ACCELERATING NUTRITION RESULTS IN NIGERIA (ANRiN) PROJECT

GENERIC MANUAL ON ESTABLISHMENT OF HOMESTEAD GARDEN (FRUITS, VEGETABLES AND SOURCES OF ANIMAL PROTEIN).

Prepared by

THE FEDERAL MINISTRY OF AGRICULTURE & RURAL DEVELOPMENT (FMARD), NIGERIA

on behalf of

World Bank Accelerating Nutrition Results in Nigeria (ANRiN) Project

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ABOUT THIS GENERIC MANUAL

This manual is designed to support the establishment of homestead gardens and rearing of poultry and small ruminants by selected households under the World Bank sponsored Accelerating Nutrition Results in Nigeria (ANRiN). It is a training tool to guide the resource persons in the training of trainers' (TOT) workshop and stepping down of key messages to the beneficiaries and households under the Agricultural Sector (FMARD) of ANRiN. It is put together by experts engaged by FMARD and structured into four components of Nutrition, Crop production and rearing of Small Ruminants and Poultry. Each component of the manual comprises a number of modules with different topics to aid learning and grasping of key messages by the participants at TOT and household levels.

The development of the generic manual is a key deliverable of Agricultural Sector World Bank Accelerating Nutrition Result in Nigeria (ANRiN) aimed at promoting diet diversity and increasing consumption of fruits and vegetables including Orange Fleshed Sweet Potato (OFSP) and animal sourced foods (goat and poultry) for improved nutrition through the promotion of mixed home stead gardens in selected households.

The manual adopts the Adult learning principle for delivering the contents of themes and sub-themes to encourage experience sharing and interactions with motivation to learn. The resource persons find out about the interest and past experiences (personal, work and study related) of the participants. It prompts the trainees to answers the question of "why do I need the knowledge and why is it important or relevant". The trainers will facilitate the process of impacting new knowledge and ideas by providing personal experience, real case studies, asking questions that motivates the trainees to assimilate the knowledge being impacted. Learning aids will, as much as possible, include starter packs to simulate real-life situations and hands-on problem solving scenarios.

The manual is generally crafted in very simple language devoid of deep technicalities of nutrition, crop production and animal rearing. More importantly, the resource persons at the TOT will emphasize the key messages the Master Trainers (trainees at the TOT workshop) will pass on to the beneficiaries at the household level.

Nutrition and Food Safety Division
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ACRONYM

ANRiN	Accelerating Nutrition Results in Nigeria
BCC	Behaviour change communication
CCPP	Contagious Caprine Pleuropneumonia
FMARD	Federal Ministry of Agriculture and Rural Development
FYM	Farm Yard Manure
GAPs	Good Agricultural Practices
GAIN	Global Alliance for Improved Nutrition
GDP	Gross Domestic Products
HAZ	Height-for-Age Z-score
IPM	Integrated Pest Management
IPNS	Integrated Plant Nutrition Systems
MNCH	Maternal, Newborn and Child Health
MDG	Millennium Development Goal
NIHORT	National Horticultural Research Institute
NTDs	Neural Tube Defects
OFSP	Orange Fleshed Sweet Potato
PVA maize	Pro-vitamin A maize
RBC	Red Blood Cells
SAM	Severe Acute Malnutrition
STIC	Sanitation, Traffic Control, Isolation, and Communication.
SSA	Sub-Saharan Africa
UNICEF	United Nations Children's Fund
USAID	United State Agency for International Development
VAD	Vitamin A deficiency
WASH	Water, Sanitation and Adequate Hygiene
WHO	World Health Organization

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Chapter One

Basic Nutrition Overview and Nutrients

MODULE ONE:
WHAT IS NUTRITION?

Learning Objectives: This is to explain to the trainees the meaning of nutrition, nutrient and their food sources. Trainees would also learn that foods, derived from agricultural activities, are the major sources of nutrients and the importance of good nutrition to their community's health and overall economic development.

Method of learning- Adult learning approach with a focus on participatory learning

What is Nutrition?
Nutrition is the study of nutrients in food and how the body uses them, including the relationship between diet, health, and disease. It has also been defined as the study of the food that a person eats and the way the human body uses that food. Eating the right amounts and kinds of food positively affects health, energy, appearance, and the way a person feels

When individuals eat foods such as rice, yam, meat and vegetables, they are not in a form that the body can make use of. Thus, the food and drink have to be converted into smaller substances called nutrients which the body can make use of by absorbing them into the blood stream and transporting them to cells throughout the body. The process of breaking food into smaller substances is called digestion and provides the body the energy it requires for movement and also to build and nourish the cells of the body for good health.

Thus, nutrition is how the body makes use of the nutrient in the food eaten for good health. The food we eat is essential as it provides the vital nutrients for our survival and helps our body function properly and to stay healthy. The food we eat is comprised of nutrients such as protein, carbohydrate and fat and also vitamins and minerals that provide energy (calories) and serve a variety of critical functions to ensure the body operates optimally to maintain health.

Nutrients
Nutrients are substances present in food. Nutrients are needed by the human body for energy, growth, maintenance and repair of body tissue, and regulation of body functions. Food provides the energy for the body's activities whether it is for physical activities such as walking, running, crawling, or doing housework or for internal activities inside the body such as breathing, digesting food, or the heart beating. The energy value of a food is measured in calories.

There are two major types of nutrients; these are Macronutrients and micronutrients. Macronutrients are required in large amounts while micronutrients are required in small amounts. Examples of macronutrients are carbohydrates, proteins, fats and water. Examples of micronutrients are vitamins and minerals. Both macronutrients and micronutrients are required

by the body to function and maintain overall health. Foods also contain non-nutrients that may be beneficial such as antioxidants and may be harmful such as dyes, and preservatives. We shall examine the macronutrients first.

Macronutrients - are required in large amounts by the human body. They are carbohydrates, lipids, and proteins and can be metabolically processed into cellular energy. This cellular energy is utilized to perform work, allowing our bodies to conduct their basic functions. A unit of measurement of this food energy is the calorie. Water is also a macronutrient in the sense that you require a large amount of it, but unlike the other macronutrients it does not yield calories.

The body is in "energy balance" when the number of calories eaten is equal to the number of calories used. Food provides the energy needed for growth and development. From the moment of conception to birth, the mental and physical development of the unborn baby is dependent on the mother's food intake. Good nutrition is essential for growth throughout infancy, childhood, and adolescence and is also essential for the maintenance of good health as an adult.

Body cells are constantly being worn down and must be replaced. Some cells need to be replaced often, such as red blood cells, skin cells, or the cells in the intestine. Nutrients from food are necessary to keep the body functioning, maintain normal body temperature and the balance of body fluids, excrete waste products, and allow blood to clot when there is an injury.

Practically all foods contain a mixture of nutrients. Most healthy people can get enough of the required nutrients from eating a variety of foods. Each nutrient performs one or more specific functions in the body. The nutrients depend on each other to work properly. Excesses of one nutrient will not make up for a deficiency of another.

Except for breastmilk for infants, no single food contains all the nutrients in amounts sufficient to sustain life and promote optimal growth. One must consume a variety of foods daily in order to obtain all the necessary nutrients. The body stores some nutrients and uses them as needed. Other nutrients are not stored very well by the body and must be supplied in the diet more frequently.
In addition to the nutrients provided by foods, under some conditions it is necessary to take vitamin and mineral supplements. For example, supplements are needed during critical periods of growth, such as pregnancy, or in a few specific medical conditions. Each nutrient will be discussed in detail, including its function and its major food sources

Functions and Importance of Nutrients in the body
Protein
Protein in foods provides the body with amino acids used to build and maintain tissues such as muscle, bone, enzymes, and red blood cells. Protein is the second most abundant substance in the body. Food sources of protein differ in quality, based on the types and amounts of amino acids they contain. Foods of high protein quality include a balanced assortment of all of the essential amino acids.

Amino Acids – Amino acids are the building blocks of all proteins. When a person eats a food that contains protein, the body breaks it down into amino acids, and then recombines these building blocks to make new proteins that it needs. The human body needs 20 different amino acids to make proteins. The human body can make 11 of these amino acids, but the other 9 need to come from food. These 9 amino acids are called the essential amino acids.

Functions and Importance of Protein in the body

Some of the important functions are:

1 Building, maintenance and repair of all body cells. Cells are continually being replaced throughout a person's life; e.g. the cells that line the intestines are replaced every week.

2 Important part of red and white blood cells and aid in the clotting of blood. Red blood cells (RBC) are replaced every three months.

3 Enzymes are important protein-containing substances formed in the body. They influence the rate (speed) of chemical reactions in the body; there are specific digestive enzymes that break down food into smaller components that allow nutrients to be absorbed and then used by the body.

4 Antibodies are proteins produced by the body to help fight infections.

5 Many hormones are made of proteins. Hormones are chemical substances produced in the body by an organ, cells of an organ, or scattered cells. Hormones serve as messengers that act on other organs to maintain constant conditions within the body; e.g. when the pancreas detects that there is a high level of sugar in the blood, it releases a hormone called insulin. Insulin ensures the excess sugar are removed from the blood and stored away until required.

6 can serve as a source of energy when the body does not get enough carbohydrates and fats for energy. On the other hand, extra calories from protein not used will be stored as body fat. One gram of protein has 4 calories.

Sources of Protein

Protein can be obtained from animal and plant sources. Food sources of animal protein sources include beef, milk, fish, poultry, eggs. yoghurt, cheese, lamb, goat etc. Animal proteins provide all 9 essential amino acids in sufficient amounts to meet a person's needs, so they are known as complete proteins and are considered high quality.

On the other hand, foods sources of plant proteins are cereals (wheat, oats, rice, barley, corn, etc.), legumes (dry beans and peas). Plant proteins from cereals are low in two essential amino acids, while plant proteins from legumes are low in two different essential amino acids. Only soybeans, provide all nine essential amino acids. Eating a small amount of animal protein with plant foods or eating combinations of plant foods helps to improve the overall quality of the proteins in such foods. For example, when a person consumes cereal with legumes, it would give the person complementary proteins. Complementary proteins are proteins from two foods that supply the amino acid the other has in limited amounts or lack totally.

Who needs them the most?

Protein are needed in increased amounts during time of rapid growth like pregnancy, when the baby is growing in the womb of the mother, and as soon as baby is delivered until when the child becomes 5 years old. These are periods of rapid cell multiplication to support growth. Maternal and fetal needs for protein are primarily fulfilled by the mother's intake of protein during pregnancy. Protein requirements increase during pregnancy primarily due to protein tissue enlargement. Additional protein is also required to maintain the protein tissue developed

Nutrition across the lifecycle – why we need to focus on women, young children, adolescent girls/boys

Critical periods of growth and development are characterized by hyperplasia, or an increase in cell multiplication. Deficits in nutrients supplied to the embryo and fetus during critical periods of cell multiplication can produce lifelong defects in organ and tissue structure and function. Thus, when babies and young children do not receive the adequate amounts of protein and other nutrients that can support adequate growth, they become undernourished and become smaller or shorter for their age or thinner and which may predispose them to chronic or acute undernutrition

or even death.
We thus need to focus on women, adolescent girls and young children (girls and boys) and encourage them to consume the recommended or adequate amounts of protein. This is because for pregnant women they carry the burden of pregnancy and the baby growing in their womb depend on the mothers to meet their requirement for protein (and other essential nutrients). Adolescent girls who often become pregnant fall in the same category while Infants and young children require protein to support their rapid growth rate.

Carbohydrates
Carbohydrates are used by the body mainly as a source of readily available energy. Carbohydrates are major source of energy in the Nigerian diet as their main role is to provide energy. Foods such as yam, cassava, potatoes, corn, beans, plantains, rice, and others such as bread and fruit contain carbohydrates.

Energy from carbohydrates is important for the body to do daily activities as simple as walking and talking and as complex as running and moving heavy objects. Energy is needed for growth, which is important for growing children and pregnant women. Even at rest, the body needs energy to perform vital functions such as maintaining body temperature, keeping the heart beating and digesting food.

Carbohydrates consist of the simple sugars (monosaccharides and disaccharides), complex carbohydrates (the poly saccharides), most dietary sources of fiber, and alcohol sugars.

There are two major types of carbohydrates in foods: sugars and complex carbohydrates. Complex carbohydrates include starch and fiber. There is also a form of carbohydrate stored in the body, called glycogen.

Functions and Importance of Carbohydrates in the body
Carbohydrates are essential for the following reasons:
- Carbohydrates provide energy for the body. Carbohydrates are considered the ideal energy source (fuel) for most bodily functions.
- The body uses carbohydrates first for its energy needs. When a person does not consume enough carbohydrates to meet the body's energy needs, then protein and fats are used to provide the body with needed energy. When protein is used to meet energy needs, this can result in the loss of lean body (muscle) tissue.
- The brain and other tissues of the central nervous system can only use glucose (sugar) for their energy supply. Glucose primarily comes from carbohydrates.

Sources of Carbohydrates
- Plants are the major food source of carbohydrates. Fruits and vegetables contain carbohydrates as a mixture of starch, naturally occurring sugars, and fiber; the amount of starch, sugar, and fiber will depend on the type and maturity of the fruit or vegetable.
- Breads, cereals, legumes, pasta, rice, and oatmeal are rich with complex carbohydrates.
- Vegetable sources such as corn, green peas, dry beans, winter squash, and potatoes are sometimes referred to as “starchy vegetables” because of the large proportion of complex carbohydrates that they contain.
- Milk and some milk products, such as yogurt and cottage cheese, are food sources of the carbohydrate lactose. Most cheeses contain only a minimal amount of lactose.

Simple Carbohydrates (Sugars)
Examples of simple sugars are glucose, fructose, and galactose. Glucose is found in foods alone or as part of other sugars or starch. Glucose is also the form of sugar that circulates in the bloodstream. Fructose is the sugar found in fruit and honey and is the sweetest of all the sugars. Galactose is bound to glucose to form the sugar in milk. All carbohydrates that are used by the body for energy are broken down into these three simple sugars in the digestive tract. The liver converts fructose and galactose into glucose.

Who needs them the most?
Pregnant women, Adolescent girls who also become pregnant before they become fully grown as well as young children below 5 years of age require extra amounts of energy that carbohydrates supply.

Nutrition across the lifecycle – why we need to focus on women, young children, adolescent girls/boys
Carbohydrates provide energy to the body to carry out normal cell function; thus critical periods of growth and development require energy. For example, extra dietary energy is required during pregnancy and thus inadequate energy in nutrients supplied to the embryo and fetus during critical periods of cell multiplication can produce lifelong defects in organ and tissue structure and function. For pregnant women and adolescent girl who get pregnant, the baby growing in their womb depend on them to meet their requirement for energy (and other essential nutrients). Therefore, when babies do not receive the adequate amounts of energy their growth become stunted, and they become undernourished or shorter for their age or thinner for their height and which may dispose them to chronic or acute malnutrition or even death.
This is one reason why we need to focus on women, adolescent girls and young children (girls and boys) and encourage them to consume the recommended or adequate amounts of energy.

Dietary Fiber
Fiber is part of the category of complex carbohydrates. Dietary fiber is different from the other carbohydrates of starch and sugar. Fiber cannot be broken down by human digestive enzymes and is not absorbed by the body. Fiber passes through the digestive system mostly intact, and this is what makes it so important.

Fiber acts like a sponge, absorbing water as it travels through the digestive tract. This adds bulk to the stool, which forces the colon to work harder to push the stool through. This extra bulk reduces constipation and other intestinal problems. Fiber may also help reduce the risks of diseases of the heart and arteries by lowering blood cholesterol.

Food Sources of Dietary Fiber
Many foods high in complex carbohydrates contain fiber. Food sources of fiber include:

- Whole grain breads and cereals
- Fruits and vegetables (preferably with the skin)
- Legumes, such as dry beans, peas, and lentils
- Nuts, seeds, and nut/seed butters.

Only plant foods contain dietary fiber. There are different kinds of fiber in foods. The best advice for overall health is to consume a variety of fiber-containing foods, which will enable individuals to obtain a variety of fibers in their diet and a variety of nutrients in the different foods.

Benefits of Fiber

- Aids normal bowel function, helps maintain regularity, and decreases constipation as long as enough fluids are also consumed.
- May lower risk of colon and rectal cancer.
- May lower blood cholesterol levels and reduce risk of heart disease.
- May help control diabetes.
- May contribute to weight loss.

Diets rich in fiber take longer to chew and add bulk to the gastrointestinal tract so you will feel full for a longer period of time. As a result, consuming a high fiber diet may be more satisfying than a low fiber diet and may help an individual to control the amount of food and calorie intake.

Fats

Fat is an important and essential component of the diet and is the most concentrated source of energy in the diet. Fat gives twice as much energy (calories) as carbohydrates and protein. For example, 1gram of fat gives 9 calories of energy while carbohydrates and protein give 4 calories from each gram. Fats are made up of basic units called fatty acids. The body can produce some of the fatty acids it needs, however some other types of fatty acids are needed that the body cannot make on its own. These are called the essential fatty acids that must be provided by the fat present in the diet.

Fats are important in the diet because they are sources of essential fatty acids.. Fatty acids are also classified as saturated and unsaturated fats. The word "saturation" refers to the chemical structure of the particular fatty acid.

Functions and Importance of Fats in the body

Fat is the main source of stored energy for the body. It provides most of the energy to fuel muscular work. Fat is an important component of the membranes surrounding all of the body's cells. It also protects vital organs of the body such as the heart, kidneys, and liver by providing padding to prevent them from shock.

Fats also help to absorb fat soluble vitamins A, D, E, and K, meaning that fat is needed to transport these essential nutrients. Fat is also converted to other compounds in the body, such as hormones, as needed. Fat serves many functions in foods as well; it adds to the flavor and aroma of foods, making foods smell and taste good and stimulating the appetite. Fat helps to make food more tender in texture. Fat in the diet helps to contribute to feeling full, or to a sense of "satiety." Most foods contain some fat.

Types of Fatty Acids: It is important to understand that fats in foods are not generally made up of only one type of fatty acid, but contain some saturated, monounsaturated, and polyunsaturated fatty acids.

Sources of Fats

Saturated fats: Foods high in saturated fats tend to raise blood cholesterol. These foods include high-fat dairy products like cheese, whole milk, cream, butter, and regular ice cream, fatty fresh and processed meats, the skin and fat of poultry, lard, palm oil, and coconut oil. Saturated fats are generally solid at room temperature.

Unsaturated fats: Unsaturated oils include both monounsaturated fats and polyunsaturated fats Unsaturated fats (oils) do not raise blood cholesterol. Unsaturated fats are usually liquid at room

temperature and can be found in vegetable oils, olive, sesame, most nuts, avocados, and fatty fish like salmon. Omega -3 fatty acids are also polyunsaturated found in oily fish like salmon and tuna. Sources of oils high in monounsaturated fat: Olive, canola, sunflower, and peanut oils. Sources of oils high in polyunsaturated fats: Soybean oil, corn oil, and cottonseed oil and many kinds of nuts. Some fish, such as salmon, tuna, and mackerel, contain omega-3 fatty acids that offer protection against heart disease.

Trans fatty acids: Foods high in trans fatty acids tend to raise blood cholesterol. These foods include those high in partially hydrogenated vegetable oils, such as many hard margarines and shortenings.

Dietary cholesterol: Foods that are high in cholesterol also tend to raise blood cholesterol levels. Cholesterol is found only in animal products such as meats, poultry, dairy products, and seafood. Liver, other organ meats, and egg yolks are particularly high in cholesterol. Vegetables, fruits, grains, and legumes do not contain cholesterol.

Blood cholesterol: In addition to the cholesterol consumed in foods and liquids, the body also manufactures cholesterol. Cholesterol actually has important functions in the body. Cholesterol is an important part of brain and nerve cells and is found in all body cells. Cholesterol is also involved in the production of hormones & vitamin D.

Cholesterol is often said to be "bad" for the human body. The "problem" with cholesterol is that it plays a role in the formation of plaque in the inner walls of the blood vessels of the human body. When plaque forms, the blood vessels get narrower, which can lead to heart attacks and strokes. The main dietary factors associated with high blood cholesterol are a high saturated fat intake and high total fat consumption.

Who needs them the most?
It is essential to eat some fats, though it is also harmful to eat too many. Getting enough health fats is essential for growth and development. Generally, young children should consume a varied diet with about one third of their energy needs coming from fats.

Nutrition across the lifecycle – why we need to focus on women, young children, adolescent girls/boys
It is important to focus on Pregnant women, Adolescent girls and young children in the provision of adequate fats in their diet. During pregnancy about a quarter of the energy needs should come from fats. Some essential fatty acids such as omega-3 fatty acids support development of the growing baby in pregnancy. Infants under six months should be offered breast milk exclusively where they can get their intakes of these essential fatty acid while young children from 6 months upward can obtain theirs from soybean oils, canola oils etc in their diet as these fats play important roles in brain development.

Micronutrients
Vitamins and Minerals
Vitamins and minerals are food components that help support overall health and play important roles in cell metabolism and neurological functions.

Vitamin and Mineral Supplements
A balanced and varied diet provides all the vitamins and minerals most people need. However, those experiencing rapid growth (children), stress to the body (pregnant women), or other conditions may need extra vitamins and minerals in the form of supplements. Sometimes

vitamins or minerals are prescribed for meeting nutrient needs or for therapeutic purposes. For example:

- Pregnant women are prescribed a vitamin/mineral supplement high in iron and folic acid.
- Women who could become pregnant are advised to eat foods fortified with folic acid or to take a folic acid supplement in addition to consuming folate-rich foods to reduce the risk of some serious birth defects.
- Older People- people with little exposure to sunlight; and infants, children, and adolescents may need a vitamin D supplement.
- People who seldom eat dairy products or other rich sources of calcium need a calcium supplement.

There are 13 vitamins that are known to be needed by humans. They fall into two groups, water-soluble and fat-soluble, based on how the body absorbs, transports, stores, and excretes the vitamin.

Water-Soluble Vitamins

In general, water-soluble vitamins are typically carried in the blood; are excreted in the urine; are needed in small, frequent doses; and are unlikely to reach toxic levels in the body. Since they are water soluble vitamins, they can be easily removed from foods by improper preparation, such as overcooking. A good supply of water-soluble vitamins is needed on a daily basis because the body does not store water-soluble vitamins, but rather excretes them in the urine when they are taken in excess of the body's needs. The water-soluble vitamins include vitamin C (ascorbic acid) and the B vitamins. The B vitamins include thiamin (B1); vitamin B6; riboflavin (B2); vitamin B12 (also called cobalamin); niacin; biotin; folic acid (folate); and pantothenic acid.

Food Sources and Major Functions of Key Vitamins

Functions and Importance of Vitamin C in the body

Vitamin C is also known as ascorbic acid or ascorbate. It helps the body resist infection and can also help increase iron absorption. Vitamin C supports production and maintenance of collagen, an important protein which holds the cells of the body together. Vitamin C helps wounds to heal, increases resistance to infection, support development of healthy gums and teeth and strengthens blood vessels.

Deficiency of Vitamin C

A severe vitamin C deficiency causes a disease known as scurvy. Symptoms include slow wound healing, poor appetite, slow growth, loose teeth, bleeding gums, bruises, and swollen painful joints.

Food Sources of Vitamin C

Numerous fruits and vegetables provide significant amounts of vitamin C; they include citrus fruits and juices (oranges, grapefruit), strawberries, papaya, mango, tomato, green pepper, broccoli, cabbage. Be aware that vitamin C is easily destroyed by things such as heat, light, and air. Therefore, the vitamin C content of a food varies depending on whether the food is eaten raw, steamed, or boiled; has been freshly harvested; or has been previously stored.

Tips for Including Vitamin C in the Diet: It is important to consume one vitamin C- rich food every day. Since vitamin C is easily destroyed, here are suggestions for getting the most vitamin C from foods:

1. When washing fresh produce, avoid soaking for a long time.
2. Steam vegetables or cook them in a small amount of water for a short time.

3. Cook potatoes in their skins.
4. When choosing fresh produce, choose items that look fresh and are not wilted.
5. Grow some of your own fruits and vegetables and consume them

B Vitamins
Functions and Importance of B Vitamin in the body
Thiamin (B1):
a) Aids in utilization of energy
b) Promotes normal appetite
Sources of Thiamin B1-Found in whole cereal grains, enriched breads and cereals, lean pork, and nuts

Riboflavin (B2):
a) Aids in utilization of energy
b) Promotes healthy skin, eyes, and clear vision
Sources of Riboflavin (B2)-Found in milk, yogurt, cottage cheese, eggs, liver, enriched bread and cereals

Niacin:
a) Aids in the utilization of energy
b) Promotes healthy skin, nerves, and digestive tract
c) Assists in digestion
d) Fosters normal appetite
Sources of Niacin- Found in liver, meat, poultry, fish, whole grains, fortified cereal products, eggs

Vitamin (B6):
a) Necessary for the metabolism of amino acids
b) Helps in the formation of hemoglobin (the red substance in blood that carries oxygen to and carbon dioxide from the cells)
Sources of Vitamin (B6)- Found in liver, meats, fish, eggs, whole grains, green leafy vegetables, bananas

Vitamin (B12):
a) Necessary for development of healthy red and white blood cells
b) Maintains healthy nervous system
Sources of Vitamin B12- Found in animal protein foods such as meats, fish, poultry, milk, & milk products

Folic Acid
Folic acid is also called folate or folacin. Folic acid is the synthetic form of the vitamin folate and is the form used in vitamin supplements and food fortification. Folate is the form of the vitamin naturally found in foods. Food folates may be destroyed by lengthy cooking and are not as well absorbed as synthetic folic acid. It is best to include raw vegetables in the diet. When cooking vegetables, try to limit cooking time to 5 or 10 minutes.

Functions and Importance of Folic acid in the body
The body uses folic acid to make new cells, including red blood cells, and is needed for protein synthesis and growth. Folic acid is especially important for women because it can help prevent a group of birth defects known as neural tube defects (NTDs). With this type of birth defect, the baby's brain, spinal cord, or both do not develop properly.

When a person does not get enough Folic acid, it increasing the risk of NTDs and its deficiency interferes with normal cell division, protein synthesis, and growth. Thus its deficiency can lead to megaloblastic anemia. In this type of anemia, which is different from iron-deficiency anemia, the blood cells are malformed and cannot carry enough oxygen.

Excess Folic acid is water-soluble, so the body can excrete the excess amounts.

Sources of Folic Acid (Folate)
Sources of folic acid include cooked dry beans and peas, Citrus and other fruits and their juices such as oranges, orange juice, pineapple juice. Folic acid is also found in Avocados, mangos, and papayas. Dark green leafy vegetables such as spinach and mustard greens. Liver also contains

Fat-Soluble Vitamins and Food Sources and Major Functions
Functions and Importance Fat-Soluble Vitamins in the body
The fat-soluble vitamins include vitamins A, D, E, and K. Vitamins A, C, and Folic Acid. Many people don't get enough of these key vitamins. Since they are crucial for growth and healthy tissues, they are especially significant for pregnant and breastfeeding women, infants, and children. In general, fat-soluble vitamins are stored in the liver and body fat.

Functions and Importance of Vitamin A in the body. The body needs vitamin A to resist infection and keep the eyes, skin, and internal organs moist. Vitamin A makes the moist surfaces inside the mouth, air passages and other mucous membranes more resistant to infection and keeps them healthy. Vitamin A also helps people to see in dim light, and is needed for proper bone growth, tooth development, and reproduction.

The body stores vitamin A in the liver and then transports it to various tissues when needed. Beta-carotene, which is the precursor of vitamin A found in plants, is also an effective antioxidant in the body. Retinol is also found in small amounts in fish, butter, and fortified margarine.

Sources of vitamin A in Animals
Vitamin A exists in animal foods such as eggs, liver, fish as retinol and is the form the body stores and uses vitamin A.

Sources of vitamin A in Plants (carotenoids)
Vitamin exist in plants as carotenoids in plant foods such as pawpaw, orange, dark green vegetables. The body converts the carotenoids in fruits and vegetables to retinol. Other food sources are

a. Bright orange vegetables like carrots, sweet potatoes, and pumpkin
b. Tomatoes and tomato products, red sweet pepper
c. Orange fruits like mango, apricots, and red or pink grapefruit
d. Leafy greens such as spinach and green leaf lettuce

Deficiency of Vitamin A
Vitamin A deficiency may cause eye changes such as inability to see in dim light, and even blindness. Vitamin A deficiency decreases resistance to infection, slows growth, affects tooth formation, and results in dry, scaly skin. In children, failure to grow is one of the first signs of vitamin A deficiency. When these children receive vitamin A supplements, they gain weight and grow taller. Children who receive adequate amounts of vitamin A are better able to survive infectious diseases.

Vitamin A Supplementation
In countries like Nigeria, where vitamin A deficiency is a public health problem, vitamin A supplementation is recommended in infants and children 6–59 months of age as a public health intervention to reduce child morbidity and mortality (strong recommendation).

Who needs the most?
Infants from 6 months of age till when they become 60 months or 5 years old are the ones who need it the most. This is because infants and children have increased vitamin A requirement to promote rapid growth and to help combat infections. Inadequate intakes of vitamin A at this age could lead to vitamin A deficiency, which, when severe, may cause visual impairment (night blindness) or increase the risk of illness and mortality from childhood infections such as measles and those causing diarrhea. The combination of childhood underweight, micronutrient deficiencies (iron, vitamin A and zinc) and suboptimal breastfeeding is responsible for 7% of deaths and 10% of the total disease burden.

