INTRODUCTION TO GENERAL AGRICULTURE

GRACE O. TAYO
CYRIL C. NWANGBURUKA
S.A. ADEYEYE

INTRODUCTION TO GENERAL AGRICULTURE

By

GRACE O. TAYO, B.Agric, M.Sc. Ph.D, M.Sc
Professor, Animal Nutrition,
Department of Agriculture,
Babcock University,
Ilishan Remo, Ogun State. Nigeria

CYRIL C. NWAGBURUKA, BSc. M.Sc. Ph.D
Professor, Department of Agriculture,
Babcock University,
Ilishan-Remo. Ogun State. Nigeria.

S. A. ADEYEYE. B.Sc., M.Sc., Ph.D
Lecturer, Department of Agriculture

First Published in Nigeria, 2003
First Reprint 2005
Second Reprint 2011
Third Reprint 2012
Fourth Reprint 2015
Fifth Reprint 2019

Designed and Printed by:
Lasob Printers, Ibadan.
No. 75, Adelaja Street,
Mokola Ibadan, Oyo State.
Tel. 08055111937, 09053896060.
E-mail: lasbolnig@gmail.com

ISBN 978-060-614-9

Preface

Agriculture used to be the mainstay of the Nigerian economy. Today however, interest in agriculture is dwindling fast because of the poor attention paid to it over the years by the government. The number of students in the various faculties of agriculture in Nigerian Universities is also on the decrease. This by itself is worrisome because there is no alternative to food. Food production must be on the increase to meet the need of the growing population and to avoid the unpalatable situation of food insecurity. Every citizen of Nigeria should have an idea of what he or she can contribute to boost food production in the country.

This book was originally prepared to meet the needs of students from other fields of study who take up agriculture as a general education course as it is done in Babcock University but it will also be beneficial to those taking introductory course in agriculture.

It is the hope of the authors that the information in this book will be of immense help to students who may eventually pick up agriculture as a hobby after graduation.

Prof. (Mrs.) G. O. Tayo
Department of Agriculture,
Babcock University,
Ilishan Remo.

Foreword

The study of Agriculture should be a must in every tier of the Nigerian educational system because the country is blessed with a vast area of yet- to-be exploited agricultural land. Agriculture was the divinely blessed basic occupation of our fore-parents in the Garden of Eden. Even now, as it was then, agriculture supplies the fundamental needs of man namely food, shelter and clothing. The study of this important discipline is rightly made compulsory for all students in some Nigerian universities irrespective of the course of study under the auspices of "General Education studies" It is apparent that these universities recognise the need to avoid food insecurity in Nigeria.

In this book, the authors have explained the concept of Agriculture including its origin and development, the importance, problems, and policies in Nigeria. The book also provides ample education in the specific areas of agricultural discipline namely: Crop and Animal Production.

I have read through the book and found it suitable for the level of study for which it is designed and also adequate for students studying for an advance level examination in Agriculture. It is hoped that serious students who read it thoroughly would become sufficiently knowledgeable to pick up agriculture as a vocation.

This review was carried out not so much as to widen the scope of this book but to update and input a few observations made over the two years the book has been in use. This according to the authors will be a dynamic process.

Prof. S. Daramola.

CONTENTS

WHAT IS AGRICULTURAL SCIENCE?

Introduction

The mistaken view that agriculture is only about farming has been perpetuated across the cream of the average Nigerian society. In fact, it has robbed agriculture of its real meaning and pride of place. This of course, has led to the dilapidated state of the economy.

Agriculture is derived from a combination of two Latin words *Ager* meaning field and *Cultura* meaning Cultivation. These words when integrated, mean "the sustainable cultivation of land" for the production of crops and animal, which are beneficial to men.

Today, agriculture is broadly defined as a science and art of cultivation of the soil and raising of livestock for the purpose of producing food for man, feed for animals and raw materials to sustain the growing industry. Going by this definition, agriculture is broad-based and highly interwoven with all other aspects of our existence. It is an embodiment of the entire knowledge of the plants, animals, their environment and the interactions between these components. The art of agriculture is farming. This includes cultivation, weeding, planting, and other practices. Farming is not all about agriculture, It merely constitutes the practical aspect. Though it takes little or no skill to practice agriculture, but it takes more than just skill to be a successful agriculturalist.

The science of agriculture is in the wealth of knowledge that is required in order to practice agriculture. Hence, an agricultural scientist must understand, the principle of crop, animal, and soil science. He must understand the environment in which crops and animals are raised. He must understand the principles of marketing agricultural produce. These knowledge and many others constitute the science of agriculture. A farmer without this knowledge is not a complete and competent agriculturist. The agriculturist understands and applies the principles of farming, therefore, he/she can explain the whys and hows of agriculture.

He can as well "predict" and not 'speculate' in the course of his practice.

The meaningful application of the wealth of knowledge from other sciences related to agriculture is the art of agriculture.

Agriculture provides information on the production, care and usefulness of crops and livestock, which sustains man's daily diet, his health, his economy and his industry. It provides solutions to environmental issues, such as environmental degradation and environmental protection. Left to man, his selfish desires will make him exploit every resource from this global habitat without consideration for their side effects. For instance, the world is in the threat of global warming, our soil and water are highly toxic, the atmosphere is highly polluted. Agriculture addresses these issues through the conservation of nature.

Origin and Development of Agriculture

Agriculture as an art and science is an unprecedented discovery by man. Its history and development is closely associated with man's civilization. Historically, agriculture was said to be an accidental discovery by the early man. It all began, when the earliest man, who then was semi-sedentary in nature, in his expedition discovered that the fruit of plants which he had earlier eaten, sprouted into full grown plants that produced fruits again. It dawned on him that he could settle in a place and replant these crops. Therefore, he adapted a semi-sedentary approach and began selecting and gathering wild fruits which were edible and delicious for consumption. He also discovered that the animals in the wild, which he hunted for food, could be controlled and raised to live at home. This act of subjecting plants and animals in the wild to live a regimented type of life at home is considered DOMESTICATION. Thus one of the earliest discoveries in the development of agriculture is domestication. It is the taming of wild plants and animals to live in a home environment. This is the subsistent stage of agriculture. From domestication, men, developed crops like the arable crops, (perennial, biennial and annual crops) and the tree crops present today. Also the domestic animals available today were formally in the wild.

As his population began to increase, his immediate resources depleted and could no longer meet the population pressure. Men began to migrate to new settlements in order to cultivate and raise animals for food. This brought about the grouping of people into the village system, and civilization began. People began to develop crude implements to assist mankind meet with the food problem. Furthermore, a cropping system called shifting cultivation was practised.

The more food is produced, the more the population exploded. As population began to increase, the early agriculture advanced to peasant farming. This stage is a little more advanced than the subsistent farming. Here, man began to use better implements, and more efficient labour. This brought about an increase in food production. Fallowing was practiced accompanied by continuous cropping. The farmer had the objective of producing for himself and the immediate community. Farmers even began to specialize on some types of crops leading to monocropping (monoculture).

Today in Nigeria, agriculture has advanced from the traditional subsistence to the traditional intensive agriculture, which involves an increase of human draft labour and other farm input in order to increase yield per unit area of cultivation.

Presently, globally, especially in the developed countries agriculture has developed to the industrialized or mechanized state. This involves cultivating huge expanse of land, with monocrops selectively bred or genetically improved high yielding varieties and utilizing fertilizers, pesticides and water in order to produce optimally. So far, this has been able to sustain man's increasing population.

Branches of Agriculture

Agriculture is a multi-facet discipline of human endeavor. It is broadly divided into:

A. Crop Science
B. Animal Science
C. Soil Science
D. The Economics and Management aspect of agricultural produce
E. Agric Engineering

Crop Science: This is the aspect of agriculture that deals with plants that are useful for man as food and that sustain his industry. Crop Science is subdivided into Crop production and Crop protection.

Crop production deals with all the practices in the cultivation, management, harvesting and storage of crops. Crop protection deals with the activities involved in preventing crop loss from diseases and pests.

Crop production is divided into:

Horticulture: The study of the cultivation of vegetables, fruits and ornamental crops.

Forestry: The study of tree and forest resources, their management and conservation.

Wild Life: The study of the wild life resources in the forest ecosystem.

Animal Science: This is the study of domestic animals. It includes the management, feeding, breeding and improvement of these animals.

Soil Science: This is the study of the soil and all other factors in the soil which affect crop growth and development.

Agricultural Economics:- This is the study of the economics of crop and animal growth as well as the development of agricultural production. It involves the management of agricultural inputs for production at least cost and also marketing of such produce.

Agricultural Extension and Sociology: This is the sociological aspect of agriculture. It involves the study of human communication in such a way as to aid the effective dissemination of meaningful agricultural findings to the rural Communities.

Fisheries: The study of aquatic wildlife resources which are important for food.

Agricultural Engineering: This cuts across the pre-cultivation and post cultivation process. The study and development of tools and machines which makes agricultural practices more efficient. It also includes fabrication of equipment to handle post harvest practices in agriculture such as processing.

Biotechnology has been integrated into agriculture research in the

area of crop and animal improvement. Here genes are extracted from plant and animal species and are used to modify other species or organisms.

Importance of Agriculture

The benefit involved in agriculture outweighs the risks. Such benefits include the following:

1. Production of food for mankind and feed for livestock. 95% of world's food comes from agriculture.
2. Provision of industrial raw materials. About 90% of all industrial raw materials are from agriculture
3. Agriculture provides employment for the unemployed. People could be self-employed, farm managers, seed merchants, Horticulturist.
4. Agriculture is an economy stabilizer:-Agricultural produce are often exported outside the country for foreign exchange.
5. Agricultural products serve as raw material for pharmaceutical industries.

Summary

- Agriculture is derived from two Latin words Ager, meaning Field and Culture, meaning Cultivation
- Agriculture is a science and an art of cultivation of the soil and raising of livestock for the purpose of producing food for man, feed for animals and raw materials for the industries
- The earliest advance in the development of agriculture is domestication
- Agriculture has advanced from Subsistent to Semi-subsistent and to mechanizes or industrialized farming
- Agriculture has different branches which include:
  Soil science, Animal science, crop science, Agricultural economics and Extension, Agricultural engineering
- The importance of agriculture include:
  Increase on food production.
  Feed for animals and raw materials for industries.
  Increase in foreign exchange.
  Creation of job opportunities etc.

AGRICULTURAL POLICIES

Introduction

The Nigerian economy has suffered so many set- backs because of badly designed unworkable policies. Even when these policies are properly designed they lack proper implementation and sustainability. For instance, after more than 100years of public research in Nigeria, dating back to the establishment of Botanical Garden in Lagos in 1893, it is still difficult to identify many varieties of crop that have been adapted by farmers on a national scale.

In the early 1900s, Malaysia borrowed Nigerian's oil palm technology, but today Nigeria has become one of the largest importers of refined palm oil from Malaysia. Nigeria has also crashed from the leading position as exporter of groundnuts with the famous groundnut pyramids of the 1950's to become a net importer of vegetable oil.

Furthermore, the consistent gap between actual yield on farmers' field and the potential yields realized from available research result is another problem which has plagued agriculture and consequently slowed down economic development.

These and many more problems in agriculture are attributed to policy constraints.

In order to attain self sufficiency in food production, successive Nigerian government at different times and era have come up with different approaches and policies to enhance the effectiveness in agricultural development. These policies pass through the planning stage to the implementation stage and finally to the impact assessment stage. Any interruption at any of the developmental stages ultimately affects the development and growth of Agriculture.

What are Agricultural Policies?

Agricultural policies are strict courses of action formulated, adapted and pursued by the government of a country to enable it achieve certain prescribed agricultural goals. They are the various positive influences of

the government on the different factors that militate against agricultural development. An agricultural policy leads to the initiation of viable programs, which are backed up by laws to ensure their careful implementation.

Why and How are Agricultural Policies Formulated?

Most National agricultural policies are responsibilities of the Ministry of Agriculture. The Minister of Agriculture and members of his cabinet in conjunction with other members of the National Agricultural programs (NAP) and senior personnel of the various ministries, whose activities affect agriculture congregate to form a committee known as the National Agricultural Advisory Council or Agricultural Science Council. This Committee, proposes programs and ways of implementing such programs as to improve agriculture. They assist in the formulation of agricultural policies.

Objectives of Agricultural Policies

- Ensure self sufficiency in food production
- Have nationally acceptable land tenure system as to eradicate monopoly on land use and ownership and enhance commercial agriculture
- Stabilize prices of agricultural produce and income for farmers benefit
- Promote agric export and trade liberalization
- Realign the exchange rate of the Naira vis-avis the major world currencies as to achieve equilibrium
- Self sufficiency in livestock production
- Self sufficiency in fish production
- Ensure a more efficient utilization of farm resources.
- Consolidation and expansion of the forest estate

Scope of Agricultural Policies

- Agricultural policies tend to address four major areas of the agricultural industry. They are
- Production
- Distribution
- Storage and Processing
- Marketing

Production

The aspect of production involves providing lasting solutions to the major factors of production, especially in agriculture. These factors include:

Land, Labour, Capital, and Management

For a considerable period of time land ownership and control (Land Tenure) has consistently plagued agricultural development and production. As a result of this, a land use act/decree was promulgated in the 1978, which makes the government, custodians of all lands in the country, and consequently breaking the monopoly on land use and ownership and eliminate the bias on meaningful investors, who in the past saw land as a limiting factor in Agricultural production.

The effect of the use of primitive tools and unskilled personnel in agricultural production is also addressed by providing Agro-services to address labour and input related issues in Agriculture.

The consistent handicap posed by finance in agriculture, has made agriculture an impregnable venture. However, providing funds and credit facilities will eliminate this fear, while trained Agricultural personnels can be sent to educate and train farmers in order to effectively manage Agricultural system.

Distribution

Despite the estimated slight increase in food production globally, between 1970 and 1990 (Miller Jr. 1996), there has been a consistent picture of malnourished people in the society. This is attributable to inefficient distribution of Agricultural produce. Proper transportation and distribution scheme from the food production centers to the markets needs to be ensured.

Storage and Processing

During most cropping seasons, so much crops e.g. grains, fruits, and vegetables are harvested in large quantities, but are lost as waste in heaps of refuse, because of lack of adequate storage and processing facilities. These storage schemes and processing units would be most appropriate to preserve and convert produce into a more useful form and reduce wastages.

Marketing

When production supersedes the demands, the prices of agricultural produce drop and hence discourage farmers who suffer the effect of huge losses. In order to keep the production level increasingly high and uninterrupted, farmers must be guaranteed stable profit through proper pricing of their products to keep them in business.

