classification of soils of Sokoto-Rima Floodplains at Sokoto, Nigeria. These and my subsequent research endeavours has shaped my understanding of Soil Science and made me to remain grateful to Allah (SWT) for the choice and successes achieved.

People consider soil important because it supports plants that supply food, feed, fibre, drugs, and other needs of humans and because it filters water and recycles wastes. They cover most lands of the earth, but regarding their service for humans they are a limited and largely non-renewable resource (Blum, 2005). The development and survival or disappearance of civilizations has been based on the performance of soils to provide food, fibre, and further essential goods for humans (Hillel, 2009).

On a global basis, about 3.2 billion hectares are used as arable land, which is about a quarter of the total land area (Scherr, 1999; Davis and Masten, 2003). Total agricultural land covers about 40–50% of the global land area (Ritchie and Roser, 2013). Global issues of the 21st century like food security, demands of energy and water, climate change and biodiversity are associated with the sustainable use of soils (Lal, 2008, 2009; Jones *et al*., 2009; Lichtfouse *et al*., 2009). Feeding about 10 billion people is one of the greatest challenges of our century and requires concerted effort by many especially soil scientists.

3.0 The Need to Study Soil Science

According to FAO (2011) only 11 percent as at then of the earth's soils have no inherent limitations for agriculture. The rest are either too wet, too dry, too shallow, chemically unsuitable or permanently frozen. This situation could not have remained the same hence the percentage of the soils without limitations could presently be much lower than previous estimates and justifies the need more than ever to be associated with soil improvement.

The percentages of total world land area as reported by FAO (2011) is presented below:

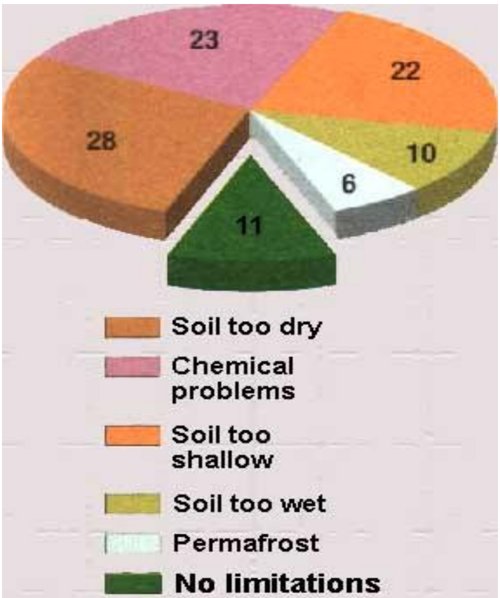


Fig. 1: Status of the soils of the World (FAO, 2011).

This clearly point to need to study Soil Science in order to manage the little available soils for the use of man with a view to satisfying his demand for food, feed, fibre, fuel and environmental conservation. Soil covers most of the land surface of the earth in a thin layer, ranging in thickness from a few centimetres to several metres. It is composed of inorganic matter (rock and mineral particles), organic matter (decaying plants and animals), living plants and animals (many of them microscopic), water and air.

3.1 Ecological functions of soil

- Supports plant growth
- Recycles nutrients and waste
- Controls the flow and purity of water
- Provides habitat for soil organisms
- Functions as a building material/base

The agricultural land the world over is decreasing while our population is increasing at a much faster rate than ever. Fig. 2. Presents status of agricultural land per capita:

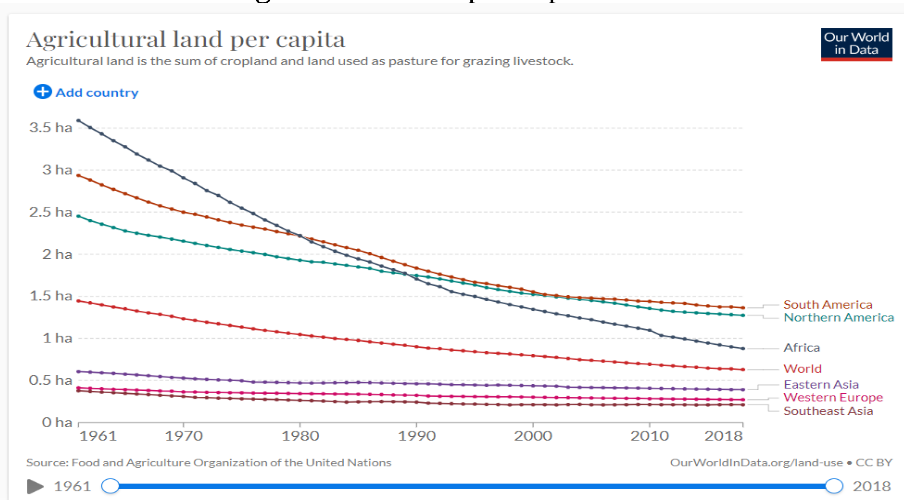


Fig. 2: Global Agricultural land per capita

Source: Hannah Ritchie and Max Roser (2013).

Worldwide, there are largely three main constraints that limit agriculture. Soil moisture is the main limiting factor in most agricultural systems (Hillel and Rosenzweig, 2002; Debaeke and Aboudrare, 2004; Ciais *et al*., 2005; 2009; Farooq *et al*., 2009). Drylands cover more than 50% of the global land surface (Asner and Heidebrecht, 2005). Available soil water is a prerequisite for plant growth. In all climates suitable for agriculture, the water storage capacity of soils is a crucial property for soil functionality including the productivity function (Boden, 2005; Shaxson, 2006; Jones et al., 2009). It is closely correlated with crop yields (Harrach, 1982; Wong and Asseng, 2006).

The second group of restrictions includes other internal soil deficiencies mainly due to an improper substratum limiting rooting and nutrition of plants. These include shallow soils, stoniness, hard pans, anaerobic horizons, or soils with adverse chemistry such as salinity, sodicity, acidity, nutrient depletion or contamination which may cause severe restrictions to plant growth or the utilization of biomass (Murray *et al*., 1983; Louwagie *et al*., 2009).

The third group includes topography, sometimes considered as an external soil property, leading to soil erosion and inhibiting accessibility by humans and machinery (Fischer *et al*., 2002; Duran Zuazo, 2008). There seems to be an interaction between natural constraints to soil productivity and societal factors. Historically, many countries with poor soils tended to be poorly developed. This has led to accelerated soil degradation.

Approaches in the Study of Soil Science

Two Concepts: One treats soil as a natural body, weathered and synthesized product in nature while 3the other treats soil as a medium for plant growth.

1) Pedological Approach: The origin of the soil, its classification and its description are examined in Pedology. (From Greek word pedon, means soil or earth). Pedology is the study of soil as a natural body and does not focus on the soil’s immediate practical use. A pedologist studies, examines and classifies soil as they occur in their natural environment.

2) Edaphological Approach: Edaphology (from Greek word edaphos, means soil or ground) is the study of soil from the stand point of higher plants. Edaphologists consider the various properties of soil in relation to plant production. They are practical and have the production of food and fiber as their ultimate goal. They must determine the reasons for variation in the productivity of soils and find means for improvement.

The earth could, in theory, feed very many more people than now inhabit the globe. But, in practice, good soils, favourable climates, rainfall and fresh water are unevenly spread around the world - and do not necessarily correspond to distribution of population. So, while some countries can produce an excess of food, others struggle with inadequate resources. Many developing countries are overexploiting their soils and several need to obtain food from land poorly suited to agricultural production calling for better understanding of the soil for sustainable production.

Branches of Soil Science

Due to the importance of soil, scientists divide soil science into various branches for ease of understanding of various soil phenomenon. There are 8 branches of soil science. These include;

Soil Physics

Soil Chemistry

Soil Biology/Microbiology

Soil Mineralogy

Soil Fertility

Soil Genesis and Classification (Pedology)

Soil Survey

Soil Conservation

5.0 Importance of the Soil

It is estimated that 95% of our food is directly or indirectly produced on our soils which are the basis for agriculture and the medium in which nearly all food-producing plants grow. Healthy soils produce healthy crops that in turn nourish people and animals.

Mr. Chairman Sir, permit me to say that undoubtedly, we are all here because we ate food of good quality obtained from soils that Allah have provided us with. It may therefore not be wrong to say we all depends on the soils not only for our food but in many other needs such as feeds of our livestock, fibre for other clothing and fuel for our energy.

Although many non-soil scientists hardly differentiate between the two terms soil and land; from the point of view of an agriculturist, these two terms though related are different as defined under definition of terms in this lecture.