In Nigeria, the delivery of vitamin A has been integrated through the Maternal, Newborn and Child Health (MNCH) Week for example, when vitamin A supplementation is combined with other child survival interventions such as deworming or nutrition education and sometimes into other routine health services.

Vitamin A supplementation Schedule and Dosages

Target group	Infants 6–11 months of age (including HIV+)	Children 12–59 months of age (including HIV+)
Dose	100 000 IU (30 mg RE) vitamin A	200 000 IU (60 mg RE) vitamin A
Frequency	Twice in a year with 4-6 months' interval	Twice in a year with 4-6 months' interval
Route of administration	Oral liquid, oil-based preparation of retinyl palmitate or retinyl acetate	Oral liquid, oil-based preparation of retinyl palmitate or retinyl acetate

Tips for Including Vitamin A in the Diet: One good strategy for including vitamin A in the diet is to snack on fresh fruits and vegetables throughout the day. Also, everyone should try to eat one or more fruits or vegetables that are good sources of vitamin A precursor on a daily basis. A good tip to pass along is that dark green, orange, and red fruits and vegetables are good choices, so it helps to prepare colorful meals.

Functions and Importance of Vitamin D in the body
Vitamin D helps maintain the proper levels of calcium and phosphorus in the blood, which results in healthy bone structure.

Sources of Vitamin D. Vitamin D is found in fortified milk, fish oils, and liver. Also note that the skin produces vitamin D when exposed to sunlight.

Who needs Vitamin D the most?
Adults who are over the age of 70 years require the vitamin most compared to any other group followed by pregnant and lactating women and young children.

Functions and Importance of Vitamin E in the body
Vitamin E is a fat soluble vitamin that acts as an antioxidant, helping to protect cells from the

damage caused by free radicals and thus preserve body cells. It helps to boost the body immune system so that it can fight off invading bacteria and viruses.

Sources of Vitamin E. Vitamin E is found in whole grains, almonds, hazel nuts vegetable oils, liver, nuts and spinach.

Who needs the Vitamin E the most?
Pregnant women, adults and adolescents have the greatest need of this vitamin.

Functions and Importance of Vitamin K in the body
Vitamin K helps to make various proteins that are needed for blood clotting and the building of bones and regulating blood calcium levels.

Sources of Vitamin K. The Vitamin is found in pork, liver, dark green leafy vegetables

Who needs the Vitamin K the most?
Adult men and young girls are the group most in need of the vitamin.

Minerals
Minerals are micronutrients. This means that they are needed only in small amounts by the body to maintain life and promote growth. While minerals make up only a very fraction of total body weight, they are necessary for life. They are single, inorganic elements that are widely distributed in nature.

Types of Minerals
Minerals are divided into two categories, based on how much the body needs. These categories are major minerals and trace minerals.

Some examples of the major minerals are calcium, magnesium, phosphorus, copper, iron, chloride and potassium. Some examples of trace minerals are manganese, fluoride, iodine, chromium, zinc, selenium, molybdenum and cobalt.

Functions of Minerals -Sodium, Zinc, Iron, Iodine and Calcium
The major function of minerals is in the maintenance of proper chemical balance for the functioning of the respiratory, circulatory, digestive, and nervous systems, and also to keep the right amount of fluid between each body cell and within each cell in the body. Each mineral has a specific function within the body.

Sodium plays a role in water balance and muscle action (transmission of nerve impulse and resulting contraction).

Zinc is involved in the transfer of carbon dioxide, taste process, and protein synthesis.

Iron plays a role in the formation of healthy red blood cells. Iron combines with protein to form hemoglobin, which is the red substance in the blood that carries oxygen to the cells and carbon dioxide away from the cells.

Iodine is part of the hormone thyroxin, which is important in energy metabolism. In iodine deficiency, the thyroid gland enlarges—a condition known as goiter. In a pregnant woman, severe iodine deficiency causes cretinism which is extreme and irreversible mental and physical retardation of the infant.

Calcium is important for the formation and maintenance of bones; but calcium's role goes beyond the skeleton. The bones are in a continuous state of change, i.e., they constantly take up calcium and then release it back into the blood. This action helps maintain a steady calcium supply in the bloodstream for functions such as forming teeth, blood clotting, muscle contraction and relaxation, heart action, and nerve transmission. As the body uses calcium, individuals need to replace it by eating more calcium-rich foods.

Iron

Functions and Importance of Iron. Iron is a trace mineral that the body needs for normal growth, to prevent infections, and to promote learning. Iron's main function is to help form hemoglobin, a protein in red blood cells. Specifically, iron carries oxygen within the hemoglobin. When the hemoglobin combines with oxygen, it turns red, giving blood its red color. Then hemoglobin travels to all of the body's cells, taking oxygen to the tissues for energy production. If a person does not get enough iron in his/her diet or if the body's iron stores get too low, the red blood cells cannot carry as much oxygen. Therefore, there is less oxygen going to the body's cells, so they cannot produce as much energy and the person feels tired, weak, and irritable—symptoms of iron-deficiency anemia.

Iron-Deficiency Anemia

Iron-deficiency anemia is a widespread health problem, especially among infants, growing children, and women in their childbearing years in Nigeria. The main causes are poor dietary intake, rapid growth, major blood loss, or a combination of these factors.

The symptoms of iron-deficiency anemia include difficulty in learning, slow growth, shorter attention span, poor appetite, problems breathing especially during exercise, lowered resistance to infection, pale skin and nails, and reduced ability to exercise. Consumption of vitamin C-rich foods along with foods containing iron increases iron absorption. On the other hand, tea and coffee all interfere with iron absorption

Sources of Iron

Iron is found in many foods and is present in foods in two different forms: heme and non-heme iron.

Heme iron: The iron found in animal sources. The body absorbs about 15 to 35 percent of heme iron and major sources of heme iron are fish. poultry, beef and pork.

Non-heme iron: The iron found in plant sources. The body only absorbs about 2 to 20 percent of non-heme iron and food sources are dry beans, baked potatoes dried fruit, and fortified cereals

Who needs it the most?

Iron needs are highest during periods of rapid growth. Thus infants, children, women in their childbearing years, breastfeeding women, and pregnant women are at increased risk for becoming iron deficient; thus there is a need to pay particular attention to these group of people, especially women. This is because women lose some amount of iron in their menstrual period. In Nigeria, anaemia is a major concern among women and over half (58%) of women age 15-49 have some degree of anaemia. As a result of its importance of iron to the health and general wellbeing of women, iron is given as supplements especially to pregnant women. The iron supplements act to boost the level of iron in the individual.

Water

Water is the most abundant nutrient in the body, making up about 60 percent of an adult's mass.

Water is the main component of body fluids and is contained in every cell of the body. Without water, a person can survive only a few days. In contrast, survival time is much longer when a person goes without one or more of the other nutrients. Water is not an energy nutrient; it provides no calories to the body.

Functions of Water

- Water is needed for almost all the life supporting functions such as digestion, and circulation.
- Water helps regulate body temperature. The body gets rid of excess heat by sweating. Evaporation of the water in sweat helps cool the body.
- Water lubricates cells and organs and acts as a cushion for joints. In the amniotic sac in the womb, water acts as a shock absorber for the unborn baby.
- Water is a cleansing agent; it carries waste products out of the body.
- Water transports nutrients and oxygen to the cells.

Milk and Milk Products

Another source of nutrients is milk and milk products. Milk product consumption has been associated with overall diet quality and adequacy of intake of many nutrients. The intake of milk products is especially important to bone health during childhood and adolescence

There are many fats free and low-fat choices without added sugars that are available and consistent with an overall healthy dietary plan.

Eggs: Health Benefits & Nutrition Facts

Eggs are an excellent source of high-quality protein, vitamin B12, phosphorus and riboflavin. They are also a good source of several minerals that can be hard to get in other foods, such as iodine and selenium. Every single B vitamin is found in eggs, as is a complete range of amino acids, making eggs a complete protein. For many years, eating of eggs was discouraged especially in adults because it was thought to increase the levels of cholesterol in the body. However, recent studies have shown that eating one egg per day was not associated with increased risk of heart attack or stroke among healthy people.

ASSIGNMENT FOR TRAINEES

The facilitator should ask the trainees to

1. Mention the nutrients and the major sources of carbohydrate, proteins, and fats in their states or locality.
2. The trainees should be asked to give examples of such foods in their local government that these nutrients can be found in.
3. How do the local people in the local government consume them? How do they treat such to preserve them?
4. Do the trainees understand why their children from 6 months of age till when they become 5 years old need to be fed high quality foods in their diet to support their rapid growth.? Which foods are common in the areas where these trainees are from?

Do the trainees understand why their pregnant and lactating women need extra foods and care?

MODULE TWO:
COMMON NUTRITION CONDITIONS

Learning Objectives: In this section, the facilitator would explain to the trainees the common nutrition conditions such as undernutrition: chronic and acute- specific to children in early years, overnutrition/obesity and some key micronutrient deficiencies like Iron, Vitamin A and.

Method of learning- Adult learning approach with a focus on participatory learning

Some Common Nutrition Conditions in Nigeria

Undernutrition in Nigeria is a long-standing problem which has persisted since the 1990s and whose magnitude is on the increase. In 2018 Nigeria's Demographic and Health Survey reports an improvement in rates of stunting from 58 in 2013 to 54 in 2018. The same report shows that 37% of children under age 5 are stunted (too short for their age) and 17% are severely stunted. Seven percent are wasted (too thin for their height), with 2% being severely wasted. Twenty-two percent of children are underweight (too thin for their age), and 7% are severely underweight. Only 2% of children are overweight. The prevalence of stunting increases from 19% among children less than 6 months to a peak of 47% among children age 24-35 months. This represents the impact of undernutrition in the first 1,000 days of life. Wasting, on the other hand, is more prevalent (15%) among children age 9-11 months.

Another report showed a similar pattern. That acute malnutrition levels have remained at alert levels of 5-9.9% over the years since 2014 with the prevalence of underweight among children aged 0-59 months was 19.9 percent just at the margin of the 20 percent threshold for serious situation that it has been since 2014, (even higher than the global estimate of 15 percent) and the prevalence of stunting at 32.0 percent with many states in the north west and north east recording prevalence above 40 percent- the WHO critical levels. Stunting indicates a long term nutritional problem in the country with serious and irreversible consequences.

However, as a country, Nigeria is facing a nutrition crisis on multiple fronts. One out of every three Nigerian children is stunted, and 7 percent of children are wasted. Sixty-eight percent of children had anaemia, with 27% having mild anaemia, 38% having moderate anaemia, and 3% having severe anaemia. Anaemia is a serious concern for children because it can impair cognitive development and is associated with long-term health and economic consequences. Severe anaemia leads to increased mortality.

Women's nutrition is of concern, with a double burden of thinness (12 percent) and obesity (28 percent). In general, undernutrition and health outcomes are worse in the North East and North West zones, compared to the Southern and Central zones; but Nigeria is a large, diverse country and the prevalence of undernutrition varies widely across, and even within states.

The nutrition situation is characterised by a double burden of malnutrition with about one third of the children under-five years stunted (more than half in the northwest) and a similar proportion of women overweight or obese. Each year about one million Nigerian children die before their 5th birthday. Malnutrition contributes to nearly half of these deaths.

Stunting
Stunting, an indicator of chronic malnutrition, refers to linear growth retardation and cumulative growth deficits in children. Stunting reflects failure to receive adequate nutrition over a long period of time. The most direct causes of stunting are inadequate nutrition (not eating enough or eating foods that lack growth-promoting nutrients) and recurrent infections or chronic diseases that cause poor nutrient intake and absorption.

For this reason, stunting – and especially stunting of children under five years of age – is a stronger indicator of hunger and endemic poverty than underweight. Children whose height-for-age Z-score (HAZ) is below minus two standard deviations (-2 SD) from the median of the WHO reference population are considered stunted or chronically malnourished. Children who are below minus three standard deviations (-3 SD) from the reference median are considered severely stunted.

There are wide variations by zone in the prevalence of stunting. The proportion of children who are stunted is highest in the North West (57%) and lowest in the South East (18%). By state, stunting is most prevalent in Kebbi (66%) and least prevalent in Anambra (14%). Although wasting and underweight are serious, the largest malnutrition burden for Sub-Saharan Africa is in fact stunting: About 37 percent of children are stunted in sub-Saharan Africa compared to a global prevalence of 25 percent. The WHO classification of malnutrition prevalence considers stunting serious (or high) if levels fall within 30 to 39.9 percent, and critical (or very high) if 40 percent and above

In developing countries, stunting follows an age pattern: prevalence rise quickly after about six months, peaks often about 24 months and slowly decreases after 36 months of age. Stunting, therefore, reflects failure to receive adequate nutrition over a long period of time and it is affected by recurrent and chronic illness. It represents the long-term effects of malnutrition in a population. Since the effects of stunting are not completely reversible and stunted children will grow up becoming small adults, chronic malnutrition has a lifelong impact on the individual, the community and the nation.

Underweight
Underweight refers to low weight-for-age, that is, a child is too thin for his/her age. It is defined in terms of standard deviation from median weight-for-age of the reference WHO population. Children whose weight-for-age is below minus two standard deviations (-2 SD) from the reference population median are classified as underweight, while children whose weight-for-age is below minus three standard deviations (-3 SD) from the reference median are considered severely underweight.

Underweight (weight for age) is a composite measure, which aggregates two different aspects of undernutrition, namely weight for height (or wasting, a measure of current nutritional status) and height for age (or stunting, a measure of long-run nutritional status). The underweight goal has served its purpose to focus attention on nutrition. Going forward we can improve on the original MDG target by using stunting as an indicator of nutrition status rather than underweight.

Wasting
Wasting, or low weight-for-height, is a measure of acute undernutrition and represents the failure to receive adequate nutrition in the period immediately before the survey. Wasting may result from inadequate food intake or from a recent episode of illness or infection causing weight loss.
The proportion of children who are wasted is approximately twice as high in the North East (10%) and North West (9%) as in the other zones (4%-6%).

Overweight
Overweight, or high weight-for-height, is a measure of overnutrition and results from an imbalance between energy consumed (too much) and energy expended (too little). Children that are above two standard deviations (+2 SD) from the reference median are considered overweight. Although globally most overweight children are in high-income countries, some low-income countries like Nigeria are starting to have a growing problem of overweight. Childhood overweight is also a strong risk factor for adult obesity and its consequences, which in turn has vast implications for the overall development of a nation.

Micronutrient deficiencies – (Deficiencies of Iron and Vitamin A)

Iron and Its Deficiency
Iron is essential for red blood cell formation and cognitive development, and low iron intake can contribute to anaemia. Anaemia is a condition that is marked by low levels of haemoglobin in the blood. Iron deficiency is a common cause of anaemia and is estimated to be responsible for half of all anaemia cases in women and children globally. **Iron requirements are greatest at age 6-23 months, when growth is extremely rapid.** Sixty-eight percent of children had anaemia, with 27% having mild anaemia, 38% having moderate anaemia, and 3% having severe anaemia. The symptoms of iron-deficiency anaemia include difficulty in learning, slow growth, shorter attention span, poor appetite, problems breathing especially during exercise, lowered resistance to infection, pale skin and nails, and reduced ability to exercise. Consumption of vitamin C-rich foods along with foods containing iron increases iron absorption.

Iron-deficiency anaemia is a widespread health problem, especially among infants, growing children, and women in their childbearing years in Nigeria. The main causes are poor dietary intake, rapid growth, major blood loss, or a combination of these factors.

Vitamin A and its Deficiency
Vitamin A supports the immune system and plays an important role in maintaining the epithelial tissue in the body. Severe vitamin A deficiency (VAD) can cause eye damage and is the leading cause of childhood blindness. VAD also increases the severity of infections such as measles and diarrheal disease and slows recovery from illness. The most recent report of the Nigeria Demographic Health Survey showed that among children age 6-59 months, the percentage of children age 6-23 months who consumed foods rich in vitamin A increased from 52% in 2013 to 59% in 2018. Also, there were increases in the percentage of children age 6-59 months who received vitamin A supplements (from 41% to 45%) and deworming medication (from 20% to 25%).

ASSIGNMENT FOR TRAINEES
The facilitator should ask the trainees to
1. Mention some common nutrition conditions in their local government councils.
2. The trainees should be asked to give examples of undernutrition
3. How do the local people in the local government councils from where the trainees come from react to these nutrition conditions?
4. Why young children and pregnant women should receive priority in consumption of the

MODULE THREE:
NUTRITION INTERVENTIONS AND LINKAGES

Section III: Nutrition interventions

1. Nutrition-Specific (with direct and high-impact on diets and nutrition outcomes)
2. Nutrition-Sensitive (addressing underlying factors like agriculture, food security, food systems)
3. Linkages across sectors: linking nutrition and agriculture systems.
4. Behaviour change and messaging

Learning Objectives: In this section, trainees would learn about the Nutrition-Specific (with direct and high-impact on diets and nutrition outcomes), Nutrition-Sensitive (addressing underlying factors like agriculture, food security, food systems) and the linkages between nutrition and agriculture and how to promote change using social and behaviour change communication messages and approaches

Method of learning- Adult learning approach with a focus on participatory learning

Addressing nutritional challenges requires a multi-sectoral approach as depicted in the figure 1 below.

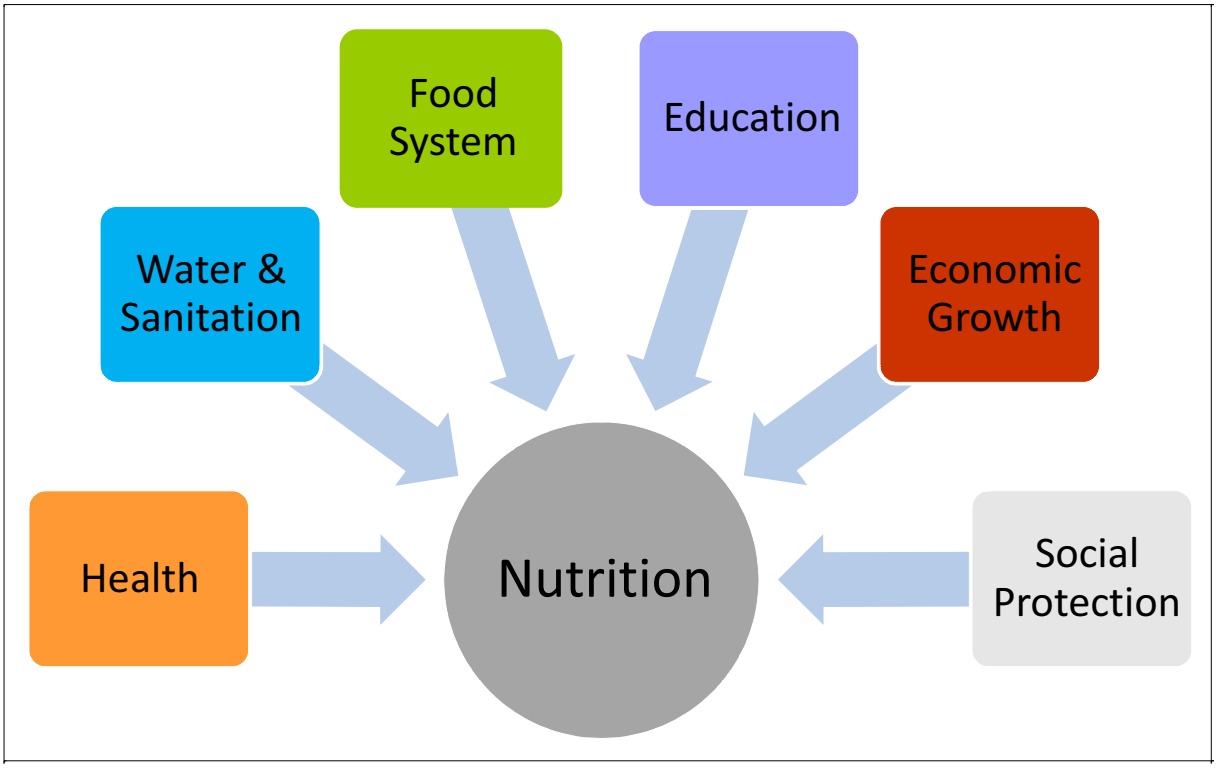

Figure 1: Multisectoral approach to addressing nutrition issues

Before we look at Nutrition -specific and Nutrition-sensitive interventions, it is important to understand the conceptual framework for the causation of malnutrition; this is depicted in figure 2

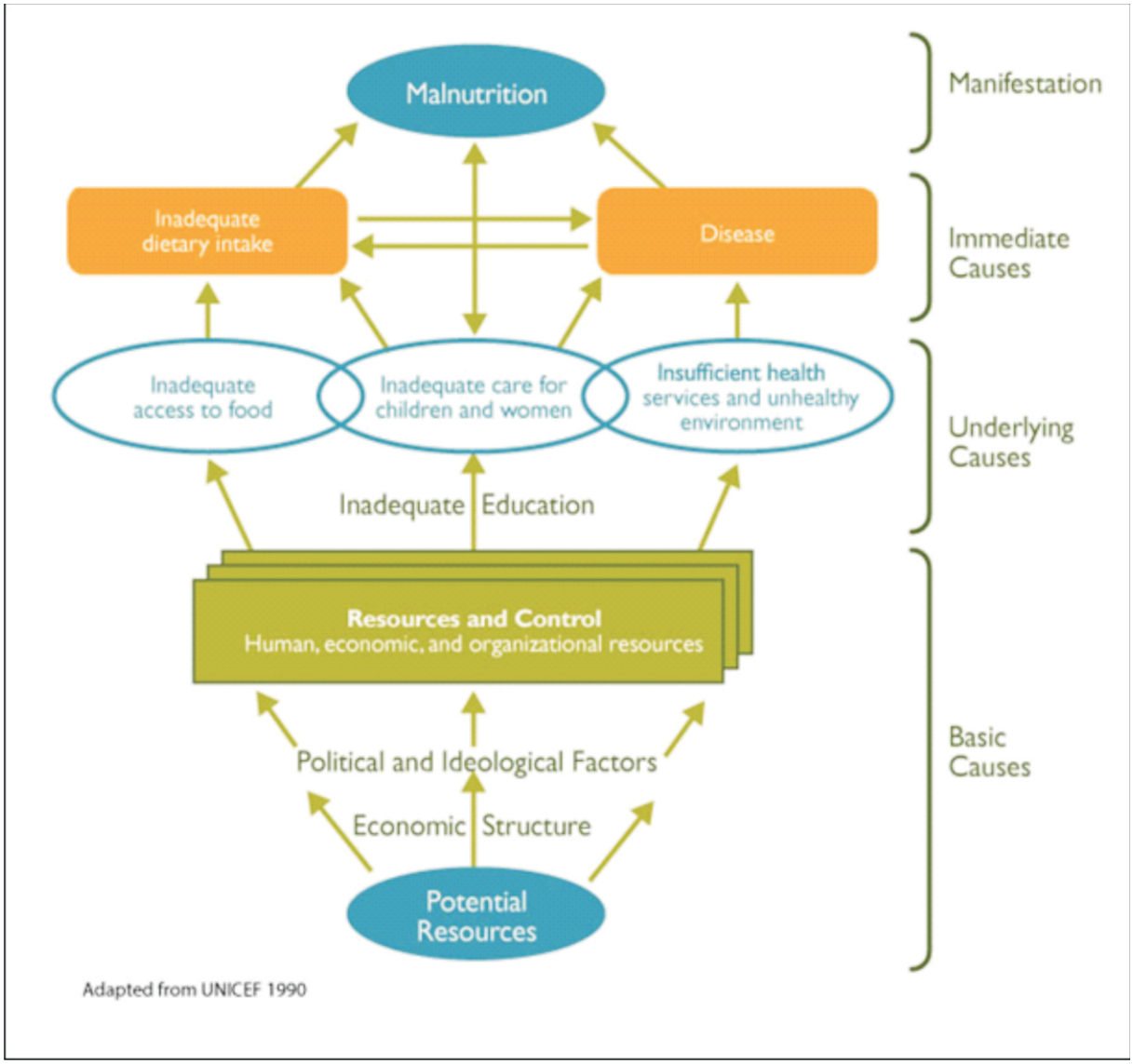

Figure 2: The conceptual framework for the causation of malnutrition

Nutrition-Specific Interventions

Nutrition specific interventions are those that address immediate causes of malnutrition. Examples include adolescent, preconception, and maternal health and nutrition; maternal dietary or micronutrient supplementation; promotion of optimum breastfeeding; complementary feeding and responsive feeding practices and stimulation; dietary supplementation; diversification and micronutrient supplementation or fortification for children; treatment of severe acute malnutrition; disease prevention and management; nutrition in emergencies, etc. The nutrition specific interventions from the Lancet and UNICEF lists are presented in table 1 along with the target populations for each intervention.

Table 1: Global Nutrition Specific Interventions

Intervention category	Global nutrition-specific interventions	Target	Remarks
Adolescent nutrition	Adolescent nutrition	Women of reproductive age	Adolescent health is considered as nutrition-sensitive in the UNICEF list
Food and micronutrient supplementation and fortification in women	Peri-conceptional folic acid supplementation	Women of reproductive age	Nutrition-specific in the Lancet and UNICEF lists
	Antenatal care interventions		
	• Antenatal iron and folic acid/ micronutrient supplementation during pregnancy	Pregnant women	Nutrition-specific in the Lancet and UNICEF lists
	• Balanced energy protein supplementation during pregnancy	Pregnant women	Balanced energy protein supplementation not included in the UNICEF list
	• Calcium supplementation during pregnancy	Pregnant women	Calcium supplementation is not included in the UNICEF list of interventions
	Iron and folic acid supplementation for non-pregnant women	Women of reproductive age	Nutrition-specific in the Lancet and UNICEF lists
	Iodine through salt iodization	Pregnant women; mothers of infants and young children; women of reproductive age	Nutrition-specific in the Lancet and UNICEF lists
	Staple food fortification	Pregnant women; mothers of infants and young children; women of reproductive age	Nutrition-specific in the Lancet and UNICEF lists
Maternal counselling	Nutrition counselling for improved dietary intake *during pregnancy*	Pregnant women	Nutrition-specific in the Lancet and UNICEF lists.
	Nutrition counselling for improved dietary intake during lactation *after delivery*	Mothers of infants and young children	Nutrition-specific in the Lancet and UNICEF lists.
	Counselling and nutrition advice to women of reproductive age and mothers	Mothers of infants and young children; women of reproductive age	Not included in the Lancet list

Interventions during delivery and the neonatal period	Delayed cord clamping	Mothers and neonates	Nutrition-specific in the Lancet and UNICEF lists
	Early initiation of breastfeeding (with one hour of birth)	Mothers and neonates	Nutrition-specific in the Lancet and UNICEF lists
	Kangaroo mother care for the promotion of early and exclusive breastfeeding and care of preterm and small for gestational age infants	Mothers and neonates	UNICEF considers Kangaroo mother care as nutrition sensitive.
	Neonatal Vitamin K	Neonates	Neonatal Vitamin K is not included in the UNICEF list
	Appropriate infant feeding practices and ARV for HIV-exposed infants	Mothers and neonates	Infant feeding practices and ARV for HIV-exposed infants not included in the Lancet list
Breastfeeding, complementary feeding, and dietary diversification	Breastfeeding promotion including exclusive breastfeeding for the first 6 months of life	Infants	Nutrition-specific in the Lancet and UNICEF lists
	Control of the marketing of breast milk substitutes	Infants and young children	Not explicitly mentioned in the Lancet list
	Appropriate complementary feeding promotion in children 6 to 24 months of age and continued breastfeeding	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists
	Public provision of complementary food	Infants and young children	Public provision of complementary feeding – not included in the UNICEF list
	Early stimulation	Infants and young children	Early stimulation included as nutrition sensitive in the UNICEF list
	Dietary diversification	Young children	Nutrition-specific in the Lancet list.
Micronutrient supplementation and fortification in infants and children	Iron supplementation for children 6 to 59 months	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists
	Vitamin A supplementation for children 6 to 59 months	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists
	Prophylactic zinc supplementation	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists
	Zinc supplementation with oral rehydration in the treatment of diarrhoea	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists

Management of SAM in children	Management of severe acute malnutrition	Infants and young children	Nutrition-specific in the Lancet and UNICEF lists
Management and prevention of disease	Antenatal care, including HIV testing and deworming for pregnant women	Pregnant women	Prevention and treatment of infectious disease - included as nutrition-sensitive in the UNICEF list.
	Prevention and treatment of infectious disease; deworming for children	Infants and young children	Prevention and treatment of infectious disease - included as nutrition-sensitive in the UNICEF list. De-worming is considered as an ineffective intervention in the Lancet
	Prevention and treatment and promotion of insecticide-treated bed nets for pregnant women in high-malaria areas	Pregnant women	Prevention and treatment of infectious disease - included as nutrition-sensitive in the UNICEF list
	Intermittent presumptive treatment of malaria in pregnancy in malaria-endemic regions	Pregnant women	Intermittent presumptive treatment of malaria not included in the UNICEF list
Nutrition interventions in emergencies	Intervention packages include the management of severe acute malnutrition, prevention, and health promotion strategies, such as breastfeeding and complementary feeding education and support.	Pregnant women; mothers of infants and young children; women of reproductive age; infant and children	Not included in the UNICEF list.

