**CHAPTER ONE**

**CONCEPT OF FOOD SECURITY**

**Introduction**

The ultimate aim of agricultural production is to get agricultural products to the consumers in the form that will be useful to them. Food items including meat, fish, milk, eggs, fruits, vegetables, cereals, legumes, roots and tubers are some of the common agricultural products. Food has been defined as something good to eat. It could be in liquid, semisolid and solid forms and are necessary to carry out one or more of the life functions of the body in terms of health, growth and normal functions of living organisms. The greatest world major problem today is how to **eliminate hunger and overcome poverty**.

This challenge is greatest in the developing countries where people starve for lack of adequate food and nourishment and where starvation and poverty go hand in hand. The common strategy adopted has been increasing output of food in tonnage per year through land clearing, improved machinery, better cultivation methods, improved seeds, and improved animal nutrition, breeding and health without considering the quantity and quality of the agricultural products (food) that get to the ultimate consumer.

The World Health Organisation recommends an intake of between 2500 – 3400Kcal of energy per person per day. It is recommended that an individual should consume between 65-86g crude proteins per day out of which 35g (or 40%) must be animal protein. While many developing countries have energy intake that is far below the minimum recommended daily per capita intake, the world today faces the greatest challenge of overcoming inadequate consumption of protein (especially animal protein), vitamins (vitamin A, C and folic acid) and minerals (iron) which may result in various deficiency symptoms (diseases).

**Fundamentals of Food**

Food is necessary for health, growth and normal functions of living organisms. It is the material that enables man to grow and reproduce himself. Essentially food is a mixture of chemicals which could be separated into different components having different functions in the body. The major constituents of food are water, protein, carbohydrates, fats, vitamins and minerals. Based on the knowledge of the chemical constituents and their functions in the body, foods are classified either as proper foods (Carbohydrates, proteins and fats) for the supply of energy or as accessory foods (water, inorganic salts and vitamins) which are essential for life but do not supply energy.

**Food Security**

In the recent time, there have been a lot of concerns expressed over the looming danger of food crisis in many nations, including Nigeria. The Food and Agricultural Organization, among others have been persistent in expressing these concerns for the global food crisis over the years**. According to Food and Agriculture Organization, “Food security obtains when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996).**

The main goal of food security therefore, is **for individuals to be able to obtain adequate food needed at all times, and to be able to utilise the food to meet the needs of the body**. Food security is multifaceted. The World Bank identified three pillars underpinning food security. These are **food availability, food accessibility, and food utilization.**

From this definition, four components of food security are identifiable: availability, access, utilization and stability of food. Based on the practical guide of Food Security Information for Action, all four

**Availability:** There has to be physical, social and economic access to sufficient and nutritious food by all people and at all times. Such food must satisfy the dietary needs and preference of the people. It is the amount of food physically available in a region or place. To a great extent, food availability depends on the level of local production, imports, stock levels and net trade in food items.

**Access:** This refers to economic, social and physical access to food by all people at all times. That an adequate amount of food is available at the regional, national or international level does not imply it is accessible at household level. It must be locally accessible and affordable.

**Utilization:** Generally, utilization refers to the pattern in which the body makes use and benefits from the various food nutrients. Utilization is determined by food quality, nutritional values, preparation method and storage as well as feeding pattern.

**Stability:** this refers to the stability of food availability, accessibility and utilization over time. All three components must be present simultaneously at all times. A person who has adequate access to quality food today is still considered food insecure if he has periodic inadequate access to food which may cause his nutritional level to deteriorate. Variation in weather conditions, political and economic instability, and price fluctuation are some factor that may impact on food security status.