A Review of some Agricultural Policies from 1972

1. ***Establishment of Agricultural Development Programmes (ADP)*** **1972:** In 1972, the Federal Ministry of Agriculture in collaboration with the World Bank established ADPs in all states to assist in the development of Agricultural projects.

   These ADPs help in circulating Agricultural findings and technologies to the local farmers.

   The establishment of National Accelerated Food Production Project (NAFPP) later in 1974, was to augment the efforts of the ADPs and rapidly hasten the urgent need for food production to alleviate the starvation caused by the civil war. The NAFPP was saddled with articulated and integrated research in Agriculture extension and training projects all aimed at increased food production.

2. ***Reorganization of Agricultural Research Institutes***

   Two decrees establishing Research institutes were formulated in 1973 and 1975. From then, Research centers like Cocoa Research Institute (CRIN) of Nigeria, Forestry Research Institute of Nigeria (FRIN), Nigerian Institute for Oil Palm Research (NIFOR), National Horticultural Research Institute (NIHORT), Rubber Research Institute of Nigeria (RRIN) Institute of Agricultural Research Training (IAR&T), National Cereal Research Institute (NCRI) and many other, were established to conduct research on cash crop providing findings on how best to cultivate these crops to obtain optimum yield.

3. ***Subsidies and other Incentive for Farmers***

   In 1976, the popular Operation Feed the Nation was the policy formulated by the government in power, This was aimed at

increasing food production and restoring the dignity of farmers by providing subsidies on fertilizers, livestock, fisheries, seeds and other inputs.

4. ***The Establishment of the Commodity Board-***
The decree establishing the commodity board was promulgated in 1977 (Decree 29). It provides to transact and buy off most of the excess products from farmers. They also help in regulating prices of agricultural produce as to favor farmers. The boards include, Nigeria Grain Board (NGB), Nigerian Cocoa Board, Nigerian Palm Produce Board, Nigerian Rubber Board amongst others.

5. ***Storage Facility:*** The strategic Grain Research scheme was formulated in 1976, to assist poor farmers, who lacked proper storage facilities for their crops during harvest to be able to store their crops after harvest.

6. ***Guarantee of Credit Facility:*** The Nigerian Agricultural and Cooperative Bank was established by the government in 1973 to handle all financial related production factors. These banks make provision to poor farmers' credit facilities or loans.

7. ***The Establishment of DFRRI:*** In 1986, the Directorate of Food Road and Rural infrastructure (DFRRI) was established. This was initiated by the government to attempt to improve the network of feeder roads i.e. roads that lead to food producing areas, as well provide rural amenities to encourage farmers to retain production in rural areas.

8. ***Establishment of Universities of Agriculture:*** in 1988, Some Universities of Agriculture e.g. (UNAAB) were established to educate young people on agriculture and research.

9. ***The Farm Settlement Schemes*** of the eastern and western Nigeria aimed at providing the necessary capital, environment and facilities for food production in the rural areas.

10. ***Others Include the Tractor Lending and Handling Scheme,*** aimed at introducing, some level of mechanization in Agriculture.

11. ***The Establishment of the National Agricultural Land Development Authority in 1988,*** was a breakthrough from all problems

related to land procurement, utilization and sustainability, since land is a very important factor of production.

Other Policies Include:

12. The withdrawal of subsidies on fertilizer in the Mid 1990s.
13. Scrapping of commodity board (1987)
14. Transfer of Agricultural Research Institutes from Federal Ministry of Science and Technology to the Federal Ministry of Agriculture in (1992) better efficiency.
15. Increase agricultural activity under the Structural Adjustment Programme (SAP)
16. Establishment of the Department of Fertilizers in the Federal Ministry of Agriculture to restore fertilizer subsidy. Restoration of producer price support scheme for grain and the Poverty Alleviation Program (PAP) 1999-2000.
17. Agricultural Extension, Technology Development and Transfer Policy
18. Agric Insurance Policy which protects farmers against disasters which may befall a farmer in the course of his operations
19. Pest control policy, this ensures that pest problems in agriculture are properly addressed

Problems of Agricultural Policies

Most Agricultural policies designed have proven to be unworkable or ineffective due to their improper implementation. For instance, the federal government introduced a producer price support scheme for grains in 1976 that turned out to be ineffective and unworkable. Also the fertilizer subsidy scheme introduced by the Federal government in 1976 turned out in the era to be unworkable. The factors affecting agricultural policies are as follows.

1. Instability in the Government:- Since the government formulate and implement all agric policies; it follows that any policy that does not meet the ideologies of a new government is most often abandoned leading to lack of continuity. For instance the National Accelerated Food

Production Project (NAFPP) formulated in 1974 by Gowon died a premature death in 1976 when Obasanjo took over power and OFN was introduced.

Lack of proper implementation due to lack of funds affects Agricultural policies. Furthermore, most beneficiary of the provision of most agricultural policies are unintended. For instance, fertilizer subsidy is not intended for the fertilizer merchants or foreign supply fertilizer merchants but the small scale farmer.

3. Lack of proper streamlined roles of Government in Agriculture. Inconsistency exists in the roles of local, State and Federal government in agriculture. Sometimes it is hardly streamlined. This ambiguity in role most often brings about neglect and insignificant Governmental involvement in agricultural production and distribution especially with the advent of the oil boom. Until 1983, there have been about 76 supposed agricultural parastatals (ldachaba 2000), no less than 50 of which were wholly owned by the Federal government. The remaining were jointly owned with the State governments. So this type of partnership has crippled the functionality of these agricultural parastatals, just as a sheep that is jointly owned suffers starvation.

4. External Factors: Most of the problems that militate against the effectiveness of agricultural policies are externally induced. The ignorance of this fact, by policy makers explains the inefficiency of majority of the agricultural policies. For instance, agriculture is interdependent on politics, transportation, health and foreign trade. Hence, successive devaluations of the foreign exchange rate have had negative consequence for Nigeria's agriculture exports and imports. It is also a fact that agricultural policy makers have not participated actively in making decision at these other policy making levels. This has been partly due to lack of technological capacity within the ministry of agriculture to influence the policy agenda in these macro economic policy areas and partly due to non functioning consultative mechanisms for such inputs from agricultural policy makers, advisory and analyst (Idachaba 2000).

SOIL SCIENCE

Introduction

Since agriculture is not practicable in space, but on land, land consequently becomes one of the indispensable factors of agricultural production. As the population of the earth increases rapidly, land becomes a limiting factor to agricultural production. The frequent unsustainable use of land such as burning, in addition to other activities of man on the environment, has rendered the environment as well as the soil almost useless for agriculture. This great threat to the environment motivated a team of American and Russian scientist to go on an expedition of the world soil in 1885. This expedition was aimed at studying the soil after which the soil of the world was classified. This was the earliest deliberate attempt to understand the functionality of the soil. Thus, soil science, simply put is the science of the soil.

Aims of Soil Science

Soil Science is aimed at:

1. Understanding the origin and formation of the soil.
2. Understanding the various components of the soil and their importance.
3. Understanding the implication of altering the soil physical properties.
4. Understanding the mineral requirement of plant in the soil and how they reach plants.
5. Understanding the various chemical reactions in the soil.
6. Understanding the factors that promotes soil loss and;
7. Suggesting methods or ways in which soil can be conserved for sustainability.

However, it should be emphasized that an indiscriminate use of soil have both direct and indirect adverse effect on soil and consequently on man and the existing planet earth.

Origin and Formation of Soil

Definition

Soil is that loose and continuous part of the earth crust that supports plant and other life forms. It is a product of weathering in addition to the accumulation and differentiation of organic matter.

Weathering:- is the wearing away or the breakdown of rock into .smaller particles called soil. The primary soil formed from weathering is called Regolith. Regolith is composed of the rock inorganic minerals, consisting of sand, silt and clay.

The process of weathering is usually slow, but continuously active. It usually takes a long period of time. Weathering occurs in two ways,

1. Mechanical Weathering
2. Chemical Weathering

The mechanical weathering is environmentally induced. This is initiated by the activity of increasing high temperature and thawing, in addition to the impact of heavy rain drop on rocks. All these collectively make rocks unstable leading to cracks, which then initiates the second type of weathering that is chemical weathering.

Chemical weathering, immediately accompanies mechanical weathering. However in reality there is usually no line of distinction between the two. As there are cracks and openings on the rock due to mechanical activities induced by climatic factor, water and air penetrate the rock, and reacts with the rock minerals leading to further breakdown of the rock. Chemical weathering takes place under the following chemical reactions.

Oxidation:- This is a chemical process, that is involved in the breakdown of rock. This disintegration process is aided by the addition of oxygen or the flow of oxygenated water into the rock. This leads to the rock minerals being oxidized. These oxides of the rock minerals take up more space and thus help to break-up the rocks further (e.g. Iron (II) is usually converted to Iron (lll).

Hydrolysis (Hvdro -water: Lysis -split):- This is the breakdown of rock minerals by water. An igneous rock material called orthoclase feldspar, with potassium, calcium or sodium compound may undergo hydrolysis leading to the formation of oxides of aluminum or silica (e.g.).

Reduction

$KAISi_30_8$ + H20_____$HAISi_3\ 0_8$ + KOH - usually leaching out
$2HAISi_30_8$ + $8H_20$_____$AI_20_3\ 3H_20 + 6H_2Si0_3$

kaolinite Aluminium oxide Silicic acid

* Rocks containing mica biotite (KAI(Mg.Fe)3 SiO 1 0(OH)2)- are easily weathered whereas, quartz are highly resistant to weathering.

Hydration:- This is a reaction involving water but does not change the rock mineral structure. It is a reversible state. It does not lead directly to rock disintegration but however weakens the rock complex structure.

For Example

$Fe_20_3 + H_20$_____2Fe203 3H20

haematite (red)_____Liminite (Yellow)

Carbonation: This breakdown of rock minerals is mediated by carbon dioxide. It occurs when carbonated water flows into the rocks through cracks. It leads to the formation of carbonate ions ($C0_3^{'2}$) or hydrogen carbonate ions (HC03-1). This is common in sedimentary rocks containing carbonate.

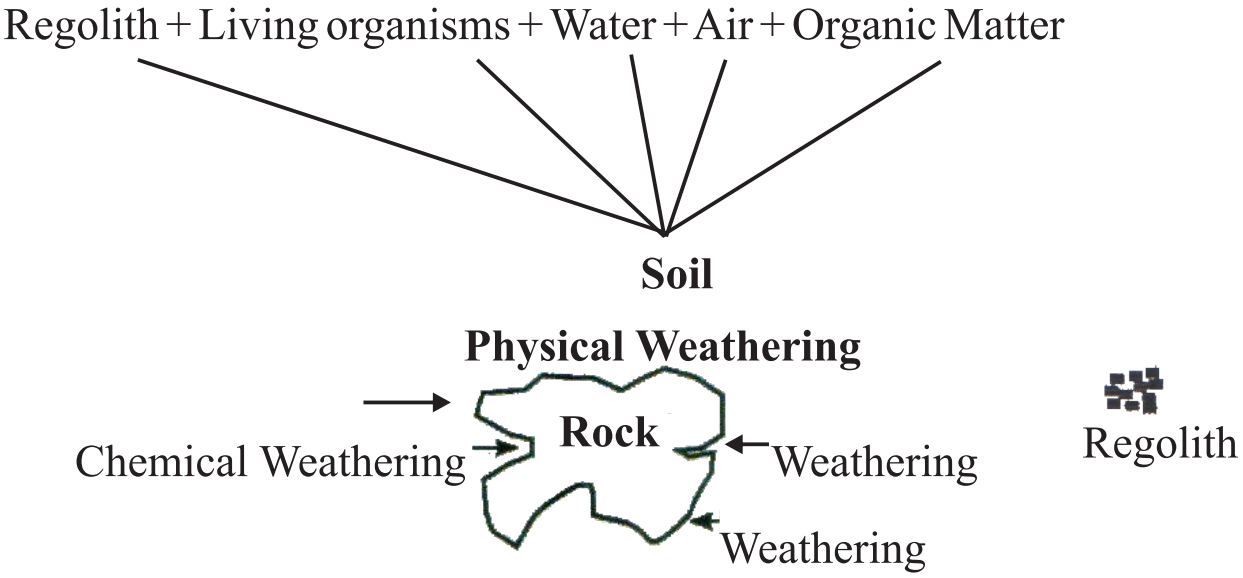
$H_20 + C0_2$_____H_2C0_3.
$CaC0_3 + H_2C0_3$_____$Ca(HCO_3)_2$

However, it should be noted that both chemical and mechanical weathering are not mutually exclusive. They occur simultaneously, resulting in the breakdown of rock to form soil.

Soil Formation

Immediately after the primary soil is formed, it attracts an array of other biological forms. For instance, the lower life forms like bacteria, fungi,

ferns and the algae. These colonize the soil formed, fulfill their life requirement and eventually die, returning organic matter to the soil. The organic matter accumulates and as they are being worked on by other biological forms, over time the soil profile is developed.

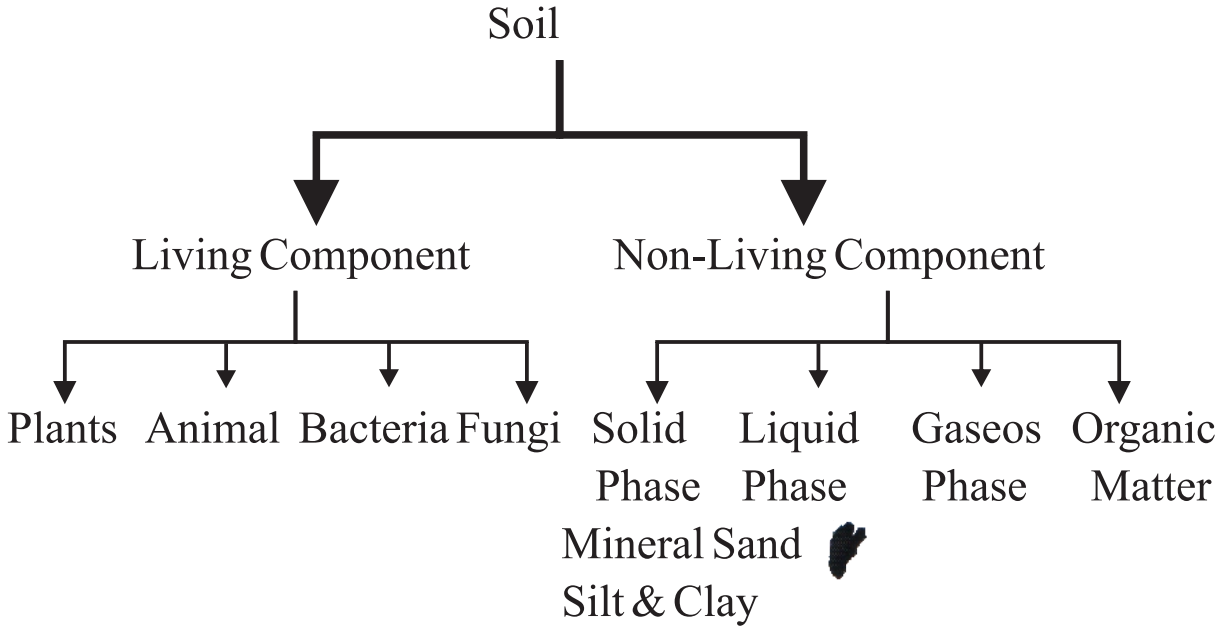


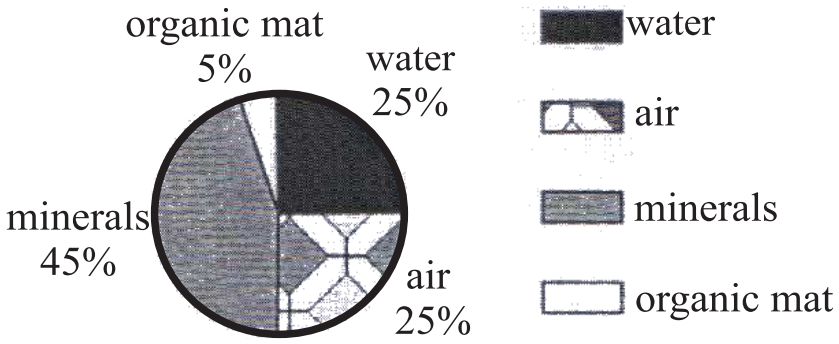
Components of the Soil

Soil is made up of the living component and non-living component.