Soil plays a vital role in sustaining life on the planet. Nearly all of the food that humans consume, except for what is harvested from marine environments, is grown in the Earth's soils. This is also so regarding feed to we give to livestock and poultry. Other obvious functions that soils provide to humans include fibre for paper and clothing, fuelwood production, and foundations for roads and buildings. Less obvious functions that soils serve are providing a medium to attenuate pollutants and excess water, groundwater recharge, nutrient cycling, and habitat for microorganisms and biota. Soils also have many secondary uses such as ingredients in confectionaries, insecticides, inks, paints, makeup, and medicines; uses of clays range from drilling muds, pottery, and artwork, to providing glossy finishes on various paper products (Schoonove and Crim, 2015). We build on soil as well as with it and in it. Soils are important for human health in a number of ways. Approximately 78% of the average per capita calorie consumption worldwide comes from crops grown directly in soil, and another nearly 20% comes from terrestrial food sources that rely indirectly on soil (Brevik, 2013a). Soils are also a major source of nutrients, and they act as natural filters to remove contaminants from water. However, soils may contain heavy metals, chemicals, or pathogens that have the potential to negatively impact human health. Which better still calls for more understanding of the soil.

5.1 People whose livelihood depends on the soil

Many people the world over depend on the soil directly or indirectly for their livelihood among whom are the following:

- Farmers
- Soil scientists
- Crop scientists
- Foresters
- Geographers
- Geologists
- Geomorphologists
- Hydrologists
- Geophysicists
- Archeologists
- Pastoralists/Herders
- Engineers
- Miners
- Pharmacists
- Environmentalists
- Horticulturalists etc.

Vice Chancellor Sir, I must quickly admit that the list is not exhaustive. Hence, I will rather submit that since we all come from the soil and will all return to it, we all depends on the soil in one way or the other.

6.0 Influence of Soils on Crop Yield/Food Security, environmental conservation and others

Food security is achieved when all people have access to sufficient, safe, and nutritious food (FAO, 2002). Food security is central to human health (Brevik, 2009a; Carvalho, 2006), and the ability to produce nutritious crops in sufficient amounts depends on soil properties and conditions. In particular, soils that have well-developed structure, sufficient organic matter, and other physical and chemical properties conducive to promoting crop growth lead to strong yields and are thus important for food security (Reicosky et al., 2011; Brevik, 2009b).

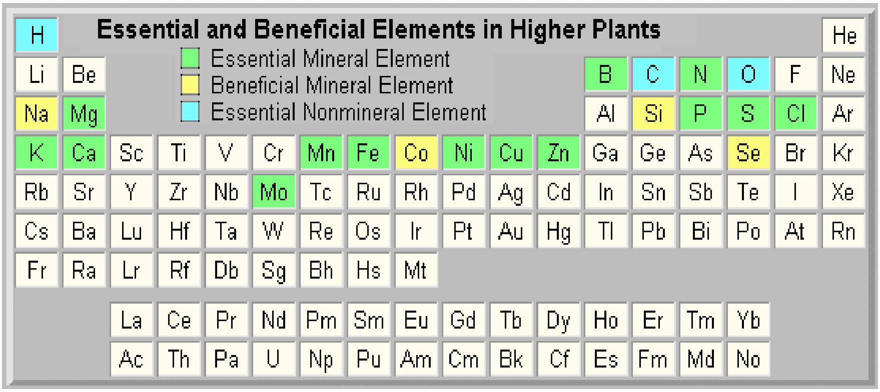
Soil plays a vital role in the Earth's ecosystem. Without soil human life would be very difficult.

- Soil provides plants with foothold for their roots and holds the necessary nutrients for plants to grow;
- it filters the rainwater and regulates the discharge of excess rainwater, preventing flooding;
- it is capable of storing large amounts of organic carbon;
- it buffers against pollutants, thus protecting groundwater quality;
- it provides man with some essential construction and manufacturing materials;
- We build our houses with bricks made from clay, we drink coffee from a cup that is essentially backed soil (clay);
- it also presents a record of past environmental conditions.

8.0 The soil and nutrient supply

Plants require 17 to 20 essential elements for growth out of the current 118 elements in the periodic table. The International Year of the Periodic Table of Chemical Elements (IYPT, 2019) has updated the list from the previous 109 elements as presented below:

Table 1: Periodic table showing essential and beneficial elements



Source: Philip Barak (2003).

These elements classified as essential and beneficial are:

carbon(C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), sulfur(S), calcium (Ca), magnesium (Mg), boron (B), chlorine (Cl), copper(Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn).

These essential elements, also called nutrients, are often split into three groups (fig. 1). The first group is the three macronutrients that plants can obtain from water, air, or both— carbon (C), hydrogen (H) and oxygen (O). The soil does not need to provide these nutrients, so they are not sold as fertilizers. The remaining essential elements are split into two groups—soil-derived macronutrients and soil derived micronutrients. This split is based on the actual amount of nutrient required for adequate plant growth. The soil-derived macronutrients are nitrogen (N), phosphorus (P), potassium (K), sulfur (S), calcium (Ca), and magnesium (Mg). The soil derived micronutrients are boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn).

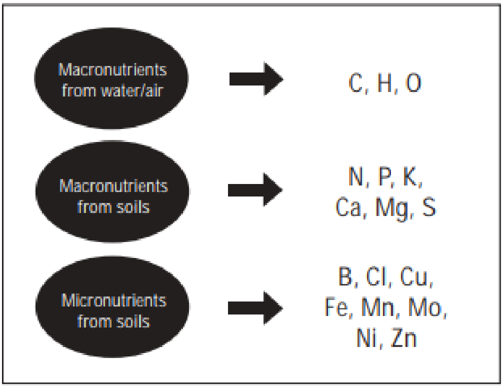


Fig. 3: Seventeen essential nutrients required by plants with the exception of addition three (Cobalt, Silicon and Sodium).

Plants require only light, water, and about17 to 20 elements to support all their biochemical needs. For an element to be regarded as essential, three criteria are required:

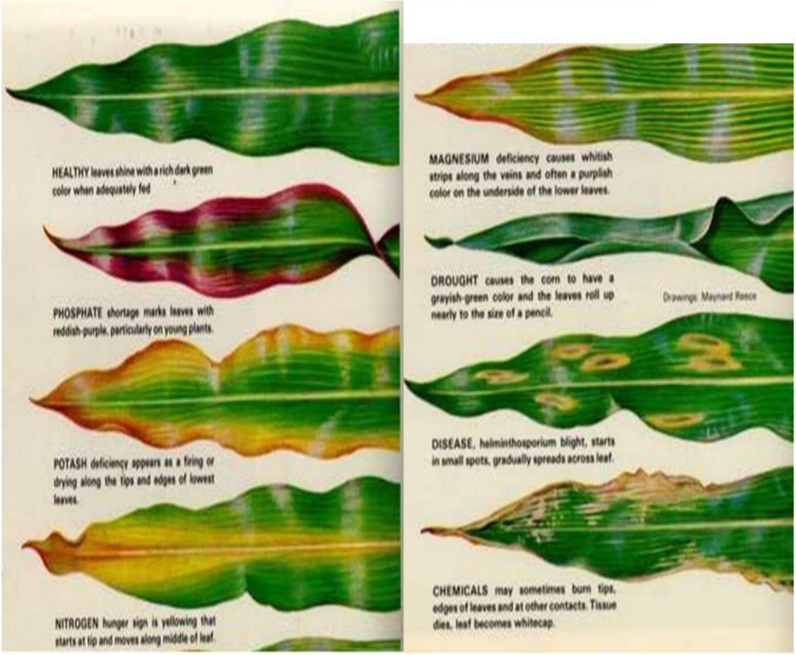
1. a plant cannot complete its life cycle without the element
2. no other element can perform the function of the element
3. the element is directly involved in plant nutrition

Table 2: Macronutrients and Micronutrients

Essential Elements for Plant Growth	
Macronutrients	**Micronutrients**
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O)	Boron (B)
Nitrogen (N)	Molybdenum (Mo)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Zinc (Zn)
Calcium (Ca)	Chlorine (Cl)
Magnesium (Mg)	Nickel (Ni)
Sulfur (S)	Cobalt (Co)
	Sodium (S)
	Silicon (Si)

Cobalt (Co), Sodium (Na) and Silicon (Si) are included in the regular essential nutrients which makes them twenty (20) in number according certain literature.