Nutrition-Sensitive Interventions

Nutrition-sensitive interventions address key underlying determinants of nutrition and enhance the coverage and effectiveness of nutrition-specific interventions. Nutrition-sensitive programs can serve as delivery platforms for nutrition-specific interventions, potentially increasing their scale, coverage, and effectiveness. Examples of nutrition sensitive interventions are agriculture and food security; social safety nets; early child development; maternal mental health; women's empowerment; child protection; schooling; water, sanitation, and hygiene; health and family planning services. Table 2 provides a comprehensive list of nutrition sensitive interventions.

Table 2. Nutrition sensitive interventions and target groups

Intervention category	Global nutrition-sensitive interventions	Target	Remarks
Food security, access, and availability	Improved availability, access and use of locally available foods	Pregnant women; mothers of infants and young children; women of reproductive age; infants and young children	Nutrition-sensitive in the Lancet and UNICEF lists. Broader interventions in agriculture and food security was mentioned (e.g., home garden, homestead production system)
Family planning	Access to modern family planning services	Pregnant women; mothers of infants and young children; women of reproductive age	In the UNICEF list, adolescent and family planning services are considered as nutrition sensitive. In the Lancet, family planning is considered as nutrition sensitive.
Social safety nets	Social safety nets (e.g., conditional and unconditional cash transfer, food, and in-kind transfer program)	Pregnant women; mothers of infants and young children; women of reproductive age; infants and young children	Community feeding program and other food transfer program are considered as a social safety net in the Lancet
	Provision of healthy foods in schools	Children	School feeding program and other food transfer program are considered as social safety net in the Lancet
	Maternity protection in the workplace	Pregnant women; mothers of infants and young children	Included in the UNICEF list, and mentioned in The Lancet
Women empowerment	Promotion of increased age at marriage and reduced gender discrimination and gender-based violence	No clear programmatic or policy action for women's empowerment or gender discrimination	Included in the UNICEF list, and mentioned in The Lancet
Early childhood development	Parenting and life skills for early childhood development	Mothers/caregivers of infants and young children; infants and young children	Nutrition-sensitive in the Lancet and UNICEF lists
	Early childhood development	Mothers/caregivers of infants and young children; infants and young children	Nutrition-sensitive in the Lancet and UNICEF lists
WASH	Promotion of handwashing with soap and improved water and sanitation practices	Mothers/caregivers of infants and young children; infants and young children	Nutrition-sensitive in the Lancet and UNICEF lists
Schooling	Increased access to primary and secondary education for girls	Women of reproductive age; children; adolescent girls	Nutrition-sensitive in the Lancet and UNICEF lists
	Early childhood education	Children	Nutrition-sensitive in the Lancet and UNICEF lists
	Nutrition and physical education in school	Children	Included in the UNICEF list, but not in the Lancet list
Maternal mental health	Maternal mental health	Pregnant women; mothers of infants and young children	Included in the Lancet list, but not included in the UNICEF list
Others	Support for birth registration and strengthening of civil registration systems	Neonates	Included in the UNICEF list, but not in the Lancet list

Nutrition sensitive agricultural interventions and programs.

The interventions designed to improve agriculture often focus on increasing the yield of the staple crops. But a much greater impact on nutrition can be achieved by shifting the focus to increasing the variety of nutrient-rich foods produced and consumed by smallholder farm families for the following reasons.

First, agriculture has the most direct influence and contact with most households where undernourished individuals reside. The beneficiaries of typical projects overlap with those most affected by undernutrition, the rural poor; therefore, any development activity reaching this population has enormous potential to influence factors that constrain human capital and well-being, of which nutrition is an essential part.

Second, agricultural-led growth is more pro-poor than non-agricultural-led growth; this increases agriculture's potential to improve nutrition. Agricultural growth is at least twice as effective in reducing poverty as GDP growth originating outside agriculture and is therefore pro-poor.

Third, agriculture is the best placed sector to affect food production and consumption of nutritious foods needed for healthy and active lives. Physical and economic access to adequate and affordable nutritious food is primarily a function of the agriculture sector, through support to increased production, improved post-harvest storage and processing including food safety issues, and reduced transport costs which can lower food prices for poor consumers. It is however important to note that agriculture does not directly influence consumer demand but can help make nutritious food available to consumers at prices they can afford.

Targeted agricultural programs can support livelihoods, enhance access to diverse diets in poor populations, and foster women's empowerment. The 8 conceptual pathways that can be leveraged by Agriculture to improve Nutrition are as follows:

1. Own productions to food consumption – the farming household can feed from their produce. Agriculture as a *source of food is the most direct pathway by which household agricultural production* translates into consumption through crops or livestock cultivated by the household.
2. Income to food purchase –Agriculture is a *source of income spent on purchasing diverse nutritious foods, either through wages* earned by agricultural workers or through the sale of agricultural goods.
3. Income to health care purchase – it can also serve as source of income spent on non-food items, particularly health either through wages earned by agricultural workers or through t h e sale of agricultural goods.
4. Food prices to food purchase – Agriculture affects food and non-food prices through supply and demand. When prices are low, it affects the income of the net sellers and the ability to ensure household food security including diet quality of net buyers. It also affects people's purchasing power. The key issue here is nutritious diet. Food means all diverse foods not just the food that can provide the most calories. Higher calories of a food do not mean that the food is more nutritious. Reducing prices of nutrient dense food has the potential for greater nutrition impact.
5. Women's time use to care capacity – Agriculture should provide time saving mechanism/technology so that women can have time to care for themselves and their family especially the children.
6. Women's workload to maternal energy use – women's workload and work- related energy expenditure has effect on child nutrition and health through the lifecycle, including pregnancy.

7. Women's control of income to resource allocation – women's control of household income and their ability to influence household decision making and household allocation of resources for food, health and care. When women do not have control over recurrent in the household, the household will suffer.
8. Health and environment – Agriculture can be a source of contaminants and diseases. For instance, diseases can be transmitted from animal to humans; pesticides and other chemicals can run off into water supply and contaminate drinking water; irrigation projects can increase the availability of standing water where malaria-carrying mosquitoes can breed; agriculture production can significantly affect food safety e.g. level of aflatoxins and other biological contaminants.

These pathways are considerably influenced by different factors such as the type of agriculture, market and consumer demands, inequalities in the system, tastes and preferences, and nutrition-relevant policies and programs. Therefore, the pathways from agriculture to nutrition are evolving and dynamic; and are not linearly associated. The areas of the conceptual framework that can be addressed through agriculture are shown in the figure 3.

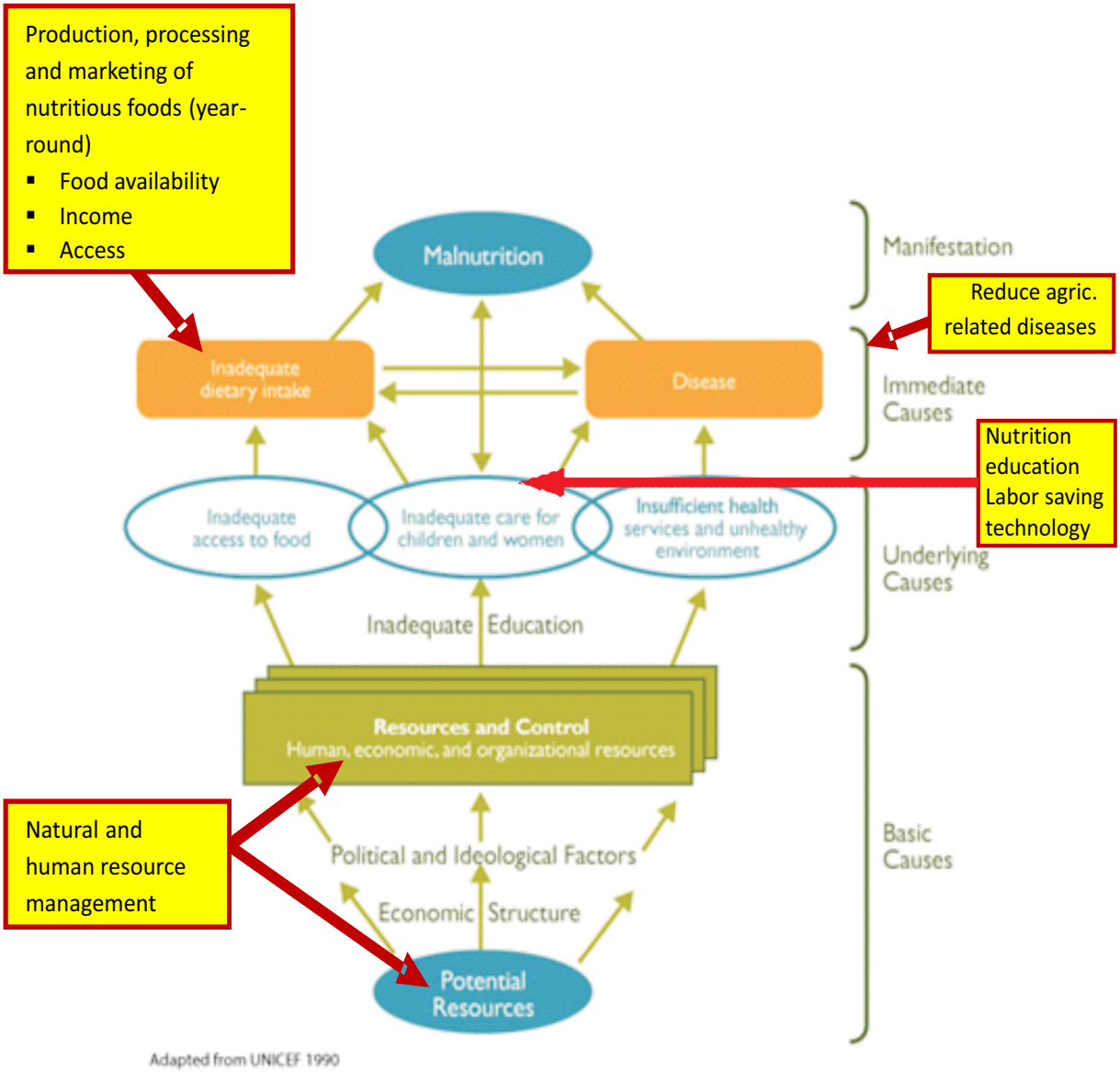

Figure 3. Conceptual pathways that can be leveraged by agriculture to improve nutrition

Biofortification

Biofortification is the process of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering. The biofortified crops currently being promoted in Nigeria are from conventional selective breeding processes.

Biofortification differs from fortification because it focuses on making plant foods more nutritious as the plants are growing. Examples in Nigeria include Pro-vitamin A maize (PVA maize), Yellow cassava, Orange Fleshed Sweet Potato (OFSP), etc. Such crops are useful in the prevention of micronutrient deficiencies.

Behaviour Change Communication

Behaviour change communication (BCC) applies targeted messages and tailored approaches to promote healthy behaviours. Some key BCC messages around nutrition that are relevant for project participants are as follows:

Maternal Nutrition

1. Pregnant women should eat a variety of locally available green vegetables and yellow or orange coloured vegetables and fruits every day; and milk, eggs and flesh foods several times a week.
2. Eating green vegetables, yellow or orange coloured vegetables and fruits, milk, eggs and flesh foods during pregnancy will ensure mother's good health and ensure that her baby grows healthy and strong.
3. The foods recommended above for pregnant women contain nutrients essential for growth and development of the foetus and mother's good health.

a. Green vegetables have iron (essential for making blood), vitamin A (essential for good night vision) and vitamin B (essential for making blood and providing energy)

b. Yellow vegetables and fruits have vitamin A, which provides resistance against illnesses such as pneumonia and diarrhoea

c. Milk contains protein, calcium and vitamins A and D. Eggs are rich in protein, fat and vitamins A, B and D. Flesh foods are a good source of protein, vitamin A, vitamin B, iron and zinc

d. Calcium and vitamin D are required for the development of bones and teeth in the foetus, protein is required for growth of the foetus and formation of blood, while zinc reduces severity of illnesses

Complementary Feeding

1. After six months, mothers should feed the baby with diverse foods like mashed fruits, green vegetables, milk products and eggs every day.
2. For babies 6-8 months: Along with continued breastfeeding, soft porridge enriched with mashed fruits, green vegetables, milk products, eggs and micronutrient powders at least 2-3 times a day ensures the baby grows healthy and strong
3. For babies 9-11 months: Along with continued breastfeeding, soft porridge enriched with mashed fruits, green vegetables, milk products, eggs and micronutrient powders at least 3-4 times a day ensures the baby grows healthy and strong
4. For children 12-24 months: Along with continued breastfeeding, soft porridge enriched with

mashed fruits, green vegetables, milk products, eggs and micronutrient powders at least 4-5 times a day, with 1-2 snacks ensures the child grows healthy and strong

5. There are several important reasons for introducing complementary foods in a baby's diet after 6 months of age. These are:

a. baby's growth is most rapid from 6–24 months.

b. Breastmilk can provide only half of the child's energy needs after 6 months.

c. The child's digestive system is developed enough to digest foods and fluids other than breastmilk.

d. Green vegetables have iron, vitamin A, vitamin B and milk products are rich in protein, vitamin A, D and calcium; Vitamin A prevents night blindness and infections like diarrhoea and pneumonia; Iron and vitamin B are needed for making blood; vitamin B is also a storehouse of energy; Vitamin D and calcium are needed for strong bones.

ASSIGNMENT FOR TRAINEES

The facilitator should ask the trainees to

1. Give examples of nutrition specific interventions in their local government councils.
2. Give examples of nutrition sensitive interventions in their local government councils
3. Describe the link between Agriculture and Nutrition.
4. What is behaviour change communication?

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Chapter Two

PROFITABLE GOAT PRODUCTION MANUAL

MODULE ONE

The objective of module 1 is to:

- Sensitize participants on the potential of goat as source of protein needed for human growth and development and goat rearing as a source of sustainable income to people.
- Stimulate the interest of participants in goat farming
- Introduce participants to different production systems in goat farming detailing importance of shelter and basics equipment and materials needed for a successful goat farm.

At the end of the session, participants should be able to:

- Know the nutrition potential of goat meat and milk in human nutrition
- Economic potential of rearing goats through creation of employment and sustainable income generation.
- Demonstrate the relative and comparative advantages of goat rearing
- Understand goat production systems, how to select a site for a goat farm and importance of shelter to goats.

1.0 INTRODUCTION

Goat is classified as small ruminants because of their size and nature of their digestive systems. They are the most widespread livestock species in the world with the existence of approximately 570 different breeds. Nigeria has about four local breeds.

Goats are the best adapted ruminants to highly anti-nutrifibrous low-protein forages, often in condition of poor water availability. They combine the advantage of being able to feed on variety of low-quality fodder and shrubs with short breeding intervals and high reproductive rates, high rate of investment returns and consequently low investment risks. These specific biological features and their small body size are important characteristics for integrating goats into pastoral and sedentary production systems. Goat are excellent user of marginal land and their docile nature enables herding by children and women. These qualities have contributed to the widespread of goat in different weather and climatic conditions of the world. Therefore, goat can be reared in any state of Nigeria because there are breeds that are adapted to each geopolitical zones of the country.

The rearing of goat is very popular in Nigeria. FAO (2014) estimates of Nigeria goat population is put at 60 million and are reared and owned mainly by small holder farmers, however, a number of commercial goat farms have been reported in the norther part of Nigeria. This might not be unconnected with the wide acceptance and popularity of goat meat in the country. Goats are reared mainly for meat (chevon) and to a lesser extent milk in the country. The initial investment for starting a goat farm is low and requirements such as housing and other management cost is less when compared to cattle.

In Nigeria, goats play a significant socio-economic role in the life of the people: they are slaughtered during ceremonies and festivals, and serve as a source of ready cash to small farmers. The skin of the Red Sokoto goat is well known for its superior quality and the high premium it commands in the world market.

The world population is expected to hit 9 billion in 2050, Nigeria population is expected to rise to 450 million within the same time. The implication of this is that, the need for food will rise from the present value. This will also lead to increase in the demand for protein of animal origin. The per-caput animal protein consumption for critical body requirement for an active and productive life recommended by the FAO is 35g/day. The animal protein consumption by average Nigerians per day is still below this FAO recommendation hence, issue of malnutrition is still a big problem in Nigeria today.

Goat can play an important role in meeting animal protein demand and contribute significantly to Nigeria meat requirement and help to address the problem of malnutrition in Nigeria. To be able to achieve this, there is need to improve on the management of goat rearing, make goat rearing a business and encourage more people into goat business. This manual is therefore designed to provide basic information on improved goat management systems for better productivity, improved nutrition among the farming household and sustainable livelihood.

1.1 CURRENT STATUS

Over the last fifty years goat population has multiplied by 2.4 times while other livestock species have maintained the same population or reduced.

Table 1. Evolution of world goat production between 1994 and 2014

S/N	Region	% Goat Production
1	Asia	60.1
2	Africa	33.1
3	America	4.3
4	Europe	2.2
5	Oceanic	0.4

Source: FAOSTAT, 2017

FAO, (2014), statistics on world goat meat production placed Nigeria as the 4th largest producer of goat meat producing 244,572MT and only coming after China, India and Pakistan in that order.

1.2 Benefits of Goat

1.2.1 Nutritional Benefit

Goat is reared mainly for meat and milk. Some nutritional benefits derivable from goat meat are as follows:

- Goat meat contain more arginine, leucine and isoleucine and is adequate in all essential amino acids.
- The meat has low levels of saturated fatty acids and thus poses no harm to heart health.
- Goat meat is leaner than both beef and chicken in terms of calories and fat.
- Many anti-inflammatory compounds are contained in goat meat and eating goat meat regularly may lower the risk of inflammation of blood vessels.
- Goat milk has higher amounts of conjugated linoleic acids that plays important role in immune system stimulation, growth promotion and disease prevention.
- Goat milk is high in vitamin A, and is highly digestible compared to cow milk.

1.2.2 Economic Benefits.

The rearing of goat is a potential source of employment in the country; therefore, it is a source of sustainable income and means of livelihood to many.

Goat is a potential foreign exchange earner for the country. The skin of Sokoto red goat commands a very high value and is in high demand in Europe. NEPC (2016) reported that Nigeria exported 3,599.26MT leather products worth $145,269,547.62

1.3 PRODUCTION SYSTEMS

Goat production systems include:

1.3.1 Intensive System

In an intensive system of production,

- The goats are continuously kept under closed confinement with provision of adequate shelter and the animals are stall fed.
- The goats are not left to fend for themselves with only minimum care; hence there is high energy efficiency but increased sensitivity to disease.
- The requirement for labour and cash input are high.
- There is the advantage of close supervision and control over the animals.
- The dung is collected in one place and used as a good fertilizer.
- A small space is sufficient for a large number of animals.

1.3.2 Semi-Intensive System

6 This system of goat production is an intermediate between extensive and intensive system; the goats are allowed limited grazing.

7 It involves extensive management but usually with controlled grazing of fenced pasture.

8 It consists of provision of stall feeding, shelter at night under shed and 3 to 5-hour daily grazing and browsing on pasture and range.

This system has the advantage of

- Meeting the nutrient requirement both from grazing and stall feeding.
- Managing medium to large flock of 50 to 350 heads and above.
- Utilizing cultivated forage during lean period.

1.3.3 Extensive System

- The system involves the grazing of goats in the entire pasture and leaving them there for the whole season.
- It involves use of marginal land and has great ability for adaptation.
- Characterised by low productivity.
- There is high risk of parasitic infections
- Cost of feed is highly reduced.
- Some form of housing is provided at night.

1.4 SELECTION OF SITE

In selecting a site for the establishment of goat farm, the following must be taken into consideration:

- Site shall be dry, well drained and not subject to flooding.
- Site must be suitable for pasture establishment.
- The site must be carefully chosen to minimize operational and constructional costs.
- There must be easy access to nearest market or town.
- It must be well separated from potential fire hazard.
- As a general guide, the minimum distance between goat facilities and a public/private water supply source, either surface or ground, shall be 60m. In vulnerable situations this distance shall be increased up to 300m.

1.5 SHELTER

Goats like shelter and will make good use of natural shelters such as trees and shrubs. The type of shelter needed is affected by the weather, climate, predators and management systems. Goats do not tolerate wetness, because it can lead to pneumonia and parasitic infection. Health problems can also occur from heat stress which can also affect the reproductive performance especially of the buck (male goat).

1.5.1Housing

Goats requires some form of shelter to be able to do well. Provision of adequate housing will preserve goats from diseases, provide safety from predators and facilitate better management. The type of housing required will reflect the complexity of the management systems. Low-cost extensive systems will have rudimentary housing such as night shelters for flocks that are grazed in the day but returned to the village at night. This system will provide protection against the weather and predators.

Housing should be well ventilated, lighted, well drained and easily cleaned. Factors to consider in providing goat housing:

1. A well-drained site should be selected
2. The floor which is commonly of rammed earth must be kept dry and should drain well. A raised floor made of wood slats is an alternative (Fig.2). The slats must be narrow enough to avoid younger goat getting their hoofs trapped. Concrete floor can also be used, although expensive but the floor should be insulated especially in cold period.
3. The goat house must be built in a way it allows for easy cleaning to prevent build-up of dung parasites.
4. Use of local material should be encouraged in building to cut cost e.g. mud, grasses for roofing, bamboo, wood etc.; the roof must be waterproof. Timbers used must be free of toxic substances and sharp edges such as nails must not be exposed to avoid injury to animals.
5. The sheds should be constructed in an elevated area to prevent water stagnation.
6. Fodder trees can be grown around the shed, as a source of feed for the growing goats.
7. Walls of the shed should be free from cracks or hole.
8. Types of sheds depend on the system of rearing; open type housing with a covered area and run space is generally enough.
9. For a comfortable house, east-west orientation with generous provision for ventilation and air movement to dry the floor will be ideal.
10. Thatched roof is best suited because of cheaper cost and durability; however corrugated asbestos sheets can be used for organized farms to minimize the recurring costs of changing the thatch and durability.
11. For small sheds lean to type roofing is advisable.
12. House can be in form of a movable ark that can be moved from one place to another.
13. When the animals are taken for grazing during the day time and sheltered only during night, a covered space will be enough.
14. When the animals are housed intensively, the pen and run system of housing is suitable.
15. There is no restriction to the length of the shelter, however breadth of shed should not exceed 12 meter and optimum breadth of shelter is 8 meters.
16. Height of eaves should be 2.5 meter and height at ridge should be 3.5 meter.
17. The height of chain link used for open space should be 4 feet. The length of the overhang should be 75cm – 1 meter.
18. Separate feeders and water troughs should be placed for concentrate feeds, green fodder and water.

1.5.2 House Layout and Size

House must be large enough to accommodate all animals and overcrowding must be avoided.

Table II. Floor Space Requirements for Goat.

Types	Space per animal (Square metre)-Covered space	Space per animal (Square metre)-Open space
Kid (up to 3months)	0.3	0.5
Kid (3-6months)	0.5	1.0
Non-Pregnant Doe (Nanny)	1.5	3.0
Pregnant Doe (Nanny)	1.9	3.5
Buck	2.8	4.0

The floor space needed for a flock of two doe(male), ten pregnant females and twelve kids in a covered space is worked out below:

2males 2 x 2.8 = 5.6
10 Females 10 x 1.9 = 19.0
12 Kids 12 x 0.3 = 3.6

28.2Sq.m

28.2 square metre is provided by a house with dimension 5m x 6m using the size for pregnant females.

Houses with slating eaves are very practical in weather conditions like Nigeria. Long overhanging eaves stop the rain from blowing into the house

Houses with raised floor (Fig.) or on slits (Fig.) provide for good ventilation and the dung and urine drops through the slated floor. This make for easy collection of dungs from under the house.

1.5.3 Goat House Designs.

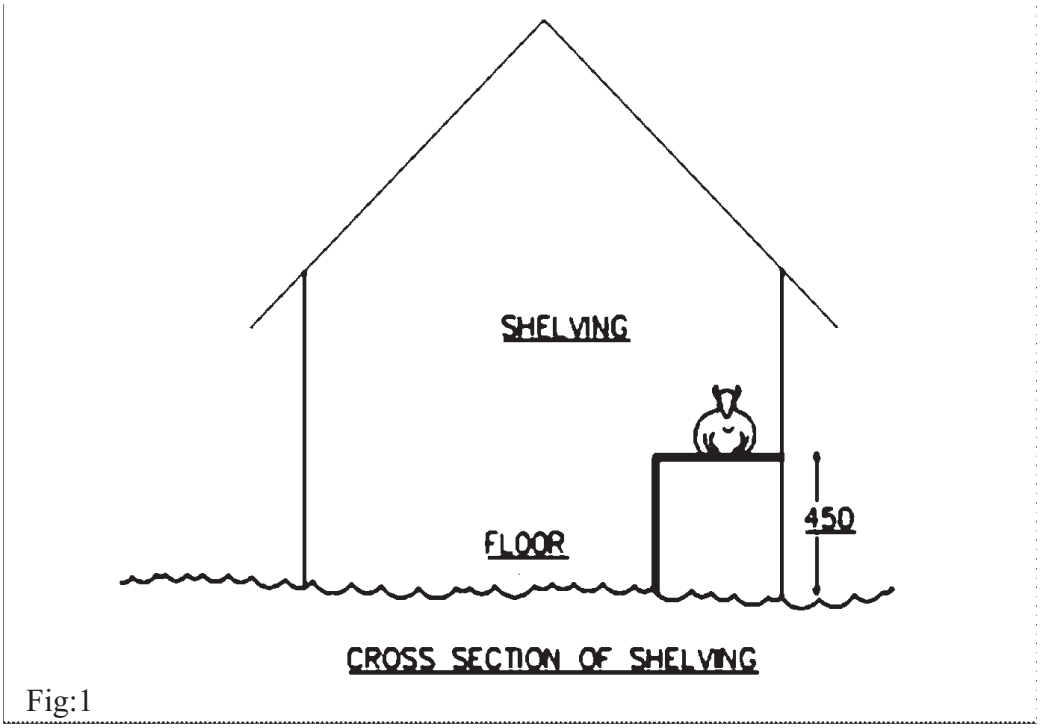

Fig:1

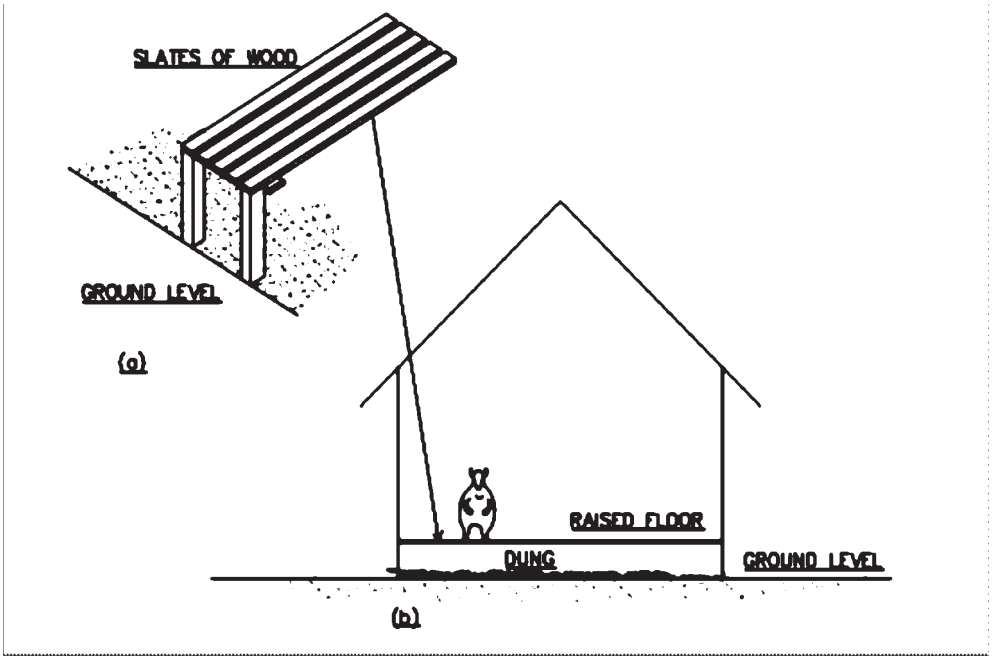

Fig:2. House showing a slated raised floor made of wood (Bamboo could be use in place of wood where it is available)

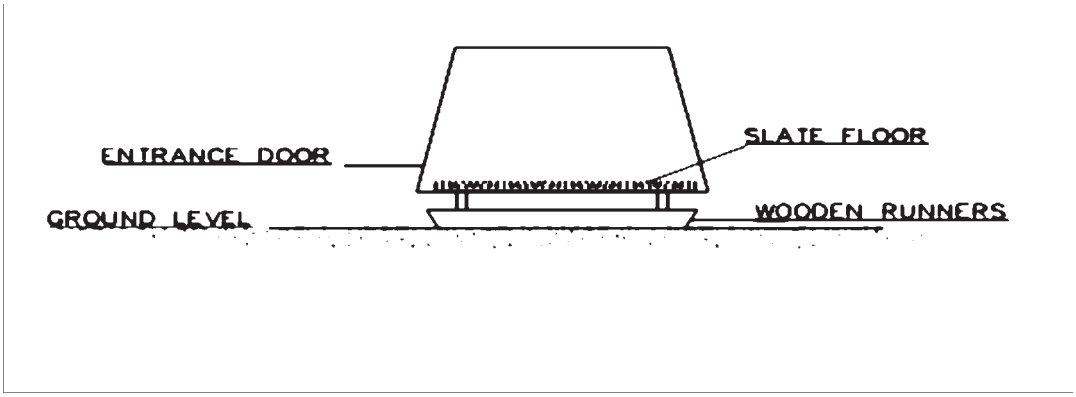

Fig. 3. Side view of a moveable ark.