The living component consists of basically the soil living organisms. They include bacteria, fungi and algae. Others include plant roots and the other macro-organisms.

The non-living components exist in four major forms, These are the solid, liquid and gaseous forms as well as the organic matter. The solid form is basically the inorganic rock mineral, e.g. Sand, Silt and Clay.





Pie Chart for Percentage Composition

The liquid form consist of the liquid found in the soil solution, this is basically water.

The gaseous form consists of the soil air, which basically is made up of oxygen, carbon dioxide etc. The organic matter component is a product of the decay of plant and animal materials

Soil Physical Properties

The soil physical properties are the properties of the soil, which can be felt and seen.

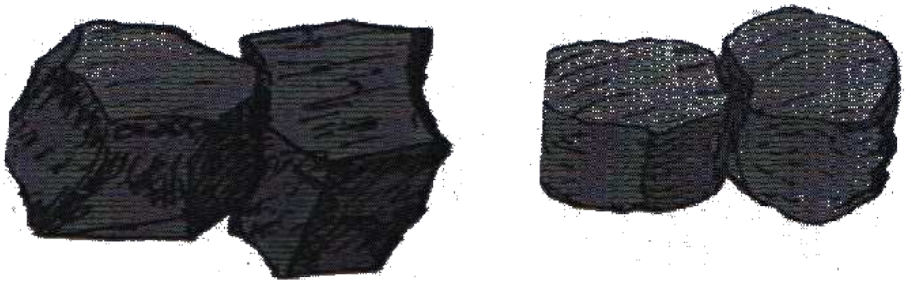
Thus the soil physical properties include.

Soil Texture:- This is the relative proportions of sand, silt and clay in soil. It describes the smoothness and coarseness of the soil, it is manually determined by feel.

Classification According to Texture

International Systems
Gravel.....above 2.0mm
Coarse Sand.....0.2-2.0mm
Fine Sand.....0.02-0.2mm
Silt.....0.002-0.02mm
Clay.....Less than 0.002mm

Soil Structure: This is the aggregate of the individual soil particle given a characteristic structure. There are various categories of soil structure.



Block Structure:- When the structure is blocky in form.

Spheroidal Structure: When the aggregate produce sphere like structures.

Prismatic Structure: When the aggregate give rise to prism-like structure.

Columnar Structure:- When the aggregate produce column like structures

Platelike Structure: The structure is said to be platy, when the associates appear as plates.

Soil Density:-

This is described in terms of particle density and as bulk density. Particle density is the ratio of particle weight to volume. The particle density of sand, silt and clay do not vary too much. However it is expressed as 2.65g/ cm3. The bulk density is an expression of ratio of individual particle weight and inter-particle space to the volume.

Mass/Volume = Bulk Density

Soil Porosity:-

This is the percentage pore space in the soil. It is derived by the following expression.

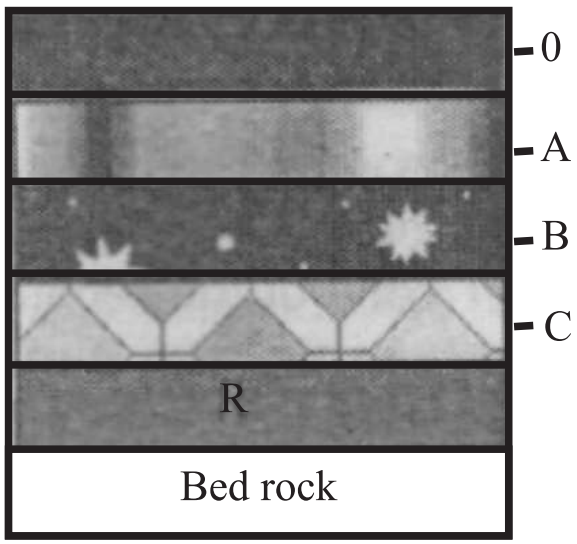
Percentage pore space = 100-(BD x 1 00)/particle density. B.D is Bulk Density.

This determines the capacity of the soil to retain water and air. There are two categories of pore sizes in the soil. These are the large pore size or macro-pore, or aeration pore which stores air and the smaller sized pore or micro-pore which stores waters. The micro-pore are also called capillary pore.

Soil Profile

During the process of soil formation the soil particles are arranged into layers by natural processes. These individual layers are called Horizons. The number of layers a soil has accounts for its maturity and the extent of geologic activity. Soil profile is therefore defined as the characteristic arrangement of the individual layers or horizons of the soil.

It is observed by taking a vertical dig into the ground. Horizons in soil profile are formed due to the accumulation of organic matter on the surface and differentiation of accumulated organic materials into various layers of varying concentration based on size of particles. The process through which these materials move from one horizon to another is called Eluviation. The process of their deposition in another profile is called Illuviation. Leaching, however involves the loss of nutrients down the soil profile.



Soil Temperature:

This is the degree or hotness of the soil. This also affects the soil living component: It is often determined by the amount of heat that is absorbed by the soil, the mineral components and organic matter level of the soil as well as the water content of the soil. A soil with high organic matter status maintains a relatively low temperature because organic matter has high specific heat capacity.

Soil Colour:

This is the various coloration of the soil. It is a factor of the soil minerals and organic matter. Dark coloured soils have high organic matter. Reddish brown soil is an indication of hydrated iron of clay or clayey soil.

Soil Consistency:

This is the ability of the soil to resist deformation. It is determined by the soil structure and the condition of the soil (whether wet or dry). Hence, soil consistency level is expressed in terms of soft, hard, looseness, toughness, plastic, or friable.

Types of Soil

Soils are classified to type based on the understanding of the their physical properties, especially, the texture, structure, color and consistency. As soon as the soil texture has been determined, experimentally, the soil type can be ascertained based on texture by the use of the soil texture triangle. The soil textural triangle is a triangle comprising a calibration of the various percentages of sand, silt and clay on each side of the triangle respectively. With this, percentage of sand, silt and clay are clearly shown.

Based on texture, there are three major types of soil. The percentage composition of each separate in the soil determines the soil type. Based on this, there are,

Sandy Soil:- This is a soil whose broad mass particle is composed of sand. A sandy soil include all soils with sand separate making up above 80% of the entire mass.

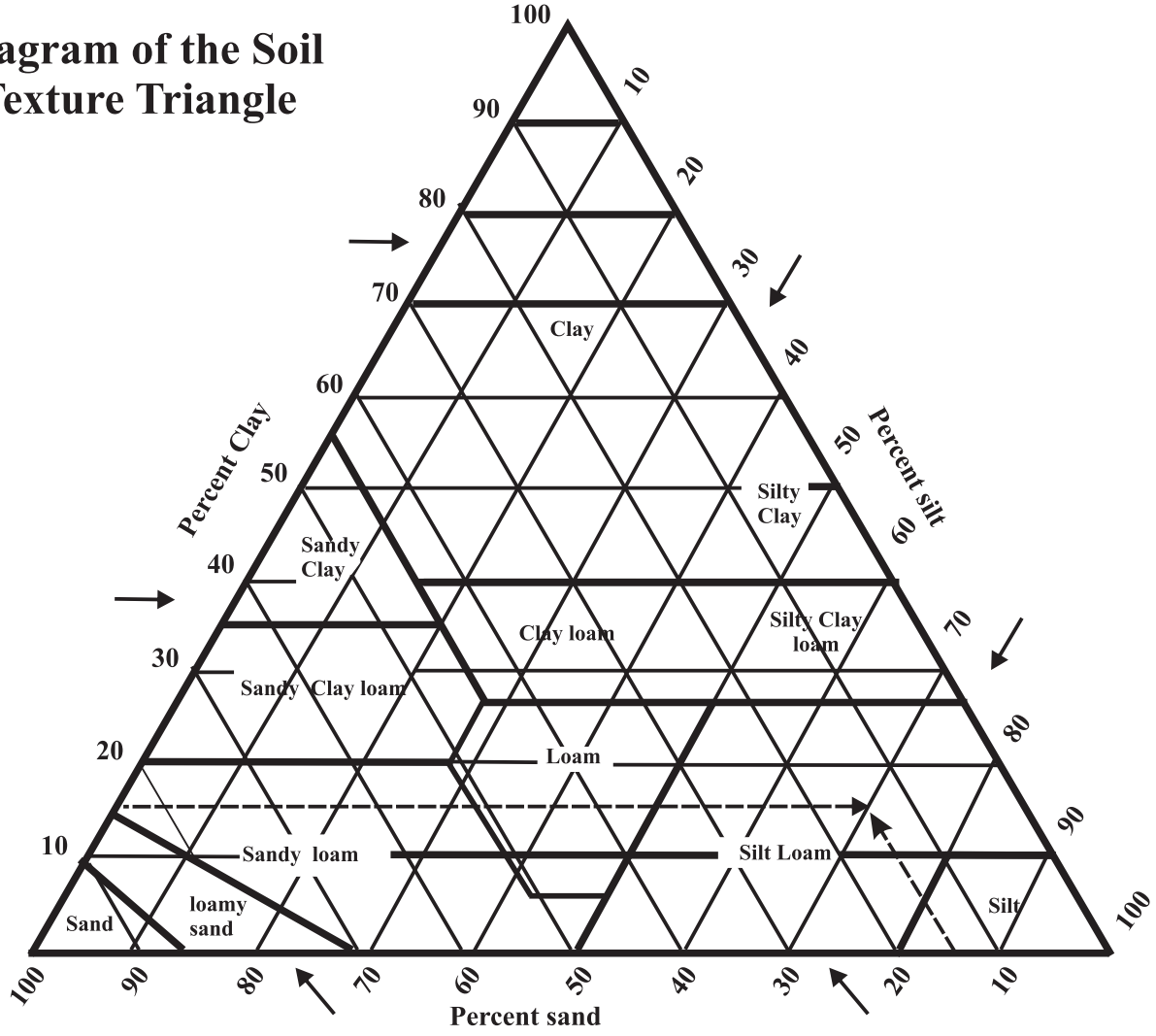
Clay Soil:- Clay particles are very fine, and very domineering. A soil is therefore said to be clayey, when it contains at least 60% clay. Clay soil is dominated by micro-pores. This gives them their characteristic water

retentive capacity. Clay soil when wet are usually sticky.

Silty Soil: This is a soil with silt separate dominating all others. This type of soil has at least 75% silt in the entire soil mass. It is usually fine in texture but not sticky.

Loamy Soil: This is a hybridized form of soil comprising of sand, silt and clay in a proportion that none of the separate dominates. This is the best soil so far for agriculture because it maintains enough pore

Diagram of the Soil Texture Triangle



The major soil textural classes are defined by the percentages of sand, silt, and clay according to the heavy boundary lines shown on the textural triangle If these percentages have been determined for a soil sample by particle size analysis, then the triangle can be used to determine the soil textural class name that applies to that soil sample. space for soil moisture and air. Loamy soils have a relative mixture of 20% clay, 40% sand and 40% silt.

Other hybridized types of soil exist, (see soil textural triangle) depending on the proportions of the separates. For instance, there are sandy clay (45-50% clay and 50-55% sand), silt clay (50-55% Silt and 45-50% clay), clayey loamy (at least 25% Clay) and Silt Clay loamy (at least 55-60% Silt).

Soil Losses in Agriculture

One of the greatest problems militating against agriculture in the tropics is the consistent incidence of soil loss. Soil loss are very significant in agricultural production. For instance about 30 million tonnes of soil is lost annually in Nigeria while about $3 million is spent every year to control the incidence of soil loss in Nigeria. Hence the issue of soil loss is a permanent one in agricultural development.

The term soil erosion is used to describe all activities leading to soil loss, either in part or in whole.

Erosion is caused by two major factors:

1. By water (water erosion) and
2. By wind (wind erosion)

Generally erosion is caused when the vegetation that gives cover to the soil is damaged, leading to the exposure of soil to the erosion agents, such as rapid rain and high winds, which act on and weaken the soil structure, finally leading to soil loss.

Erosion is technically defined as the detachment, transportation and deposition of soil particles from one place to another as mediated by water and wind.

Water Erosion

Water causes erosion mainly by

a. The impact of raindrop on the soil surface (detachment)
b. Its flow between rills and in channels down slope
c. Deposition of eroded materials down slope (deposition)

The erosion effect of rain drop is determined by the following factors:

1. Intensity and duration of rainfall (threshold intensity of 25mm/hr)
2. Amount and velocity of surface flow
3. Nature of soil
4. Ground cover and
5. Slope of the land surface

The rate of soil erosion is directly proportional to 1, 2, and 5 and inversely proportional to 3 and 4 above.

Types of Water Erosion

Water erosion is classified to types based on the volume of soil loss and the effect it leaves behind on the soil. Based on this water erosion is classified into three types.

Ranging from the mild effect to the detrimental effect. There are:

1. Rill
2. Sheet and
3. Gully Erosions

Rill Erosion:- is the detachment of soil particles leading to the formation of small channels. These particles are transported as run-offs in the surface flow.

Sheet Erosion:- is the uniform removal of the soil surface. It is often associated to most clay soils.