NUTRIENT DEFICIENCY SYMPTOMS IN CORN



http://www.ctahr.hawaii.edu/oc/freepubs/pdf/SCM-10.pdf
http://www.puricare.co.za/UserFiles/File/Essential%20Nutrients%20for%20Plant%20Growth.pdf

Uchida, R. Essential Nutrients for Plant Growth: Nutrient Functions and Deficiency Symptoms in Silva, J. A. & Uchida, R., eds., CTAHR UH 2000. Plant Nutrient Management in Hawaii Soils, Approaches for Tropical and Subtropical Agriculture.

Plate 1: Nutrient Deficiency Symptoms in Corn

10.0 Soil Classification and its purpose

Soil classification is the systematic arrangement of soils into groups or categories on the basis of their characteristics. Classification of soils is necessary for the following reasons:

 to organize knowledge about soils of the area, locality or region;

- **to bring out and understand relationships among soils and classes of soils being classified;**
- **to remember properties of the soils being classified;**
- **to learn new relationships and principles in the soils being classified and**

to help in technology transfer

11.1 Types of Soil Classification Systems

There are many soil classification systems in the world, most of which being national and others international in terms of their usage. The following are common soil classification systems in use:

- **United States Soil Classification System (also referred to as Soil Taxonomy)**
- **FAO-UNESCO Soil Classification System**
- **World Reference Base (WRB) for Soil Resources**
- **USSR Soil Classification System**
- **Natural System of Soil Classification of Kubiena (1953)**
- **ORSTOM Soil Classification System.**
- **British System of Soil Classification**
- **Australian System of Soil Classification**
- **Canadian Soil Classification System**

11.2.1 THE USDA Soil Taxonomy

The USDA Soil Taxonomy system is a multi-categorical and hierarchical system of classification. The categories of the USDA Soil Taxonomy System are:

Order, Suborder, Greatgroup, Subgroup, Family and Series.

Table 3: Categories of the USDA Soil Taxonomy Classification System

Category	**Nature of differentiating characteristics (Differentiate)**
Order	Soil-forming processes as indicated by presence or absence of major diagnostic horizons.
Suborder	Genetic homogeneity, subdivision of orders according to presence or absence of properties associated with wetness, soil moisture regimes major parent material, and vegetation effects as indicated by key properties; organic fiber decomposition stage in histosols
Great group	Subdivision of suborders according to similar kind, arrangement, and degree of expression of horizons, with emphasis on upper sequum; base status; soil temperature and moisture regimes; presence or absence of diagnostic layers (plinthite) fragipan, duripan.
Subgroup	Central concept taxa for great group and properties indicating intergradations to other great groups, suborders, and orders; extra gradation to "not soil"
Family	Properties important for pant root growth; broad soil textural classes averaged over control section or solum; mineralogical classes for dominant mineralogy of solum; soil temperature classes (based on mean annual soil temperature at 50cm depth.
Series	Kind and arrangement of horizons; colour, texture, structure, consistence, and reaction of horizons; chemical and mineralogical properties of the horizons.

Table 4: Soil Orders and Formative Elements of the USDA Soil Taxonomy System

Order	**Formative Element**	**Derivation**	**Mnemonicon**
Entisol	ent	(nonsense syllable)	rec***ent***
Inceptisol	ept	L. - *inceptum*, beginning	inc***ept***ion
Alfisol	alf	(nonsense syllable)	ped***alf***er
Spodosol	od	Gr. - *spodos*, wood ashes	p***od***zol; ***od***d
Alfisol	alf	(nonsense syllable)	ped***alf***er
Ultisol	ult	L. - *ultimus*, last	***ult***imate
Oxisol	ox	Fr. - *oxide*, oxide	***ox***ide
Gelisols	el	L. - *gelare,* freeze	**gel**ifluction
Mollisol	oll	L. - *mollis,* soft	m***oll***ify
Aridisol	id	L. - *aridus*, dry	ar***id***
Histosol	ist	Gr. - *histos*, tissue	h***ist***ology
Vertisol	ert	L. - *verto*, turn	inv**ert**
Andisol	and	Sp. - Andes	**and**esite

Adopted from Steve Kite, 2007

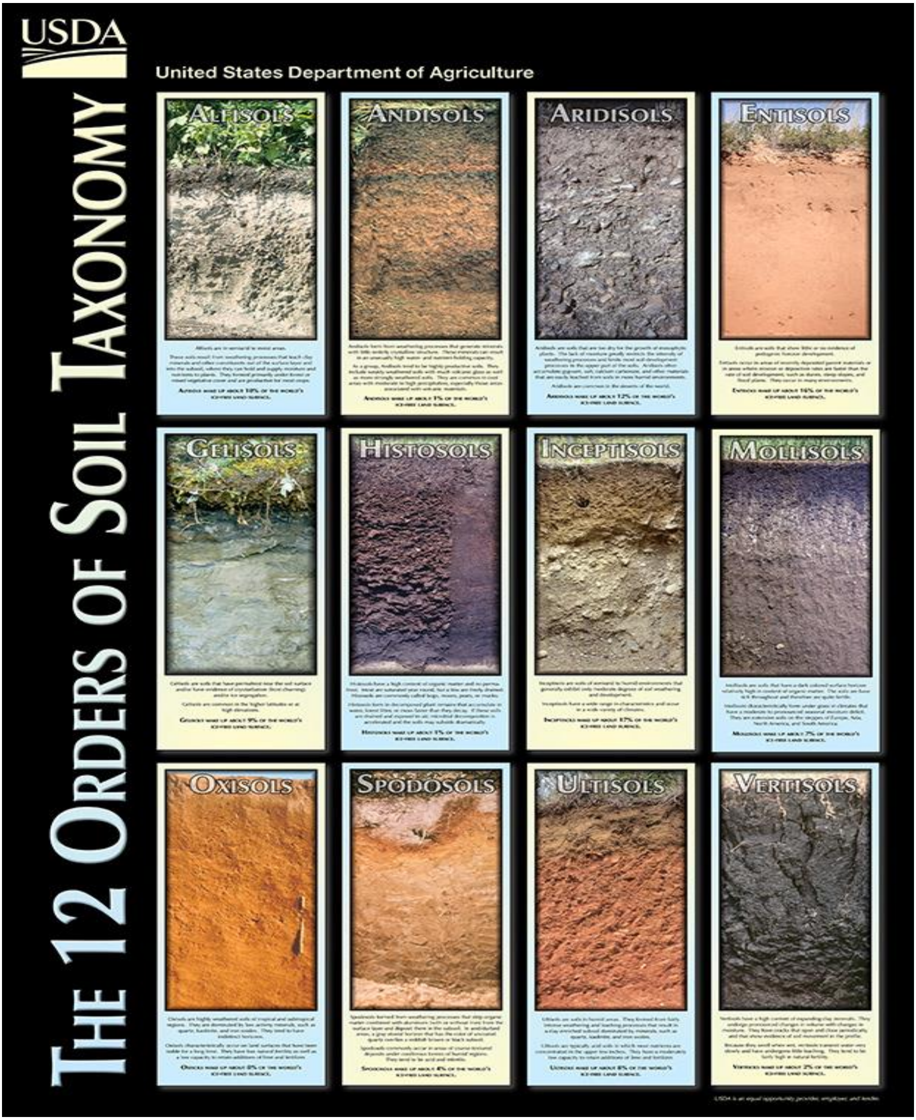


Plate 2: Soil Orders of the USDA Soil Taxonomy System

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_053588

Out of these twelves soil orders only five are mostly found in many places in Nigeria. This however does not mean isolated few other soil orders might not be found elsewhere in Nigeria.