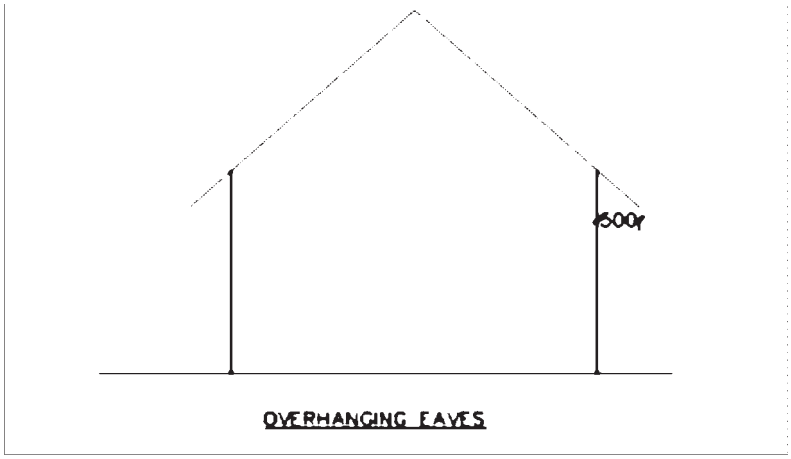

Fig. 4. Showing over hanging eaves

Key Messages to the Households.

- Nutrition and economic benefits of rearing goat
- Factors for selecting a suitable site for goat farm and materials for housing
- Equipment required in goat rearing
- Readiness to start a goat farm

1.Kid Pen

2.House showing roof and partition

3.Elevated house with slated floor

4. West African Dwarf goat

Goat Breeds

5.Sokoto Red

6. Boer goat

MODULE TWO

The objective of this section is to:

- Introduce participants to breeds and breeding of goats
- Explain husbandry practices involved in goat breeding
- Show the importance of breeding to profitable and sustainable goat farming
- Help participants to understand what is involved in goat nutrition

At the end of this section participants must be able to:

1 Identify goat breeds
2 Know the importance of breeding and how selection for breeding stock is done, the significance of right mating process to profitable goat rearing
3 Know how to manage female (Does) and male (Bucks) goats.
4 Understand the place of nutrition in goat rearing, fodder crops, importance and identification of fodder crops.

2.0 BREEDS OF GOAT

A breed is a specific group of domestic animals having homogeneous appearance, homogeneous behaviour, and/or other characteristics that distinguish it from other animal of the same species. Two classes of breeds shall be discussed under this heading namely, Nigeria Local breeds and the Exotic breeds

2.1 Local Breeds

Four types of breeds are common. The breeds and their characteristics are discussed below.

2.1.1 Red Sokoto or Maradi

- Found in north-west Nigeria
- Has spread to savannah region
- Uniformly dark red in colour
- Mature weight 20-30kg
- Noted for its valuable skin
- Both sexes are horned

2.1.2 Kano brown goats

i. The Kano Brown goat are among the few breeds in Nigeria that are not well defined.
ii. They are characterized by their uniform light brown coat colour with short and horizontal ears.
iii. Both sexes have horns. The yearling weighs between 10 and 16 kg.
iv. The breed is most typically raised by the Hausa peoples of Kano State, Nigeria.

2.1.3 Sahelian Goat

- Found in the semi-desert area of lake chad, in North East of Nigeria
- Varying coat colours usually black, white and brown
- Short ears and long legs
- Mature weight 25-35kg
- Adapted to nomadic and wide range grazing
- They are meat animal but could be used for milk & skin

2.1.4 West African Dwarf Goat

- Found in the forest belt of Nigeria
- Hardy and trypano-resistant
- Small body size and short legs
- Brown, Black or white or combination of the three colours
- Mature weight -20-25kg
- Highly prolific
- Bred for meat, has dairy potential

2.2 Exotic Breed

2.2.1 Boer Goat

- Developed and improved in South Africa
- Have large pendulous ears
- High fertility
- Fast growth rate
- Excellent carcase quality
- Mature weight-87-105kg
- Boer buck weight between 87-155kg

2.3 Management of Does (Female Goat)

Doe is the female goat. Good nutrition is key to growth and development of the animal and helps the animal to be ready for mating. Nutrition also have effect on fertility of the animal and the size of the litter. Young females should be mated from the age of 7-8 months.

The gestation period for goat is between 144-155 days (five months). Female can only receive male only when they are on heat.

Heat period is the period in which the doe will stand and allow the buck to bred her (i.e. allow the buck to mate with her). The heat period lasts for 2-3 days.
Some signs of heat to look for are highlighted below:

1. Flagging of the tail
2. Red coloured vulva
3. Restlessness
4. Frequent urination
5. Mounting other animals
6. Continuous bleating
7. Cervical mucous discharge
8. Seeking males.

Pregnant does must be separated from the flock about two months before kidding. In an intensive system they should be raised in the kidding pen where they can receive more care and attention.

2.4 Management of Bucks (Male)

Bucks should be kept in good condition and fed properly. Male goats come to maturity earlier than the females. The right husbandry practice is to separate the male from the females and raise them separately to prevent unplanned mating.

Bucks can be selected at early stage. A male kid with birth weight of 2.5kg and above could be selected for future breeding. Young bucks could be bred at 4-8 months.
Bucks not suitable for breeding must be culled or castrated.

2.5 BREEDING.

Two breeding systems; Crossbreeding and Pure breeding will be discussed

2.5.1 Crossbreeding involves the mating of different breeds to combine characteristics found in the different breeds to make use of the hybrid vigour. In simple terms this means the offspring perform better than the parents.

2.5.2 Pure Breeding involves the mating of a purebred female with a purebred male to maintain the desired trait (colour, meat and milk qualities) of that breed

2.5.3 Breeding objective: This refers to decisions as to which traits the livestock keeper wants to improve, maintain or introduce in the flock. This is achieved through selection. Such traits may include for meat, milk production or fertility.

2.6 Selection of Breeding Stock

Selection is a process of choosing the animal with desired trait/characteristics to be the parent of the next generation for a certain period.

2.6.1 Selection Criteria

- Appearance
  - Buck- standard buck vocalisation, large scrotum circumference
  -Doe -Large body capacity and volume, well-structured udder
- Performance Records- rearing ability, growth rate, vigour, good milk production, skin quality

Others

- Select animals that are alert
- Sound feet free from rot
- Does with good udder
- Good mothering ability

2.7 Mating

Mating can take any of these methods depending on the type of management

1 **Flock or pasture mating** (1 buck to 20 Does))-In this system males are allowed to run along with the females throughout the day and night for about 6-8weeks. The buck may lose most of its body reserve in chasing the doe and may even lose their body condition. The method is simple, cheap and goat can kid at anytime but there is high risk of inbreeding and spread of disease

2 **Individual or pen mating:** This is possible under intensive system where the male is introduced to the female in the pen. This system is good and you can be sure your animal is mated. It also encourages the maintenance of genetic base and production of high-quality k i d s . Lack of record and technical skill is a limitation to this method

3 **Synchronised artificial insemination methods:** Animals are synchronised to come on heat at the same time and are serviced at the same time. Mostly used for breed improvement. The technical and competent personnel should be approached for this.

Note

10 Select animals for breeding 3 month after weaning
11 Separate sexes at age of 4 months
12 Animals can be bred all year round depending on the type of management system
13 Doe can join breeding flock at 9 months old

2.7.1 Mating Ratio: A male goat should run with female for 36-42 days. This gives the female that misses the chance to be pregnant a second chance within the period

Ratio: Male buck to 40-50 females

Young male to 25-30 females

When to mate: A doe should be mated 12 to 24hrs after you have seen her on heat

- Heat signs in the afternoon, the goat should be mated the next morning
- Heat sign in the morning, should be mated in the evening

How to identify your goat is pregnant

- 3weeks after mating, the doe will not be on heat, so no heat signs.
- 8 weeks later the vulva shows an enlargement.
- 12 weeks after, the abdomen is enlarged noticeably.

2.8 Kid Management

Kids should be given the best of care to reduce mortality (death) and ensure good growth. The farmer should understand that the more kids he has, the more animals that will be available for sale at maturity and so the income.

Kidding Season

Farmer should plan their breeding programme so that kidding will fall into the period of abundant feed resource. This will ensure enough feed for the doe to be able to produce milk and enable the kid to develop before the coming of harsh weather. Kidding should fall between December and February

2.8.1 Kid Rearing

Preparation for kidding

There are three very important rules for kidding/lambing:

- **Rule 1:** Ensure the kidding doe is put in a dry clean and quiet place at the time of kidding.
- **Rule 2:** The kidding place should be under a shelter (in the house) or shade.This is to protect the kid from too much sun
- **Rule 3:** The doe must have water as soon as she has given birth so she can make sure she has enough to balance the loss of water from giving birth and to have enough milk to feed the newborn.

Animals ready to deliver are to be kept where you can see what is happening easily and often.

At Birth

- Farmer or farm attendant must be present at the time of kidding
- Does must be allowed to clean their kid and groom them; they should be left undisturbed for 2-4 hours to allow for bonding of the kid with the mother

Offer assistance when:

- There is difficulty in kidding
- Kid is in difficult condition when it cannot bleat or breath because the doe failed to clean it. The membrane covering the nostril should be removed
- Cut the navel and treat with disinfectants such as tincture of iodine

2.8.2 Kid Feeding.

The kid should suckle the first milk in the first 30-40 minutes after birth. This is important because colostrum; the first milk is rich in antibodies needed by the kid to build immunity. In a situation the mother cannot produce enough milk or is unable to feed the kid, fostering (adoption

of a female that has kidded about the same time) or bottle feeding is advised.

From the age of 3weeks the kid should be allowed to nibble grass and leaves for the development of its rumen at the age of one month, the kid should be allowed to browse while effective browsing starts from 6-7weeks

2.9 Weaning

This is the act of removing the kids from the mother. This is done when the kids are 12-16 weeks for male and 16-18 weeks for female or has attained a weight of between 8-12 kg. Ensure all vaccination is completed before weaning and the animal should be removed completely from the mother.

2.10 Culling

Culling is selective removal of animal from the breeding stock. It is a method used to improve the overall productivity of the flock.
Reasons for culling

- Unproductive animals
- Genetic defect or predisposition to disease
- Physical problems
- Disease
- Old age, thinness, inability to eat well.

2.11 Identification

Identification is an important management practice in goat husbandry. This helps the farmer to effectively keep performance records of individual goat and monitor their development. Two identification methods; ear tagging or ear notching are discussed here.

2.11.1 Ear Tagging

This involves the use ear tags containing numbers that is logically used such that each number represent a factor, for example, year of birth, sex, and order of birth. For example: If an animal is born in 2020, female and its kid number is 23 in the flock, it can have the number 20223 meaning that 20 is the year of birth, 2 for female and 23 for the order of birth.

This method is simple and tags can be made of metals or plastics. The limitation of this method is that the tag can tear off the ear of the animal and where the stock is large, identification is lost. To avoid this, it is advised that tags should be placed on both ears.

2.11.2 Ear Notching

Ear notching involves making a V-shaped notching of this ear of the animal. The position of the V-shaped stand for certain numbers.

The demerit of this method is that it cannot be unique for one farmer especially where there is communal grazing and that farmer will have to hold the animal before reading the number.
In ear notching the right ear represents tens while the left ear represents units.

NOTE: The trainer should stress that the issue of identification should be handled by a professional from whom the farmer can gradually learn the act.

2.13 NUTRITION

Goats are natural browsers, preferring to eat leaves, twigs, vines and shrubs. They are very agile and will stand on their legs to reach vegetation up to 20-120 cm high.

2.13.1 Nutritional requirement

Goats require balanced ration comprising of energy, protein, vitamins, mineral, fibre and water. Daily feed requirement of goat is 3-5% of its body weight.

Table III. Nutrients and their Sources

S/N	NUTRIENT	SOURCE
1	Protein	Leguminous plants, poultry litter, cotton seed cake, palm kernel cake,
2	Carbohydrates	Cereals (maize, sorghum, Millet, Guinea corn), molases, cassava chips.
3	Vitamins	Vegetable, Green forage
4	Minerals	Agro-industrial waste, limestone, salt lick
5	Fibre	Crop residues, hay.

Best feeding practices

- Give feed that is clean and devoid of mould, excessive dust/dirt
- Ensure clean water is provided always
- Clean the feeding tough and the water bucket everyday
- Provide mineral lick(block)
- Promote diverse diets such as grasses and legumes
- Where Leucaena is used, it should not be more than 1/3 of the total feed
- For confined animals, feed 2 to 3 times daily and maintain the time of feeding
- Give attention to weak animals

2.13.2 Feeding bucks- As with any healthy matured animal, the amount and quality of feed should sufficiently meet the animal's daily requirements. For breeding males, it is best if they maintain a steady weight but do not become too fat/heavy. Below are the recommended best practices for feeding breeding bucks:

1 Give more feed two months before the buck has to serve the does this will improve the buck's sperm and make it more active.

2 When a buck is being used a lot to serve does, it should be separated from other goats for about 2-3 hours per day. This will allow it time to eat and rest.

3 Because of their increased activity, breeding males should be offered increased amounts of clean water throughout the day/night.

4 Breeding males should have access to mineral lick or loose minerals at any time; this will help maintain balanced electrolyte levels.

2.13.3 ***Feeding breeding does*** Below are feeding best practices specifically for breeding does. • One month before mating the doe should be fed and watered very well so that she is in the best of health. If she is very well, she is more likely to have twins or even triplets

- Concentrates should be fed to does just before the does are served by the buck.
- Increase feed gradually from 2 months of pregnancy up until the doe gives birth.
- Continue feeding concentrate while she is giving milk to the kids.
- Mineral licks hasten coming on heat.
- Always have fresh water for goats to drink at any time.

2.13.4 Feeding during pregnancy- The nutritional needs of pregnant females changes throughout the pregnancy. Below are some general guidelines for feeding pregnant does over length of the pregnancy.

The last two months of pregnancy

1. Late gestation (last 4 to 6 weeks) is a critical period for doe reproduction. This is when the majority of fetal growth is occurring, placing increasing nutritional demands on the doe.
2. Does consuming inadequate diets are prone to pregnancy toxemia and milk fever.
3. Nutrition in late-pregnancy affects the size and vigor of kids and the milk producing ability of the doe.

During first 2 months after Kids birth when doe is giving milk

- The goat must be well fed for milk production and maintenance of bodyweight.
- Mothers can be supplemented with at least 200 gm/day of concentrate. Make this addition gradually so as not to disrupt her gastro-intestinal system. Reduce added concentrate to 100gm/day after the 3rd month

2.13.5 Feeding kids

Feeding the newborn up till 3 months

- Newborn kids should suck colostrum within 24 hours and more importantly the first 30-40 minutes. In the first 24-48 hours after being born, it is best to leave the newborn with the mother, but with some supervision, to make sure the newborn is able to nurse and receive colostrum.
- At one week, kids should be provided with small quantities of good clean feed e. g. sweet potato vines, tree legumes leaves or natural tree leaves
- Kids should continue with milk for the first three weeks
- Kids should be allowed milk with fresh mixed fodder up to 3-4 weeks

2.13.6 Feeding young stock

1 Should be fed on fresh, highly nutritious mixed fodder
2 Give lots of water at all times
3. Mineral blocks must be given at this stage

Key Messages to the Households.

- Identify types of breeds and breeds that are suitable for the climatic condition of their areas.
- Steps in goat breeding
- How to manage male(buck) and female (doe) goat
- Care during kidding period (during birth) and kids care
- Local feed material for feeds
- Best feeding practices.

MODULE THREE

This section is designed to achieve the following objectives:

- Introduce participants to fodder cultivation and conservation
- Health management system in a goat herd
- Record keeping
- Biosecurity measures

At the end of the session, participants should be able to:

- the importance of fodder cultivation and conservation, be able to identify some fodder crops with the trainer showing examples
- Understand fodder conservation methods – silage and hay making
- Identify a diseased animal and be able to seek help
- Know different biosecurity measures
- Record keeping, types of records and how good record can help in profitable goat production.

3.1 Fodder Production and Conservation.

Feed resource is always difficult to come by during the dry season and so farmer must properly plan to produce fodder crops for supplementary feeding. Fodder crops are crops grown for livestock feeding. They can be fed while still fresh or preserved. Examples include; **grasses:** cereals, napier grass or elephant grass, bana grass. **Legumes:** cowpea, velvet beans and **Forage tree:** Leucaena, Acacia, gliricidia sepium

3.1.1 Fodder conservation

Reasons for conserving fodder are:

- To ensure all year-round supply of good quality feed for livestock.
- To maintain production and fertility in livestock.
- Maintain good body condition and prevent deaths.
- To minimize stress to animals through food search.

3.1.2 Conservation methods

The two major fodder conservation methods are -silage and hay making.
Preservation of crop residues is also a common practice in the smallholder sector.

3.1.2.3 Silage Making

Silage is material produced by the controlled fermentation of green succulent crop material with a high water and sugar content in a sealed container called silo. A silo can be:

- a pit covered with plastic
- a drum
- a plastic bag.

The silo has to be sealed completely and the contents should be chopped and well packed together so that all air is driven out and therefore fodder inside will ferment.

- Bacteria convert some of the sugars in the plant into pleasant tasting lactic acid which prevents spoilage bacteria or moulds from making the fodder to rot.
- Wrongly fermented fodder rots, is unpalatable and toxic.
- Properly ensiled fodder has energy and protein in it.

3.1.2.3.1 The Plastic Bag Method

- Every year before ensiling begins, the room should be checked.
- 15kg plastic bags are usually used and these should be clean.
- Chop clean material (with no soil) to 15-20mm
- Seal the material completely in the bags so that all the acid is retained.
- Store in a dry place at room temperature, safe from rodents.

The silage should be ready after 3 weeks.
The whole bag can be fed completely once opened which reduces chances of spoilage to the remaining fodder. Bags are easily stored and portable. It also reduces the workload in comparison with the pit method.

Storage after preparation

It is important to store bags of silage in a room safe from rodents and ants.
Empty bags must be carefully washed, dried and stored in a safe place for use the following year.

3.1.2.3.2 The Pit Method

- Dig a pit 2m in depth and 1.5m wide x 3m long with one end sloping to allow easy entry and exit of the water drums
- The pit is dug where the water table is not near the surface e.g. on an upward slope.
- The side walls of the pit should slope slightly inwards at the bottom so that settling of the silage will not produce pockets of air at the sides, pockets of air causes spoilage.
- Sides must be completely smooth with no rock outcrops or bumps.
- Trenches should be dug on either side of the pit to facilitate surface drainage / run-off.
- Chopped length of fodder material should not be more than 20cm and should be compacted as thoroughly as possible with the use of heavy water drums pulled / rolled over each layer.
- Pit must be filled as quickly as possible and sealed with plastic sheeting well tucked in at the sides
- The silage pit should maintain a doom shape to avoid seepage of water into the pit and allow runoff.
- Leave to ferment for three weeks
  It is good for mass production.

3.1.3 Hay making

- Excess grasses and legumes which are in abundance in raining season can be conserved and made use of in the dry season and during dry periods.
- They should be cut during the growing season when they are young and tender, and have sufficient minerals and vitamins.
- The grasses should be cut out in dry weather, left to wilt and then heaped in small bunches in order to dry thoroughly.
- The dried hay should then be stored on a properly constructed hay rack to avoid losses.

3.2 MANAGEMENT OF HERD HEALTH

Animals should be kept in good health at all time. This require the vigilance of the farmer to observe and quickly take steps when there is observed disease condition.
Signs to identify a sick or diseased goat

1 The goat stands apart from then others in the group (pregnant does about to give birth also show this sign)

2 The animal holds its head down

3 The eyes are dull and show little interest in the surrounding
4 The animal often has rough coat, look weak and tired and do not feed well
5 They do not lie down and rest like other animals in the group

Common diseases of Goat

Some diseases of Kids (Some of the disease could also affect adult)

Disease name & Symptoms	Treatment	Prevention
Coccidiosis • Sudden onset of Diarrhoea • Foul smelling faeces containing mucus and blood. • Anus smeared with blood stained faeces • Sudden death may occur • Severe straining • Eat less • Common in housed goats.	• Give sulphur antibiotics or a drug called cocci.	Reduce stock rate • Clean and make sure pens are well drained and dry • Minimise fouling of feed and water with faeces, hair, fleece etc. • Use of coocidiostats in feeds to keep egg level low but allow goats to become immune
Colibacillosis • Fever at the beginning and later, fever drops down • Mouth dry and cold • Diarrhoea (yellowish to whitish) • Depression and weakness • Goat found lying down • Survivors of the infection may show nervous signs and problems of joints	Give plenty of clean water (oral fluids) • Give antibiotic preparation on Vet's. advice • Isolate affected goats • Treat new cases immediately	• Give colostrum at birth • House new born kids separately • Disinfect the navel with iodine solution at birth • Avoid contamination of feeds and utensils by keeping clean • Avoid overcrowding • Regular feeding should be kept
Colostrum deprivation • Dry mouth • Fever • Severe weakness • Most die	Use of antibiotics on vet's. advise	Cleanliness of the pen • Quarantine of kidding pen if diseases occur with kids • Clamp and disinfect the navel • Give 10% of birth weight of colostrum in the first 24hours • Avoid moving late-pregnant does to new, distant locations to avoid exposing their off springs to infections of which they have not met before • Supervise birth to make sure births and animals do not get cold or too high temperatures
Enterotoxemia • Sudden depression and deaths of kids • Unable to eat • Fluid, brown feaces, some with blood or green pasty diarrhoea • Fever • Death within 2-4 days • Drunken appearance • Lies on side when close to death, paddling legs.	Use of antibiotics on ve't advise	Reduce feed intake • Vaccination with clostridial vaccines 3 to 4 weeks of age and then boost at 6 to 7 weeks and finally at 6 months • Give concentrates gradually to kids

Internal Parasites • Sudden death • May have swelling under chin • Anaemia, and weakness. • Post Mortem by a vet will reveal parasites in intestines,esp. ***Haemonchus Contortus*** in stomach • Poor exercise tolerance • Severe weight loss • Break in hair/falling off of hair	Use dewormers • All dewormers could be grouped into three - yellow - white - colourless Always start by using them in the following order for each ani mal you deworm 1st and 2nd deworming - use yellow 3rd and 4th deworming - use white 4th and 5th deworming - use colourless • No physical signs of disease. • Can occur if many kids and adults are kept together, especially in cold climate.	• Avoid contaminated feeds • Deworm just before the rains and after • Good housing prevents contamination of feeds with feaces
Suffocation • No physical signs of disease. • Can occur if many kids and adults are kept together, especially in cold climate	Give first aid if found not dead	Don't overstock the kid pens
Malnutrition • Weakness, no stomach fill • Dramatic fall in milk production • Staggery gait and recumbence when deprivation is severe • Weight loss • Mental depression	In cases of complete deprivation give small amounts of highly digestible carbohydrates and protein feeds through the mouth. Avoid fats	Feeds should be balanced diets-proteins, carbohydrates etc • Feed 3 times a day with water and mineral block always easy to get

Common disease of adult goats

Mastitis This is an infection of the udder. • Fever, toxaemia • Lameness on affected side • Swelling, gangrene of udder, belly wall • The udder will become hot and painful. • Milk is watery and contains clots of blood	Milk twice a day • Apply antibiotics via the teat as instructed by the vet • In severe cases of infection,an injection of antibiotics may be necessary. • After weaning check the udders especially of high yielding goats for mastitis. • Frequent milking and massaging of the affected udder NB. Precaution should be taken because misuse of drugs could lead to resistance. Ask for vet's advice	Could result from injuries as a result of pulling teats during milking therefore milking completely and use of squeeze method instead of pulling will prevent, use tincture iodine to dip teats. After milking clean the milking area thoroughly While milking; • Good clean hands, equipment and teats at all times • Provide clean bedding area • Wash hands clean before milking.
There are different types of pneumonia Here are the common ones ***a. (Pneumonia) Contagious Caprine Pleuro Pneumonia (CCPP)*** • Usually many animals are sick at the same time. • They become sick 20-30 days after they get infected with CCPP. • Some animals die before they have signs of the disease. • With severe infections that happen quickly, animals cough and have a discharge from the nose . They find breathing hard. • They are weak and tired and have high fever. • Many goats die after 4-5 days. • With mild disease that goes on for a long time , animals cough and have a discharge from the nose.	Early treatment with Tylosin or Erythromycin as advised by a vet	• Vaccine for CCPP are given to the goats. • Restriction of animals so that they don't come in contact with non sick goat.

They find breathing hard. • They are weak and tired and have high fever. • Many goats die after 4-5 days. • With mild disease that goes on for a long time , animals cough and have a discharge from the nose. • Some animals have diarrhea. They become thin and look very sick. Most animals recover slowly but some become very sick and die. *How goats get it* • Goats get CCPP from close contact with infected animals. Infection comes from discharges from the noses of infected animals		
b. (Pneumonia) Pasteurellosis • Goats usually become sick 7-10 days after they get infected. • Disease spreads fast in a group. • Mostly results from stress, which could be due to management, climate or feeding of the goats.	• Other animals are sick from several days. • They lose weight and become thin and weak. Sometimes they have a swollen abdomen. • They grind their teeth. • Their breathing is often rapid but weak. • They usually have diarrhoea. • They die after 5-6 days if they are not treated	Use antibiotic injections early enough • Remove the cause of stress

Worms • Goats get worms from fodd e r which hold many worm eggs or larvae. • Goats can suffer very severe disease. Adult goats suffer as much as young ones. • Usually can be source of stress in goats. • Lungworms will cause the goat to cough and no fever. • Worms in goats can cause death. • Eggs may be observed in feaces. • Do not grow well even with good feed. • Rough coat. • May have a swelling under the jaw and may also have swelling under the abdomen. • May have diahhroea.	• Use dewormers • All dewormers could be grouped into three - yellow - white - colourless Always start by using them in the following order for each animal you deworm 1st and 2nd deworming - use yellow 3rd and 4th deworming - use white 4th and 5th deworming – use colourless	• Avoid contaminated feeds • Deworm before the rains and just after • Good housing that prevents contamination of feeds with feaces.
Babesiosis • High fever • Depression • Urine dark red in colour • Abortion • Reduced milk yield **Tick control** You can control ticks and fleas with Acaricides.	• To be effective the treatment must be urgent • Use diminazine aceturate on advice of your vet i) Dipping or spraying ii) Topical application on body iii) Tick greases	• Vaccination • Control of ticks
Anthrax • Gets it from soil while eating. Common in places where animals have had the disease before. • Death occurs before the signs can be seen	Consult a vet.	Vaccination

Enterotoxcenia/Pulpy kidney • Many animals die before they have signs of diseases. • Restlessness, sudden weakness. • Throw their heads backwards and stretch their legs out. • Some convulsions and die within1-2 hours.	Consult a vet.	Vaccination

3.3 BIOSECURITY

Biosecurity refers to the actions and measures taken to prevent diseases being introduced through animal into a specific geographical area or region. It is about managing risks to prevent infectious diseases, pest and weed from entering a livestock property. Some biosecurity measure that must be put in place in a goat farm include the following:

1. Start a herd with good, healthy animals. Keep a herd history; this records the details of all individual animals.
2. Design and follow a quarantine protocol for animal additions to the herd.
3. Prevent unplanned contact with other animals over which you have no control.
4. Limit vehicle traffic onto the farm to those that are essential for farm business and provide an area outside the farm to disinfect tires.
5. Control insect populations and the access of wildlife, rodent, bird, and domesticated animal populations to your herd.
6. Ensure that feed is not contaminated by manure or urine.
7. Disinfect reusable equipment between animals.
8. Examine the herd for diseases.
9. Design and implement a disease control program as soon as potential diseases are detected inside the farm.
10. Consult animal health personnel and vaccinate the herd against clostridia and other important locally endemic diseases.
11. Treat animals returning from market or exhibition as new additions to the herd and follow a quarantine protocol for these animals.
12. Necropsy all animals that die on the farm as a means to diagnose any diseases present.