Gully Erosion:- as rill increases with increasing run- offs it leads to the creation of deep cuts and holes which are uncrossable by farm machinery. These ditches and deep holes are called gullies.

Generally the initiation of water erosion is called splash, which is the dissipation effect of water drops carrying some amount of kinetic energy which on impact with soil structure dissipates and detaches the soil particles. Once this is done, absorption (infiltration) of the soil decreases while run-offs increases.

Wind Erosion

Wind causes erosion of dry, bare soils. The four factors that determines the extent of erosion are,

1. Wind speed intensity
2. Nature of soil (size of soil particle and aggregate)
3. Ground cover
4. Slope of land surface

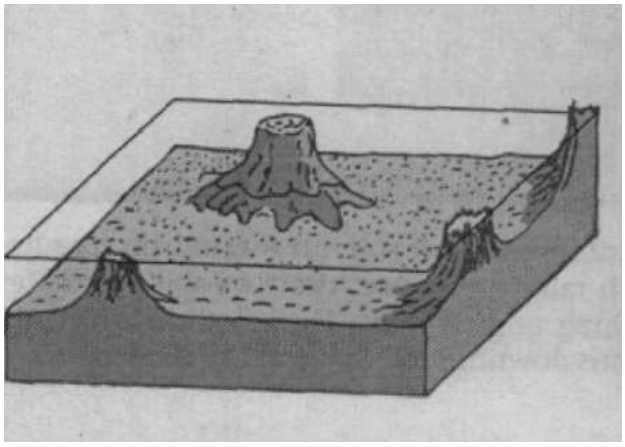
The amount of soil erodable by wind at any given velocity depends upon the Critical height. The critical height is defined as the height that slows wind velocity to 9 miles per hour or low. The critical height varies

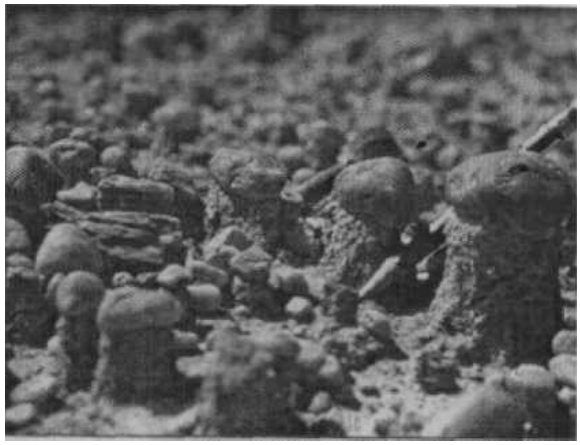
from place to place, (measured at about 2m above the ground).

Types of Soil Movement by Wind

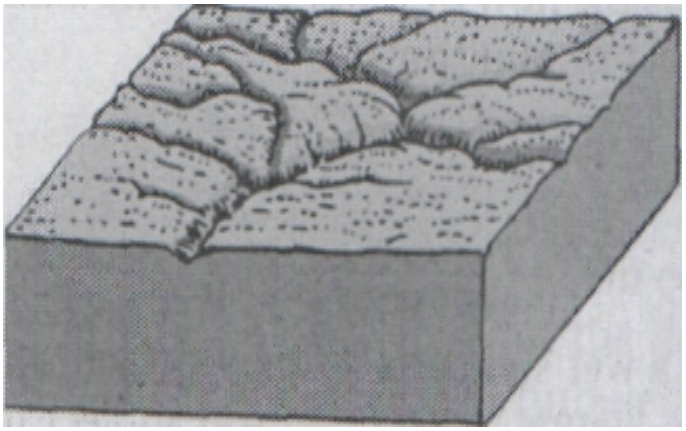
Wind erosion unlike water erosion is classified based on the particle size moved by wind. Hence soil movement by wind is grouped into:

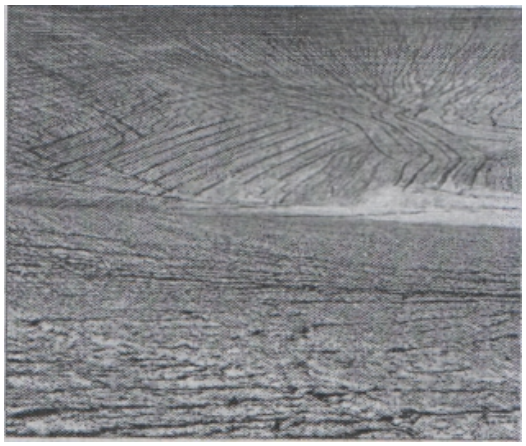
1. **Surface Creep:** This involves the movement of large particles like coarse sand (0.5mm) at the surface.



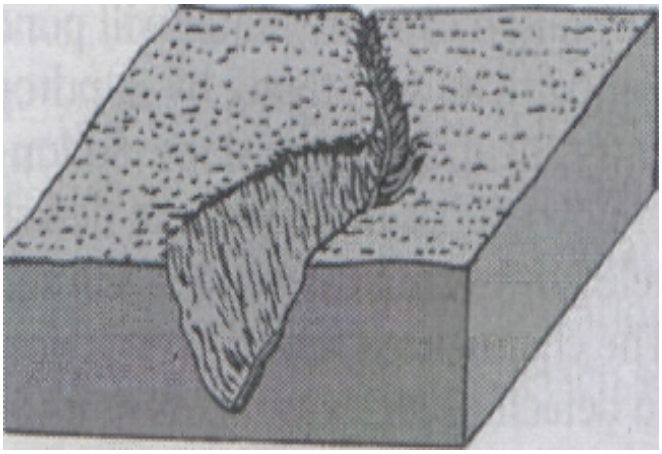


(a) Sheet Erosion





(b) Rill Erosion



(c) Gully erosion

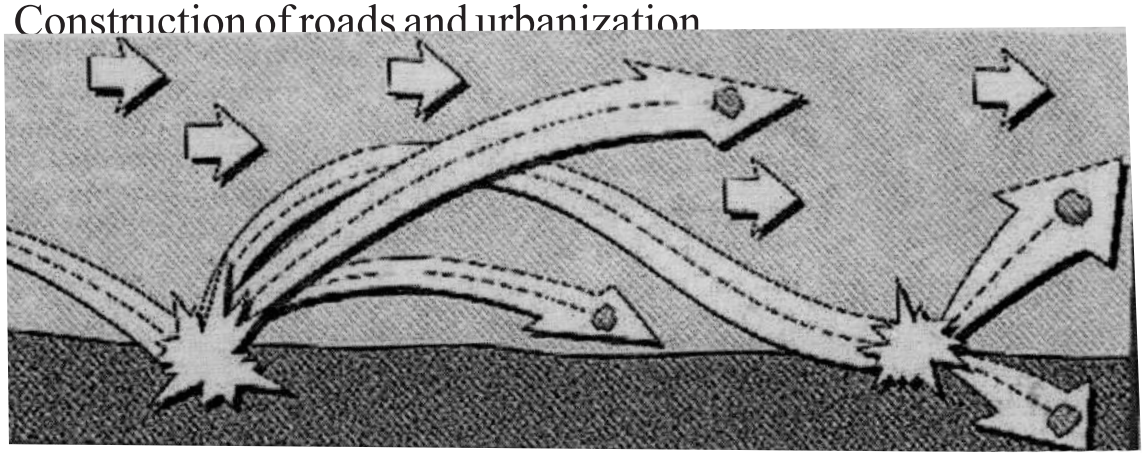
Three major types of Soil Erosion. Sheet erosion is relatively uniform erosion from the entire soil surface. Rill erosion is initiated when water concentrates in channels Gully erosion creates deep channels that can not be erased by cultivation. From FAD 1987*8 USDA Natural Resources Conservation Service.

2. **Saltation:** Much smaller particles like tine sand and silt (0.05-0.5mm) when lifted by wind pressure above the soil surface, with series of re occurring bounces is called saltation. Saltation causes the most devastating effect in wind erosion.

3. **Suspension:** This involves the movement of even smaller particle like clay and humus (0,005 -0.05mm) in wind and are carried much longer in air and constituting the dust storms, characteristic of dry seasons in the deserts.

Causes of Accelerated Erosion

1. Destruction of woodland by excessive logging, burning and intensive grazing leading to destruction of vegetation cover.
2. Continuous cultivation of land leading to destruction of soil structure.
3. Continuous tillage tends to destroy and dislodge the soil particles from their original blocky structure.
4. Wrong cropping system e.g. cultivation on steep slopes.
5. Paths and animal tracks collect run-offs.
6. Construction of roads and urbanization



The Process of Saltation in Wind Erosion

The process of saltation Medium-sized particles (005 to 05 mm in

diameter) bounce along the soil surface, striking and dislodging other particles as they move They are too large to be carried long distances suspended In the air but small enough to be transported by the wind, (from Hughes (1980); used with permission of Deere & Company, Moline, III).

Effects of Soil Erosion

1. Destruction of soil structure
2. Loss of soil fertility
3. Loss of ability of the soil to support crop growth
4. Deposition of sediment load causing river to change course leading to flooding.
5. Water pollution
6. Blocking of irrigation channels and canals

Preventing Soil Erosion/Soil Conservation

Soil conservation is the wise use or management of land resource for sustainability. In conserving soil as to prevent erosion, the following must be adhered to:

1. There must be an efficient cropping system in practice
2. Use crop rotation
3. Planting of cover crops to stabilize slopes
4. Mulching must be done where vegetation is absent
5. Trees are planted and used as hedges for wind breaks
6. Contour terracing
7. Minimum tillage
8. Minimal grazing

CROP SCIENCE

Introduction

Crop science teaches the principles and practice of cultivating and managing crops. Crops are plants grown for human and animal consumption or for industrial uses.

The type of crop grown is determined by such factors as the

a. Amount and distribution of rainfall
b. Relative humidity
c. Temperature
d. Length of the day
e. Quality of the soil

Before any crop can be grown, the native vegetation has to be partly or wholly destroyed and seedbeds or nurseries have established. Here the seeds are planted and grown until they can be transferred to the field.

Nurseries are always located on fairly level, fertile land with a convenient supply of water all the year round as the young plants must be watered regularly. Sowing of seeds must be done at the proper time and season. Crops should be cultivated to control weeds and natural enemies of crop plants such as pests and diseases.

Prompt harvesting and good storage are also essential to save the bulk of the crop from pests and diseases. If crops are not harvested promptly they quickly attract pests.

Agricultural Systems

These are the various methods used by different groups of people to produce crops and livestock in for human needs. Traditions of land tenure, topography and climatic conditions, the social and economic place of farming in the community, as well as superstitions and religious customs, may influence the agricultural systems adopted by the people of a specific region. These agricultural systems will be treated as both Cropping and Farming systems. Cropping system involves all the various methods employed by different people in crop cultivation while Farming system involves all the various method employed by different

people in handling of livestock and crops ensemble.

Among the well-known farming and cropping systems in West Africa are shifting cultivation; annual cropping; which embraces crop rotation and mixed cropping; mixed farming; animal rearing which embraces nomadic pastoralism, semi-nomadic pastoralism and ranching; and plantation agriculture.

a. **Shifting Cultivation and Bush Fallow:** This is a system of farming where the production of crop is alternate with periods of fallow. The systems are adopted in many parts of West Africa where agricultural development has not reached an advanced stage. In shifting cultivation, a piece of land is cultivated for two to four years. When the soil nutrients are exhausted and crop fields are low the farmer with his family will abandon the farm altogether and move onto farm else where.

   Bush fallowing involves growing crops on a piece of land until is exhausted when the land is allowed to go back to bush for six to twelve years before it is used again. Meanwhile the farmer clears other areas in succession to make new farms. It is also referred to as Land Rotation.

   Shifting cultivation is thus practicable where land is abundant and also where other means of restoring soil fertility are either unknown by the people or are not practicable. It is not practicable where land is scarce and where population density is high.

b. **Continuous Cropping:-**This is uninterrupted cultivation of one piece of land for a very long time or putting a piece of land under cultivation from year to year. The crops planted may either be annual or perennial. This system is practiced in densely populated areas where there is "land hunger". The practice often leads to soil exhaustion, erosion and low productivity.

c. **Crop Rotation:** This is a method of farming where by a piece of land is kept under cultivation every year in Such a way that the crops follow in a definite order or cycle. It is planned so that fertility of the soil is maintained.

Different crops require different amounts of plant food. Some use much

and are known as exhaustive crops, e.g. maize, yam and cassava, Others use less, e.g. vegetables such as tomatoes and pumpkins. Others can actually add nutrients to the soil, e.g. legumes like cowpea.

The Principles of Crop Rotation

1. Deep rooted crops like yam and cassava, should be follow by shallow rooted crops for example, maize, millet, or groundnuts.
2. Crops that are susceptible to the same diseases should not follow each other in the rotation.
3. Leguminous plants should be included in the rotation.
   This will help to add nitrogen into the soil.
4. There should be an alternation of crops with peak requirements of labour, water, e.tc.

Benefits of Crop Rotation

1. It maintains and improves soil fertility.
2. It prevents the build up of pests, weeds, and soil born diseases.
3. It controls soil erosion.
4. It ensures a balanced programme of work throughout the year.
5. It prevents or limits period of peak requirements for irrigation water.
6. Conserves soil moisture from one season to the next.

d. Monocropping (Sole Cropping): This is growing exclusively one type of annual crop and harvesting it before planting another on the same piece of land.

In West Africa monocropping is mostly practiced by government, Ministry of Agriculture, in forestry, And by agricultural corporations and private plantation enterprises.

e. Monoculture: This is the growing of the same crop on the same piece of land from year to year. This applies both to annual crops such as yam, cassava and maize and perennial crops such as cocoa, rubber and oil palm.

Example of a 4 Years Rotation Scheme 1

	Plot 1	Plot 2	Plot 3	Plot 4
Year 1	Yams	Maize	Cassava	Cowpeas
Year 2	Maize	Cassava	Cowpeas	Yams
Year 3	Cassava	Cowpeas	Yams	Maize
Year 4	Cowpeas	Yams	Maize	Cassava

Note:- There should be enough flexibility in the rotation to guard against outbreaks of disease and falls in market prices, finally, the number of field plots must correspond with the number of years or rotation.

This is not a good system because after some years the production will diminish (poor yield) due to loss of soil nutrients. It is also a system which exposes the farmer to great risk in the case of adverse climatic conditions or an invasion by pests and diseases.

f. Mixed Farming: This is the system of farming whereby the cultivation of crops is kept side by side with the rearing of farm animals. The practice enables some of the farm crop wastes to be fed to the animals being raised and .the animals in turn supply work such as "load-carrying" and pulling as well as manure to feed the plants.

h. Taungya Farming: This system of farming combines the production of crop)and forest management. Food crops are grown in parts of forest areas where trees have been felled.

i. Mixed Cropping or Intercropping: This system involves the growing of more than one crop on a piece of land. Under this system, the crops are interplanted, that is the planting of a second crop in the space between the plants of another. For example cassava, maize and melon may be interplanted together.