**Food Insecurity**

This means that a nation whose food production level is unable to satisfy these three criteria is said to be **food insecure**. Supporting this assertion, Maxwell stated that a country and its people are food secured when their food system operates in such a way as to remove the fear that there will not be enough to eat. He further stressed that food security requires that the poor and vulnerable have secure access to the food they want. The World Food Summit plan of Action states that food insecurity occurs when;

1. People experience a large reduction in their sources of food and are unable to make up the difference through new strategies.
2. The prevalence of malnutrition is abnormally high for most time of the year, and this cannot be accounted for by either health or care factors.
3. A large proportion of the population or group is using marginal or unsuitable strategies, and people are using ―coping strategies that are damaging to their livelihoods in the longer term or incur some other unacceptable cost, such as acting illegally or immorally.

**Consequences of Food Insecurity**

Food insecurity and hunger are forerunners to nutritional, health, human and economic development problems. They connote deprivation of basic necessities of life. As such, food security has been considered as a universal indicator of households‘ and individuals‘ personal well – being, the consequences of hunger and malnutrition are adversely affecting the livelihood and well - being of a massive number of people and inhibiting the development of many poor countries.

Malnutrition affects one out of every three pre-school age children living in developing countries. This disturbing, yet preventable state of affairs causes untold suffering and presents a major obstacle to the development process. It is associated with more than half of all children deaths worldwide. It is therefore the bane of a major waste of resources and loss of productivity which are common occurrences in developing countries.

**Origin of Food Crisis in Nigeria Agriculture**

Agriculture in Nigeria has been the most important sector of the economy from history and the standpoint of rural employment, food production and fibre, and export earning prior to the discovery of oil. The above assertion is based on the fact that as at independence in 1960, little was known of petroleum as a source of revenue for the Nigerian economy. There was sustained emphasis on agriculture to the extent that Nigeria was a major exporter of such agricultural products such as palm produce, cocoa, groundnut, cotton and rubber. In addition to these cash crops, the national agricultural system was able to produce enough of food crops like yam, cassava, maize, millet, sorghum and soya beans to the extent that there was almost no need for food importation.

Hitherto, agriculture accounted for over 60% of the Nation‘s Gross Domestic Product (GDP). However, with the advent of petroleum in the early 1970s, petroleum became the country‘s major foreign exchange earner and agriculture became grossly neglected. Agriculture has remained the largest sector of the Nigerian economy. It generates employment for about 70% of Nigeria‘s population and contributes about 40% to the Gross Domestic Product (GDP) with crops accounting for 80%, livestock 13%, forestry 3% and fishery 4%.

The roles of agricultural sector in the Nigerian economy therefore include:

1. A major contributor to the country’s gross domestic product
2. Source of income for a large proportion of the population engaged in the sector
3. Provision of adequate food for the people
4. Supply of raw materials required by the industrial sector
5. A major foreign exchange earner through export
6. Provision of employment opportunities for the teeming population

**WAYS TO IMPROVE FOOD SECURITY**

For there to be improvement in food and nutrition security situation of a country, national governments must address a number of issues including the following:

1. Provision of access to sufficient quantities of food items. This may require formulation of policy for sustained, broad-based, economic growth.
2. Direct nutrition interventions to provide food to those suffering from acute hunger and malnutrition and nutrition information and supplements to women of childbearing age and young children are necessary. Such interventions are a vital component of any effort to build the quality of human capital, encourage economic growth, and improve standards of living.
3. Enhancing the means to acquire food, whether through cash incomes or access to productive resources. Increased food supplies simultaneously increase the income of farming households and reduce the prices people pay for food in the marketplace, both of which enhance nutrition security.
4. Provision of clean water, adequate sanitation and effective health services. This is very important for the individuals to benefit from the food consumed. Poor health situation of the individuals may prevent them from having nutrition security.
5. Efforts must be made to open national markets to international trade, both within Africa and globally, as national food availability should not depend upon national food production alone.
6. Locally conceived and implemented action has been shown to be the most effective way to improve food and nutrition security. National governments should give broad direction to local efforts and facilitate the success of such efforts through resource allocation, institutional support, and the provision of necessary expertise.
7. Central governments should ensure that budgetary allocations reflect the central importance that food and nutrition security have for the welfare of all people, as well as the immense economic benefits they provide for relatively little cost. In this regard, donor funding should be viewed as a secondary resource, and used to complement the resources allocated by governments.
8. Dedicated advocacy should be used to inform policymakers at all levels of the critical role that improved nutrition plays in development and poverty alleviation. The need to improve food and nutrition security must be communicated effectively and understood widely; its significance for the welfare of all members of society must be recognized.