3.4 RECORD KEEPING

Record keeping is very important for the following reasons

- It helps the farmer to know his goat
- It increases animal value
- Record promote improved genetic merit
- It helps in better management of the animals

3.4.1 Types of Record

Kid ID	Sex	Doe ID	Buck ID	Birth type	Birth weight	Date of Weaning	Weaning weight.	Date of Death	Observed causes of death

Health Records

Animal ID	Date	Clinical signs	Diagnosis	Treatment plan	Date of treatment	Animal recovered- Yes or No

Doe and Buck Record

Doe ID	Doe date of birth	Any observed cause/symptoms of disease	Buck ID	Buck date of birth	Any observed cause or symptoms of disease

Cull Record

Animal ID	Date Culled	Breed	Age	Sex	Reason for culling	

Animal Sale Records

Animal ID	Breed	Sex	Value	Sold price	Date of sale	Buyer

Cash flow sheet

MONTH	1	2	3	4	5…….	TOTAL
SALES						
Does						
Bucks						
Kids						
Total Inflow	**Aaaaa**	**Aaaaa**	**aaaaa**	**aaaaa**	**aaaaa**	**Aaaaa**
Capital Expenditure						
Salt						
Supplements						
Health programme						
Deworming kid						
Transport						
Supplies						
Labour						
Total Expenditure	**Xxxxx**	**Xxxxx**	**xxxxx**	**xxxxx**	**xxxxx**	**Xxxx**
Opening Balance						
Closing Balance	**Vvvvv**	**Vvvvv**	**vvvvv**	**vvvvv**	**vvvvv**	**Vvvvv**

Key Messages to the Households

1. Importance of fodder, fodder production and conservation
2. What to look out for on goat health and how to maintain a healthy goat herd
3. Types of record and how to keep records

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Chapter Three

MODULE ONE:
TRAINING OF TRAINERS MANUAL ON
POULTRY PRODUCTION

INTRODUCTION (45 MINUTES)

OBJECTIVES
At the end of Module 1, the trainer should be able to understand and communicate the following clearly:

1. Definition of the term "poultry" and identification of different poultry species.
2. Various terminologies used in poultry production.
3. Nutritional and economic benefits of keeping poultry.
4. Difference between exotic and local chickens as well as the types of exotic chickens.
5. Details of the rearing systems of poultry keeping and the advantages and disadvantages of the each of the systems.
6. Identification of the rearing system(s) most suitable to the local environment.

POULTRY

"Poultry" is a term that refers to domesticated birds that are raised for their meat, egg and sometimes feathers. It does not mean any form of birds, therefore vultures for instance cannot be referred to as poultry.

There are different species of birds that have been domesticated. These include quail, duck, geese, turkey, chicken etc.

1. Quails are relatively smaller birds reared for the meat and eggs which are considered to be medicinal.
2. Ducks also called waterfowls are relatively bigger than the fowls or chickens.
3. The goose (plural geese) belongs to the same family as the duck, but they are larger. Apart from the meat and egg, the feathers are also used for making clothing, upholstery and bedding. Because of their large size, good memory and sight as well as ability to make noise, they are also used by owners as security alerts at the entrance of intruders.
4. Turkeys are big-sized poultry usually raised for their meat.

Figure 1: Quail

Figure 2: Duck

Figure 3: Goose

Figure 4: Turkey

Figure 5: Broiler chickens

Figure 6:Layers on deep litter system

Figure 7: Layers in battery cages

Figure 8: Noiler chicken

The Chicken

This is by far the largest population of poultry species reared all over the world. In Nigeria, our indigenous breeds of chickens are not reared in large commercial scale because of their very low productivity. They are characterised by small size, slow growth rate, low meat and egg production. Usually, they lay only between 60-80 eggs per year.

There are however different types of exotic or foreign strains of chickens commercially available in Nigeria which give the farmer high yield in terms of meat and egg within a short period of time. For instance, an exotic strain of layers can lay as many as 300 eggs in a year.

The exotic strains of chicken are fundamentally of three types:

1. The meat type chickens: These are referred to as broilers, both males and females which are reared for their tender meat. They have high growth rate and could attain a mature weight of 2kg in 7-8 weeks under good management conditions. Examples include Arbor Acres and Marshall.

2. The egg type chickens: These are referred to as layers (only the females). They are reared for production of unfertilised table eggs for human consumption. They can lay as many as 300 eggs in a year under good management conditions.
   Examples include ISA Brown and Bovans Nera.

3. Dual purpose chickens: These are chickens that are reared for both meat and egg production. They are usually adapted to household or small-scale backyard farming especially in the rural areas. Their meat and egg productivity may not be as high as that of the meat type and egg type chickens respectively, but are well above that of the indigenous or local chickens. The meat is tougher than that of the broilers but not as tough as that of the local chickens. They reach mature weight of 3-4kg in 4 months while the hens start laying in about 5 months. An example is the Noiler chickens developed in Nigeria by Amo Farm Sieberer Hatchery Ltd. They are popular among rural small households because of their hardiness and ability to perform well under backyard extensive and semi intensive systems.

DEFINITION OF TERMS IN POULTRY PRODUCTION

1. Hatcheries: These are facilities where fertilised poultry eggs are kept under controlled temperature and humidity (incubation) for the eggs to hatch into day-old chicks.
2. Day-old chicks: Young ones of poultry that have just been hatched.
3. Pullets: Young female chickens reared for egg laying.
4. Cockerels: The male chickens from the layer type strain. They are usually separated from the females meant for egg laying from day-old, and then reared for their meat. They are characterised by slow growth rate.
5. Layers: Female chickens that are laying unfertilised eggs for human consumption.
6. Hens: Female chickens that are laying whether fertilised or unfertilised eggs.
7. Broilers: Chickens either male or female, bred and raised for production of meat. They grow very fast.
8. Mother units: Designated farms where day-old chicks (especially of layers and Noiler chickens) of certain hatcheries are reared according to specifications till about five weeks, from where farmers can obtain their stock.

BENEFITS OF KEEPING POULTRY

Nutritional Benefits

1. The egg and poultry meat provide the household with cheap and affordable protein needed in the meal for proper growth of the children, good health and well-being.
2. Eggs are highly nutritious because they contain various nutrients that are necessary for

good health.

Economic Benefits

i. There is a high rate of turn-over and return on investment because poultry generally have short rearing cycles or generation intervals compared to most other domestic animals. For instance, the Noiler chickens reach slaughter weight of 3-4kg by four months and by five months, the females start egg laying which can last for a period of two years.

ii. Poultry keeping therefore has a high prospect of improving the livelihood of the rural household in a sustainable manner.

iii. Poultry keeping is profitable as there is no religion or tradition in Nigeria that forbids the rearing and consumption of poultry.

TYPES OF REARING SYSTEM IN POULTRY PRODUCTION

i. **Free-Range Extensive System:** This is usually practiced in the rural areas. The chickens are not provided for, rather they are left to scavenge or fend for themselves over a wide area by picking any edible materials like grass, seeds, worms, insects and even household wastes in the environment. Such chickens are susceptible to hazards of the environment (bad weather, thieves and predators like snakes) and their productivity is very low. Although the chickens are owned by individuals or household family members, there is no form of capital investment on them. The indigenous chickens are usually reared under the extensive system. At night, the chickens gather outside to sleep, usually on trees.

ii. **Backyard Extensive System:** This is also commonly practiced in the rural areas. Individual owner families provide their chickens with some form of shelter during the night such as a small hut or specially woven baskets kept in the compound and during the day allow the chickens to roam around. They are given a handful of grains in the morning and evening to supplement edible materials like grass, seeds, worms, insects and household wastes they are able to scavenge in the environment. The Noiler chickens are adapted to this rearing system. The night shelter must provide space (the chickens should not be over-crowded), ventilation and safety from predators like snake.

iii. **Semi-intensive system:** This is also commonly practiced in the semi-urban communities and some rural areas. The chickens are allowed to move around during the day in a confined area (run) where they may have access to vegetation, worms, insects and household wastes. They are housed at night. Water and supplemental feed in the form of commercial feed, grains and crop residues are provided by the farmer in the house to avoid wastage by rain, wind or wild birds. The quantity of supplemental feed supplied depends on the availability of feed resources like vegetation in the run. This may be scarce during the dry season. It is advisable to have at least two runs which can be used alternately to avoid build-up of diseases and parasites. The chickens are more productive compared to the extensive rearing system. Exotic strains of chickens like the Noiler have been known to perform well under the semi-intensive rearing system. In order to avoid excessive competition and reduce laying of eggs on the floor, one nest should be provided for every five hens. Baskets, pots and cardboard boxes can be used to make nests. Dimensions suitable for a basket or pot nest are a 25 cm base diameter, 18 cm high walls, and a 40 cm open top diameter. Nests should be situated in a secure, shady and secluded place out of the sun, lined with fresh litter such as straw and kept clean. The eggs should be collected frequently to avoid contamination and cracks.

Figure 9: Semi-intensive system

The Fold System

This is an improved semi-intensive system of rearing chickens on a small scale. It is suitable for rural household poultry production. Rather than allow the chickens to move around in a fenced area to scavenge for feed, they are kept in a fold unit that has an open place (run) in which the chickens can move around in the day and an enclosed compartment (house) where they can sleep at night. The open area of the fold unit is covered with wire mesh to ward off predators. In the fold unit, each of the chickens is provided with a space of 3 square ft in the run and 1 square ft in the house. A fold system measuring 20ft long and 5ft wide will be suitable for fully grown 25 chickens. Using this dimension, the run will be 15ft by 5ft while the house will be 5ft by 5ft. The fold unit is placed on fresh grass for the chickens to feed on the vegetation, insects and worms to supplement the feed supplied by the owners. The unit is moved to another patch of fresh grass daily. The Noiler chickens reared for meat will be well adaptable to this system. The system is however not practicable on a land that is not level.

Figure 10: A fold unit

iv. Intensive System: This is the fully commercialised system of rearing poultry in which the chickens are provided with feed and water and all other things they require for optimum productivity indoors, that is within an enclosed house or pen. Unlike the extensive and the semi-intensive rearing systems, the chickens reared under the intensive system are specially bred or exotic strains of chickens which require special care for optimum productivity. There are two types of husbandry systems under the intensive rearing system namely the deep litter and the battery cage (Pictures were earlier shown).

Important facts about the deep litter:

- As the name implies, the chickens are confined in a poultry house or pen with litter material such as sand, wood shavings, rice hulls, chopped maize cobs spread on dry, damp-free floor. The thickness of the litter materials on the floor should be about 2cm for s a n d , 5cm for wood shavings, 8cm for rice hulls and 10cm for chopped cobs.
- Floor space requirement per adult chicken is about 1.5 square feet.
- The litter material serves to absorb the liquid content in the chickens' excreta and acts as insulator to keep the chickens warm against the bare cold floor.
- Wet, stale or caked litter material is changed to avoid spread of disease.
- For laying hens, nests lined with fresh litter material are provided at the sides of the wall where the hens go to lay their eggs.
- The eggs are collected about five times daily to avoid cracks since the hens have access to the eggs and have natural tendency to brood i.e. sit on the eggs.
- The deep litter system is the more common intensive system of backyard poultry production especially in the rural and semi-urban areas.

Important facts about the battery cage

1 The birds are kept in compartments individually or in a group of two or three chickens per compartment depending on the dimension and design of the cage.

2 Unlike the deep litter system where feeding and water troughs must be provided either by placement on the floor or by hanging, the battery cage system comes with feeding a n d water troughs as component parts of the system.

3 The battery cage also has a component part away from the reach of the hens to which the eggs roll down for collection twice daily.

4 The excreta of the birds fall through the bottom mesh of the cage to the ground.

5 There is better health management in the battery cage system as the birds are not in direct contact with the excreta and sick birds are more easily detected since they are in compartments.

6 Although the battery cage system is more expensive, it is less laborious to operate.

Key Message to the Households:
• Good nutrition and health of both children and adults can be greatly improved through household poultry production.
• The Noiler chickens are well adapted to the backyard extensive and the semi-intensive systems.

MODULE TWO:
SITING AND CONSTRUCTION OF POULTRY HOUSES
(45 MINUTES)

OBJECTIVES

At the end of Module 2, the trainer should be able to understand and communicate the following clearly:

- Where to site a poultry business and how to build a poultry house.
- The basic equipment needed in poultry production.

Factors to Be Considered When Siting a Poultry Business.

- Land: The land must be well drained. Water-logged land is not suitable for poultry production. A level ground is also preferable to avoid high construction costs.
- Security: This is to avoid losing your chickens to thieves.
- Proximity to markets: Where inputs like feeds and drugs can be bought and where the chickens and eggs can be sold should not be too far.
- Distance from other poultry farms: In order to avoid transmission of diseases from one poultry farm to the other, farms where clusters exist are advised to be at least 250m apart.

While this may not apply in rural household small-scale poultry production under the semi-intensive and intensive systems, contacts between different poultry facilities should be avoided as much as possible.

Construction of a Poultry House or Pen

In commercial poultry production, construction of the pen or house is the largest single capital investment. It must therefore be carefully and thoughtfully considered before commencing construction in order to get it right as wrong construction will impact negatively on the performance of the chickens.

The following factors should be considered:

1. Shape: Poultry houses are usually rectangular in shape with the long axis along the East-West orientation. This is to prevent rays of the sun from directly penetrating the poultry house and causing excessive heat load in the pen.
2. Floor: This is best made of concrete for ease of cleaning and drainage. The floor should have a slight slope for ease of drainage when washed.
3. Frames: The frames could be made of metal poles or locally available termite-resistant hard wood.
4. Roof: This can be made of either sheet metal or locally available thatch (straw) which will be cheaper. Thatch-roofed poultry houses are cooler but must be interlaced with bamboo or wooden slats to keep predators out. It also has to be replaced every three years.
5. Light: The poultry house should not be dark as light is essential for both egg laying and easy access to feed and water.
6. Ventilation: For optimum performance, it is important that the poultry house has excellent airflow and ventilation. In order to achieve this, a typical poultry house/pen with either a battery cage system or deep litter should have a height of not less than 2.4m (about 8ft) from the floor to the roof. A width of 8-10m (about 26-32ft) should not be exceeded for excellent airflow. The length depends on the number of birds or cages. The side walls should not exceed 1.5ft.
7. Protection against predators, pests and adverse weather: To guard against pests and predators such as snakes, hexagonal wire mesh, preferably 0.5-inch size should be used to

cover the sides of the house from the side walls to the roof. Furthermore, a side tarpaulin can be attached to the sides. This can be rolled down during torrential or heavy rains to safeguard the birds.

Figure 11: A typical poultry house

Basic Equipment Required in a Poultry Production

- Feeders or feeding troughs: These are used to serve feed. They are either made of galvanised sheet, plastic or wood. They could either be placed on the floor or hung. However, for baby chicks a flat feeder (see Figure 13) is usually used to serve feed and changed to the hanging feeders as the chickens increase in size to avoid wasting of feed.
- Water troughs: This is used to serve fresh, cool and clean water. It is usually made of plastic for ease of washing. There are a lot of improvisation that can be adopted in serving the chicken water. No matter the kind of water troughs the farmer adopts, the most important factor however is that the water must be kept from being contaminated and spilled.
- Shovels: These are used in packing litter.
- Wheel barrows: Used for carrying materials like poultry waste.
- Weighing scale: For measuring the weight of feed, chicken etc
- Farm wears: These include farm clothes or overalls and rubber boots or footwears. It is advisable to always change to these on getting to the farm. Rubber boots or footwears can easily be washed and disinfected to prevent harbouring of disease-causing microorganisms.
- Egg trays: They are either made of plastics of paper. They are used for safe holding of eggs. Eggs collected into open containers are usually prone to cracks.

Figure 12: Feeding trough

Figure 13: Feeder for baby chicks

Figure 14: Wooden feeder (well suited for rural/backyard household poultry)

Figure 15: Adapted water trough for baby chicks

Figure 16: Plastic water trough with guard

Key Message to the Households:

1. List already existing household facilities that can be adapted or modified for rearing chickens under the backyard extensive or semi-intensive system.
2. Identify locally available materials that can be used in the construction of poultry house.
3. Poultry production even at the small-scale rural household level can be a business and a complimentary means of sustainable livelihood and therefore should be properly planned before starting to avoid costly mistakes.

MODULE THREE:
GENERAL MANAGEMENT PRINCIPLES IN POULTRY PRODUCTION
(1 HOUR, 15 MINUTES)

OBJECTIVES

At the end of Module 3, the trainer should be able to understand and communicate the following clearly:

- Safe transportation of poultry from the source of purchase to the farm.
- Care, feeding and watering of chickens.

Transportation of poultry

During transportation of day-old chicks from the hatchery or older birds from the mother units, the following rules must be observed:

1. Birds must be transported during the cool periods of the day or night. This is to avoid exposing the birds to heat stress and losses due to death because poultry species generally have limited mechanism to cope with heat.
2. Do not exceed the maximum holding capacity of transportation crates to avoid overcrowding and death due to suffocation. Ensure the transportation crates are always washed and sanitised before use. This is to avoid contact with disease-causing micro- organisms from the previous use.
3. A well-ventilated vehicle should be used for transportation.

Brooding of day-old chicks

Naturally, when a hen hatches its chicks, it provides warmth for the chicks at night by covering them up under its wings with her feathers. This provision of warmth must be artificially supplied when rearing day old chicks purchased from the hatchery. Brooding is the act of providing supplemental heat to keep the chicks warm in an enclosed facility until they can adapt to environmental temperature depending on growth of plumage and season. (Brooding period is usually shorter during hot seasons than in cold seasons). Heat sources used to brood include charcoal, suspended electric bulbs and kerosene stove.

Some important tips to note when brooding chicks:

- At least, two weeks before the arrival of the chicks, ensure that the brooding house or facility is thoroughly cleaned out, washed and disinfected.
- During brooding, ensure the heat is regulated not to be too much or too little. A rule of the thumb to know when the heat is adequate is when the chicks are evenly scattered around the heat source. The heat is too little when the chicks huddle around the heat source or too much when they move too far away from the heat source.
- The heat source should be on one hour before the arrival of the chicks. This is to keep the brooding house adequately warm to prevent the birds from cold when they get in the house.
- To protect the birds from drafts and pilling in corners, a cardboard ring can be made around the heat source and expanded weekly.
- The heat can be reduced gradually on a weekly basis until about the third week when the birds are able to cope with ambient temperature.
- While the brooder house must be covered with heat insulators like black polythene, ensure that it is not completely sealed up to allow for some ventilation.
- The chicks need a light source such as electric bulbs or lanterns to be able to see

and locate feed and water.

- Feed and water in the right quantity and quality should be provided.
- Use dry absorbent litter material such as soft wood shavings. This is to prevent moist floor which could lead to diseases and deaths. Any mistaken spill of liquid on the floor must be immediately scraped and the place replaced with fresh litter materials.
- Immediately the day-old chicks are unpacked, destroy the paper boxes by burning far away from the brooding house. This is to prevent possibility of harbouring disease-causing organisms from the hatchery.

There are however established mother units from where beginners and smallholder farmers in the rural areas can obtain healthy 5 weeks old Noiler chickens for rearing.

Debeaking

This is the process of removing part of the upper and lower beak of the chickens to prevent pecking on one another which could lead to injuries, bleeding and death. Debeaking is usually carried out by experts at the 5th day of life of the chicks. In later life, laying hens that are not debeaked could engage in egg eating. Whenever pecking is noticed in a flock, salt can be added into the chickens' water to reduce the rate of pecking before debeaking is carried out. Overcrowding, poor ventilation and lack of adequate feeding space could initiate pecking in a flock.

Feeds, feeding and watering

For optimum performance, the chickens should be fed with diets balanced in all the required nutrients namely carbohydrate, protein, fats/oils, vitamins and minerals. The chickens require different levels of nutrients at different stages of their lives from chicks to growing stage to adult or laying stage. For chickens that are reared intensively either in the battery cage system or the deep litter system, all their required feed must be supplied. This is best achieved by purchasing commercially prepared quality feed and given to the chickens in the right quantity. For instance, for layers under the intensive system, a bag of commercial feed weighing 25kg is fed to about 200 layers daily (half bag in the morning and the other half in the afternoon). The commercially prepared feeds usually come in the form of mash, pellets or crumbs. However, for Noiler birds raised by the smallholder farmers under the semi-intensive system, they can obtain a substantial portion of their required nutrients from grasses, insects and worms. Supplementation with grains, crop residues, kitchen leftovers and commercial feed is required.

Points to note when feeding:

1. Under the intensive and semi-intensive system of rearing poultry, feeding is usually done twice daily, morning and afternoon. The Noiler chicken eats slightly more feed than the purely meat type (broiler) or egg type (layer) chickens.
2. It is important to be consistent and not be haphazard in times of feeding. For optimum performance, choose particular times of the day and be consistent (e.g 9am for morning feeding and 3pm for the afternoon feeding). The chickens too get used to your chosen times of feeding them.
3. Avoid wastage of feed as this will impact negatively on your profitability. This can be achieved by using the right size of feeding troughs.
4. The provision of cool and clean water always for the chickens is very important for optimum performance.

Facts about the Noiler chickens

- Source: The Noiler chicken is developed by Amo Farm Sieberer Hatchery Ltd.

- Physical appearance: The chickens are in varied colours like black, white, brown and white specks.
- Utility: The chickens are dual purpose birds for both meat and egg.
- Maturity: They can attain a mature weight of 3-4kg in 4 months. The meat is tougher than broiler meat but not as tough as the meat of local chickens.
- Table egg production: The hens start laying at about 5 months of age and can lay between 150-200 eggs per year for up to two years if well cared for under the semi-intensive system. For table egg production, the hens must be separated from the males by the time they reach two and a half months of age.
- Adaptability: The chickens are hardy and are well suited to backyard or smallholder farming in rural areas under the semi-intensive system, although from five weeks of age, they can also survive like the local chickens in free range extensive system like the local chickens. However, productivity under the extensive system will be lower than that of semi-intensive or intensive system.

Feeding of the Noiler Chicken

The Noiler chickens are raised under the intensive system from day old till week five with a commercially prepared chick mash. Thereafter, they can then be raised under the backyard extensive or semi-intensive systems and given commercially prepared grower feed as supplemental feed (semi-intensive). However, for optimum performance, the males should be separated from the females. The females are shifted to commercially prepared layer feed from fourteen weeks. The Noiler chickens eat slightly more than pure egg type or meat type chickens. As a rule of the thumb, commercial feed generally weighs 25kg per bag and in a bag, there are five small paint bucket measures of feed weighing 5 kg each. A paint bucket full of feed will be okay for 40 birds per day on intensive rearing system. However, for the semi-intensive system, the amount of commercially prepared feed given the chickens will depend on other available feed materials such as grains, crop residues from the farm, as well as vegetation, insects, worms in the run.

Key message to the households:
List the available quantity of feed materials (grains, crop processing residues) that can form part of the total feed resources for raising your Noiler chickens.

MODULE FOUR:
HYGIENE AND HEALTH MANAGEMENT IN POULTRY PRODUCTION
(1 HOUR)

OBJECTIVES

At the end of Module 4, the trainer should be able to understand and communicate the following clearly:

- ✓ Define biosecurity as it relates to poultry farming.
- ✓ Mention the components of biosecurity and practical steps that can be taken under each component to ensure biosecurity on the farm.
- ✓ Describe signs of diseases in chickens.
- ✓ What should be done immediately signs of diseases are noticed on the farm.

The Principle of Biosecurity

Biosecurity refers to measures put in place daily to reduce the possibility of introduction and spread of disease-causing organisms to your farm. Biosecurity measures on the farm have four basic components namely sanitation, traffic control, isolation, and communication. (STIC)

Sanitation refers to maintenance of high level of hygiene on the farm. Practical steps for achieving this include:

- Ensure your flock is always obtained from reputable hatcheries or mother units that practice high level of hygiene.
- Always ensure feed and water are free of contaminants.
- After clearing out your flock for sale, leave a period of at least two weeks between cleaning and disinfecting your poultry house and equipment before bringing in another batch of chickens.
- Ensure the poultry house and its environment are clean and free of dirt.
- Old litter, excreta and dead birds should be disposed of in a designated area far away from the farm. Dead birds should be properly buried.
- Personal hygiene of poultry attendants is important.
- Provide foot dip containing disinfectant for attendants and other people who must come into the farm.

Traffic control refers to restriction of both vehicular and human movement into your farm to guard against carrying disease-causing organisms from another farm to your farm. Practical steps for traffic control include:

1 Keep visitors to your farm to the barest minimum.
2 Limit visits to other poultry farms.
3 Attend to buyers at a designated area outside the farm.
4 Keep proper records of visitors to your farm. This will allow for traceability in case of cross-infection.

Isolation generally means steps taken to separate your farm from carriers of disease-causing organisms. These include:

1. Siting of your farm far away from other poultry farms. It is recommended that poultry farms give a distance of at least 250m away from each other where poultry clusters exist to guard against cross-infection. However, for the rural household poultry production, contacts between different poultry facilities should be avoided as much as possible.
2. Fencing of the farm perimeter and poultry house: This will guard against vermin (wild

animals, wild birds, rodents) which may be carrying diseases from coming in contact with the chickens.

3. Inspect your flock daily to isolate sick birds for treatment to prevent spread of the disease on the farm and immediately call the attention of your animal health expert.
4. On the farm, birds of the same age should be reared together. Young birds should be separated from old birds. Movement of personnel should be from young to old birds. and from healthy to sick chickens.
5. Do not exchange feed and equipment with other farms.
6. Keep your chicken feed in a secure place away from the reach of rodents.

Communication component of biosecurity simply refers to prompt reporting of any incidence of disease within the flock at the local animal health office. This is to allow for quick containment and prevention of spread of the disease to other farms.

It is worthy of note to state that your flock should be adequately vaccinated to help their ability to resist diseases. Noiler chickens obtained at five weeks old from a reputable mother unit will have received all the scheduled vaccinations.

General Signs of Diseases in Chickens

Healthy chickens generally look bright and active. Poultry farming requires a lot of vigilance and daily inspection of the flock for early detection and containment in case of disease incidence. The following signs and symptoms point to disease conditions among the flock:

1. Loss of appetite (A sick chicken will usually go off feed).
2. Weakness (It will be less active)
3. Watery excreta
4. Loss of weight or emaciation.
5. Humped-up posture
6. Drowsiness
7. Ruffled feathers
8. Scabby sores on the comb.
9. Swollen face, head and comb.
10. Discharges from the eyes and nostrils
11. Coughing
12. Sneezing
13. Rattling breathing sounds and gasping for air.
14. Lameness and paralysis.
15. Reduction of egg number (Be sure this is not due to pilfering).
16. Sudden and unexplained mortality/death.

Immediately report and seek intervention of animal health experts.

Medication and Vaccination

Farmers are always advised to use medications (drugs) for their chickens either for prevention or treatment, based on the advice of their animal health experts and to also adhere strictly to recommended vaccination schedule for their flock.

Guide Vaccination Schedule for Noiler Chickens for the First Five Weeks

DAYS	WEEKS	DISEASE TO PREVENT	METHOD
On Hatch Day		Marek's	Given at Hatchery
Day 1 -5	1	Antibiotics + Vitamins	Water
Day 1	1	Infectious Bronchitis	Beak dip
Day 5	1	Beak Trimming + Vitamins	
Day 9	2	1st infectious bursal disease (Gumboro)	Water or eye drop
Day 12	2	Newcastle	Water
Day 16	3	2nd infectious bursal disease (Gumboro)	Water
Day 28	4	Newcastle + infectious bronchitis	Water
Day 32	5	Fowl Pox	Wing Web

Source: Amo Farm Sieberer Hatchery Ltd.

Note: This vaccination programme is only a guide. Amo Farm Sieberer Hatchery Ltd is not liable for any vaccination failures.
Farmers obtaining their stock from mother units should demand for verification, records of vaccination schedule for the stock they are buying.

Key message to the households:
Routines can sometimes be seen as drudgery. However, the daily routines of biosecurity are precautions that safeguard the farmers' investment.

MODULE FIVE:
RECORD KEEPING
(45 MINUTES)

OBJECTIVES

After the end of the module, the trainer should:

1. Have a full appreciation of the importance of record keeping to the poultry enterprise.
2. Design a format for different types of record (Production, Inventory, Medication and Vaccination, Purchases and Sales Records).

Record Keeping

A good record-keeping involves proper and legible documentation of all farm activities and flock performance data or information either in written (note) or electronic form (computer system) and kept in a manner that such information can be retrieved at any given time. Record keeping enables the farmer to determine whether the business has done well or not within any given period. The farmer is able to arrive at a definite conclusion when he is able to compare the well documented performance data of his flock with recommended standard performance. Farmers should be disciplined to record all activities and performance indices immediately they are carried out or measured. This is to avoid procrastination and eventual forgetfulness.

Components of a good farm record include the following:

- Date: Accurate date is very important.
- Activity carried out: This should be documented in details.
- Follow-up activity if any This is a detail of an activity that is to be carried out in future as a follow up to the activity just carried out. This should however be marked on the calendar.

Some advantages of good record-keeping are:

1. It helps to keep track of performance and provides basis for comparison of performance of different batches of chickens.
2. It helps to easily verify the number of chickens and consumables such as bags of feed on the farm at any given time.
3. It helps to avoid past errors of judgment.
4. Good record is always a requirement by all business financing schemes or programmes either as loans or grants.

Types of poultry production record are:

- Production record: This involves records of the flock stock as stock population, amount of feed taken, egg production, etc.
- Medication and vaccination record.
- Inventory record (Record of daily consumption and balances of inputs such as feeds and drugs).
- Purchases and sales record.