Types of Crops

a. Arable Crops: These are crops which are planted, cultivated and harvested within a year. They supply food for man. These crops can be classified according to the use to which they are put. They include :- maize, ground nut, yam, rice,

beans, kenaf, cassava etc.

b. **Permanent Crops:** These are planted and left on the same plot of land for many years, while the crops can be harvested for a number of years. The economic life of permanent crops ranges between 3 years (pine apple) and 50 years e.g. (Oil palm, cocoa). There are few instances of permanent crops under very good management lasting for an almost indefinite period for example, in Ibadan, Nigeria, a Cocoa tree has been producing fruit for almost 100 years.

c. **Forage Crops:** These are primarily grown to provide food for farm animals. They include grasses or legumes which can be grown separately or as mixture e.g. Elephant grass, Guinea grass, Mucuna, Centrosema etc.

d. **Vegetable Crops:** usually annual, key are grown and harvested within one year under an Intensive or gardening system as food for man e.g. water melon, tomato, amaranthus pepper etc.

e. **Fruit Crops:** These are usually permanent crops whose fruits can be eaten raw by man. They supply the bulk of the vitamins and minerals essential for healthy human growth.

Classification of Common Tropical Crops by Their Life Cycles

Annuals: These crops germinate, grow flowers, produce seeds and die within one season.
Most food crops are annuals, e.g. Legumes, grains, vegetables etc.

Biennials: These crops require two season for their growth. In the first season, plants produce stem and leaves, undergo vegetative growth and also store food in their storage organs. In the second season, the crop plants produce flowers and seeds and then die e.g. Carrot, Cocoyam etc.

Perennials: These are plants which live for more than two seasons. Most tree crops are perennials, e.g. Oil palm Cocoa, Kolanut, Citrus, etc.

Cultural Principles and Practices

The Principles of Cultivation

The agronomic operations on the farm are designed to control the factors

These factors include moisture, sunlight, air, and heat in various intensities, nutrients from the soil and control of pests and diseases.

Mulching, ploughing and planting of shade or cover crops are some of the practices used to conserve soil moisture by reducing the evaporation rate from the soil surface. Excessive heat which can destroy soil micro-organisms is prevented by shade.

High winds which increase the evapotranspiration rate can be reduced by the provision of wind breaks.

The extent to which air is incorporated in the soil depends on the structure of the soil and the nature and frequency of tilling.

Replacement of soil nutrients depleted by successive crop removal requires applications of fertilizer, manure or periods of fallow.

Anti-erosion devices such as covering the soil with vegetation, terracing, erection of contour bunds and ridging are based on the principle that top soil {the part rich in plant nutrients) can easily be removed by strong winds or flood water running off at high speed.

Weeding is done because, apart from competing with crop plants for water and nutrients, weeds harbour some of the pests and parasites that destroy cultivated plants. Crops are sprayed with insecticides such as Gammalin 20, and Didimac 25, or in the case of grains dusted with Aldrex T. Also fungicides such as Perenox, Bordeaux mixture are sprayed to destroy fungi which can cause disease.

Cultivation Practices

Cultivation practices can be divided into three, these are:

a. Pre-planting operations
b. Planting operations
c. Post planting operations

Pre-Planting Operations

a. Bush Clearing: In the tropics a piece of land is recovered from the bush by clearing. The type of clearing will depend on the vegetation of the area and the type of management the farmer wants to adopt. In the forest zone the underbrush is cut down and the bigger trees either pruned or cut down with a cutlass or an axe. Some trees may be left to

provide shade, however, in the savanna, very little clearing is needed.

b. Burning: The materials cut down in clearing land are generally disposed off in the tropics by burning. This produces ash which contains mineral plant food in an available form. It raises the alkalinity of the-soil, which can lead to increased nitrification and availability of cations. On the other hand, the ash can easily be washed away by rain.

On government or big private farms, plant materials are cleared using machines such as the bulldozer. This is very expensive although easier and faster.

c. Stumping: This is a labour consuming operation which is not commonly carried out on small farms, it is done on large and mechanized farms where crop rotation systems are practiced. It can be done manually with cutlass, digging mattock and axe or mechanically by using stumper, root cutter, or bulldozer.

d . Farm Layout: A new farm can be laid out into rectangular plots, blocks or fields by using the 3-4-5 methods after stumping operation. Find the length and breath of the field and divide the whole field into plots for crop rotation. Paths can be made with convenient distances across the plots to make blocks.

e. Tilling: After a piece of land is cleared for cultivation, it should be tilled or dug. This can be done with the simple or Indian hoe, or mechanically by using a tractor-driven mould board plough, disc plough, or tined implement.

The digging should be as deep as possible especially in places where there is low rainfall. By digging, the surface of the soil is broken up and the particles loosened so that air and water can reach the roots of the plants.

The soil should be made as fine and as soft as is appropriate for the crops to be grown. A fine tilth will make it easier for the roots to push their way through the soil and for the root hairs to take in food.

It may be useful to incorporate manure or fertilizer into the soil during tilling.

The weeds growing on the plot can be incorporated as green manure.

f. Ridging: Ridges and heaps or mounds perform the same role in crop production. Heap making is done more easily than ridge making with the short handled hoes commonly used by West African farmers.

Ridges are made at right angles to the slope on the land. In school farms where ridges are made manually, they are spaced approximately 120cm apart (from crest to crest), but in mechanized farming they are 90cm apart. At intervals in the trench between the main ridges, tie ridges are made. These prevent water from running down the trenches and washing away top soil which contains valuable plant food.

This is an important means of reducing soil erosion. Gathering the rich surface soil into ridges means that the depth of top soil available to plants is increased. Manure can be buried more easily in a ridge than in a heap; and a supply of water is assured to the plant roots.

Planting Operations

No definite date can be given for planting a crop, because climatic and topographic factors vary widely even within relatively small areas. The time of planting of particular seeds or seedlings often determines the success or failure of the crop.

Planting is done when the rains have sufficiently moistened the soil; In West Africa the erratic nature of the rainfall makes choice of planting time very difficult. In two-peak rainfall regions the "small rains" may fail completely and there is no way of predicting such weather hazards.

The method of planting also influences the growth of seeds or seedlings. Proper attention must be given to soil and seed bed preparation, there must be suitable soil tilth to receive the seeds.

The depth of planting required by seeds or seedlings varies with the type of crop. The seed should be covered with rich top soil which is gently pressed down to avoid air pockets. Special care must be taken not to destroy the roots of transplanted seedlings.

The optimum distance of planting holes from one another (spacing) varies from species to species. It must be strictly controlled to prevent either overcrowding or too Iowa plant population. Seed rate is the number of seeds used per hectare of land. Plant density is the number of stands per hectare of land. For crops that require thinning, seed rate might be different from plant density.

Watering may be necessary in dry conditions. Crops may be planted either on ridges or on the flat.

Post Planting Preparation

a. Thinning: This is the removal of extra seedlings from a 'stand' when all the viable seeds have germinated. It is ideally done after rain when soil is moist. Great care should be taken to remove only the weakest plants without damaging the remaining ones. The soil around the roots of the remaining plants should be pressed firmly down.

b. Mulching: Mulching can be done with any plant waste material. It will conserve moisture when rainfall is limited, reduce the upward movement of soil water, limit the effect of temperature fluctuation, keep down weeds, reduce run-off and when it decays, forms humus which will improve the soil structure and its water holding capacity.

c. Fertilization: An adequate supply of nutrients promotes plant growth and development. These nutrients must be supplied in a balanced amount at the right time and under the right condition in order to be effective.

The soil should first be tested to find out what nutrients are lacking so that the right type of fertilizer may be applied. Fertilizers must not have any direct contact with the plants because they may have a toxic or burning effect

d. Control of Pests and Diseases: The agricultural significance of pests and diseases of crop plants is that the damage they cause reduces the quantity or quality of yield. Often the first evidence of the presence of a pest-or disease is the appearance of the crop whim may exhibit particular types of pest damage or disease symptoms.

Therefore it is necessary to control the incidence of pests and diseases by the following ways.

i. The use of chemicals sum as insecticides to kill the insects, herbicides to kill the weeds, nematicides to kill nematodes etc.

ii. Cultural method whim involves dose season method crop rotation, fallowing, trap cropping. An example of trap cropping is the planting of Cassius spp between cotton to attract the Lygus bug Tavloritvqus vosseleri from cotton to Cassius which is a preferred plant

iii. Biological method-which involves the use of living organism to control pests and diseases e.g. the use of lady bird beetle to control cotton-cushion scale pest.

iv. Harvesting: This should be done on time to avoid loss or waste. Various types of equipment or tools are used for harvesting various crops, e.g. Go-to-hell for harvesting orange, Cocoa etc.

MAIZE *(Zea Mays)*

Maize is one of the few crops widely cultivated in almost all the different ecological zones of the world. There are seven types of maize.

a. Dent maize *(indentata)*
b. Pint Com *(indurata)*
c. Flour maize (amy/acea)
d. Pop com (everta)
e. Sweet com *(Saccharata)*
f. Waxy corn
g. Pod com *(tunicata)*

Climatic and Soil Requirement

Maize does well in areas where temperature is between 21°C and 27^{D}C but the maximum temperature it cart tolerate is 34°C. Rainfall should be well distributed and high, about 220-250 wet days per year.

It is a short day crop i.e. requires ample supply of light for photosynthesis. Maize does better on fertile, well-drained soil which can be sandy-loam to clayey-loam with ph range of 5-8.

Land Preparation: This could be done manually by hand or mechanically, using tractor where ploughing and harrowing will be carried out. Ploughing depth should be about 22cm into the soil.

Planting: Maize can be planted twice in a year in areas with two peaks of rainfall per year or where irrigation facility can be provided. Early maize is planted in March/April and late maize in July/August, in southern Nigeria. The spacing is 90cm x 30cm (sole cropping) or 1 m by 1 m (mixed cropping). Germination occurs after 4-7 days of planting.

Fertilizer Application: Four, 50kg bags of N.P.K 15: 15: 15 per hectare are applied at planting followed by two 50kg bags of sulphate of ammonia at 6-7 weeks of planting. It can be applied in a ring form of l0cm radius and 2cm deep around each stand.

Maize Plant

Weeding for Maize

3 weedings are recommended
1st weeding 2nd-3rd week after planting
2nd weeding 6th-7th weeks after planting
3rd weeding 9th-10th weeks after planting

Herbicides such as Atrazine can be applied at the rate of about 3.5kg active ingredient per hectare 1-2 days before or a day after planting.

Harvesting: If maize is to be consumed fresh, harvest period is at 60-90 days after planting. If dry it should be harvested at 90-120 days after planting.

Yield: An average yield of 3,500kg/ha is expected for the improved variety and 600-l,200kg/ha for the local variety.

Diseases and Pests

(a) Corn Smut:-This is caused by a fungus named Ustilago mavdis. It affects the aerial part of maize forming black spores on the stems leaves and tassels. The smut organism lives over in soil.

Control:

i. Seed treatment with mercury dust
ii. Use resistance variety
iii. Uproot and burn the infested plants

(b) Leaf Spot: It is caused also by fungus name *Puccinia Polysporia.* The leaf of the infested plant is covered with spot on the lower surface. It can be controlled by crop rotation,

(c) Maize Rust: This is also caused by a fungus named *Puccinia sorghi.* It causes reddish to purple colouration of infested leaves resulting in death of such leaves. Control is by the use of resistant variety and by planting crop at the right time.

Maize Streak: It is a viral disease which is transmitted by an insect named *Cicadulina imblla.* The virus produces long yellowish irregular strips on the leaves leading to plant deformation and stunted growth.

Control Is By:

a. Control of the insect vector
b. Infected plant should be uprooted and burnt

Stem Borers: These are larvae of some insects, they bore into the stem of maize plant, especially the young seedlings causing serious damages to the tissues.

Control Is By:

a. Use of resistance varieties
b. Use of chemicals e.g. Vetox 85 at the rate of 28g per gallon of water, 14 days after planting.

   For effective control second application is done 28 days after planting at the same rate:

The Major Pest of Maize is Weevil

The zoological name is *Sitophilus zeamais,* it attacks maize in store. It is a field to store pest. It reduces maize grain into powdery substances, and it is the larvae of the insect that does the damage.

Control

1. Early harvesting of cobs.
2. Maize grains should be dried properly to a safe moisture level before they are stored.
3. Containers to be used for storage should be properly dried and, fumigated using phostosin.

   Also grasshoppers also is another pest of maize that feeds on the foliage of the maize plant.

CASSAVA *(Manihot Spp)*

Cassava is an important food crop grown in Southern Nigeria but now also grown in the Northern part. It is very easy to cultivate and can thrive even in poor soils. This makes it more popular and is now replacing yam in some parts of Nigeria.

The root is processed into garri. The sweet variety is boiled or roasted fresh. There are two main species of cassava based on their cyanide content

a. Sweet cassava - *Manihot palmate* (low cyanide content)
b. Bitter cassava - *Manihot utilissima.* (high cyanide content)

Cassava Crop

There are many varieties of these two species and many hybrids. Among local varieties in Nigeria are Kiaragba, Okoto ruwa, Dalejoro, Udukanana and Dan warn which is the most commonly grown variety in the North.

Date of planting in the south is between March and October and in the North is between June and August.

Cassava is propagated by stem cuttings, the cutting should be about 25-30cm long and planted at angle 45° to the ground with approximately 20cm of the cuttings buried in the ground.

Spacing is 1 m x 1 m or 1.6m x 1.6m. The germination of the cuttings starts from 7th -14th day after planting. Cuttings from healthy plants are usually selected.

Fertilizer Application: Potash fertilizer is required for proper development of the tubers. The soil should have a pH above 5.7.

Cassava is able to withstand drought by shedding its leaves during the dry season to reduce moisture loss through the leaves.

Soil:-The best soil for cassava is light sandy loam of medium fertility

Time of Maturity:- Local variety take long time to mature (2 years) while the new varieties reach maturity between 6-8 month of planting. Matured crop is harvested using cutlass, the cover soil is removed and the whole plant is uprooted. The roots cannot stay for long before decaying and so processing follows after harvesting. The plant can be left on the field for more than 2 years at which time, it will become fibrous but still useful. Cassava peels can be fed to livestock, and the edible part can be processed into *Garri, Lafun, Fufu,* etc.