**ARABLE CROPS PRODUCTION**

**CASSAVA** Manihot esculenta Crantz

Cassava is a perennial woody shrub with an edible root, which grows in tropical and subtropical areas of the world. Cassava originated from tropical America and was first introduced into Africa in the Congo basin by the Portuguese around 1558. Today, it is a dietary staple in much of tropical Africa. It is rich in carbohydrates, calcium, vitamins B and C, and essential minerals. However, nutrient composition differs according to variety and age of the harvested crop, and soil conditions, climate, and other environmental factors during cultivation. **Importance**   
In sub-Saharan Africa (SSA) cassava is mainly a subsistence crop grown for food by small-scale farmers who sell the surplus. It grows well in poor soils with limited labor requirements. It provides food security during conflicts when the invader cannot easily destroy or remove the crop, since it conveniently grows underground. Cassava is usually intercropped with vegetables, plantation crops (such as coconut, oil palm, and coffee), yam, sweet potato, melon, maize, rice, groundnut, or other legumes. The application of fertilizer remains limited among small-scale farmers due to the high cost and lack of availability. Roots can be harvested between 6 months and 3 years after planting. Apart from food, cassava is very versatile and its derivatives and starch are applicable in many types of products such as foods, confectionery, sweeteners, glues, plywood, textiles, paper, biodegradable products, monosodium glutamate, and drugs. Cassava chips and pellets are used in animal feed. **Production**  
More than 228 million tons of cassava were produced worldwide in 2007, of which Africa accounted for 52%. In 2015, Nigeria produced 65 million tons making it the world's largest producer. According to 2002 FAO estimates, Africa exports only one ton of cassava annually.

**Consumption**  
Almost every person in Africa eats around 80 kilograms of cassava per year. It is estimated that 37% of dietary energy comes from cassava. Nigeria is the largest consumer of cassava in Africa.

**Choice of land**

Choose well-drained, deep, loamy soils. Where such is not available sandy and clayey soils can be managed intensively for cassava production. However, very sandy and clayey soils should be avoided. Planting on the flat is recommended when the soil is deep and well drained as in sandy loam soils

**Choosing a variety**

Carefully select varieties with multiple pest and disease resistance, high and stable root yields and acceptable quality characteristics that meet end users requirements for food (gari, fufu, fermented flour etc) and industrial raw material (starch, chips, pellets, unfermented flour etc). The major genetic factor that determines quality of roots is dry matter content.

**Recommended varieties**

Several improved varieties of cassava have been recommended and released in Nigeria. Some cassava varieties include TMS 30572, TME 419, NR 8082, TMS 1412

**Acquisition of planting materials**

Stems of improved varieties can be obtained from National Seed Service (NSS), state offices of Agricultural Development Programs (ADP), the Cassava Growers Association (CGA) and several out-growers who produce quality stems for sale. Stems are usually tied in bundles each having 50 stems that are 1metre long. Fifty of such bundles are needed to plant 1 hectare of land. Keep bundles of stems stacked vertically on the soil under a shade. The distal end of the stem should touch the soil. Moisten the soil regularly and keep the surrounding weed free. This way you can store your stems for more than 3 months. Under low relative humidity and heat stress store your stems in pits under shade.

**Stem quality**

Cassava stakes (cuttings) for planting should be taken from plants 8 – 18 months old. Stakes taken from older plants are lignified and they perform poorly due to delayed sprouting and rooting. A mature cassava stem has 3 sections – hardwood, semi-hardwood and shoot-tip. The hard and semi-hardwood sections are the best for planting. Shoot tips are very fragile and have high mortality rate especially if they are subjected to moisture stress during the first month after planting. If you must source planting materials from an old field (over 18 months) the semi-hardwood section gives the best quality.