A Typical Example of a Comprehensive Production Record in a Layer Farm

Year: 2020 **Month:** May **Pen No.:** 01

S/N	Date	Opening Stock	Mortality	Closing Stock	Egg Production	Percentage Production	Feed (kg)	Water(litres)	Medication	Remarks
1	01/05	1000	0	1000	600	60%	125	250	None	
2										
3										
4										

Key message to the households:
It is absolutely impossible to keep in one's head, all information required to determine how well the enterprise is faring. Write them down!

REFERENCES

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Chapter Four

MANUAL ON CROP PRODUCTION AND POST-HARVEST MANAGEMENT

1.0 General Introduction

The fundamental purpose of agriculture is not just to produce food and raw materials, but also to grow healthy, well-nourished people. One of the sector's most important tasks then is to provide food of sufficient quantity and quality to feed and nourish the world's population sustainably so that all people can lead healthy, productive lives. Achieving this goal will require closer collaboration across the sectors of agriculture, nutrition, and health, which have long operated in separate spheres with little recognition of how their actions affect each other. It is time for agriculture, nutrition, and health to join forces in pursuit of the common goal of improving human well-being.

This manual intends to provide simple guide for sustainable crop production and post-harvest management techniques to farmers using Train the Trainer method. The training is sequenced to facilitate learning and allow opportunities to practice new skills.

Teaching others new aptitudes, methods or procedures requires that the trainer to be aware of different parameters in order to ensure the best learning methodology. Determining the training objective, or managing the audience are some of the essential elements that must be taken into account.

Therefore, this manual emphasizes the elements on which learning efficacy and teaching competences depend. It enables trainers to use learning principles intended for adults and to acquire a guiding pedagogy and interactive methods in line with active communication principles, while creating a positive environment to optimize the learning process. Review questions provided at the end of every session will facilitate a positive interaction between the trainer and the audience for revision of the concept taught and evaluation of the comprehension of the topics by the audience.

MODULE ONE:
BIO FORTIFICATION OF CROPS

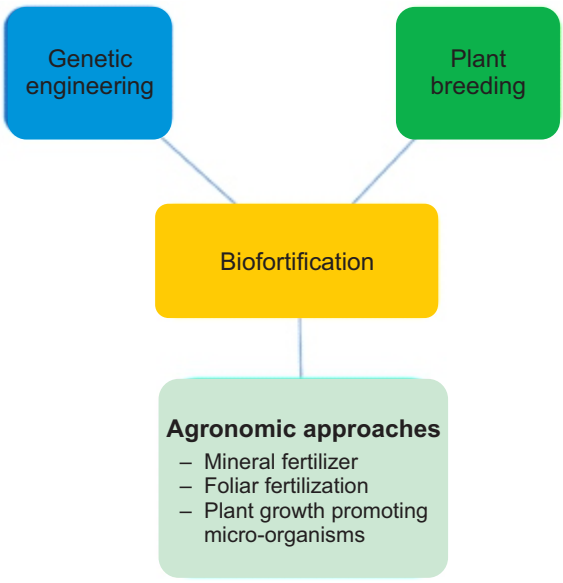
The trainer should;

1. **Explain the meaning of Bio fortification of crops**
2. **Take quality time to explain the unique qualities and nutritional benefits of OFSP and VITA maize to participants**
3. **Should display samples of these products**
4. **Allow for discussion by participants to assess their knowledge of the products**

At the end of this module, participants will be able to:

5. Understand what is Bio fortification of crops
6. Familiarize with some Bio fortified crops available in Nigeria

2.1 Bio fortified crops currently available in Nigeria



Bio fortification is a process of improvement of nutritional profile of plant-based foods through agronomic interventions, genetic engineering, and conventional plant breeding.

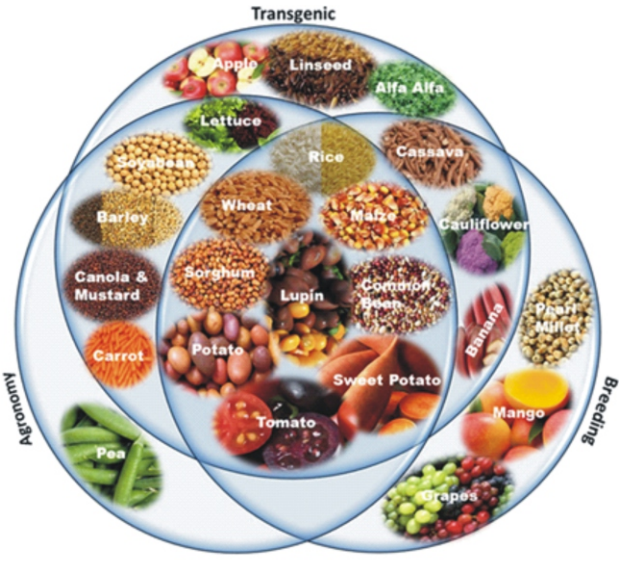
Bio fortification of staple food crops has emerged as a very potent solution to tackle this problem of deficiency of nutrients in developing countries where a large section of the population cannot afford enough fruits, vegetables, legumes, fish, and other food products to meet their essential nutritional requirements.

Bio fortification is the process of developing micronutrients – rich food crops using the best conventional breeding practices or via genetic modification using modern biotechnology. It differs from ordinary fortification and it focuses on improving the nutrient profile of the food crop as it grows and matures instead of manually adding nutrients to the food while it is being processed. Bio fortification is a realistic and cost-effective source of conveying micronutrients to those populations who have limited access to different diets and other micronutrient interventions. This idea is proven mainly to measurably increase human health and nutrition. As per the records Bio fortified crops are now grown and consumed by more than 20 to 25 millions of people all over the world.

Bio fortified crops formally released in Nigeria are pro-vitamin A cassava, iron rich beans, orange flesh sweet potato and yellow maize as well as quality protein maize. Research into bio-fortification of these and other staple crops are at various stages in different parts of the country. This training manual will be limited to Orange Fleshed Sweet Potato and Vit A maize

2.1.1 Orange Fleshed Sweet potato

OFSP is a nutritious type of sweetpotato that is additionally rich in beta-carotene, a precursor of vitamin A. Beta-Carotene is an organic, strongly colored red-orange pigment abundant in plants and fruits. Beta-carotene is what gives OFSP an orange color and is converted to Vitamin A in the body after consumption. The orange color of OFSP is indicative of the level of beta-carotene present; the more intense the color, the more vitamin A present. OFSP also has powerful antioxidants that help prevent cancers, as well as natural sugars, which are slowly released into the bloodstream, helping to ensure a balanced source of energy, without the spikes in blood sugar that are sometimes associated with fatigue and weight gain.



2.1.2 VIT A Maize

In Nigeria, Vitamin A Deficiency (VAD) is recognized as one of the most serious micronutrient deficiencies (hidden hunger) affecting many people but the most vulnerable are children under five years, pregnant and lactating mothers. It is estimated that nearly 1 in every 5 children under 5 years of age are Vitamin A deficient and same is true for women of child bearing age (15-49 years old). Vitamin A deficiency is widely prevalent in Africa and afflicts millions of children, resulting in morbidity, nutritional blindness, and even death. Even mild levels of Vitamin A deficiency (lack of Vitamin A) may damage our health leading to decreased school performance in children and may lead to poor productivity for adults. As a staple food, maize is consumed by most people in Nigeria. Maize is also one of the most genetically diverse crops in the world, and can therefore be a cheap and sustainable source of Vitamin A especially for the vulnerable rural poor population.

What are the qualities of PVA maize?

a) Rich in ProVitamin A (ranges from 8ppm-14ppm)
b) The varieties are intermediate maturing (100-110 days)
c) Colour ranges from deep yellow to deep orange
d) Very good resistance to crop pests and diseases
e) Grain yields as good as the white maize varieties (The hybrids yields between the range of 6-8 tons/hectare, and the OPV's can yield 5-8 tons/hectare)
f) Both hybrids and open pollinated varieties are released to provide basket of choices for farmers

Review question

1. What is bio-fortification of crops
2. What are the nutritional benefits of OFSP and VIT A Maize ?

2.0 Module 2: CROP PRODUCTION TECHNIQUES AND GOOD AGRICULTURAL PRACTICES

Learning Objectives:
By the end of this training, participant will;

a) Identify different fruits and vegetables
b) understand the fundamental practices of fruits and vegetables production
c) understand how site selection, land preparation and choice of seed influences productivities of fruits and vegetables
d) Identify different soil nutrient deficiencies in fruits and vegetables understand the harvesting and handling of different fruits and vegetables

1.1 Module 2a:
HORTICULTURAL CROPS PRODUCTION TECHNIQUES

- Horticultural crops include a wide range of commodities, these includes, fruits and vegetables that are highly valuable and essential for humanity.
- They are extensively grown worldwide, and their production can be described as an open and highly complex system affected by many factors, among which are: weather, soil and cropping system, as well as the interaction between these factors..

No General Fundamental practices essential for horticultural crop productivity are:

The trainer should;

1. Show the participant the pictures of different fruits and vegetables (If available, show examples of Plants with nutrient deficiencies or physiological disorders)
2. Explain the harm of cultivating fruits and vegetables on nutrient deficient soil
3. Emphasis the need for proper harvesting and handling of different fruits and vegetables

Pre-Cultivation Preparation (market survey, crop planting calendar(s), soil testing, composting, and quality seed/planting material(s));

Land Preparation: land preparation practices, incorporation of crop residues, and basal application

Crop Establishment: raising seedlings, spacing, fertilizer application

Crop Management: supplemental watering, managing weeds, top-dressing, pests & diseases management practices, and safe and effective use of pesticides

Harvest: Harvesting indices

Post-Harvest Handling: appropriate containers/standard packaging materials, and value addition techniques, and

Cost and Income Analysis: cost and income analysis.

2.2 Vegetables

Improved production techniques for major vegetable crops, including Sweet Potato, tomato, Carrot, Pepper, Ugu and Amaranth are:

Land/site selection: To take into account crop adaptation to soils, climate and market considerations.

Seed/cultivar choice: Sources of seed, characteristics of good seed, advantages of using high quality seed, adaptability, market suitability, seasonal adaptation and resistance to diseases.

Nursery Management: intensive care unit, nursery requirements, site selection, rotation, good sanitation, irrigation, fertilizer needs, pest and disease management.

Land preparation for vegetables: Importance of good tilth, different tillage systems raised beds, farrows, flat beds, basics. Suitability of tillage systems according to season, soil types, irrigation methods respectively.

Fertilizers: Sources of nutrients - organic (compost, green and cattle manures) and inorganic fertilizers. Nutrient requirements of vegetables to determine yields and quality in relation to amounts, timing and placement. Handling and application of manure. Integrated Plant Nutrition Systems (IPNS) concept for the maintenance or adjustment of soil fertility and plant nutrient.

Seed rates: It is important to use recommended seed rates.

Spacing: It is also important to use optimum spacing so as to archive high yields.

Crop rotation: To minimize pests and disease build up and to enhance soil fertility good crop rotations is encouraged.

Irrigation: The functions of water in horticultural crops cannot be denied. Nevertheless, moisture requirements for different crops and critical growth stages to avoid moisture stress is of high consideration. Soil moisture management in the nursery and direct seeded crops such as okra, beans and peas. Use of mulch to conserve soil moisture.

Staking: The importance if staking for vegetables like tomatoes to avoid diseases is important.

Pruning: Essential to enhance fruit quality in indeterminate tomato cultivars.

Pest and disease management: This is the biggest problem in vegetable production. Proper pest and disease identification needs to be emphasized. IPM concept approach including; cultural, biological, cultivar resistance and use of pesticides is correct.

Weeding: weeding is importance to avoid competition for space, nutrients, water.

Post harvest handling: proper harvesting methods, time of harvest, care in handling of produce, use of field storage sheds, proper packaging materials, treatment of produce and grading of produce.

Marketing of horticultural crops: Marketing decisions should be made before planting the crop. market requirements, when to sale, timing, off-season production, formation of association for better bargaining, formation of marketing days to create awareness, market research and crop diversification should be known.

Review question

c) What are the essential practices to attain good yield of horticultural crop

d) List the major constraints to attain good yield

The trainer should;

1. Understand the principles and practices that can contribute to good sweet potato production
2. Deliberately explain the best altitudes for sweet potato plants
3. Describe market, and climate conditions (especially temperature)that favors sweet potato
4. Explain the soil important elements requires for best yield practice in sweet potato
5. Emphasize the strategies to fight disease build- up through crop rotation
6. Explain the planting methods in respect to planting timing
7. Emphasis the important of harvesting Period, process and package of sweet potato

2.2.1 Orange Fleshed Sweet Potato Production and Management

Learning Objectives

By working through this topic, participants will be able to:

- Describe the timing, social, soil, market, and climate conditions that sweet potato advocates must be aware of.
- Explain the soil conservation and crop rotation practices that must be used to optimize sweet potato production in the long term.
- Describe optimal techniques for sweet potato planting in terms of drainage, timing, use of planting materials, and fertilizer.
- Create a staggered planting schedule tailored to an individual farm.
- List and describe the stages of the sweet potato growth cycle.
- Distinguish symptoms of plant nutrient deficiencies from pest-borne and physiological disease symptoms.
- Sweet potato has the potential to produce remarkably high yields if given the right growing conditions.

- Sweet potato can also yield more reliably under unfavorable conditions than many other crops, which is why it is so important for household food security in many places in Sub Saharan Africa (SSA).

4.2.1.1 Selecting and Preparing Land

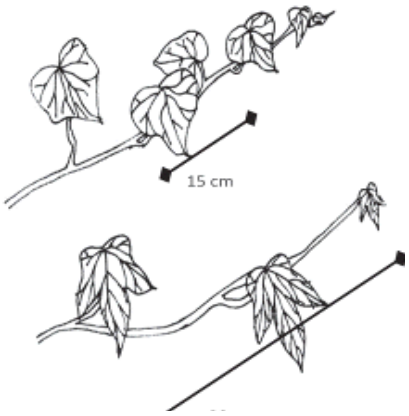
2.2.1.2 Planting Methods and When to Plant

Key Points

- Sea level up to 1,700 m above sea level are the best altitudes for sweetpotato plants.
- Sweet potato can adapt to different soils, but deep, sandy, moderately fertile loam with a slightly acid pH is optimal.
- Sweet potato plants like potassium, which can be obtained from ash.
- High nitrogen soils are not optimal.
- Fallow periods and crop rotation fight disease build-up. Using the same plotfor sweet potato only one year out of three is best.

Key Points

- Sweet potato is usually planted in mounds or ridges for good drainage. Flat beds are possible where labour is scarce, but yields are lower.
- Land preparation is labor-intensive, and the form and size of the plantingareas depends on whether tractors or oxen are available.
- Sweet potato is often harvested piecemeal.
- Sprouts or vine cuttings are used to grow new sweet potato plants. They are planted at a distance of 25-30 cm between plants and 60-100 cm between ridges.
- Tighter spacing creates smaller potatoes, which are preferred in some markets.
- Hoes or machetes are used to create depressions for planting.



Internode lengths may differ b etween varieties, in some varieties 3 nodes = 15 cm, in others 3 nodes = 30 cm length

2.2.1.3 Sweet potato Requirements and Physiological Disorders

Key Points

- Sweetpotato can grow at a fairly wide range of temperatures, although the temperature affects root yield.
- Low temperatures, lack of sunlight, and dry weather reduce yield and require an extended growing season.
- After planting, the root primordia in sweetpotato nodes produce adventitiousroots that differentiate into storage roots under good conditions.
- The growth cycle includes three main phases, each of which requires farmers to perform specific tasks.
- In good growth conditions, normal levels of pests and disease will not greatly reducethe harvest.
- Irrigation is not always required, depending on the region, but drip irrigation is most efficient

Table 1The Different Development Phases of the Sweet potato Plant and Tasks

Week	Development phase	Characteristics	Tasks
0 1 2 3 	I. Establishment phase	• Planting • Fast growth of young roots • Storage roots start to differentiate • Slow growth of vines	• Planting • Gap filling • Avoid stress
4 5 6 7 	II. Intermediate phase (storage root initiation)	• Initiation of storage roots • Fast growth of vines • Large increase in leaf area	• Weeding
8 9 10 11 12 13 14 15 16 17 18 ? 52 	III. Final phase (storage root bulking)	• Growth of vines ceases • Rapid bulking of storage roots • Reduction of leaf area due to yellowing and falling • Harvesting	• Vine lifting • Hilling up • Harvesting

Physiological disorder	Symptoms	Causes	Prevention strategies
Mutations 	Roots have areas of different coloured flesh or skin	Sweetpotato has an unusually high natural rate of mutation	Use positive selection to avoid plants giving such roots, when selecting planting materials
Water blisters (edema) 	Small lumps (enlarged lenticels) on the outside of the roots.	Prolonged exposure of roots to very wet soils leading to lack of oxygen	Plant sweetpotato in well- drained soil. Ensure ridges or mounds are high in wetlands

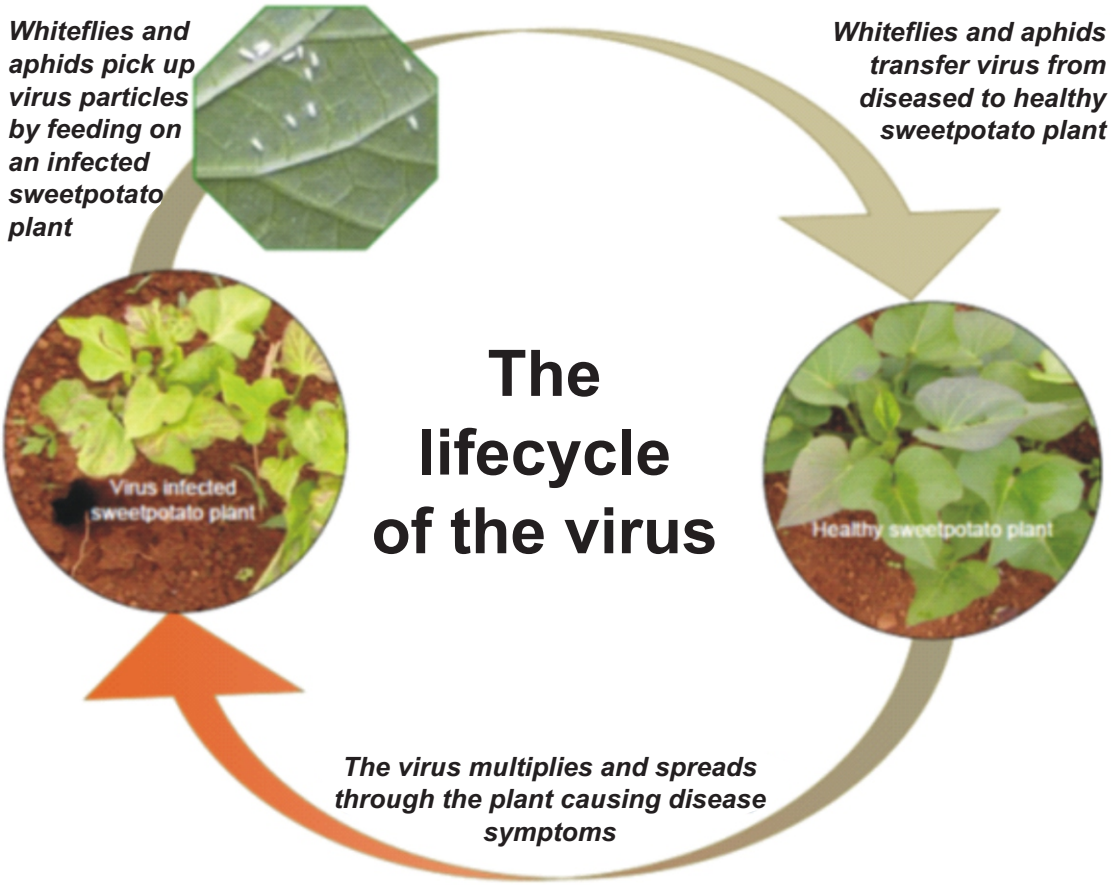
Sun scalding 	Scalded areas are purplish-brown and prone to secondary infections	Exposure of roots to direct sun at high temperatures	Place sweetpotato roots in shade immediately after harvest
Growth cracks 	Cracks in root skin. More common on large roots. Nematode infested roots are more susceptible.	Cracks develop due to uneven growing conditions, especially uneven watering.	Cultivars differ in their susceptibility to this problem. Irrigation during dry spells.
Flattened stem (fasciation) 	Flattened stem with numerous leaves	Uncertain	Fasciated vines are usually rogued and should not be used as planting material.

2.2.1.4 Symptoms of Potassium (K) Deficiency on Sweetpotato

- Short vines with short internodes and small leaves are the first symptoms
- Leaves are of a darker colour (dark green), especially at the edges
- Short and pale petioles
- Small, shiny brown spots emerge on the leaves, first on the bottom of the leaves and on old leaves
- Old leaves become yellowish or reddish, starting at the top of the leaves and developing via the edges to the leaf base
- Plants wilt faster and leaves easily fall off
- When experiencing heavy deficiency, the whole leaf becomes yellow except the leaf base and the leaf tissue just next to the veins that become dark green
- Low number of storage roots
- Storage roots are long and thin
- Yellowing appears on the oldest leaves
- Storage roots are more easily infected by root rots and nematodes

Plants which received 100%, 14%, and 1.7% of optimum potassium supply

Small necrotic lesions following inter veinal chlorosis on a mature leaf



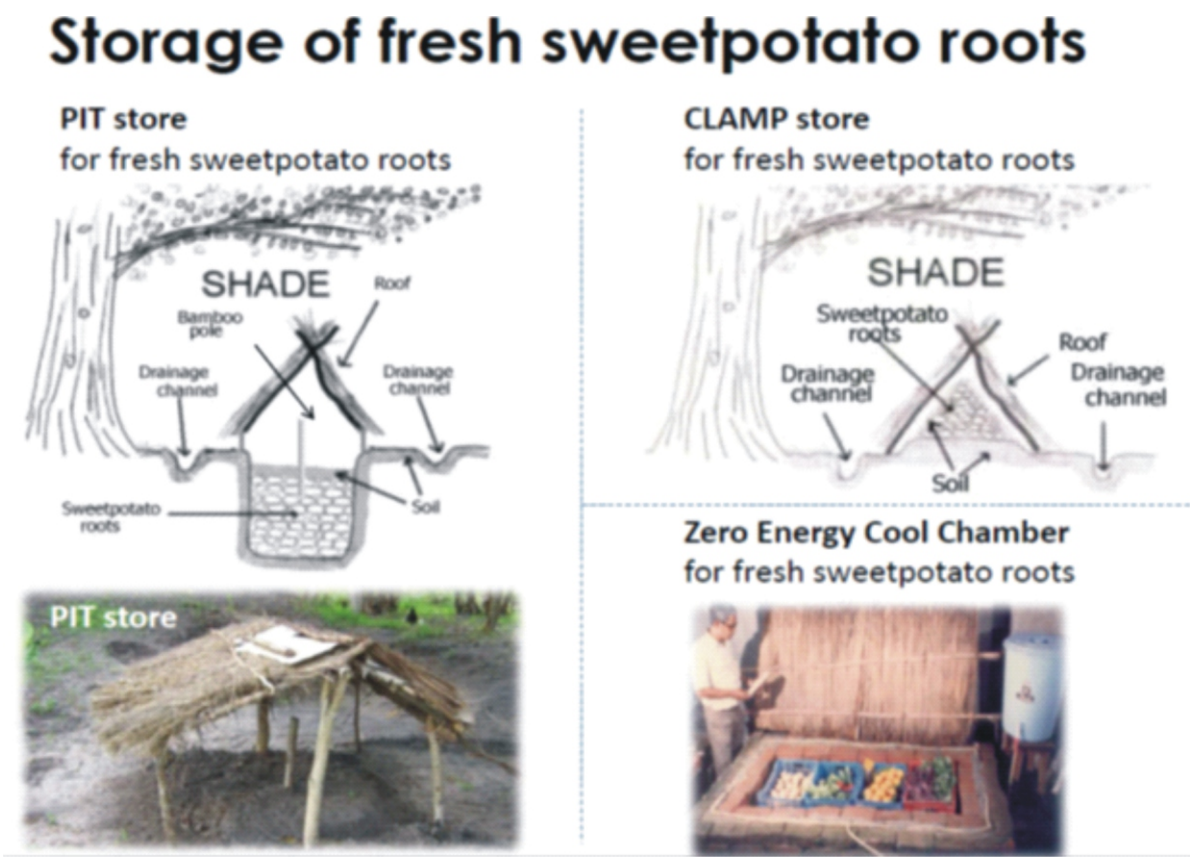
3.2.2. Harvesting, packaging and Storage of Sweet potato

3.2.2.1 Harvesting period of sweepotatoes

Harvest period of sweetpotato

- The harvest period for sweetpotato can be extended through use of piecemeal harvesting, staggered planting dates, or use of different varieties with different maturity times
- Sweetpotato roots are typically ready for harvesting from 3 to 8 months after planting depending on the variety
- If harvested too early, storage roots will not have reached their maximum size
- If harvested too late, storage roots may have become fibrous and attacked by weevils while in the ground, particularly if the soil dries out and cracks providing easy entry places for weevils
- Harvest with care, avoid cutting or damaging the roots. This will prolong shelf-life

2.2.2.2 Storage of fresh sweet potatoes



2.2.2.3 Processing of orange-flesh sweet potatoes

Processing of orange-fleshed sweetpotato

- Traditional methods of preparing sweetpotato for consumption include boiling, steaming, roasting and drying
- Three primary OFSP products can be used as ingredients for a diverse range of recipes:
  - Grated raw OFSP
  - OFSP puree (boiled and mashed)
  - OFSP flour (chipping, drying, storing, milling)
- Chipping does not affect the beta-carotene content much
- Over-drying (>3 days) reduces the beta-carotene content
- But it is during storage that the beta-carotene content of OFSP chips most reduces. Try not to store dried OFSP for longer than 1 month

Review question

1 Mention the tools best use for sweet potato cultivation
2 Why is sweet potato best planted in mounds or ridges
3 …….. is a good source of potassium for sweet potato
4 Highlight the symptoms of Potassium (K) Deficiency on Sweet potato
5 Describe the best way to store sweet potato after harvesting

2.2.3Vitamin A Maize Production and Management Topic Objectives

By working through this topic, participants will be able to:

- Understand choice of land and preparation.
- Describe optimal techniques for maize planting in terms of drainage, timing, use of planting materials, and fertilizer.
- Create a staggered planting schedule tailored to an individual farm.
- List and describe the stages of the sweet potato growth cycle.
- Distinguish symptoms of plant nutrient deficiencies from pest-borne and physiological disease symptoms.

2.2.3.1. CHOICE OF LAND AND PREPARATION

4. CHOICE OF LAND AND PREPARATION
✓ Maize can be well in a well-drained sandy loam or loamy soil..
✓ Use any method (Mechanical, Chemical or Manual) that can adequately remove weeds and keep the soil loose for good seedbed.
✓ Plant seeds immediately after land preparation to allow maize to get ahead of weeds.
✓ The land should have adequate drainage.
✓ To grow maize, you must first choose the best spot to grow it.
✓ The soil should be wind sheltered, exposed to direct sunlight, well sourced with a good drainage system and sufficient organic matter to ensure that the ground will not dry quickly.
✓ The top layer of the soil must be fertile and slightly acidic.
✓ You must put a substantial grade of compost into the soil complemented with a reasonably good source of fertilizer two weeks in advance to sowing the seeds, the fertilizer incorporated during tillage operation

The trainer should

1. Emphasis the choice of land and best planting practices for optimum maize production
2. Identify the time best for planting maize base on harvesting objectives (early or late season)
3. understand the spacing, number of seeds per hole and the need to cover each hole with soil
4. Explain why fertilizer application is important in growing maize
5. Emphasize the need for the management of weed, pest and diseases control on maize farm
6. Critically explain the factors that affect maize yield

2.2.3.2. TIME OF PLANTING

2. TIME OF PLANTING

✓ There are no specific dates to plant your maize. However, it is best to plant after it has rained consecutively for 2 times.

✓ **Early Season**

In the Forest zone, the optimum planting date is between March and April, although planting could be done as soon as rainfall becomes steady.

In the Derived Savannah zone, plant as soon as the rainfall becomes steady, between 1-30 April.

In the Southern Guinea Savannah zone, planting could still be done as late as May and June, depending on rainfall.

✓ **Late Planting**

This is done early August which is not appropriate. Poke holes that are 1 inch deep for heavy soil and 2 inches or less in sandy soil. Make straight rows that are 2 to 3 feet apart. The distance allows the roots room to grow. This pattern will help in proper pollination and provide wind protection as well. The seeds must be directly planted in the soil rather than in trays and pots since corn is difficult to be transplanted.

Plant 3 or 4 seeds per hole and cover each hole with soil. Looking after and tending to each seedling individually is of the utmost importance.