The five common soil orders in Nigeria are shown below:

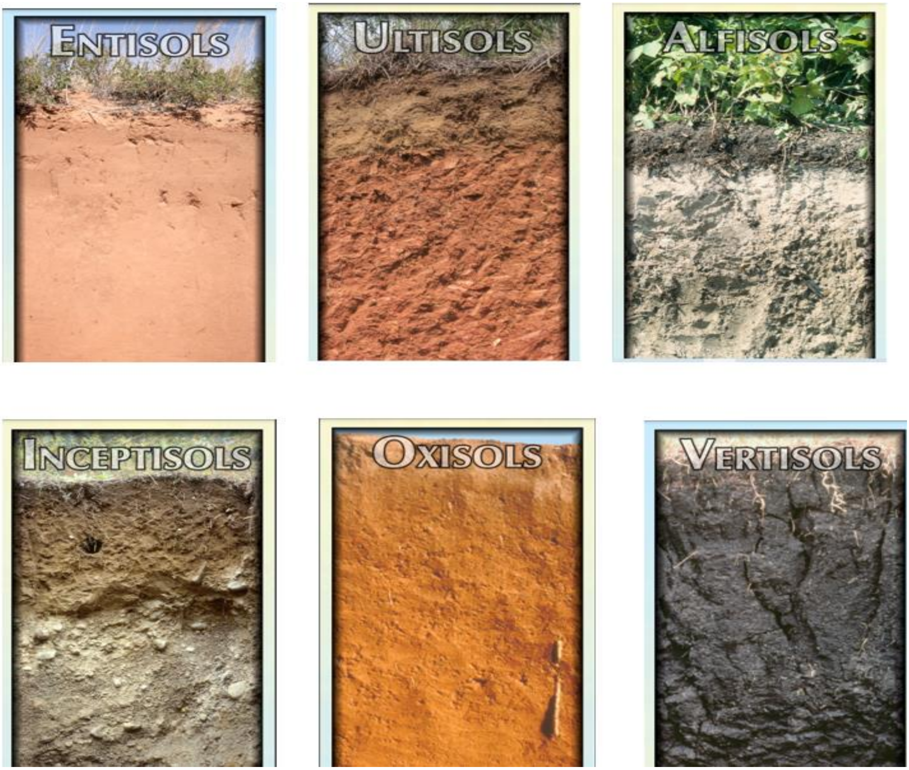


Plate 3: Some Soil Orders Common in Nigeria

11.2.2 The FAO-UNESCO Soil Map of the World Legend (Now World Reference Base)

The FAO-UNESCO classification system is basically a bi-categorical system i.e. with two levels of classification. The two levels are level-1 major soil groupings or References Groups and level-2 soil units. Like in the USDA Soil Taxonomy, this system of classification makes use of diagnostic horizons and properties to give names to soils. Apparently, most of the diagnostic features used in this system are derived from those of the USDA and have been modified and simplified to suit the purposes of the classification scheme. Most soil names end with -sol(s) and this is connected with formative elements which indicate some properties of the soils.

This system has 32 Major Soil Groupings or Reference Soil groups and 153 soil units. Phases are also used in this classification to include features of the land which are significant to its use and management. Phases usually cut across soil boundaries and hence have not been used to define individual soil units. These are the Major Soil Groupings or Reference Soil Groups:

Table 5: Major Soil Groupings (Reference Soil Groups) of the FAO-UNESCO Soil Map of the World Legend (World Reference Base) System.

S/No.	Reference Soil Group	Symbol
1.	Soils with thick organic layers	
	Histosol (with thick organic layers)	HS
2.	Soils with strong human influence	
	Anthrosol (with long and intensive agricultural use, altered to enhance fertility)	AT
	Technosol (containing significant amounts of artefacts)	TC
3.	Soils with limitations to root growth	
	Cryosol (permafrost-affected)	CR
	Leptosol (thin or with many coarse fragments)	LP
	Solonetz (with a clay-enriched subsoil with high concentrations of exchangeable Na)	SN
	Vertisol (high contents of shrink-swell clays, alternating wet-dry conditions)	VR
	Solonchak (high concentrations of soluble salts)	SC

S/No.	Reference Soil Group	Symbol
4.	Soils distinguished by Fe/Al chemistry	
	Gleysol (groundwater-affected, underwater or in tidal areas)	GL
	Andosol (with allophanes or Al-humus complexes)	AN
	Podzol (subsoil accumulation of organic matter and/or oxides)	PZ
	Plinthosol (accumulation and redistribution of Fe)	PT
	Nitisol (low-activity clays, P fixation, many Fe oxides, strongly structured)	NT
	Ferralsol (dominance of kaolinite and oxides)	FR
	Planosol (stagnant water, abrupt textural difference)	PL
	Stagnosol (stagnant water, no or only moderate textural difference)	ST
5.	Pronounced accumulation of organic matter in the mineral topsoil	
	Chernozem (very dark and well-structured topsoil, secondary carbonates)	CH
	Kastanozem (dark topsoil, secondary carbonates)	KS
	Phaeozem (dark topsoil, no secondary carbonates (unless very deep), high base status)	PH
	Umbrisol (dark topsoil, low base status)	UM
6.	Accumulation of moderately soluble salts or non-saline substances	
	Durisol (accumulation of, and cementation by, secondary silica)	DU
	Gypsisol (accumulation of secondary gypsum)	GY
	Calcisol (accumulation of secondary carbonates)	CL
7.	Soils with clay-enriched subsoil	
	Retisol (interfingering of coarser-textured, lighter coloured material into a finer-textured, stronger coloured layer)	RT

S/No.	Reference Soil Group	Symbol
	Acrisol (low-activity clays, low base status)	AC
	Lixisol (low-activity clays, high base status)	LX
	Alisol (high-activity clays, low base status)	AL
	Luvisol (high-activity clays, high base status)	LV
8.	Soils with little or no profile differentiation	
	Cambisol (moderately developed)	CM
	Arenosol (very sandy)	AR
	Fluvisol (stratified fluviatile, marine or lacustrine sediments)	FL
	Regosol (no significant profile development)	RG

Source: IUSS Working Group WRB. (2015).

12.0 The Role of Soil Science in Achieving Sustainable Development Goals (SDGs)

In 2015, the UN formulated seventeen (17) global Sustainable Development Goals (SDGs), among them ending poverty, eliminating hunger, protecting the planet and ensuring peace and prosperity (Fig. 4).

Fig.: 4 Pictorial Representation of the 17 SDGs

Fig. 5 The SDGs that has direct link to soils.

Soil and Sustainable Development Goals

Global developments such as increase in population, decrease in availability of resources (e.g., water, land, nutrients), and climate change restrict our capacity to increase food production while sustainably managing our natural resources. Furthermore, issues such as land degradation, soil erosion, and loss of organic matter are deeply intertwined with decline in environmental quality and threaten the livelihoods of millions of people around the world (Bouma et al., 2017).

13.0 Producing Food without the Soil

It has been documented that over 95% of the food and feed produced for human use globally comes from the soil directly or indirectly. This notwithstanding, nearly 5% of the remaining food and feed could be produced through soilless cultures such as hydroponics and aeroponics. Hydroponics, by definition, is a method of growing plants in a water based, nutrient rich solution. Hydroponics does not use soil, instead the root system is supported using an inert medium such as perlite, rockwool, clay pellets, peat moss, or vermiculite.

https://www.rimolgreenhouses.com/blog/5-reasons-hydroponic-growing-more-profitable-soil-growing

Plate 4: Vegetables grown using soilless culture (hydroponics)

Plate 5: Example of vegetables cultivated through hydroponics

In the same way crops are also cultivated in the air through aeroponics. Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium.

Plate 6: Vegetable crops cultivated through aeroponics

https://farmtrybe.com/how-does-aeroponics-work/

Plate 7: Vegetables grown through Aeroponics

14.0 My Contribution in Soil Science Research

Vice Chancellor Sir, when I joined the services of this University some 28 years ago as Assistant Lecturer precisely in August, 1995, I could hardly dream of becoming a professor as the entire faculty of Agriculture had only one or two professors then. However, the situation has now changed and Allah has made it possible to Which I remain grateful. I have since my employment assigned to handled courses such as Soil survey and Land use planning, Soil genesis and classification and general pedological courses among others. Consequently, much of my contributions centered on soil classification, soil survey, influence of land use on soil properties, soil fertility, soil conservation and soil management. To date I have made a modest contribution of 87 publications in journals and peer reviewed conference proceedings nationally and internationally. I will present just a few of the published works in the next few slides:

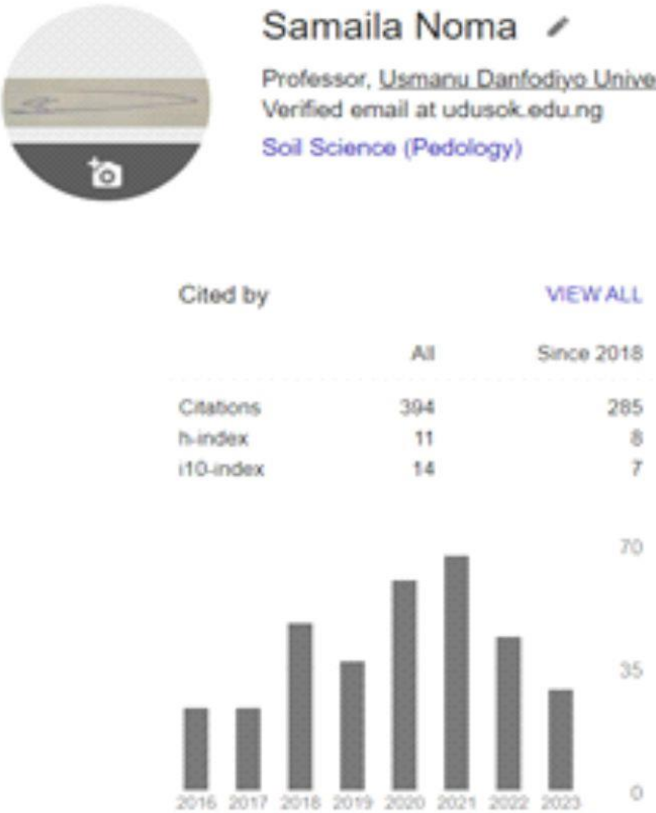


Fig. 6: My Visibility

14. 1 Poor Agricultural Practices and their impacts on soil productivity

Vice Chancellor Sir. Most of our soils are no longer producing the required quantity of agricultural produce as evidenced by decline in yield of crops. One of my initial studies investigated the reasons behind this decline in the soils of the erstwhile Sokoto state (Noma, 1997). The findings revealed that anti-erosion farming practices such as cultivation across the slope could help greatly in maintaining soil health and agricultural productivity.