Diseases and Pests

Cassava Mosaic:- This is caused by cassava mosaic virus. It affects mostly the stem and leaves causing leaf distortion and typical mosaic discoloration of leaves. The vir transmitted by a white fly.

Control is by planting healthy stock, control of insect vector, use of resistant varieties. Infested plants should be uprooted and burnt.

Leaf Spot:- a fungal disease caused by Cercospora spp. The spores are airborne and deposited on the leaves producing pale brownish spots on leaflets which later turn dark brown. Infested plants die.

Control is by application of fungicides like Bordeaux mixture. Infected plant should not be used for propagation.

Rodents:- e.g. grass cultar, big giant, rat, ground squirrel, they dig into the soil and eat the roots. Trapping is the only method by which they can be controlled.

Grasshopper:-(*Zonocerus variegates)* this causes considerable damage by defoliating the plan, especially, during the dry season.

Control is by application of insecticide or hand picking etc.

CITRUS *spp*

Citrus is a very popular fruit, cultivated in most parts of the world. Citrus plant is a source of vitamins, minerals and carbohydrates. There are many varieties of citrus, they differ mostly in the fruit produced and sometimes in appearance of the trees.

Types of Citrus

a. Sweet orange *(Citrus* Sinensis)
b. Grape fruit *(Citrus Paradisi)*
c. Lime *(Citrus aurantifolia)*
d. Lemon *(Citrus limon)*
e. Sour Orange *(Citrus aurantium)*
f. Shaddock *(Citrus grandis)*
g. Tangerine *(Citrus reticulata)*
h. King Orange *(Citrus nobills)*

Sweet Orange (Citrus Sinensis)

Methods of Propagation:- It is propagated by seed, budding or grafting. The most commonly used method are seed and budding.

Nursery Operation is Required in the Cultivation of Citrus.
The seeds are sown in raised seed trays about October/ December and at 5cm deep. The seed tray is filled with good top soil mixed with farm yard manure at a spacing of 4cm x 4cm (Pre nursery stage)

The seedlings are then transplanted to the nursery around April/May at a spacing of 60cm X90cm. When the seedling is about one year old from the time of planting, budding or grafting can be done.

Soil and Climatic Requirement

This crop requires well drained fertile and deep soil with rainfall of between. 80-125 cm per annum. It also thrives well on high and sloppy lands. Fruiting starts at about 3-7 years of planting depending on soil condition and climatic condition.

Matured fruits are harvested using go-to-hell and ladder for those on top of trees. The ripe fruits are yellow to orange in colour.

Yield:- of sweet orange is between 700-2000 fruits per tree. Juice from the fruits can be cannel as orange drinks. Fruits of some citrus varieties is also used for medicinal purpose.

Diseases and Pest

1. **Tristeza:** is a viral disease, transmitted by Aphids and bud wood insects while feeding on the plant. It affects the stem, destroying the xylem and phloem tissues, leading to the death of the plants. Control: Use of resistant varieties e.g. Lemon orange as stock.

Orange Plant

2. **Citrus Scab:** caused by fungus named Sphacelona faucetti. It attacks the plants from the root and progresses to the other parts, common with the plant in the nursery. Yellow spot first appear on leaves and later develop to form a corky out-growth.

   Control: Spray with Bordeaux mixture, void the establishment of new nursery site very close to the old ones.

3. **Gummosis:** A fungus disease, the pathogen is named Phvtoph-thora citraphthora. It is borne in the soil and air. It attacks the cortex and gum packets found in the cambium resulting in the death of the cortex and production of gum exudates from the cambium.

   Control by the use of resistance varieties e.g.(Sour Orange).

   Branches should not be allowed very close to the ground.

4. **Die-back disease:** It is caused by a soil inhabiting nematode.

   It bores into the roots causing serious damages to the tissues. It causes slow growth, reduced vigour and yield Control soil fumigation with carbon disulphide or Aldrin dust.

5. **Green Shield Bug:** *(Nezara viridula)* this is a pest of citrus. It causes leaf distortion and transmits virus.

Control: Spray plant with Dieldrin, ants can also serve as control agent by feeding on the bugs.

OKRO: *(Abelmoscus Esculentus)*

Okro is an annual herb erect with hairy stems. It is propagated from seed. The flower is bright yellow.

It is a crop which can be grown in most soils provided there is enough water or where irrigation facility is available. However, it per-forms better on well drained coastal soils.

Beds or flat ridges can be prepared for okro on which the seeds are sown. It can be planted twice in a year. First in April and secondly in August/ September.

Spacing in okro is about 60cm x 60cm and 2 -3 seeds are planted per hole and later thinned to one with the depth of between 3cm and 5cm.

Fertilizer Application: Okro responds very well to nitrogen fertilizer which can be applied using any method of fertilizer application.

It matures in 3 months depending on the varieties. The mature fruits are green. Harvesting is spread over a number of weeks at 4 days interval using a sharp knife. It is very rich in vitamins and oil. Okro seeds looses viability very easily due its oily nature and must be properly stored in an appropriate environment.

Diseases and Pest

Root Knot Disease: This is caused by an eelworm nematode, it results in plant becoming dwarf and pale. The effected crop wilts easily in hot weather.

Control - Infested plant should be uprooted and burnt.

Dysdercus: It attacks okro on the field as well as when in store. It sucks juice from the leaves and destroys the ripe seeds. It eats the seed embryos making them unsuitable for planting.

Control is by the use of insecticides and early harvesting of ripe fruits.

LIVESTOCK PRODUCTION

Introduction

Livestock or farm animals are animals which man has domesticated and are reared for his consumption and benefit. These animals include cattle, sheep, goats, pigs(swine), horses, donkeys, camels, poultry and rabbits, of recent other species such as snails and grass cutters are also being domesticated.

Importance of Livestock

The domestication of animals have been of benefit to man in various areas which include the following.

a. The provision of food: livestock have been a source of animal protein to man. This has been mostly in the form of meat, milk and eggs.
b. Provision of raw materials for industries: raw materials such as hides and skins, wool, mohair are used in textiles, shoes and bags industries. Butter, cheese and yogurt are processed from milk.
c. A means of transportation and sports: In some areas in Nigeria donkeys, camels and horses are used as means of transportation for man as well as heavy loads, Horses are also a means of sports and recreation as in the case of polo game.
d. Provision of farm labour. Some livestock are used as draught animals to plough and till the soil, examples are bullocks, carabao etc. Farm implements such as plough, harrow and ridgers are attached to them and they drag this along the farmland for land preparation operations.

Problems of Livestock Industry in Nigeria

The livestock industry in Nigeria is faced by a number of problems and these include:

a. Poor Nutrition: Most of the livestock in Nigeria are raised on the extensive system whereby animals are allowed to fend for themselves, they subsist on poor quality grasses, farm and kitchen waste. Improved pastures and concentrates are not usually made available for them. This tends to encourage poor growth and performance.

b. Inadequate Veterinary Care: Veterinary care and disease control is still inadequate. Vaccination as a control against disease is not strictly followed and in some cases may not even be available.

c. **Low Level of Education on the Part of Livestock Farmers:** Majority of the cattle raised in Nigeria are in the hands of uneducated Fulani cattle rearers. Many of them resist practice that can improve livestock performance and production.

d. **Poor Breeding Program:** The indigenous livestock in Nigeria are mostly the dwarf types characterized by low yield and production. These breeds have been largely left unimproved because breeding programmes and selection are mainly confined to few research stations and institutions.

e. **Poor Management System:** The extensive system characterized by low input--low output is mostly common in Nigeria. Housing facilities are not usually provided and where they are available such facilities are poorly constructed.

f. **Lack of Fund:** This result in the inability of the farmer to access sufficient fund to establish or maintain a well equipped livestock farm, livestock can generally be classified as *Ruminants, Monogastrics and Non-ruminant herbivores.*

Ruminants

These are animals with four-compactment stomach which include rumen, reticulum, omasum and abomasum. Examples of ruminant livestock are sheep, goats and cattle. The rumen is inhabited by micro organisms which help in breaking down the cellulose cell wall of plants, fermentation also takes place in the rumen. Ruminant feed by swallowing their food without much of chewing initially, this food is later regurgitated back to the mouth and then chewed properly (chewing the cud) after which digestion continues. The abomasum is the true stomach and there enzymatic digestion takes place.

Monogastrics

These animals have one compactment stomach. Examples are poultry and pigs. They are usually omnivorous, enzymes are secreted in the stomach for Digestion of food.

Non-Rominant Herbivores

These are not ruminants, that is they do not posses rumen, reticulum, omasum and abomasum, but they are plant eaters. Examples are horses, donkeys and rabbits. They are able to digest plant cell wall easily because of the presence of microorganisms in some specialized organs in the gastro- intestinal tract.

POULTRY

They are domesticated birds, example are: chicken, turkey, guinea fowl and ducks. They can be classified into three on the basis of production.

a. Meat type or broilers
b. Egg type or layers
c. Dual purpose type

Meat Type

These are raised for commercial meat production and they have a good food/meat conversion ratio. The birds reach market weight between 8 to 12 weeks.

Examples are Plymouth Rock, White Sussex and White Wyandotte.

Egg Type

They are usually light breeds but are raised for egg production which is high.

Examples include Harco Black and White Leghorn.

Dual Purpose

As the name implies they are raised for both meat and egg production. Examples are Rhode Island Red, Light Sussex.

Breeds of Fowls

The local breeds in Nigeria are small having a live body weight of 1 kg - 2 kg. The colour is varied some have black, brown or barred feathers. Eggs are small and they produce about 12-18 eggs in one clutch. The hen is very broody.

The Exotic Breed

The American breeds include the following"

a. Rhode Island Red
b. New Hampshire
c. Plymouth Rocks
d. Jersey Giants
e. Wynadotte

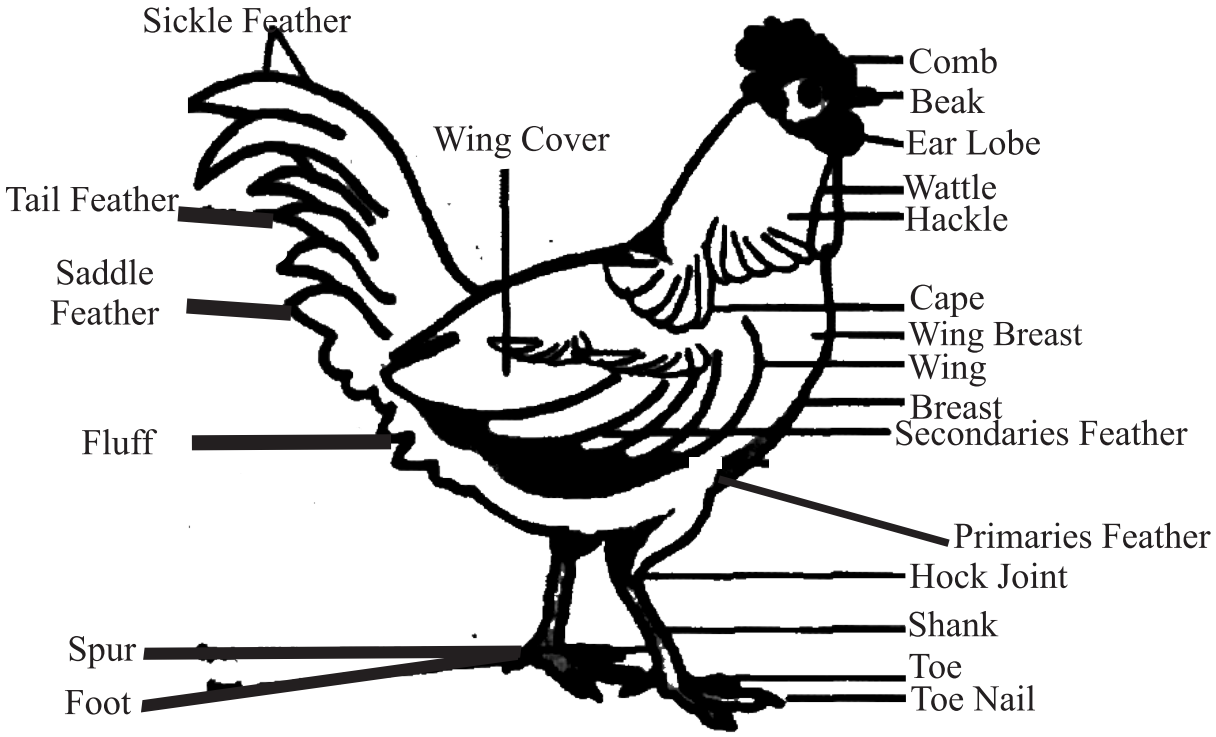
The Rhode Island Red

The hens are good layers of brown shelled eggs. They are considered as

dual purpose. The average weight is 4kg for the cock and 3kg for the hen.

The New Hampshire
They are general purpose breed, they lay brown shelled eggs, the cock is about 3.8kg at maturity and the hen about 2.7kg. They are similar to the Rhode Island Red and are early maturing.

The English Breed includes:



Parts of a Chicken

a. Orpington
b. Australop
c. Sussex

The Orpington

This breed has different varieties. The Buff Orpington is the most popular. They are docile and lay tinted eggs. They are good table birds and at maturity the cock weight 4.5kg while the hen weights 3.6kg.

The Mediterranean Breed
They are mostly famous for egg production laying white shelled eggs. Examples are:
1. leghorn
2. Ancona

The Leghorn:
The most popular Mediterranean breeds. They are very good layers. They have yellow beaks, skin and shanks. The weight at maturity is about 2.8kg for cock and 2kg for the hen.

Systems of Livestock Management

There are three main management systems of livestock production. These are the:

Extensive system, Intensive system and the Semi-intensive system.

Extensive System: livestock are managed by raising them on a free range. They are allowed to fend for themselves with little or no shelter provided for them at night. Feeding is usually not supplemented.

Intensive System: livestock are raised indoor under confinement, their food are brought to them in the enclosure while adequate and comfortable shelter is provided.

Semi Intensive System: Animals are provided with shelter and supplementary feeding but they are also released from their enclosure at specific periods of the day when they can scavenge. Runs are attached to their fixed units (Shelter).

Poultry Management Systems

The following are systems used in poultry management

1. **The Free Range System:** This is an extensive system of management in which birds are allowed to scavenge for themselves. Little or no shelter is provided for them at night. It is less expensive but it exposes birds to predators and diseases.

2. **Deep Litter System:** Birds are confined to a house where litter materials are provided on the floor to absorb their faces e.g. sawdust, wood shavings. Overcrowding must however be avoided. A floor space of 1 sq metre can accommodate about 20 birds between the ages of 0-4 weeks.

3. **Battery Cage System:** Birds are confined in cages. This floor of cages allow faces to drop outside the cage and also for easy collection of eggs. Feed must be balanced. Both the battery cage and the deep litter systems are examples of intensive system.