	Germination/Emergence Early vegetative growth 25-30 days	Vegetative maturation 25-40 days	Flowering 15-20 days	Early grain filling/Grain maturation /Harvest 45-60 days
Frost				
Haul				
Brought	xxxxxx	xxxxxx	xxx	
Food	xxx			

Weather risk	April		May		June		July		Aug		Sept		Oct	
Heat wave	x	x	x	x										
Drought			x	x	x	x								
Flood														

2.2.3.3. FERTILIZER APPLICATION

3. FERTILIZER APPLICATION

- ✓ Fertilizer that is rich in nitrogen is the best for maize to grow healthy. Maize needs a lot of nitrogen to grow and do well. A 4 bag fertilizer of NPK 25:10:10 (200 g) per hectare for proper growth.

- ✓ Note that it is ideal to carry out soil test before applying fertilizer. It is important because that same fertilizer may have been used on that same land for years which might affect the growth.

2.2.3.4. WEED CONTROL

4. WEED CONTROL

- ✓ There are many types of weeds, pests and diseases that affect maize plants. Weeds do not only choke the crops, it also zaps off soil nutrient that is meant for the crops.

- ✓ Hand Weeding
  Carry ou t the first weeding 14 –21 days after planting or as soon as necessary. A second weeding may be done if necessary before the second application of fertilizer.

- ✓ Herbicide Application
  Fortunately, there are several herbicides you can apply to prevent a breakout on your farm. Apply Atrazine pre -emergence at the rate of 3 kg ai/ha on a clean seed bed. 4 For 50% flowable (PW), rate is 3.0 kg active ingredient per hectare. Local unit is 1 small tomato tin full/4.5 liters (1 gallon) of water. For type 80% wettable powder, rate is 3.0 kg active ingredient per hectare. Local unit is approximately one standard match box full/4.5 liters (1 gallon) of water. Volume of Water to be Used: Ideally, the sprayer should be calibrated to determine the spray volume.

2.2.3.5. DISEASE AND PEST CONTROL

5. DISEASE AND PEST CONTROL

Pests and diseases are not yet serious problems in maize except for Striga, stem borers termites and storage pests.

- ✓ Planting early can also help minimize the attack.
- ✓ Rodents, birds and termites are also another threat to maize farming in Nigeria.
- ✓ Termite hills in the field and surrounding area should be located and destroyed

Stem borers

Stem Borer Infected maize leaf & cob

Infected maize leaf & Symptom of downy mildew

6. HARVESTING

- ✓ When the cobs are ready for harvesting, each cob should be tested to see its ripeness.
- ✓ This is usually carried out when the tassels have turned a dark brown and the rear part of the sheath is pulled to check quality of the liquid squeezed out from a couple of grains.
- ✓ Harvest your maize when the plants are mature. The amount of maize that can be harvested per hectare depends on the variety you planted, amount of rainfall, sunshine, weed, pest and disease control management that was applied .

Pre-maturation stage i.e. not proper time of harvesting for seed production

Full-maturation stage i.e. proper time of harvesting for Maize seed production

Review question

1 Itemize the factors that affect the amount of maize that can be harvested per hectare.

2 Why is it ideal to carry out soil test before applying fertilizer
What type of soil is best for maize production

The trainer should;

Use the pictorial instruction to brush up the memory of the participant, it would aid their understanding and participation

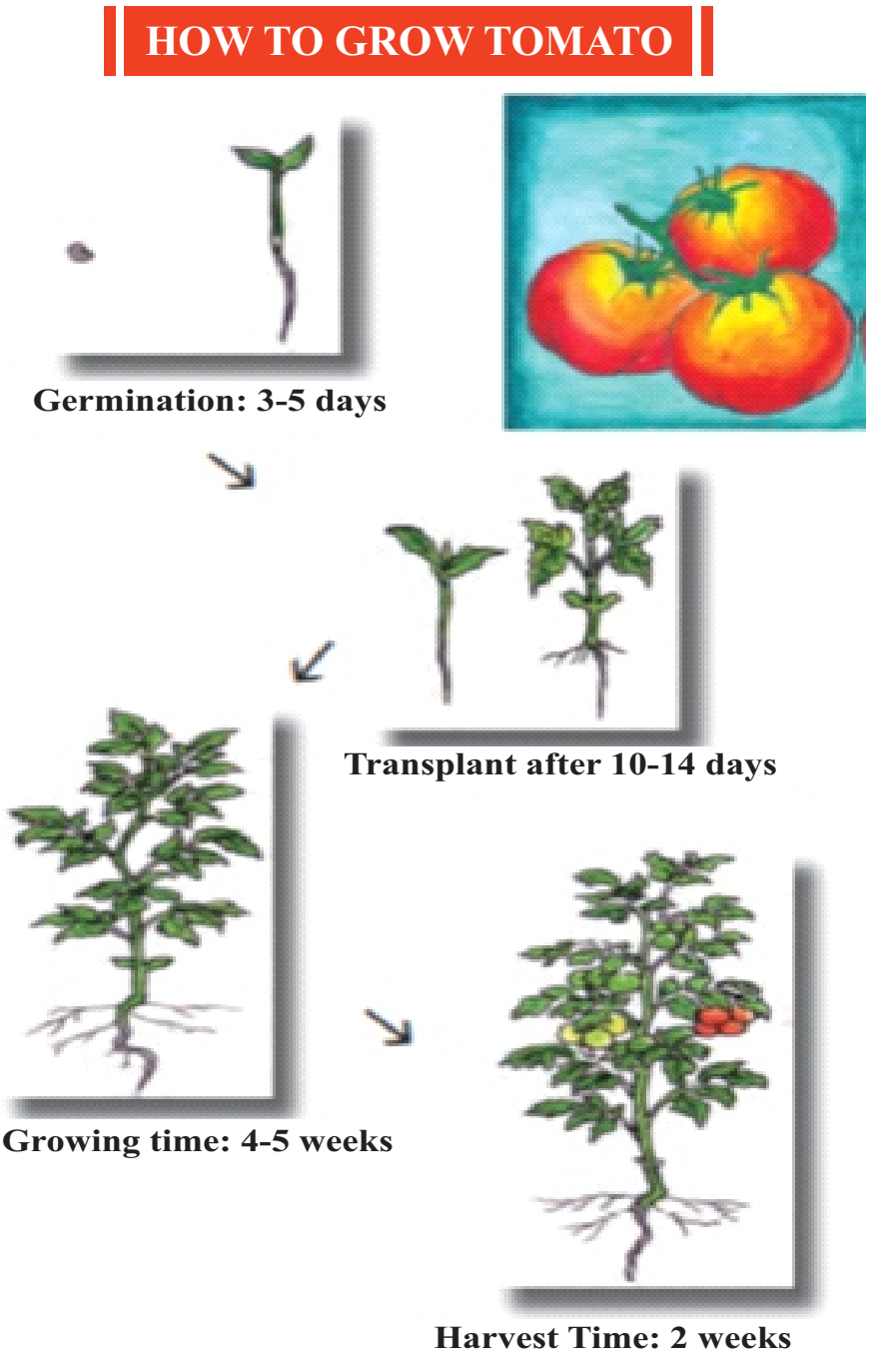
2.2.4 Production and Management of Tomato, Pepper and Amaranth

2.2.4.1. How to grow tomatoes

Topic Objectives

By working through this topic, participants will be able to:

- Successfully plant and transplant potatoes.
- Give required intensive care for tomatoes survival.
- List and describe the stages of the tomatoes growth cycle.



4.

Mulch seedlings with dried grass or banana leaves.

5.

Weed plants when necessary, water on dry days, stake when plants are 1 m tall. Collect and remove leaves with brown spots and rotting fruit. Bury or burn away from crop to stop spread of disease.

6.

Regularly look on and under leaves for pests and diseases.

7.

Harvest when fruits are orange or red.

8.

Save seed!

1. Select good quality red fruit for saving seed.
2. Cut and squeeze seeds into a bowl of water.
3. Leave until while fungus forms (1-2 days).
4. Sieve seeds.
5. Leave to dry in the sun.
6. When dry, store in a sealed jar.

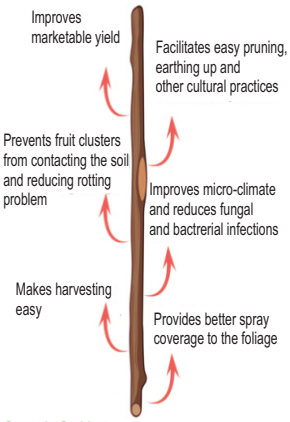
STAKING IN TOMATO

What is staking?

Supporting tomato plants with bamboo/wooden poles, or any other sturdy material to keep the foliage and fruit off the ground.

Staked vs Non Staked

Benefits of Staking



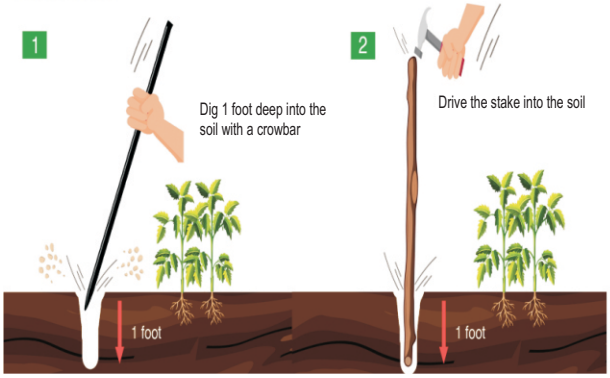
Growing plants can be staked as soon as the branches start developing; around 25-30 days after transplanting.

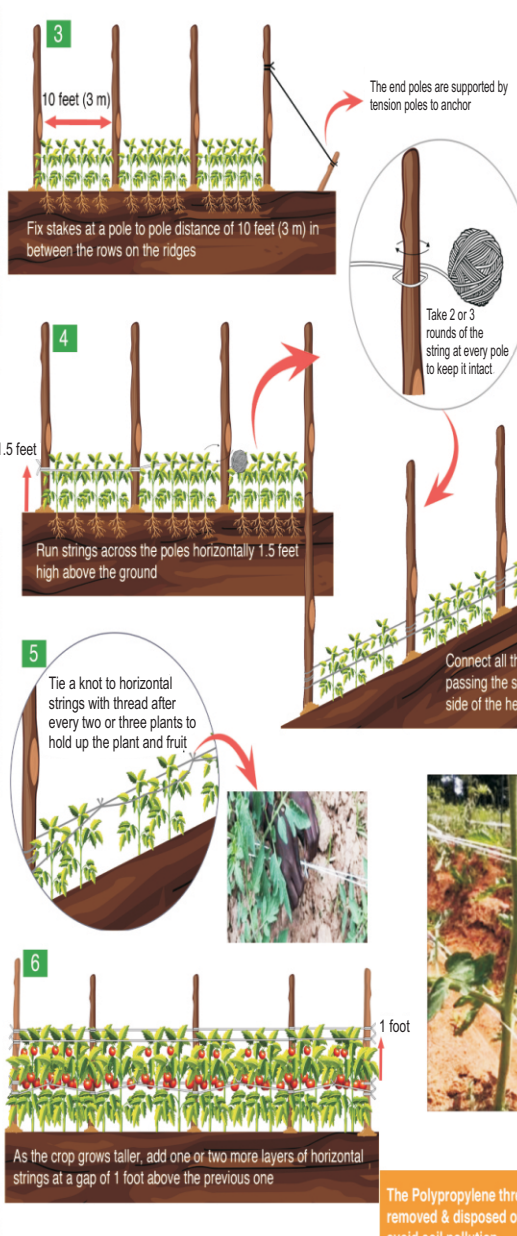
Materials Required

Bamboo or wooden Poles (5 to 6 ft. Height can be reused for 2 to 3 seasons)

Staking Twine (Polypropylene thread)

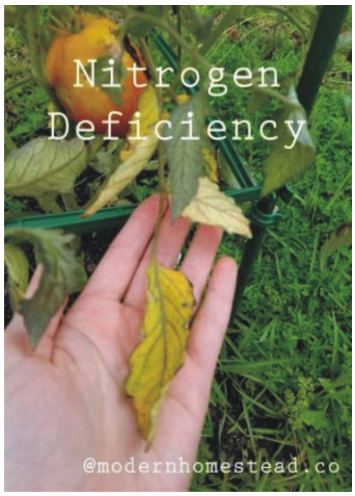
Steps in Staking

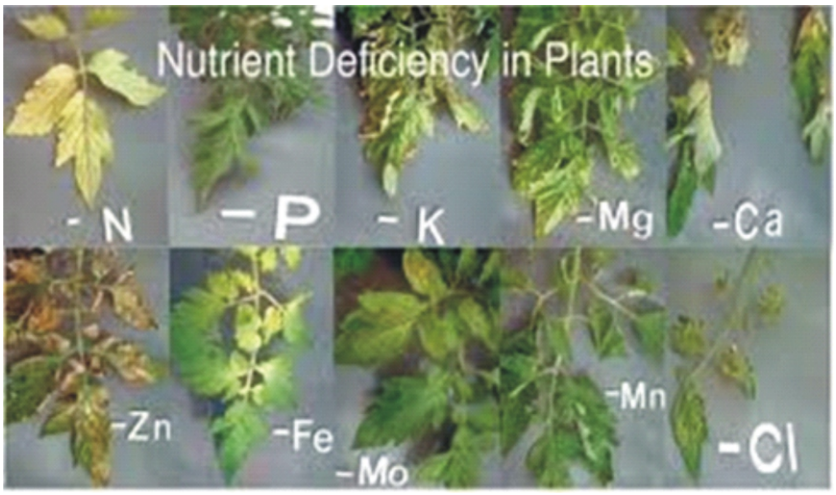


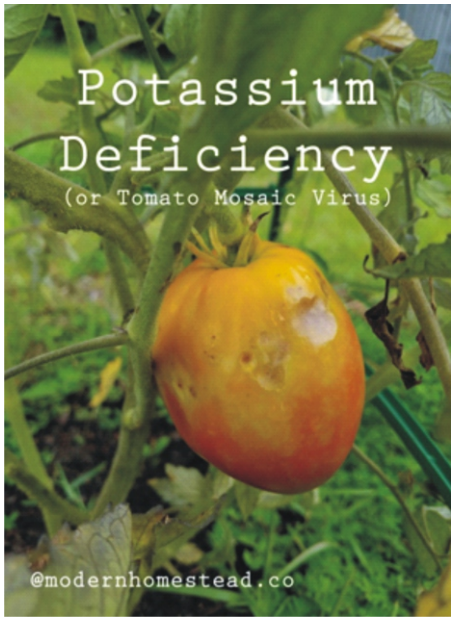


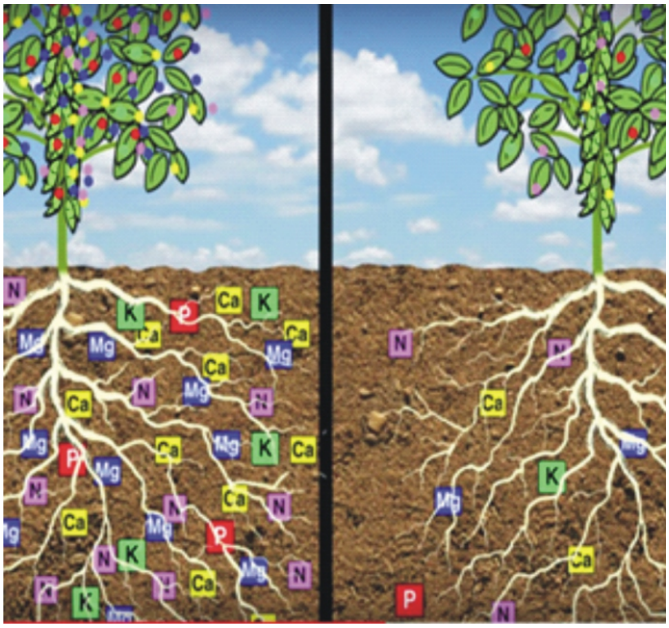
The Polypropylene thread has to be removed & disposed off properly to avoid soil pollution

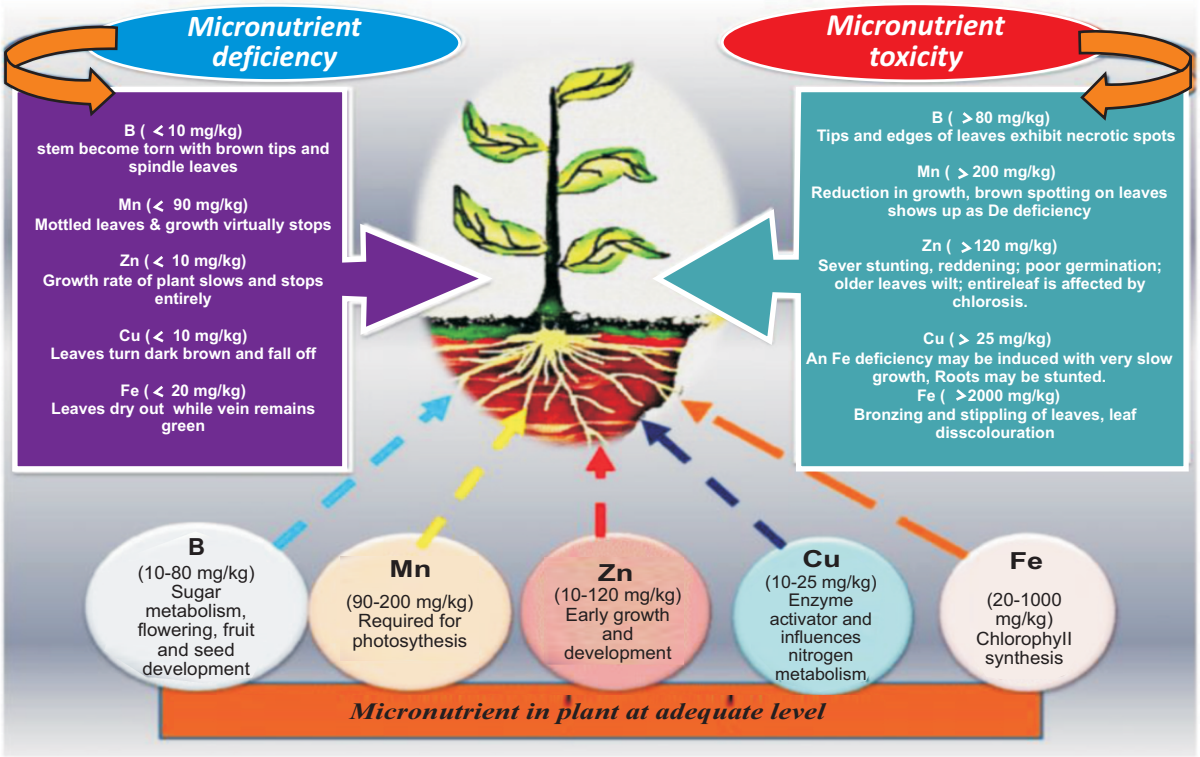
Illustrations: Brgft / Freepik









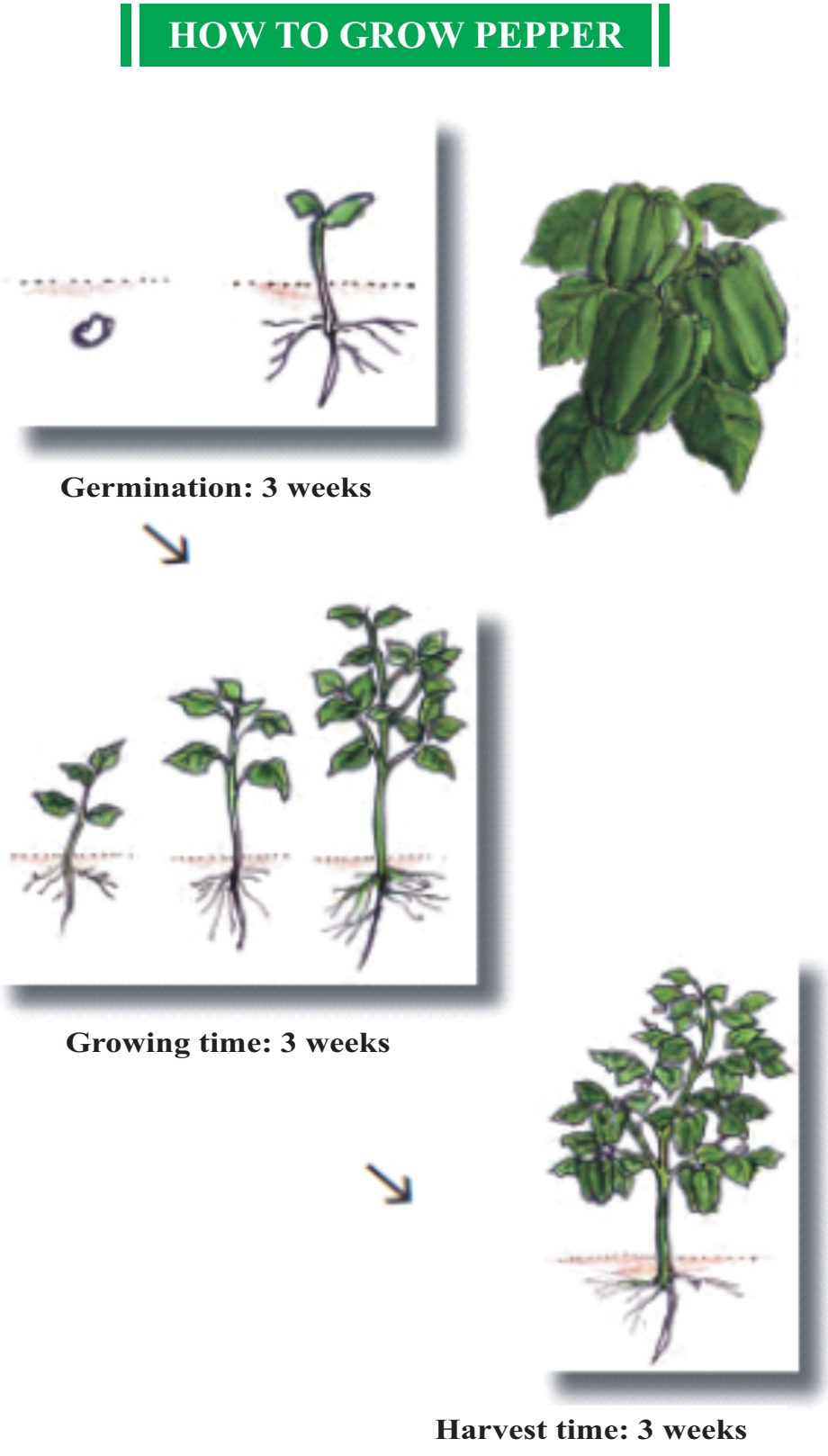


Review question

1 Itemize the duration required for germination, growing time and harvesting weeks of tomatoes.
2 What period of growth of do you stake tomatoes
3 When do you harvest tomatoes
4 Mention three deficiencies of tomatoes

2.2.4.2 How to grow pepper

Topic Objectives



By working through this topic, participants will be able to:

- Successfully plant and transplant pepper.
- Give required intensive care needed for pepper survival.
- List and describe the stages of the pepper growth cycle.

How to grow PEPPER

1.

Plant seeds into seed tray. Use a mix of 3 parts old, grated coconut husk, 1 part compost and 1 part soil. Place trays in a shady place. Thin when plants have 2-3 leaves.

2.

Mix compost or manure into the bed before planting to give plant food.

3.

Transplant when seedlings have 4-5 leaves, early morning or later afternoon. Plant 2 rows, 45 cm between plants. Water well after transplanting. water morning and evening until the roots have established.

4.

Mulch seedings with dried grass or banana leaves.

5.

Weed plants when necessary, water on dry days, stake plants when are f m tall.
Collect and remove leaves with brown spots, and rotting fruit. Bury or burn away from crop to stop spread of disease.

6.

Regularly look on and under leaves for pests and diseases.

7.

Harvest when fruits are firm and shiny. They can be red or green.

8.

Save seed!

1. Select good quality red fruit for saving seed.
2. Cut fruit in half.
3. Scrape out the seeds.
4. Leave to dry in the sun

When dry, store in a sealed jar.

2.2.4.3 How to grow Amaranth

Amaranth

(Amaranthus spp.)

Nutrition and cooking:
Leaf and tender steins are rich in vitamins A,C,E,B, folic acid, calcium, iron and protein. The can be eaten boiled, steamed, stir-fried, as soup, stewed or pureed.

Characteristics:

Amaranth grows rapidly under hot-wet and full sunlight conditions, with few pest and disease problems. The optimum temperature is 20-30 C for germination and 25-35 C for growth. It adapts to different kinds of soil conditions and tolerates heat and drought, but not cool temperatures.

Cultivation instructions:

Directly broadcast the seeds to the field and cover wit fine soil. The seeds germinate 2-3 days after sowing. Thinning is required for better growth. The spacing is 10cm between rows and between plants. Amaranth is tolerant to drought, but adequate water during growing periods can produce better quality and higher yield. The plant height reaches 20-25 cm in 20-25 days after sowing. Plants can be uprooted or 50% of foliage and tender stem can be cut repeatedly every 1-2 weeks at 15-20 cm above ground surface until flowering.

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2.2.4.4 How to grow Ugu

Topic Objectives

By working through this topic, participants will be able to:

1. Successfully cultivation of different ugu
2. Give required care needed for ugu survival.
3. List and describe the stages of the growth cycle.

The trainer should;

1. Use the pictorial field expression to guide the participant, it would aid their understanding and participation
2. Give effective cultivation instruction on ugu to participants

SOIL TYPE AND LAND PREPARATION

The best soil for ugu farming is loamy soil. After the land have been secured land preparation is important, you can hire labor depending on the size of the land to till it and ease up the soil for easy permit traction of water to the soil. Consider supplementing the soil with lots of manure. It could be cow dung or poultry waste. Also, you might want to make beds or ridges for the seedlings you want to germinate. It is not compulsory you make them before planting, but it's a good thing when you do. The land needs to be ready at least two weeks before planting.

PLANTING OF UGU

Make a bed, remove the seeds from the pod and you have to remove all the juicy parts, allow it to dry before planting. The ideal time for planting is from April and May when rain is just starting for

the season or at any time of the year with the help of irrigation. Dig a small hole of about 15cm-25cm deep, with spacing between 5cm. Then plant the seed and close it with soil. I will recommend covering it with grass also this will reduce transpiration. The seeds are not just planted anyhow; It should be place in the soil based on their shape (the pointed part of the seed is placed downwards, though, some seeds seem to be round all over, in such a case just lie it flat on the ground and then cover with the soil. Staking is compulsory when the trendies begins to grow

WEED/ PEST CONTROL

Weeds and pests are a thing to keep in check to ensure that the growth of the pumpkins is not retarded. On this ground, early weeding is advisable because failure to do so will make the plant to be starved of its nutrient (nitrogen), and then, turns yellow. However, you should weed whenever you see them sprouting up.

FERTILIZER APPLICATION

Organic manure (Compost)or a nitrogenous fertilizer such as Urea and NPK (15:15:15) is the best to be applied on the farm they promote the growth of the leaves likewise the seed yield. This should be done one month when the seed has germinated.

IRRIGATION

After planting the seedlings, you then need to start irrigating the farm every day or two days; depending on the weather. In other words, you will need to water the farm more in the absence of rainfall.

HARVESTING

you can start harvesting 30days after planting, when the stems are pretty long, you can start harvesting. The harvesting is by pruning, that is cutting below the lowest acceptable leave. You can use your hands to do this by cutting the stem not too far away from its bottom position, where you have the nodes and cut. Well, if you're inexperienced with the use of hand (as a newbie) you can employ the use of a knife.

Note, for the pods you will have to cut them off when the tendrils are dried, or at times, they fall off on their own.

Review question

1. What time of the year for ugu planting
2. What period of growth do you stake ugu
3. What best practice can be adopted to avoid pest and diseases of ugu
4. When can you start harvesting ugu

2.3. FRUITS - PAPAYA *(Carica papaya)*

- Papaya (Carica papaya) also known as Pawpaw, originated in tropical America. It is now produced commercially in several Caribbean countries and is in high demand in the tourism industry and the local market. It also has tremendous potential as an export crop.
- The pawpaw fruit is rich in vitamin A and C, iron, calcium, protein, carbohydrates and phosphorus.

Varieties

Various accessions of land races and exotic varieties such as Homestead, Pink solo, Kapoho solo and JS.22 are available at the National Horticultural Research Institute (NIHORT). Since fruit size, shape, pulp color, and time of fruiting differ, advice must be sought in selecting which variet y to plant.

Nursery

Although pawpaw may be planted directly in the orchard, considerable savings can be made on seeds and labor, by using transplanted seedlings raised in the nursery. Raise seedling from seeds extracted from ripe pawpaw fruits. Scrub the seeds lightly with sand to remove the gelatinous covering. Mix the slurry of sand with water; the bad seeds and gelatinous covering of the seed will float. These should be removed. Drain the good seeds and spread out in the shade to air dry. Sow the air-dried seed trays, polybags or any container which has rich moist topsoil by watering every other day. The seeds should germinate within 2 weeks and be ready for transplanting within 8–12 weeks after sowing. Seeds meant for transplanting in May should be sown in February/March.

Fertilizer application

Apply 50 g of NKP 15-15-15 per plant , 3 weeks after transplanting and at monthly intervals up to 6 months after transplanting. Optimum yields have been obtained using 45 g N/plant and a 1:2 N: P ratio. However, application rates should be based on soil test results in order to make maximum use of the fertilizer application

Weeding

Weed control is very important especially during the first 3 months after transplanting. This may be achieved by hoe weeding, slashing at monthly

intervals, or by the use of the herbicide Paraquat glyphosate at 4—6 or 3 kg active ingredient per hectare.