14.2 Soil survey and classification

Vice Chancellor Sir, knowing the type of soils at one's disposal is the beginning of successful enterprise having to do with the soils. On the basis of this, our other early contributions started with the determination of the properties of the soils and classifying the types of soils in our environment Table 1 and 2 (Noma and Yakubu, 2002, Yakubu *et al*., 2003; Yakubu *et al.*, 2006, 2008; Lawal *et al*., 2012).

Table 6: Classification of the soils in the permanent site of the Usmanu Danfodiyo University, Sokoto

Profile No.	Classification	
	Soil Taxonomy (subgroup)	FAO/UNESCO (Soil Subunits)
1	Typic Ustifluvents	Dystric Fluvisols
2	Typic Ustipsamments	Ferralic Arenosols
3	Typic Ustorthents	Dystric Leptosols
4	Typic Udifluvents	Dystric Fluvisols
5	Typic Ustipsamments	Ferralic Arenosols
6	Typic Ustipsamments	Ferralic Arenosols
7	Typic Ustipsaments	Ferralic Arenosols
8	Typic Ustipsaments	Ferralic Arenosols
9	Typic Fluvaquents	Dystric Fluvisols

Table 7: Chemical Characteristics of Irrigation Water from Sokoto-Rima Floodplains

Sample	pH	EC (dSm^{-1})	Exchangeable base ($cmol.kg^{-1}$)				Co_3^{-2}	HCo_3^-	Cl^-	SAR
			Ca	Mg	Na	K	($cmoll^{-1}$)	($cmoll^{-1}$)	($mmoll^{-1}$)	
D_1	7.7	12.26	0.03	0.08	0.59	0.02	0.05	1.75	6.3	2.51
D_2	7.7	13.61	0.02	0.09	0.67	0.02	0.10	2.70	6.9	2.91
D_3	9.3	11.14	0.02	0.08	0.65	0.13	0.45	1.85	13.2	2.90
D_4	7.3	15.68	0.03	0.09	0.98	0.07	0.25	175	13.3	4.08
D_5	7.8	2.47	0.02	0.09	0.15	0.01	0.30	2.90	10.5	0.64

Table 8: Classification of some upland soils

Pedon	Horizon	Depth (cm)	pH (1:2)	EC (dsm^{-1})	Organic carbon (%)	Na	Ca	K	Mg	CEC	BS
						Cmol (+) Kg^{-1}					%
Jigawa (Typic Ustipsamments/ Haplic Arenosols)											
1	Ap	0.29	5.14	0.14	0.26	0.07	1.20	0.03	0.12	1.6	89
	AC	29-60	4.31	0.15	0.29	0.06	1.00	0.02	0.16	3.6	33
	C1	60-89	4.32	1.20	0.29	0.07	1.40	0.02	0.16	3.0	55
	C2	89-150	4.34	0.140	0.27	0.07	2.20	0.01	0.14	3.4	71
	C3	150-170	4.22	0.23	0.31	0.08	2.60	0.02	0.11	3.4	83
2	Ap	0-31	5.47	0.19	0.30	0.08	1.30	0.03	0.4	2.5	62
	AC	31-57	5.30	0.14	0.26	0.08	1.62	0.03	0.14	3.0	62
	C1	57-90	5.60	0.14	0.27	0.06	2.10	0.01	0.16	3.6	65
	C2	90-152	5.41	0.20	0.21	0.07	2.15	0.01	0.14	4.0	59
	C3	152-176	5.33	0.15	0.21	0.07	2.15	0.03	0.13	4.5	53
Fako (Typic Ustorthents / Eutric Regosols)											
3	A	0-10	5.66	0.12	0.27	0.07	1.60	0.02	0.12	2.4	75
S	AC	10-40	6.32	0.15	0.33	0.07	1.40	0.02	0.13	2.2	74
		40+		Plinthite							
4	A	0-15	5.70	0.14	0.38	0.08	1.70	0.01	0.21	4.1	49
	AC	15-46	5.92	0.13	0.25	0.06	2.20	0.02	0.17	3.6	68
		46+		Plinthite							
Tsakwamya (Lithic Ustorthents / Dystric Regosols)											
5	Ap	0-15	6.35	0.54	0.27	0.07	2.40	0.05	0.20	6.8	40
	AC	15-39	6.49	0.77	0.29	0.07	2.00	0.02	0.21	7.8	29
	C1	39-70	6.56	0.21	0.34	0.07	2.40	0.02	0.18	6.6	40
	C2	70-79	6.12	0.30	0.36	0.08	3.00	0.02	0.20	5.6	59
		79+		Ironstone	Hardpan						
6	Ap	0-17	6.41	0.46	0.34	0.06	2.10	0.04	0.11	6.0	38
	AC	17-35	6.23	0.52	0.28	0.07	1.70	0.02	0.16	47.1	27
	C1	35-62	6.34	0.32	0.28	0.08	1.51	0.002	0.21	6.4	28
	C2	62-73	6.16	0.30	0.25	0.08	1.54	0.01	0.13	6.8	26
		73+		Ironstone	Hardpan						
Laka (Vertic Fluvaquents /Eutric Fluvisols)											
7	Ap	0-21	5.49	0.10	0.10	0.32	3.22	0.05	1.82	10.8	50
	B1	21-63	6.79	0.14	0.18	0.34	3.70	0.10	1.89	10.2	59
	B2	63-100	6.89	0.15	0.16	0.37	3.62	0.12	1.23	11.7	46
		100+		Water Table							
8	Ap	0.18	6.41	0.21	0.18	0.18	4.11	0.12	1.14	116	48
	B1	18.55	6.56	0.15	0.17	0.14	4.64	0.05	1.76	11.2	59
	B2	55-103	6.72	0.15	0.13	0.10	3.12	0.07	1.10	10.1	43
		103+		Water Table							

Table 9: Organic Carbon Content of the Soil

Table 11: Organic Carbon Content of the Soil

Pedon	Horizon	Depth (cm)	Organic Carbon (gkg⁻¹)
1(Irrigated Area)	Ap	0-43	28
	AB	43-59	28
	BC	59-80	33
	C	80-109	32
W. ave.			**30**
2(Permanent Cropped area)	Ap	0-12	30
	AB	12-34	28
	Bw	34-45	30
	C	45-105	28
W.ave.			**29**
3 (Wind break Area)	A	0-18	21
	AB	18-43	29
	B	43-59	22
	BC1	59-78	26
	BC2	78-93	24
	C	93-112	23
W.ave.			**24**
4. (Arable Land Area)	Ap	0-30	23
	AC	30-56	15
	C	56-180	27
W. ave.			**24**

W. ave. Weighted average

Table 10: The pH of the soils from different land use types

Table 12: The pH of the soils from different land use types

Pedon	Horizon	Depth (cm)	pH Value
1(Irrigated Area)	Ap	0-43	6.0
	AB	43-59	5.8
	BC	59-80	6.1
	C	80-109	5.8
W. ave.			**5.9**
2(Permanent Cropped area)	Ap	0-12	6.1
	AB	12-34	5.9
	Bw	34-45	6.0
	C	45-105	6.0
W.ave.			**5.9**
3 (Wind break Area)	A	0-18	5.9
	AB	18-43	5.9
	B	43-59	5.5
	BC1	59-78	4.6
	BC2	78-93	5.6
	C	93-112	5.6
W.ave.			5.8
4. (Arable Land Area)	Ap	0-30	5.4
	AC	30-56	5.4
	C	56-180	5.1
W. ave.			**5.2**