Management of Poultry

Poultry eggs can be incubated naturally or artificially. Eggs take about 21 days to hatch. Day old chicks are transferred to brooder house immediately after separation of male and female. Mortality should not exceed 3-5%. Mortality could be higher if chicks are not managed properly. Brooders should allow comfortable accommodation and initial temperature of about 32-33°C. Vaccination programme should be strictly followed.

After 6 weeks, chicks are transferred to rearing house. At this stage they are fed with growers mash. Proper ventilation, optimum feeding and watering are important. Broilers are fed with high protein and energy rations so as to reach market weight of about 1.8 to 2kg body weight in 8-12 weeks. Layers are further transferred to battery cage or laying houses from the 19th week. Breeding stock are housed together for breeding purposes.

The Process of Egg Formation

Egg or ovum is formed in the ovary which contains about 4000 ova. It is released from its protective envelope called follicle during ovulation. The egg is immediately caught by the funnel of the infundibulum or oviduct. Fertilization occurs in the infundibulum.

Deep Litter System

Battery Cage System

The hen has only one functional ovary. The ovary contains many hundreds of minute ova or yolk which mature to form eggs-at sexual maturity. Yolks mature between seven to ten days after they start to grow. The yolk is released into the funnel shaped opening of the infundibulum (oviduct), and here fertilization occurs if the hen has been previously mated. From the infundibulum, the egg move to the magnum where albumen in secreted around the yolk, it remains there for about three

Lifecycle of Chicken and Related Management Operation

Stage	Duration	Management
Embryonic (Prenatal)	21days (-21days to day old) fertilized egg	Incubation
Post natal (Chick)	Day 1 -8wks	Brooding
Grower	8 -20wks	Rearing
Adult a. Layers b. Breeders	20/24wks	Layers/Breeder Management

Vaccination Schedule

Age	Vaccination
1st day	Marex
1st - 4th day	New Castle
14th day	Gumboro
3-4th wk	Fowl Pox
5th wk	Gumboro
6th wk	Newcastle
16th wk	Newcastle
18th wk	Gumboro

hours. It then moves to the isthmus and here the shell membranes are secreted around the albumen where it remains for one and a quarter hours. Lastly, the egg descends Into the uterus where the egg shell is added. This last process takes about eighteen hours before the egg passes into the vagina prior to laying. Only fertilized eggs hatch into chicks.

Common Diseases of Poultry

1. **Newcastle:** This is a viral disease which is highly fatal. It is spread by contact. Symptoms include green diarrhea, coughing occasionally paralysis and soft shelled eggs.

   Treatment: There is no effective drug against Newcastle. All affected birds should be killed.

   Prevention: Vaccination prevents Newcastle disease, avoid contamination by refusing visitors access to poultry house.

2. **Coccidiosis:** Caused by protozoan, it is transmitted through droppings, Symptoms include bloody droppings, droopy birds and high mortality.

   Treatment: Use of sulphur drugs

   Prevention: Avoid over-population, damp litters. Use coccidiostat in feeds.

3. **Fowl cholera:** Caused by bacteria, highly infectious, it is transmitted

by contamination of feed and water with bowel or nasal discharges from infected birds. Symptoms include yellowish colouration of droppings, high mortality rate, difficult breathing and loss of appetite.

Treatment: Sulphur drugs in feed and drinking water, remove dead birds and disinfect houses.

Prevention: Adopt good sanitary measures and avoid stress.

Avian influenza

This is a viral disease affecting the respiratory, digestive and nervous system of different species of birds, both domestic and wild. Avian influenza virus vary in their pathogenicity.

Clinical signs of infection include

1. Ruffled feathers
2. Soft shelled egg
3. Depression and droopiness
4. Sudden drop in egg production
5. Diarrhea
6. Cyanosis of wattles and comb
7. Respiratory distress inco-ordination
8. Sudden death

Transmission

This avian disease is transmitted from bird to bird through faecal and oculo-nasal discharges.

Treatment:- There is no effective treatment.

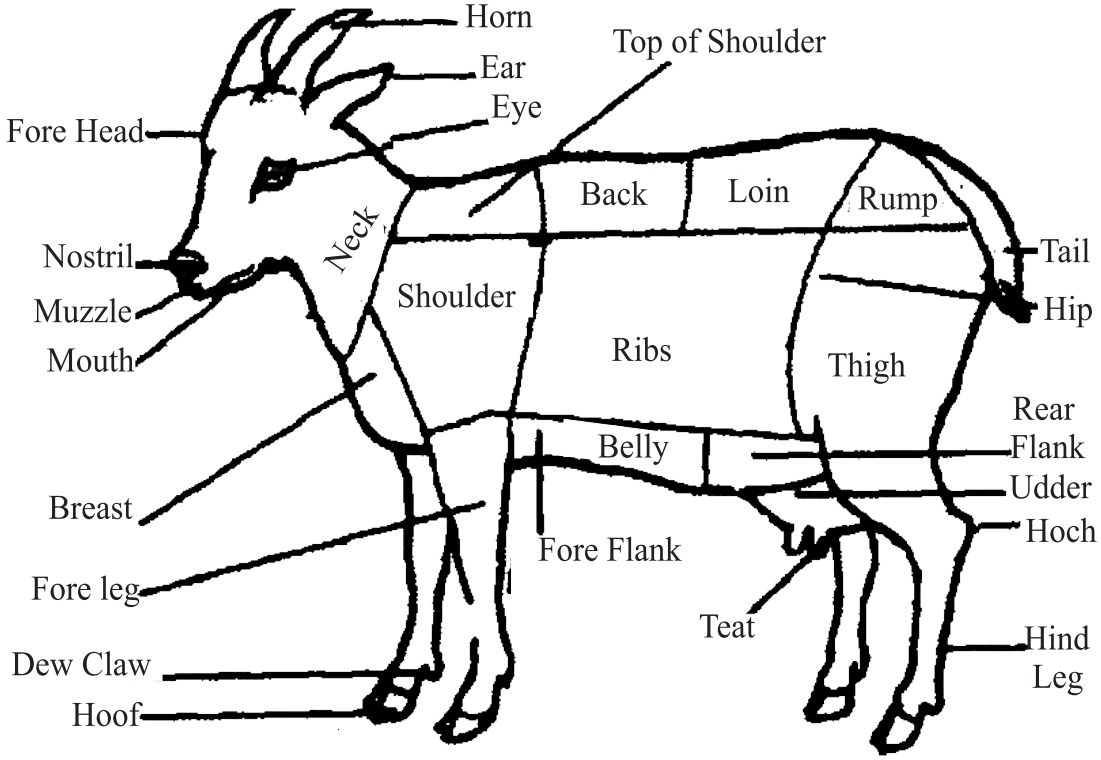
Prevention:-Vaccination programme, biosecurity, good husbandry and nutrition system have proven helpful. It is also good to quarantine infected birds to avoid possible spread of infection to unaffected birds or areas.

GOATS

Goats (with the generic name Capra) are small ruminants raised basically for meat, milk, mohair or skin and hide production. Goats are very hardy and they adapt to many differing climates. They browse on a variety of vegetation and have appetite for many edible materials. There are different breeds all over the world.

Examples of exotic breeds are *Anglo Nubian, British Saanen* and *Toggenburg*, while breeds found in Nigeria include West African dwarf, *Red Sokoto and Sahel.*

Parts of a Goat



Breed of Goats

1. **The Anglo-Nubian:** It is a large strong goat which may weigh up to 75kg. It has long legs and long pendulous ears. The milk is high in butterfat content but yield is lower than Toggenburg or Saanen. It is a dairy breed of goat

2. **West African Dwarf (WAD):** This is commonly found in the South of Nigeria. It is achondroplastic and trypanotolerant, weighing up to 20kg on the average. The colour varies from uniform black, brown to white. It is highly prolific, but growth rate and milk yield are low. WAD goats can give birth to 2-3 kids at a time.

3. **Red Sokoto:** The colour is uniformly red, ears are short and horizontal. Both sexes have horns. The skin is very valuable. It kids about 3 times in 2 years. They are relatively short about 2-30kg. The skin is very valuable.

4. **The Sahel:** It has pendulous ears, and it is well adapted to hot dry environment. They have large size and long twisted horns.
The coat is short, they thrive well in arid sub Saharan region.

Terms for Goat at different stages

Buck of the West African Dwarf Breed

West African Dwarf Doe

Doe: Female goat that has kidded at least once

Buck: Mature male goat

Kid: Young goat that are less than six months

Management Systems of Goats

a. **Tethering:** Goats are tethered to a stake by rope. This allows them to graze around depending on the length of the rope.

b. **Semi-Stall Feeding:** Goats are raised in an enclosure with fenced yard.

c. **Herding or Ranching:** The ranch is fenced. Improved pasture is cultivated in paddocks which are well managed to provide grazing for the goats at all times. About 8-10 goats are kept per acre. Farmstead may also be provided on the ranch.

Management Practices

Breeding: Females should be bred at about 15 to 18 months old while males can be bred at 12 months. One male can serve about 30 goats. Service takes place when the animal is on heat.

Signs of Heat

A female animal is on heat (oestrus) when it desires to be mated. It is the peak of the reproductive cycle of the animal and it is accompanied by symptoms specific to each species of animals. For the goats there are about 18-21 days between heat.

Reproductive Cycle of Goats

The signs include:

a. Restlessness
b. Bleating
c. Redness around the vulva and sometimes mucous discharge.
d. Twitching of the tail

Heat lasts about 24-36 hours.

The gestation period is: the period from the fertilization of an ovum to the birth of the young. It takes about 150 days. The number of kids per parturition is between 1 and 3.

ESTRUS CYCLE IN LIVESTOCK

	Occurrence animal of cycles	Average duration of cycle	Duration of heat	Time of ovulation	Duration of pregnancy (days)
Cow	All year	21	8-24hrs	1st day after heat	275-290
Ewe	Varies with Breed and Climate	18	1-3 days	At end of heat	15-115
Mare	Feb-July	22	2-6 days	Near end of heat	325-345
Sow	All year	21	1-4 days	Towards the end of heat	11-120

Kidding and Care of Kids

Goats should be given extra feed per day from about a month before kidding. The goat can also be separated about one week before kidding. It will normally kid by itself without assistance. Kids should be allowed to suckle colostrums after kidding. Colostrum is the thick yellowish milk produced during the first 2-4 days after birth. It contains antibodies that provide protection for the newborn against infection and it is highly nutritious. Kids can start nibbling at forage and concentrates after 3 weeks.

Other Management Practices

1. **Dipping:** This is carried out to control ectoparasites. Animals may be sprayed or allowed to pass through a dip to control ectoparasites such a ticks and lice.

2. **Deworming:** Goats are easily infested by worms. Deworming is carried out to control endoparasites e.g. round worms, tapeworms and fluke.

Ant helminthes such as albendazole can be given to the animal, the bolus can be given by drenching. Ivomec injectable also controls

ecto and endo parasites.

3. **Disbudding:** This prevents the growth of horn. It can be carried out by applying caustic soda at the base of the horn. The horn can also be clipped off, this prevents animals from using horns to damage or injure their skin. It should be carried out when goat is young.

4. **Castration:** This is done on male animals not used for breeding purpose. It is done with a burdizzo or an elastrator. The burdizzo crushes the cords which go to the testes, rendering the animal impotent. Goats are also highly susceptible to worms and parasites.

Diseases of Goats

i. **Pests des petits ruminants** (P. P. R or Goat Kata)
The transmission is by direct contact. The symptoms include gastroenteritis, pneumonia, fever, nasal discharge, lethargy.

Control is by vaccination.

ii. **Foot and mouth disease:** it is a viral, highly communicable disease, symptoms include high fever, eruption of vesicles in the mouth and on the feet. Control is by use of multivalent vaccine.

CATTLE

Cattle belong to the genus Bos and the bovidae family. They have large body sizes and mayor may not possess a hump.

A female cattle which has had one or more calves is called a **cow**.
A **bull** is an uncastrated mature male cattle.
A **steer** is a male cattle that has been castrated before reaching maturity.
A **stag** is a male cattle that was castrated after maturity.
Heifer is a female cattle under one year or which has never calved.
Calf: cattle that is less than one year old.

Cattle can be basically classified into the following:
a. Beef type or cattle raised for meat
b. Dairy type or those raised for milk
c. Draught type or cattle raised for farm labour (animal traction)
d. Triple purpose type: these can be used for meat, milk or farm labour

Breeds of Cattle
The most common breeds in Nigeria are:

i. **The Sokoto Gudali:** They are a dairy drought breed. The hump is well developed and the dewlap and sheath are large. They are medium sized, the female is generally white, cream or light gray with dark shading over the poll, neck, shoulders and tail, male may be dun coloured. The male has upturned horns, while the female horns are smaller but longer.

ii. **The White Fulani:** These are white with black spottings, they are found predominantly among nomadic Fulanis. The horns are medium and lyre shaped, they also have good milk potentials.

iii. **The Red Bororo:** They have long lyre shaped horns and long legs, they are poor milkers and are difficult to handle. The colour is red to dark red.

iv. **The Ndama:** These are dwarf, humpless breeds with straight topline, characterized by some degree of trypanosomiasis resistance. They are poor milkers but are stocky and can be used to upgrade other breeds. The ears are small and horizontally placed, they are essentially beef animals.

Examples of Exotic Breeds include:

Beef: Hereford, Aberdeen
Dairy: Holstein Friesian, Ayrshire

Holstein Friesians: This is a dairy cow originating from Netherlands. They are heavy and strong. They possess large feeding capacities and udders.
They are black and white in colour. Holsteins are alert and vigorous. The cows are quiet and docile while the bulls can be vicious.

Average weight is about 800-900kg for males and 500-650kg for females.
They are less heat tolerant as such they may not perform as well under tropical conditions.

Systems of Cattle Management
The dairy cattle require special handling while the beef type requires less specialized management.

a. **The Extensive System:** Cattle are moved from place to place depending on availability of pasture. No effort is made to provide improved pasture. Livestock farmers sometimes pool their stock together under a Fulani herdsman. Under this system animals are driven to graze in the morning and they are brought back to their temporary home in the evening. Herdsmen in the Northern Nigeria move down south during the dry season when grasses in the savannah regions die, the movement is by trekking this causes the animals to loose weight.