Irrigation
Dry season irrigation is important for pawpaw. For newly transplanted seedlings, apply 3 liters of water per plant twice a week, For flowering plants, apply 5 litres twice a week, and for bearing plants apply 15 liters of water per plant once a week.

Intercropping
Intercrop pawpaw, planted at a spacing of 2 x 2 m, with early maturing plants like okra, leafy vegetable, melon, sweet potato, or sweet corn. These plants should mature within 3 months or poor yields will be obtained due to shading of pawpaw canopies.

Pest control
Nematode control is very important. This can be achieved by applying a teaspoonful of Furadan per seedling, 3 weeks after transplanting and rotating the orchard. If grasshoppers invade the plot spray Gamalin 20 15 mls/10 liters of water.

Summary;
1. Use recommended variety
2. Use recommended spacing
3 Apply fertilizer as recommended
4 Irrigate in the dry season
5 Harvest at 'Blush' stage

3.0 MODULE THREE: GOOD AGRICULTURAL PRACTICES
(Fruits and Vegetables)

At the end of this training, participant will;

a) identify different fruits and vegetables
b) enjoy better and safe quality food, with sustainable production
c) contribute in the general creation of better environment, that will benefit all
d) be better concerned and able to obtaining safe fruits and vegetable
e) will understand the need to improve worker and consumer conditions to enhance the fruits and vegetable for family welfare
f) successfully contribute to the Improvement of food security
g) produce healthy fruits and vegetable, not contaminated of higher quality so as to improve to nutrition and consumption of fruits and vegetable
h) contribute to avoiding contamination of water and soils
I) handle agro-chemicals in a rational manner through practice join in the conservation of biodiversity

The trainer should;

1. Explain the concept of Good Agricultural Practices (GAP)
2. Deliberate on the activities involved before planting, during cultivation, during harvest and post-harvest activities of different agricultural products.
3. Outline various aspects of fruits and vegetable production GAPs

3.1 General Introduction

Good agricultural practices (GAPs) for fruits and vegetables involve multi-faceted efforts at ensuring that the products are safe for human consumption. Food safety has become a serious issue in our society because of pathogens and food contamination. There are a variety of GAPs that can be instituted at the farm level as theses programes help farmers self-audit their operations of producing, processing and transporting products of plant origin to safeguard food products, the environment, and the consumers thereby providing safe foods and promoting safety for humans and the environment include all the steps in the production chain from farm to consumer. Similarly, GAPs are a set of recommendations to improve the quality and safety of fruit and vegetable products. Like in all food, good fruits and vegetables must be economically viable, environmentally sustainable, social accepted and sustainability for on-farm processes and should result in safe and of high quality.

3.2 Good Agricultural Practices

Broad outline of various aspects of fruits and vegetable production that needs to be managed are:

1. Site history and management
2. Soil management
3. Soil mapping
4. Plant nutrition management and fertilizers
5. Irrigation and fertigation
6. Integrated pest management
7. Plant protection products
8. Traceability
9. Complaints management
10. Visitors safety

11. Record keeping
12. Health welfare and safety of workers
13. Environmental conservation
14. Waste and pollution management

3.2.1 Before Planting

These GAPs should be followed before planting in order to avoid contaminating produce:

- The likelihood that the produce will be thoroughly cooked before being eaten should be assessed. If it will not be cooked, then on-farm contamination from pathogens should be prevented
- production sites should be located uphill, upstream, and upwind from areas where manure is stored or animals are grazed.
- To avoid contamination of produce, the potential of nearby feedlots, animal pastures, or livestock farms should be evaluated.
- fields that regularly flood or are exposed to excessive runoff should be avoided.
- Manure should be stored away from growing and handling areas, and store it in a manner that prevents runoff and wind drift.
- In areas where manure or other animal products (blood meal, bone meal, feather meal) are to serve as soil amendments, contamination risk should be reduce
- sources of soil amendment should be recorded, application dates, and methods of composting or treatment should be noted.
- flood zones or downhill from other sources of contamination should be avoided.
- Protect wells with grouting, sanitary caps, and intact casings.
- wells and water sources should be inspect before each growing season to identify and deal with potential sources of contamination.
- water used for drinking and hand washing should be tested to make sure it meets standards is potable.

3.2.2 During Production

To avoid contamination of fruits and vegetable, the following GAPs should be followed while the crops are growing:

- Domestic, nonworking animals (pets, chickens, grazing livestock, etc.), must not be allowed to enter produce fields during growing or harvesting
- Wild animal access to growing areas should be limit using reasonable, appropriate, and legal measures.
- During crop production, manure or animal products should not be apply unless properly composted or treated.
- If you use well water for irrigation or sprays, test it for generic E. coli before the growing season, and continue to test it quarterly. Keep records of tests and results.
- In cases where surface water is used for irrigation or sprays, drip or furrow irrigation is advisable to minimize contact with produce.
- As much as possible using surface water for overhead irrigation or sprays should be avoided unless it is documented to have a low risk of contamination.
- Test water sources for generic E. coli before using each season and regularly during the season. Keep records of tests and results.
- Adequate number of toilet and hand-washing facilities for workers should be provided and maintained.
- Workers should be well trained in proper hand-washing methods, when and how to wash,

and other farm food safety policies. Post signs as reminders and keeping records of training efforts is encouraged.

- Ensure that workers wash hands before starting work, after breaks, and after engaging in non-food handling activities including restroom Only EPA-approved pesticides should be use and follow all label instructions.

3.2.3 During Harvest

The following GAPs should be followed while harvesting F&V to avoid contamination

- Clean and sanitize harvest bins, tools, and wagon beds before using them during harvest.
- Non-absorbent, durable, and washable materials are advised to be used for equipment and tools that directly contact produce during or after harvest
- Equipment and farm implements should be kept clean and in good condition
- Remove as much dirt and debris from produce as possible while in the field.
- Damaged, diseased, or visibly contaminated produce should not be harvest.
- Records of cleaning, sanitizing and maintenance should be kept.

3.2.4 Post-harvest

These GAPs after harvesting produce to avoid contaminating the crop

- Cool produce quickly to remove field heat and minimize potential pathogen growth.
- Prevent bruising and damaging produce. Discard any bruised or damaged produce.
- Keep packed fruits and vegetables off the floor. Place containers on clean pallets.
- Keep floors and equipment clean and dry. Avoid pooling water in packing sheds and coolers.
- Use only potable water sources for washing or cooling harvested produce and for cleaning surfaces that will contact produce
- Regularly change produce wash or dump tank water to prevent organic debris from building up in the water.
- Treat dump tank or recirculate water to kill microorganisms and prevent cross contamination.
- Regularly measure the sanitizer and pH levels of postharvest water. Always maintain adequate sanitizer concentration and desired pH. Record measurements.
- Avoid immersing tomatoes, apples, and other fruits in water that is more than 10oF cooler than the produce. When the water is too cool, the produce can absorb water along with any pathogens that may be present.
- Ensure produce is dry before packing to limit the potential for bacterial growth on the surface of the produce.
- Install appropriate backflow prevention on hoses and water supply lines
- Regularly remove trash and culls to avoid attracting animals to packing areas.
- Prevent birds from perching or roosting in rafters.
- Before loading with produce, make sure transport vehicles are adequately clean and, if previously used to transport goods or animals that could contaminate produce, have been thoroughly cleaned and sanitized.
- Keep wagons and vehicles used to dispose of culls and trimmings out of animal lots or other places of possible contamination.
- If a transport vehicle has a cooling system, cool it before loading and ensure cooling equipment is functioning properly.
- Keep records of where each product was grown, dates of harvest and packing,

dates of sale/shipping, and where it was sold/shipped.

- Be prepared to show records to authorities if requested.

Review question

1 List the different common good agricultural practices.
2 itemize activities involved before planting agricultural products
3 Enumerate activities involved during cultivation of a given agricultural products
4 Mention the processes of harvest a given agricultural products
5 Name the post-harvest activities of a particular agricultural products.

4.0 MODULE FOUR: INTEGRATED PEST MANAGEMENT AND PLANT HYGIENE

At the end of this training, participant will;

a) Understand IPM, it objectives and component

b) know how to prevents pests, diseases and weeds using IPM and plant hygiene know different methods of controlling pest, diseases and weeds

The trainer should;

1. Critically explain the objective of IPM and importance of plant hygiene.
2. *Explain the component of IPM*
3. Tell them the different way for weed, disease and pest controlled and management.
4. Show the participants the advantages in IPM and importance of plant hygiene

4.1 Introduction and objective

IPM is an ecosystem-focused style of supervision that allows the effective management of pest in a more sustainable manner, helping in the less use of harmful pesticides with an added bonus of get to know our gardens more intimately. It involves the intelligent incorporation of biological controls, cultural practices, and habitat operations giving a better understanding of the whole ecological system and the role pests play within it, therefore working to control pests in the long term.

Implementing different methods to keep the crops healthy without solely relying on spray of pesticides, is called Integrated Pest Management (IPM). IPM is attractive because it has the following benefits:

- Effective control;
- Lower costs;
- Safer to farmers and families;
- protects the environment.

Plant hygiene aims to locate plant processes, procedures, practices, equipment and raw materials that can contribute to microbial contamination. In order to address problem areas economically and before serious quality issues impact on the final product plant hygiene is of paramount consideration. Implementing a plant hygiene program will therefore eliminate the vast majority of microbial-induced problems. The general areas requiring attention are in plant hygiene are:

- source water and source water-handling systems;
- recycled water and recycled water-handling systems;
- recycled raw material or recycled product;
- raw material storage and handling systems;
- mixing, milling and reaction vessels and their associated piping systems;
- product packaging systems; and
- product transportation and delivery systems.

IPM is not just one single pest control system. It does not offer any magical silver bullet solutions, but a combined effort of many different methods. It implementation, involves the following steps:

- Identifying action levels: Knowing the point at which a slight nuisance becomes a problem. Action levels are designed to; identify exactly the point at which the scale has been tipped, the balance is off, and action must be taken.

- Monitoring: Ability to start playing and identify what to play with, regular monitoring, including site inspections and trapping all these helps to understand exactly what is on the land
- Prevention: The name of the game in IPM is called "prevention". With a core idea of stooping a pest or disease in its tracks before it even becomes a problem.
- Curative action: with all the best will in the world, something it gets out of hand. So what to do then when pests have frustrated the best control efforts? At this point, hierarchy of appropriate control method should be adopted. Introducing an effective, less risky pest controls including things like pheromones to disrupt pest mating, or mechanical controls, such as trapping or weeding. If this does not succeed, additional, harsher pest control methods can be employed, such as targeted spraying of pesticides, although this is very much a last resort option.

4.2 Preventives techniques of pest diseases and weeds using Integrated Pest Management and plant hygiene

Having a good idea of what's going on, and want to get fast with some preventative techniques. Preventative methods of pests, diseases and weeds, these include;

i. Biological controls: This part of the games involves playing nature at her own game. Beneficial predatory organisms (animals or insects) help keep pest levels at a controllable level and restore the natural ecological balance.

ii. Physical controls: Also called "mechanical" control method. In this practice, pest are physically removed from the garden through crushing or killing, or through barriers, traps, mowing, and tillage. For diseases, Physical controls means pruning and removal of diseased parts or plants.

iii. Chemical controls; IPM works with the goal to reduce chemical inputs as much as possible, but they can still be helpful from time to time if situations really get out of hand

iv. Cultural controls: all possible things that can be done when you design and work in your system. Cultural methods involve farming practices that prevent problems such as:

- Crop rotation (choosing the appropriate variety of plant adapted for your growing conditions so that they have the best chance of thriving without help)
- Destruction of crop residue (Practicing good hygiene habits (always using clean tools)
- Having an appropriate watering schedule (over-watering can cause fungal problems, whereas under-watering can weaken your plants).
- Sowing date
- Plot selection and layout
- Associating crops
- Tilling
- Reasoned fertilization
- Resistance varieties

Review question

5 List the advantages of IPM.
6 itemize the areas of plant production that requires attention in plant hygiene
7 How can the use of IPM be prevented.
8 What is the objective of IPM

Tomato Diseases

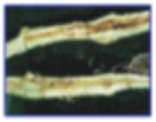
Bacterial Diseases

Bacterial canker *(Corynebactenum michiganense pv. michiganense)*

Bacterial canker *(Corynebactenum michiganense pv. michiganense)*

Bacterial speck *(Pseudomonas synngae pv. tomato)*

Bacterial speck *(Pseudomonas synngae pv. tomato)*



Bacterial wilt *(Raistonia solanacearum)*

Bacterial wilt *(Raistonia solanacearum)*

Bacterial Spot *(Xanthornonas vesucatona)*

Bacterial Spot *(Xanthornonas vesucatona)*

Fungal Diseases

Early blight *(Alternaria solani/A. porn)*

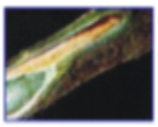
Early blight *(Alternaria solani/A. porn)*

Anthracnose (Collectotrichum spp.)

Anthracnose (Collectotrichum spp.)

Leaf mold (Fulvia fulva Syn. Cladosporium fulvum)

Leaf mold (Fulvia fulva Syn. Cladosporium fulvum)



Fusanum wilt (Fusarium oxysporum f. lycopzersici)

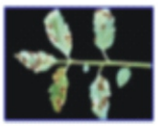
Powdery mildew (Leveillula taurica/ Oidopsis taurica)

Late blight (Phytophthora infestans)

Late blight (Phytophthora infestans)

Late blight (Phytophthora infestans)

Buckeye rot (Phytophthora spp)



Black leaf mold (Pseudocercospora fuligena Syn. Cercospora fuligena)

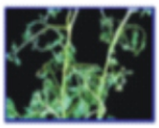
Black leaf mold (Pseudocercospora fuligena Syn. Cercospora fuligena)

Southern blight (Sclerotum rolfsi)

Septoria leaf spot (Septoria lycopersicr)

Viral Diseases

Cucumber Mosaic Virus (CMV)



Cucumber Mosaic Virus (CMV)

Cucumber Mosaic Virus (CMV)

Cucumber Mosaic Virus (CMV)

Potato Virus Y (PVY)

Tomato Leaf Curl Virus (TLCV)

Tomato Leaf Curl Virus (TLCV)

Tomato Mosaic Virus (TMV)

Tomato Spotted Wilt Virus (TSWV)

Tomato Spotted Wilt Virus (TSWV)

Tomato Spotted Wilt Virus (TSWV)

World Vegetable Center

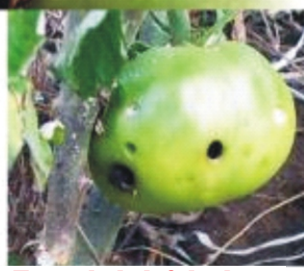
Tomato Fruit Borer *(Helicoverpa armigera)*

Tomato fruit borer affects not only tomato, but some other crops such as brinjal, chili, chickpea, cowpea, maize, etc.

Damage syptoms

- Young larvae feed only on leaves; older larvae feed on flower buds and fruits.
- Larvae feed on fruits by thrusting part of larval body inside the fruit making holes surrounded by faecal pellets.
- A watery cavity with frass and decay is seen inside the fruit.
- Damaged fruits are invaded by fungus and bacteria causing rots and eventual fruit drop
- Infested tomatoes ripen early but are not usually marketable.

Larva thrusting inside the fruit



Entry hole left by larva

Larvae feeding inside the fruit

Secondary infection after damage by borer

Management

Preventive and control measures

- Before sowing
- Follow field sanitation keeping the field and borders weed free
- Avoid vegetable monocropping and follow crop rotation
- Ensure deep ploughing in summer to exposes dormant stages (pupa and larva) of fruit borer
- Flood the prepared soil before planting to reduce amount of fruit borer pupa
- Constant monitoring of the field; Collect and destroy larvae and infected fruits
- Grow marigold as trap crop (1 row of marigold for 7 rows of tomato).
- Install pheromone traps with Helilure at 2 per 30 decimals. Replace the lures regularly at a 3-4 week interval.
- Spray Azadirachtin (Neem Oil) @ 2.0 ml per litre of water as a preventive measure, starting from 4 weeks after transplanting on a weekly basis.
- Use biopesticides: Spray Bacillus thringiensis subsp. kurstaki, B. thuring giensis subsp. aizawai @ 2 g/litre of water.

Chemical Control

- At beyond ETL 1 larva per plant, chemical control is recommended.
- As a chemical control measure, spray any of the chemicals as mentioned in the below table.
- It is always advised to rotate chemicals to pest resistance.
- Avoid using insecticide at the time of fruit maturation and harvest.
- Follow recommended dose of application and safety measures while handing chemicals.

Insecticide	Action	Dose
Flubendiamide	Control	2.5 ml/15 lit
Chlorantraniliprole	Control	5.0 ml/15 lit
Emamectin Benzoate	Control	15 g/15 lit
Spinosad	Control	3.0 ml/15 lit

5.0 MODULE FIVE: POSTHARVEST MANAGEMENT AND PROCESSING

Section 5a: harvesting and storage

Section 5b: Techniques

At the end of this training, participant will;

a) understand the need for fast storage for Fruits and Vegetables (F&V)
b) be able to identify different storage facilities for F&V
c) difference between climacteric and non-climacteric fruits
d) identify appropriate harvesting techniques to adopt for F&V
e) identify appropriate tools for the harvesting of F&V
f) be able to identify different processing methods available for F&V

The trainer should;

1. Emphasis difference between climacteric and non-climacteric fruits
2. Emphasis the need for fast storage for F&V
3. Show participant different storage facilities
4. Explain appropria te harvesting techniques to adopt diffrent F&V.
5. Explain different processing methods available use in F&V
6. Emphasis the need for value added products of F&V

5.1. Introduction

All fruits, and vegetables crops are living biological organisms, having a respiratory system, similar to that of humans. They continue their living processes after harvest. After harvest, most fruits and vegetables have between lower and moderate respiration rate Both quantitative and qualitative losses occur at all stages in the post-harvest handling system of the distribution chain of perishables (from harvesting, through handling, packing, storage and transportation to final delivery of the fresh produce to the consumer). Factors affecting post-harvest losses vary widely from place to place and are more and more difficult. The objective of post-harvest handling is, therefore, the creation of an understanding of all the operations concerned from harvesting to distribution so as to enable people to apply the proper technology in each step and in such a way to minimize losses and maintain quality as high as possible during the distribution chain.

5.2. Harvesting and storage:

Temperature and humidity are used to control shelf-life of commodities in refrigerated cold stores.

Temperature management: It is the most important tool that can be used to extend shelf-life of fruits and vegetables at fresh state. Temperature management begins with a rapid removal of the field heat cold storage facilities should be well constructed and adequately equipped. They should have good construction, insulation and vapour barrier, strong floor, adequate doors for loading and unloading, effective distribution of refrigerated air, properly located controls, enough refrigerated coil surface etc.

Relative humidity: Appropriate relative humidity is important to control the; water losses, decay development, incidence of some physiological disorders and uniformity of ripening. proper relative humidity should be 85-95% for the majority of the fruits, 95-98% for vegetables (except dry onions and pumpkins at 70-75%) and 95-100% for some root vegetables. Relative humidity can be controlled by using the following methods, addition of moisture to air by humidifiers, regulation of air movement in relation to produce, maintaining coil temperature to 1 ℃ difference to air temperature, wetting the floor in the storage room; and addition of crushed ice

Controlled atmosphere: Controlled atmosphere means the addition or removal of gases resulting in an atmospheric composition surrounding the commodity that is different from that of the air 79% of nitrogen, 21% of oxygen and traces of carbon dioxide). Usually this involves reduction of oxygen and elevation of carbon dioxide, in a perfectly sealed room. The use of controlled atmosphere can be considered only as a supplement to the proper temperature and humidity procedures. Controlled atmosphere is used for a certain fruits and vegetables to extend shelf-life, reduce disorders such as chilling injuries, reduction of pathogens and some insect control.

Climacteric and Non-climacteric fruits

i. Climacteric fruits ripen after being harvested. Non-climacteric fruits do not ripen after harvesting.

ii. Climacteric fruits have an increased respiration rate, whereas non-climacteric fruits do not display any increase in the rate of respiration.

iii. Climacteric fruits secrete ethylene at an increased pace during the ripening stage. Non-climacteric fruits do not show increased ethylene secretion.

iv. Climacteric fruits can be forced to ripen by treating with small doses of ethylene. Non-climacteric fruits do not show ripening when treated with ethylene.

v. Some examples of climacteric fruits are mango, banana, papaya, tomato, apple, blueberry, and guava. Some examples of non-climacteric fruits include orange, kinnow, pomegranate, lemon, limes, grapefruit, and watermelon.

5.3 Techniques

For fruits and vegetables, manual harvesting is the most appropriate as pickers can be selective because, selective picking can ensure that only required quality is harvested, i.e. required size, colour, free from defects and diseases. Meanwhile, training of workers is important for quality assurance.

Either the whole or a part of vegetative growth can be harvested by hands only or sharp knives. Knives must be kept sharp and clean at all times to prevent from spreading virus diseases from plant to plant.

In fruits and vegetables, harvesting techniques varies with parts to be harvested:

leaves only (spinach, rape, etc.) and lateral buds (Brussels sprouts): the stem is snapped off by hand;

above-ground part of the plant (cabbage, lettuce): the main stem is cut through with a heavy knife, and trimming is done in the field (the cut stem must not be placed on the soil);
bulbs (green onions, leeks, mature bulb onions): immature green onions can usually be pulled

from the soil by hand; leeks, garlic and mature bulb onions are loosened by using a digging fork as for root crops (such as carrots) and lifted by hand. Therefore, good harvesting techniques include the use of:

white clean cloth and gloves

correct clean containers

selective harvesting and correct maturity index.

correct equipment and harvesting techniques.

harvesting time and weather conditions

Also, overfilling should be prevented

damaging the fruit, dropping the fruit in to the containers at a distance and rough handling should be prevented

Review question

1 Explain the storage technique in in F&V

2 differences between climacteric and the non-climacteric fruits

6.0 HOW TO PREPARE COMPOST MANURE

At the end of this training, participant will;

g) understand what compost manure is and how it can be prepared
h) be able to identify the materials required for making compost manure
i) understand the important of compost manure in crop production
j) know where they can make compost manure
k) know the methods of preparing compost manure and compost pith

The trainer should

1. Use pictures to explain the sources and materials used for compost making
2. Explain the significance of composting

6.1 General introduction

Compost manure can be prepared as alternative to FYM. Compost making is the best option for the farmers who don't rear the animals or cattle's with them. Compost manure is decomposed mixture of straws, grasses, fodder, ash, leaves and other parts of trees, farm waste, kitchen waste and similar material, together with dung if possible.

6.2 Advantages of the compost manure

- It provides necessary nutrients to the soil for improving its fertility.
- Increases the water absorbing capacity of soil.
- Improves the physical, chemical and biological quality of soil.
- Increase air aeration and water movement in the soil.
- Manure can be kept in soil for long time.
- Increases the microbial activity in the soil; due to which soil become soft, and increase fertility status in the soil.
- Compost manure can be prepared in own accessible places, so that it will be easy for carrying manure in the field.

6.3 Materials required for making compost manure

- Waste straws and grasses.
- Weeds, leaves fallen from trees.
- Roots and stems of young plants.
- Dung and urine of animals.
- Organic kitchen product (vegetable, food wastes)
- Limestone, ash, urea, etc.

6.4 The Place for Making Compost Manure

- The near place from farm.
- Elevated & well drained place
- Place of easy care and observation.

6.5 Methods of Preparing Compost Manure

(A) Digging pit

It is better to dig a pit on winter season than in summer season due to which the chance of drying out of material is less.

The length of the pit should be as per need, but depth should not be more than one meter.

(B) Filling pit

- The collected raw materials for making compost manure should be kept arranging in layers inside the pit.
- Wooden stick or a bamboo should be put in the middle of the pit during filling materials inside the pit.
- Spraying water in each layer of compost during its preparation will help for making good compost manure.
- It is better to make each layer up to15-20 cm (1 to 1.5 hand span).
- The use of dung and urine between the raw materials will increase the quality of the compost.
- The raw materials should be forcefully pressed inside the pit so that it decays soon.

(C) Using bamboo or wood stake for manure ventilation

During the winter and dry summer, the compost should be prepared by pit method due to which the moisture can be preserved inside the pit.

In case the temperature inside the compost become so much hot (over than 70 ºC), bacteria cannot be survived and that will damage the compost, which will give the less quality of compost. Therefore, to maintain the temperature only up to 60 ºC, bamboo or wooden stake should be put during the time of compost preparation.

The bamboo or wooden stake should be swing or stirred round by hand in every week for maintaining the temperature and passing air inside the manure, which will give well decomposed compost manure after 3-4 month.

(D) Covering by mud or plastic

After filling up the materials the pit should be covered with mud.

Covering the pit with mud stops the spread of bad smell and preserves manure from rain, direct sun-light and from nutrient loss.

(E) Heap method of making compost

Compost manure also can be produced by making heap on earth surface without digging a pit. The heap method of compost making is done in rainy season due to which the manure cannot be damaged by excessive moisture.

It is better to make a heap in slightly elevated, and drainage facilitated site. This method of making compost is better in the area where shortage of labor and time.

6.6 Identifying the Well Decomposed Compost & FYM

- The manure is decayed and appears black.
- The used materials loses its original form, and cannot be distinguished
- The manure does not stick in hand.
- The bad smell of manure is less.

Review question

1 mention the material used for compost making
2 where do you think is the best place to make compost
3 what are the advantages of compost over other manure
how would you identify a well-drained compost

7.0 IMPROVISED MEDIUM FOR PLANTING FRUITS AND VEGETABLES

Learning Objectives:
At the end of this module, participants will be able to:

1. *Understand the need to Improvised medium of planting fruits and vegetable*
2. *Understand the Types of improvised medium of planting fruits and vegetable*
1. *Understand the fruits and vegetables that grow well in each medium*

The trainer should;

1. Emphasis the importance of Improvised medium of planting especially in urban community.
2. Explain the types of improvised medium for planting fruits and vegetable in areas limited by land Take advantage of the pictorial view in this session to explain different medium
3. Explain the fruits and vegetables that grows well in different improvised medium for planting.

7.1 General introduction

All an organic fruits and vegetable garden needs is a little soil: it doesn't need to be big. Grow boxes or plant pots van can be used. You might start out with just four lettuces in a plant pot, or some leafy tomato plants in a large window box, but the experience is always magical and satisfying. Every plant, every living thing, opens a door into a world of discovery and learning. All we have to do is watch and care about what we are doing

7.2. Types of improvised medium of planting fruits and vegetable

7.2.1. The Container Garden

The cointainer garden works well in limited space. The vegetables grow into a lovely plant. Container gardens are very easy to set up and get started. The needed supplies are: containers, gardening soil, hand rake or tiller, seeds, water and compost .common vegetables that grow really well in containers:

- Tomatoes
- Potatoes
- Cucumbers
- Carrots
- Peppers
- Green onions
- Turnips
- Green beans
- Lettuce
- Squash

7.2.2. The In-Ground Garden Bed

The in-ground garden bed can be a very economical choice if there is good soil and a little extra room. A size of 500 square feet is enough to feed a family of four for eight months out of the year with plenty fruits and vegetables over to share with family, friends, and neighbours. All you need for an in-ground garden are hand tiller, seeds, compost trellis and stakes to properly grow tomatoes and Ugu. A small fence of stones, bricks, or wood will help prevent ground runoff after especially during heavy rains. With an in-ground garden, your options are limited only by your imagination. But the most common vegetables and fruits grown successfully in in-ground gardens are:

- Cabbage,
- Corn
- Beets
- Pumpkins
- Watermelon
- Squash
- Tomatoes
- Peppers
- Potatoes
- Eggplant

7.2.3. The Raised-Bed Garden

A raised-bed garden gives a little bit more room to experiment and it offer higher yields. Often ideal for a slightly larger space and can be a great alternative to direct-to-ground planting, especially if your soil conditions are not ideal. The supplies need are; built pre-made beds with cut wooden boards, a couple of layers of newspaper, top soil, peat moss, compost, grass clippings, seeds, water, and a hand tiller. Plants that grow well in raised-bed gardens include:

- Beans
- Pumpkins
- Spinach
- Pepper

7.2.4. The Window Box Garden

Even if you live in an apartment, you can still try your hand at vegetable production with a window box garden. All you need for a successful window box garden is a window box or hanging box, garden soil, seeds, and water. The best type of vegetables to grow in a window box

garden are lettuce, greens, and spinach, as they are sown on top of the soil and do not have deep roots.

7.2.5 Other growing Media
Sack or Bag Gardens or Container Garden

What You Need For Container Gardens

- buckets, pots, barrels, baskets, bottles, tins, boxes or other containers
- soil mixed with compost
- rocks for drainage




Review question

1 Mention the different improvised medium of planting fruits and vegetable available in your neighborhood
2 Why is improvised medium of planting fruits and vegetable important
3 Highlight the supply needed for each practices
4 Provide the list of fruits and vegetables that grow really well in each medium.

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