W. ave. Weighted average

Table 11: Physical Properties of the Soils

Table 3. Physical Properties of the Soils

Soil Series	Horizon	Depth (cm)	Particle Size Distribution (%)			Textural Class	Silt/Clay Ratio	D_b MgM^{-3}	Porosity (%)
			Sand	Silt	Clay				
Rima Series (Aeric Endoaquepts/ Gleyic Cambisols)									
	Ap	0-23	36	56	8	SiL	7	1.29	51
	Bw	23-46	36	60	4	SiL	15	1.15	57
	C	46-79	74	26	0	LS	0.0	1.46	45
	2Cg	79-100	25	52	23	SiL	2.3	1.22	54
	3C2	100-110	58	38	4	SL	9.5	-	-
	4Cg	110-148	9	29	62	C	0.5	1.26	52
	5Abg	148-180	35	37	28	CL	1.3	1.19	55
	6C	180-200	84	16	0	LS	0.0	-	-
Laka Series (Vertic Endoaquepts/ Vertic Cambisols)									
	Ap	0-11	19	12	69	C	0.2	1.30	51
	Bw1	11-30	17	62	21	SiCL	3.0	1.31	51
	Bw2	30-70	17	63	20	SiCL	3.2	1.44	46
	2Cg1	70-100	15	34	51	C	0.7	1.21	54
	2Cg2	100-150	6	51	43	SiC	1.2	1.19	55
Allaka Series (Aquic Ustifluvents/ Eutric Fluvisols)									
	Ap	0-14	52	44	4	SL	11	1.40	47
	Bw1	14-26	54	42	4	SL	10.5	1.38	48
	2Bw2	26-42	41	44	15	L	2.9	1.32	50
	2Abm	42-44	41	44	15	L	2.9	1.34	49
	3B	44-69	53	30	17	SL	1.8	1.08	59
	3C1	69-111	58	30	12	SL	2.5	1.34	49
	4C2	111-173	21	30	49	C	0.6	1.27	52
	4C3m	173-200	54	21	25	SCL	0.8	1.15	57
Kanwa Series (Vertic Endoaquents/ Eutric Gleysols)									
	Ap	0-28	31	51	18	SiL	2.8	1.29	51
	AC	28-55	37	55	8	SiL	6.9	1.44	46
	C	55-64	72	20	8	SL	2.5	-	-
	Cg1	64-67	46	45	9	SiL	5.0	1.21	54
	2Cg2	67-77	35	57	8	SiL	7.1	1.21	54
	2C1	77-85	35	59	6	SiL	9.8	1.17	56
	2C2	85-100+	79	14	7	SL	2.0	-	-
Tsakwany a Series (Humaqueptic Fluvaquents/Dystric Gleysols)									
	Ap	0-29	51	31	18	SCL	1.7	1.15	57
	2Bwg	29-62	25	30	45	C	0.7	1.31	51
	2cg1	62-70	13	49	38	SiCL	1.3	1.23	54
	2Cg2	70-100+	14	62	24	SiCL	2.6	1.14	57

Key: **Textural Class-** Si =Silt, S= Sand, C= clay. D_b= Bulk density

Our findings have also revealed great variability in the soils of the Sokoto area especially the floodplain soils as indicated in figure 7:

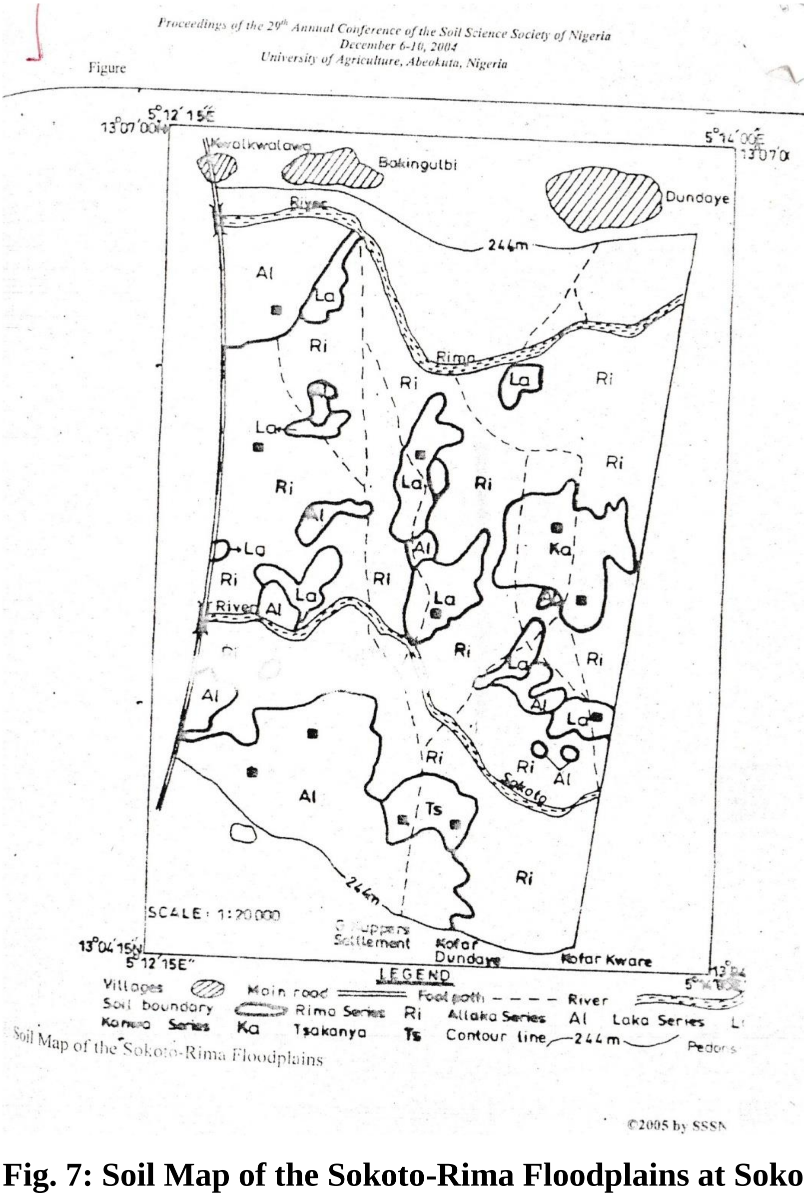


Fig. 7: Soil Map of the Sokoto-Rima Floodplains at Sokoto

Vice Chancellor Sir, It might interest you to know that we have excavated and described over one hundred (100) soil profiles in different soil units both on the lowlands and uplands.

We generally classify soils using the USDA Soil Taxonomy System and correlate the names with those in the World Reference Base (WRB) for Soil Resources. It should be noted that a soil can only be classified after describing its profile.

Some of the profile pits are displaced in the following photographs:

Soil Profile description in progress at some locations in 2021.