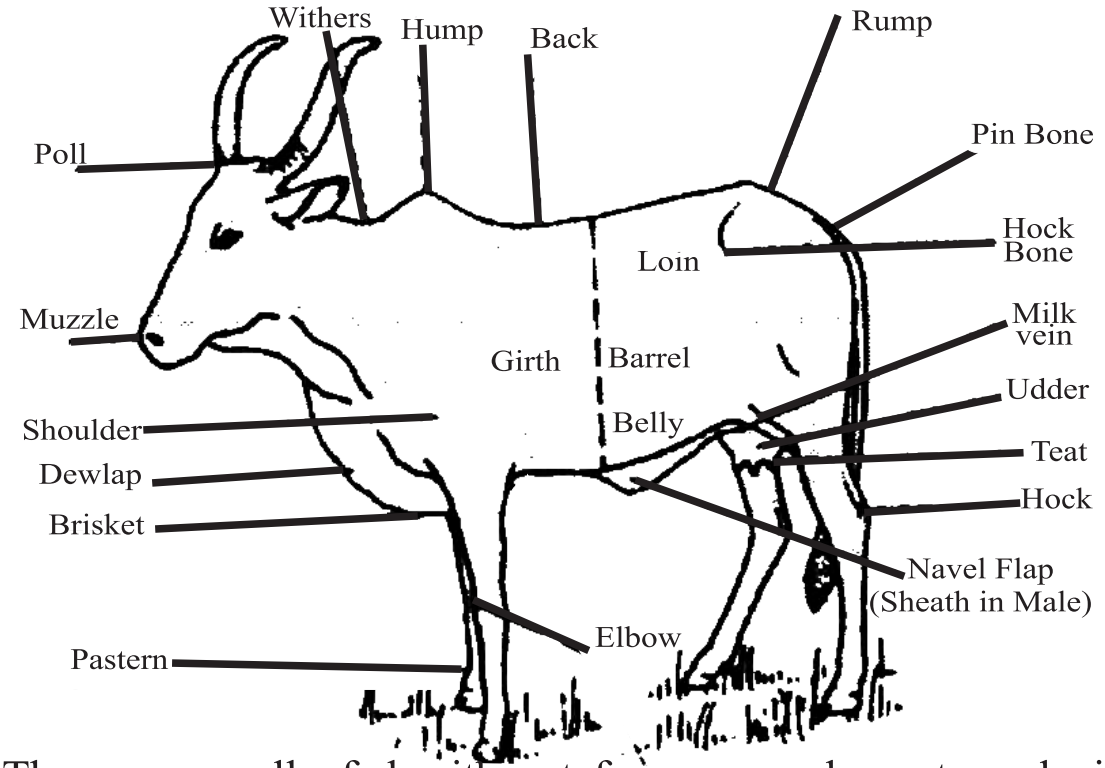
b. **The Semi Intensive System:** This system combines the extensive and the intensive systems in that it involves controlled grazing as well as feeding in stalls. Feeding may include concentrates, an example of the semi- intensive system is ranching.

   Ranching: It is usually employed for raising beef cattle especially on land that is not suitable for crop production. The land is fenced and improved pasture is established on it. The area must be large enough to allow about 5 hectares (ha) of grassland per head of cattle. Rotational grazing may also be practiced on the improved pasture. Houses and pens are constructed for the animals. This system is

usually used in government, research and experimental farms.

c. **The Intensive System:** Under this system cattle are confined, they are not allowed to graze, a situation termed zero-grazing.

Care must be taken to provide a balanced ration since they are not allowed to graze.



They are usually fed with cut forage, supplements and vitamin mineral premix. The system also involves provision of adequate and comfortable housing for the animals. It can be expensive because of the cost of feeding and housing.

Management of Beef Cattle

Calf: Calves are reared by the cow and calf system whereby the calf runs with the dam until it is weaned. After calving, the calves navel should be disinfected with tincture of iodine solution, calves should also be allowed to take colostrums. Creep feed may be introduced as supplementary feed after one week. The housing must be warm and clean. Calves may start nibbling at roughage from about 3 weeks of age.

Breeding Stock: A ratio of 1 bull to 20 cows is recommended where the cattle *graze* together. They should be *grazed* on quality forage.

Artificial insemination (AI) may also be practiced where bulls are scarce or expensive. Artificial insemination is a process whereby semen is obtained from a chosen bull and introduced into a cow that is on heat. However to practice A. I. the herdsman or farmer must be able to detect heat. Gestation lasts for about 270-290 days. Cows will normally calve without assistance but in case of difficulty, a veterinarian could be invited. Cow may be steamed up prior to calving. It should also be separated from the herd and clean bedding, feed and water should be provided in the pen.

Management of Dairy Cattle

Dairy cattle are handled with care and intensive feeding to promote high milk yield. In advanced countries it is a specialized operation. Cows are milked twice a day, that is, morning and evening in the milking parlour. The udder must be washed with warm water before milking. Milking may be done by machine or by hand. Feeding with concentrates should be done in the milking shed for easy handling. Concentrates are high protein, carbohydrate and mineral mixture.

Breeding: Cows can be bred at 18 months. Most cows calve at age 3 and subsequently calve every year. A 1 may be used as a means of breeding.

Calf Rearing: Under dairy cattle management calves are not usually reared alongside their mothers. In most cases the calves are bucket fed. They may be allowed to suckle colostrums directly from the mother for a few days before starting them on bucket feeding. Calves can be introduced to fresh fodder as supplement at 3 weeks old.

Weaning: It is a crucial time in the life of calves. Since the dependence upon the cow for food is cut off, Calves usually lose weight immediately after weaning, their resistance becomes low. They are usually weaned at 3-6 months old.

General Handling and Routine Management Operations

Identification: Each animal should have an identity. This identification pattern may be by branding, tattooing, ear-notching or by tagging.

Information concerning breed, age, parity and other performance records should be kept by the farmer.

Castration: (see under goat management operations) Dehorning: (see

under goat management operations)

Deworming: (see under goat management operations) Dipping: Since cattle are large animals, a large dip consisting of a trench well concreted and with stairs leading down into it can be constructed for dipping purposes. On the other hand, cattle may be sprayed by driving them across a spray race or with the use of a knapsack sprayer. This is to control ectoparasites.

N'

M

Culling: This is the process whereby unwanted cows and the poorest of

the heifer weaners are removed from the flock and sold off possibly for slaughter. Other livestock for example poultry and goats can also be culled as a result of poor performance.

Weighing: Calves should be weighed at birth and at least every two weeks as they grow. This is to assess their growth rate. Weighing bridge or girth and length measurement can be done to estimate their weight.

Vaccination: Cattle are generally vaccinated against common diseases such as anthrax, rinderpest and foot and mouth diseases. The vaccination programme should be strictly followed.

Diseases of Cattle

Anthrax: This is a bacterial disease. The symptoms include high fever, bowel inflammation. It is very fatal. After death blood oozes from the anus, nose and Mouth. Carcass of such animals should be burnt. Prevention is by vaccination and treatment by administration of penicillin at the early stages.

Foot and Mouth Disease: It is a viral disease that is highly contagious. Symptoms include high fever, blisters in the mouth and feet and lameness. Prevention is by vaccination and treatment by the administration of antibiotics.

Trypanosomiasis: The disease is transmitted through the bite of tsetse fly. Its symptoms include high fever, anaemia, weakness and emanciation. Prevention is by clearing bush to destroy tsetse fly.

NON-CONVENTIONAL LIVESTOCK

The livestock industry is expanding rapidly to accommodate other non-conventional livestock. These Include rabbittery, snailery, bee production and grass cutter production. This is in a bid to meet the animal protein need of the populace, even though the consumption is based on religious beliefs.

Snail

Grass Cutter

RABBITS

These are small animals that grow very quickly. The breeds common in Nigeria include the following:

Flemish Giant

New Zealand

Californian White

Rabbit

Like goats the male rabbit is called buck while the female is called doe.

Breeding

The doe can be bred at 5 to 7 months of age. A mating ratio of 1 buck to 8 to 10 does is recommended. The gestation period is 30 to 32 days. The doe prepares her nest by pulling off her fur before kindling. A doe can produce 4 litters in a year.

Care of Litter

Rabbits are born blind and deaf with fur on their body. Therefore they are very fragile. The litter is raised on milk for about 8 weeks. Housing: The house should protect rabbit from rain, wind, sun and predators. Wooden cages could be provided.

Feeding

Rabbits are not ruminants but they feed on forages such as grass, sweet potato vines, Lucerne, cowpea and groundnut vines. They practice coprophagy and hence are able to digest roughage. Conventional feeds are also commercially available for them.

Diseases of Rabbits

Coccidiosis: This is a protozoan disease. It affects the liver and intestines. Symptoms also include swollen stomachs and diarrhoea. Control is by maintaining cleanliness.

Skin Mange: This is caused by mites. Symptoms include scaly skin and scabs. Control is by cleaning rabbit's hutches. Terramycin ointment can be applied for treatment.

BIBLIOGRAPHY

Adeniji et al (1989). New Syllabus Agricultural Science for Senior Secondary Schools. Evans Brothers Limited.

Akinsami, 0. (2000) Senior Secondary Agricultural Science. 2nd Ed. Longman.

Anyanwu A. C. et al (1993). A Textbook of Agricultural Science for Schools and Colleges. Fifth Edition. Africana -Fep Publishers Limited.

Brady N. C. and Weil R. R., (1999), The Nature and Properties of Soils. Twelfth Edition. Prentice Hall, Upper Saddle River, New Jersey 07488.

Cobley L. S. and Steele. W. M. (1976). Introduction to the Botany o f Tropical Crops 2nd Ed. Longman.

Falusi, A. O. Adeleye I. O. A. (2000) Agricultural Science for Senior Secondary Schools.

Gopalakrishnan C. A. and LaL G. M. M. (2000) Livestock and Poultry Enterprises for Rural Development V.kas Pub. House.

Idachaba F. S. (2002), Desirable and workable Agricultural Policies for Nigeria In Departmental Lecture Series In Tropical issues in Nigerian Agriculture.

Macdonald I. and Low J. (1985) Livestock Rearing in The Tropics. Macmillan Education Ltd. London and Basingstoke.

Miller G. T. Ur] (1996) Sustaining the Earth. An Integrated Approach, Second Edition. Wadsworth Publishing Company.

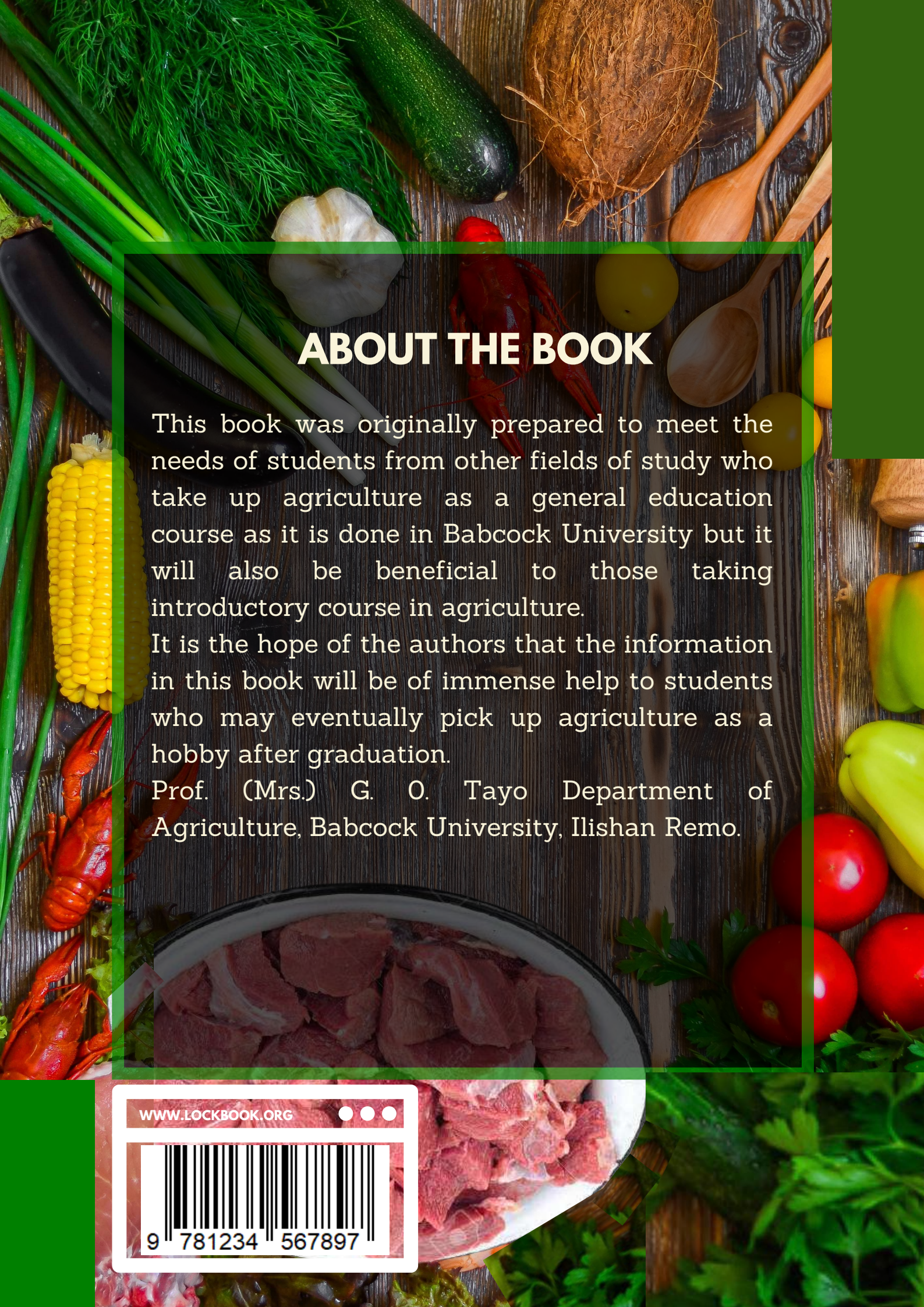
Okorie J. U. (1978) A. Guide to Livestock Production in Nigeria. Macmillan Education Limited London and Basingstoke.

Shaib, et al. (1997). Nigeria: Natural Agricultural Research Strategic Plan: 1996-2010.

Webster C. C. and Wilson P. N. (1980) Agriculture in the Tropics 2nd Ed. Longman.

Webster C. C. and Wilson P. N. (1985) Agriculture in the Tropics. Second Edition. Longman Singapore Publishers pte Ltd.

INDEX



ABOUT THE BOOK

This book was originally prepared to meet the needs of students from other fields of study who take up agriculture as a general education course as it is done in Babcock University but it will also be beneficial to those taking introductory course in agriculture.

It is the hope of the authors that the information in this book will be of immense help to students who may eventually pick up agriculture as a hobby after graduation.

Prof. (Mrs.) G. O. Tayo Department of Agriculture, Babcock University, Ilishan Remo.

WWW.LOCKBOOK.ORG

9 781234 567897