Plate 8: Profile description at Wurno LGA, Sokoto State

Plate 9: Profile description at Wurno LGA, Sokoto State

Plate 10: Some Selected Profiles

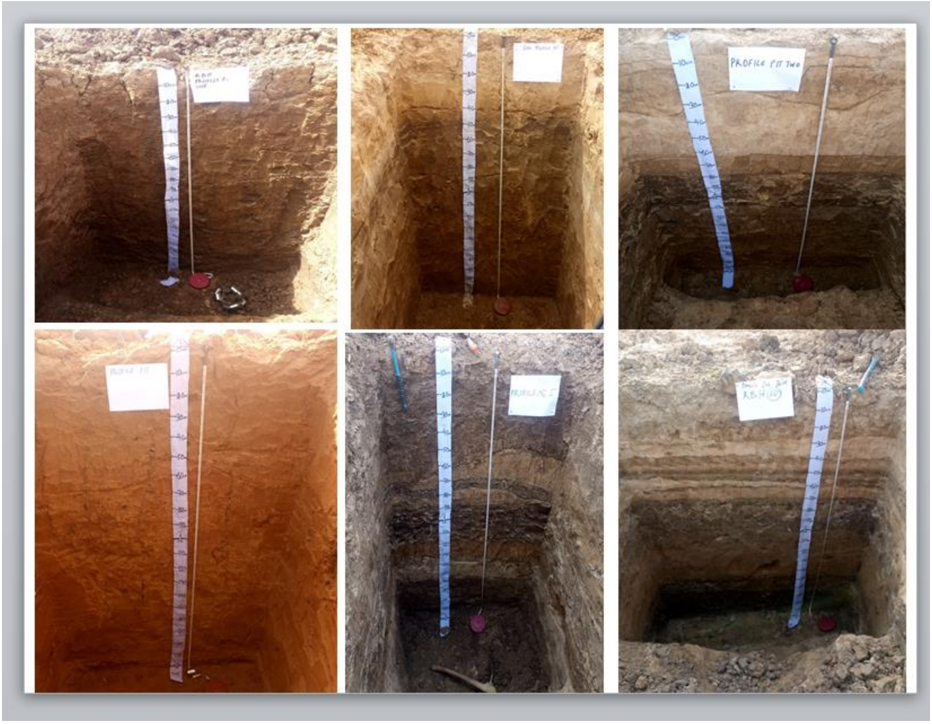


Plate 11: Some Selected Profiles

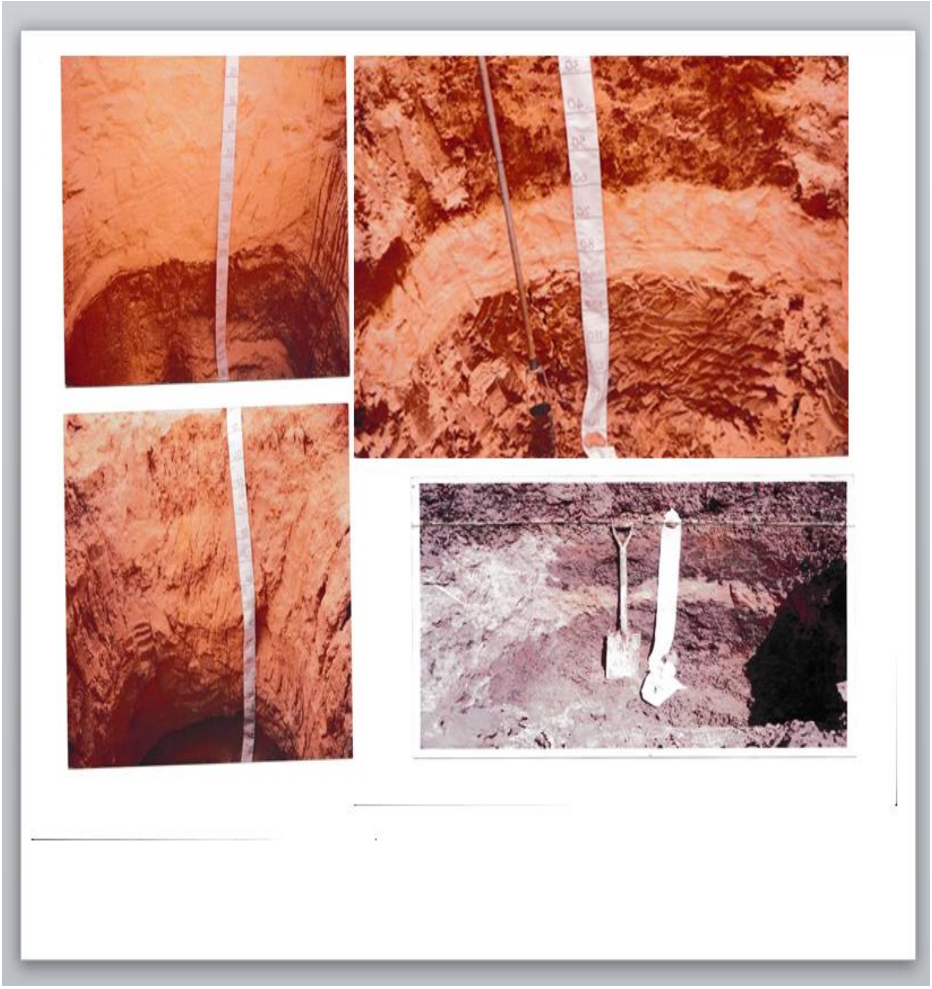


Plate 12: Some Selected Profiles

14.3 Soil degradation and rehabilitation studies

Vice Chancellor Sir, Distinguished audience, we have also discovered that some of our soils are at various stages of degradation calling for urgent attention. The good news is that some of these soils could be rehabilitated and reused for agricultural production (Noma et al., 2003; Yakubu et al., 2008). A reasonable number of organic materials including crop residues when returned to the soil have great potential to improve the soil and thereby increase crop yields. Unfortunately, the price of inorganic fertilizers coupled with skyrocketing inflation has made the situation worse in recent years.

As demand for food rises with an increasing world population, there will be need to find new ways to maximize agricultural yield. However, a considerable portion of agricultural lands in Africa and elsewhere are either degraded or are heading towards degradation. The most frequent response to this problem by most farming communities is abandonment. Unfortunately, there is no much new land to move to hence, as the land becomes degraded the owners consequently becomes further impoverished migrating to urban centres ending up as displaced persons. Since these soils are mostly characterized by surface sealing, crusting, gravely nature and eroded with poor soil structure and low soil organic matter; any effort to improve these properties could help in rehabilitating the soils. The increasing incidence of armed banditry and kidnapping in Northwestern Nigeria has made the hitherto productive forests that used to serve as alternatives for farmers to expand into a-no-go-area.

The properties of the soils have further revealed that most of the soils particularly those located in upland areas are either degraded or are tending towards degradation. For these soils to produce high yielding crops adequate measures we have to take which could include general addition of soil organic matter, good soil and water conservation techniques, rehabilitation etc. One of the studies have shown the potential of using selected amendments in rehabilitating the soils with promising results especially the use of a combination of cowdung (CD), poultry droppings or poultry litter(PD), sawdust(SD) and Sokoto Rock Phosphate(SRP) as indicated in fig. 8 (Noma et al., 2003).

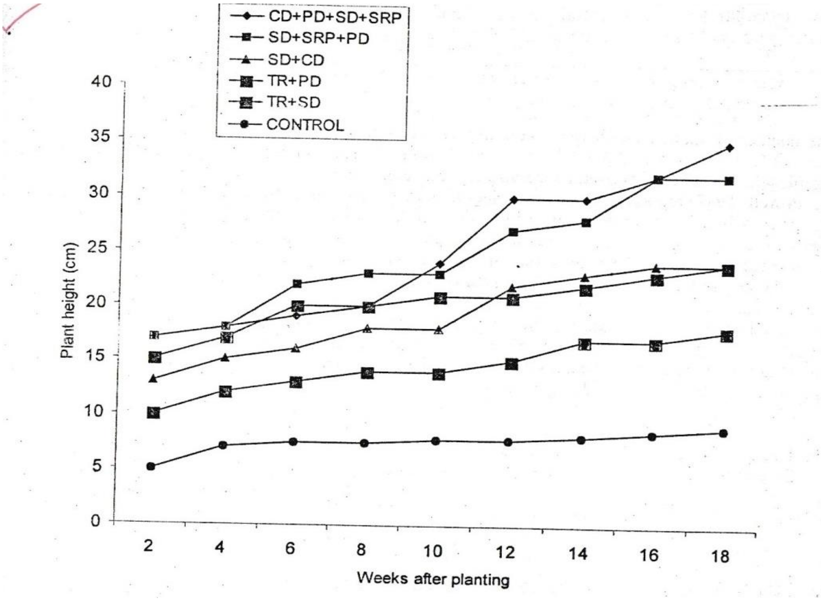


Fig. 8 Effect of Soil Amendments on Degraded Soil

14.4 Soil fertility studies

Vice Chancellor Sir, maintaining soil fertility is critical for sustaining agricultural productivity. We have therefore conducted a number of researches on soil fertility. Notable among which include (Noma et al., 2004; Audu et al., 2009; Abdullahi et al., 2010, Noma et al., 2010). The findings indicated continuous decline in fertility of the soils. The situation is more worrisome in the upland soils than in Fadama soils. The use of household made compost has been found to be handy in managing soil fertility problems (Noma and Makki, 2005).

Our studies over the years have revealed that the soils are low in fertility which is declining steadily owing to continuous cultivation occasioned by land fragmentation. This implied that the use of improved varieties, good soil and water conservation measures in addition to planned application of soil amendments alongside adequate quantity of inorganic fertilizers must be practiced if good and sustainable yield is to be obtained from these soils.

Vice Chancellor Sir, we have also looked at the influence of trees on soil properties given the sparse nature of vegetation in most parts of the Northwest zone. We found that trees especially leguminous species plays a significant role in maintaining soil fertility hence improves agricultural productivity (Noma et al., 2009; Malami et al., 2011). It therefore important to maintain some trees especially leguminous ones in our farms which could be through agroforestry system or otherwise.

Similarly, considering the semi-arid nature of the northern part of this country, soil and water conservation (SWC) could offer a great opportunity in improving the performance of crops grown in the area. Common SWC measures in use in the area have been identified as reported by Noma (2009) as presented in figures 9-12 below:

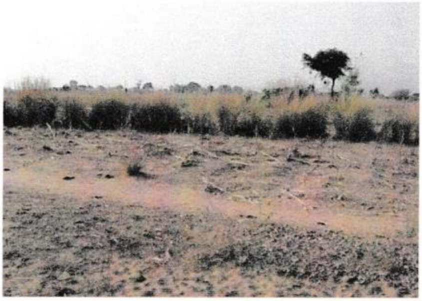


Figure 1. Grass stripping

Figure 2. Stone lining.

Figure 3. Trash lining.

Figure 4. Sunken beds.

Figs. 9-12 Some soil and water conservation techniques

14.5 Soil conservation and other studies

Vice Chancellor Sir, the impacts of climate change have affected agricultural production in a variety of ways mostly at the detriment of farmers. Droughts, spells and occasional floods have become annual events necessitating the need for their mitigation. We have in the past few years looked at the impact of soil moisture inadequacy from the farmers' perspective (Noma, 2009; Noma et al., 2010). One of the ways to minimize the impact of climate change is to key into climate smart agriculture (CSA) where we have also conducted some level of investigation (Usman et al., 2012; Noma, 2013).

Since the quality of the soil is influenced by the nature of water in use especially in irrigated agriculture we also looked at the quality of irrigation water in the Sokoto-Rima Floodplains as presented in Table 3 of another paper (Noma and Gabasawa, 2005).

Similarly, we became interested in the influence of land use on soil organic matter and microbial biomass which also revealed an interesting pattern as shown in (Noma et al., 2009).

The properties of the soils have further revealed that most of the soils particularly those located in upland areas are either degraded or are tending towards degradation. For these soils to produce high yielding crops adequate measures we have to take which could include general addition of soil organic matter, good soil and water conservation techniques, rehabilitation etc. One of the studies have shown the potential of using selected amendments in rehabilitating the soils with promising results especially the use of a combination of cowdung (CD), poultry droppings or poultry litter(PD), sawdust(SD) and Sokoto Rock Phosphate (SRP) as indicated in fig. 1 (Noma *et al*.,2003).

Our studies have also revealed that farmers' indigenous knowledge is very important in soil management as evidenced by incidental liming observed in some parts of Dange-Shuni area of Sokoto State (Noma *et al.*, 2010).

People are generally aware that good soils give raise to good yields especially where improved varieties are used. Hence the knowledge of soil science ensures good site selection and in variably good yields as shown in the plates below:

Plate 13: One of my rice plots in 2018

Plate 14: My second rice farm approaching harvest in 2019

Plate 15: One of my rice farms in 2020

15.0 Conclusion

Vice Chancellor Sir, the soil is our beginning and our end. The first profession on earth is Agriculture that probably explains why even non-agriculturalists are into agriculture today. While it is possible to produce 1-5% of the food, feed or fibre used the world over at some specific locations using improved technologies in our world without the soil, which is grossly inadequate for our survival. Therefore, our survival will continue to depend largely on the soils. This therefore calls for greater understanding of our soils in terms of their capacity to produce the required food, feed, fibre and the need to conserve this resource. To adequately achieve this interest, have over the years focused on the following:

1. Investigating and documenting the properties of the soils;
2. Classification and mapping of the soils of the selected areas;
3. Developing management strategies and rehabilitation of degraded soils
4. Evaluating farmers' indigenous practices and soil moisture conservation measures and
5. Evaluating the influence of land use of microbial biomass and soil properties.

16.0 Future Challenges in Soil Science

1. There is the need more than ever before for provision of Nigeria Soil Information System (NiSIS) and its utilization in agriculture as well as in many developmental projects to avert increasing menace of building collapse in the country;

2. World politics and other considerations could affect acceptability of agricultural produce from developing countries in the name of using contaminated soils example China is now into yam production and have accused Ghana of producing yam from contaminated soils; and

3. The impact of climate change on increasing rates of soil degradation, moisture deficiency and floods could further

worsen food and feed crisis in future calling for more concerns.

Plate 16: Packaged Fresh Yam for Export by China

17.0 Recommendations

While commending the federal government for establishing the Nigeria institute of Soil Science (NISS) I wish to recommend that:

i. Government should adequately fund the Nigeria institute of Soil Science (NISS) for execution of its laudable projects in the country;

ii. Provision of world class laboratories in Soil Science and other departments;

iii. Provision of reasonable funding for soil for detailed soil survey leading to soil map of the country;

iv. Federal and state governments especially those in the Northwest, North central and Northeast should utilize the suitable soils in the zone for establishment of plantations of cashew, shear butter and locust bean trees for economic diversification and foreign earnings, and

v. Research funding in the area of soil management.

18.0 Acknowledgements

Thanks are due to Allah (SWA) for the gift of life, good health and the religion of Islam. May the blessings of Allah be with His noble and the last prophet Muhammad (SAW), the Rightly Guided Caliphs and those who followed their teaching to the last day.

My unquantifiable thanks go to my late parents Mal. Abubakar Baba and Malama Hauwa'u Tohih may their gentle souls rest in Aljannatil Firdaus. Ameen. Similarly, the roles played by my uncles, aunties, brothers, sisters, cousins, nephews and nieces are greatly appreciated.

I wish to most sincerely express my gratitude to university for the great opportunity granted me which paved way for the achievements in my life so far. I remain highly indebted to authorities of this university. The sponsorship I enjoyed for my masters and Doctorate programmes will forever remain key to

successes that shaped my life. I wish to state that I will remain committed to services of the university, the nation and humanity at large.

The contribution of the erstwhile Sokoto State made up of Kebbi, Sokoto and Zamfara States in my educational pursuit cannot be forgotten especially the scholarship enjoyed during the undergraduate days.

Supervisors/Mentors

In the course of my studies from primary to university levels I came across a number of great personalities who as teachers/lecturers served as my mentors. Well, it is almost impossible to exhaust the list, I cannot afford to fail to mention a few of them. May Allah forgive the late amongst them and grant those that alive good health. Some of these personalities include:

At Primary School Level	**At Secondary School Level**
1. Mal. Muhammadu Sani Na-mera	1. Mrs. Bah
2. Mal. Nuhu Isah Iko	2. Mrs. R. Joseph
3. Mal. Muyaya	3. Mr. M. Joseph
4. Mal. Kala-Kala	4. Mr. Philip Benjezo
5. Mal. Ibrahim (Iro)	5. Mal. Yahaya Kaura
6. Miss Stella	6. Mal. Barade
7. Mal. Sode	7. Mr. Bawa Zizi
8. Malama Hannatu	8. Mr. Rudge
9. Mal. Hanne	9. Mal. Zakari Jankidi
10. Mal. Mikailu (The Boy)	10. Mal. Abdullahi Tumbi
11. Madam Ayo etc.	11. Mal. Yusuf Tanko

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1. Prof. B.R. Singh
2. Prof. S.A. Ibrahim
3. Prof. A.U. Dikko
4. Prof. G.A. Babaji
5. Dr. Dogara Bashir
6. Prof. A.G. Ojanuga
7. Prof. A.A. Fagbami
8. Prof. M.D. Magaji
9. Prof. H.M. Bello
10. Prof. K.M. Baba
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16. Dr. Abubakar Musa
17. Prof. W.A. Hassan
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10. Prof. Ibrahim Magawata
11. Prof. A. A. Yakubu

12.	Prof. A.S. Muhammad
13.	Dr. Salisu Abdullahi
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15.	Mal. Aliyu Dogon Daji
16.	Mal. Rabiu Mohammed Kaoje
17.	Prof. Isah Garba Abor
18.	Dr. L.A. Argungu
19.	Prof. U.Z. Farouk
20.	Mal. Jamilu Saidu Dabai
21.	Prof. M.D. Tongos
22.	Mr. Yakubu Henka
23.	Mr. Augostine Gozi
24.	Barr. Bello Gwamba
25.	Hon. Kabiru Mohammed Sokoto
26.	Mal. Abdullahi Tukura
27.	Mal. Musa Anaruwa
28.	Hon. Kabiru Ibrahim Tukura
29.	Mal. Muhammad Samaila
30.	Mal. Lawal S/Pawa
31.	Mal. Ibrahim Bawa Manga
32.	Hon. Abdullahi Garba Maganda
33.	Alh. Labaran Isah
34.	Mr. Patrick Lakmu
35.	Mal. Aliyu Mohammed Gwaja
36.	Mal. Idris A. Noma
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