**Time of planting**

Planting should be done as soon as the rains become steady in your area. This varies from March to November in the rain forest, April to August in the derived savanna, May to July in the Southern Guinea savannah (SGS) and July to August in the Northern Guinea savanna (NGS).

**Method of planting**

Stakes can be planted vertically (buds facing up with 2/3 of the stake in the soil), horizontally (whole stake buried 3-5 cm in the soil) or inclined (buds facing up with 2/3 of the stake buried in the soil at an angle of about 45). When stakes are planted vertically, tuberous roots bulk deep into the soil. Although this gives more stability to the plant against lodging, it makes harvesting very difficult. This orientation is recommended for sandy soils.

Stakes planted horizontally produce multiple stems and more tuberous roots but they are comparatively smaller in size. The roots are produced near the surface and they are easily exposed to mechanical damage and to rodents. However, in loamy and rich soils the multiple stems and roots are at an advantage resulting in high yields. Stakes that are inclined on the ridge produce tuberous roots in the same direction. The inclination of the stem and roots provide a leverage which makes harvesting easier than in the other orientations. In shallow and clayey soils, stakes should be inclined. In the rain forest and derived savanna, farmers incline their stakes at planting.

**Plant population**

The optimum plant population for high root yield is 10,000 plants per hectare obtainable when plants are spaced at 1 x 1 m. This population is seldom achieved at harvest due to losses caused by genetic and environmental factors.

**Chemical Control**

If your field is infested with difficult-to-control weeds like Spear grass (Imperata cylindrica) carefully apply systemic herbicides like Glyphosate, Fusilade or Sarosate. Follow the manufacturers’ guidelines for each of the herbicides. Weather conditions affect herbicide performance. Do not apply herbicides soon after a heavy rainfall or when it is likely to rain to avoid diluting the chemical and reducing its effectiveness. For best results gramozone should be sprayed only when you are sure of having at least 3 hours of sunshine after spraying. For cost effectiveness and results use skilled staff for chemical weeds control.

**Fertilizer rate and time of application**

Ideally, fertilizer recommendations should be based on soil analysis but when this is not done then use the land history and vegetation as a guide. Lands naturally inundated with Chromolaena odorata (Akintolataku or Siam weed) as this weed can support a good cassava crop without fertilizer while the presence of Spear grass or poorly established vegetation is a signal for fertilization. Under continuous cultivation in the forest zone apply a first dose of 200kg (4 bags) of N: P: K 15:15:15 per hectare at 4-6 weeks after planting (June-July). A second dose of 100kg of muriate of potash per plant at 14-16 weeks after planting (September) should also be applied. Do not apply fertilizer if the soil is dry.

**Harvesting**  
Nineteen million hectares of cassava were planted worldwide in 2007, with about 63% in Africa. Cassava requires less labour than all other staple crops (21% in working days as compared to maize, yam and rice). However, it requires considerable postharvest labour because the roots are highly perishable and must be processed into a storable form soon after harvest. Roots can be harvested between six months and three years after planting. Many varieties contain a substance called *cyanide* that can make the crop toxic if inadequately processed. Various processing methods, such as grating, sun drying, and fermenting, are used to reduce the cyanide content.

Plants can be harvested at 9 – 18 months after planting to give root yields ranging from 15 – 50 tons or more per hectare depending on the variety, environment (soil fertility status, acidity level, moisture level and sunshine hours) and agronomic practices adopted. Harvest roots only when you have a ready market. Avoid bruising the roots excessively during harvesting otherwise they will deteriorate very rapidly. For quality products, process the roots as soon as they are harvested and not later than 48 hours. The major quality trait for market acceptability of roots is dry matter content.

**Diseases**  
The major pests of cassava in SSA are the cassava green mite and the variegated grasshopper. The main diseases affecting cassava are cassava mosaic disease (CMD), cassava bacterial blight, cassava anthracnose disease, and root rot. Pests, disease and poor cultivation practices combined can cause yield losses as high as 50% in all of Africa.

**Pests:** Cassava mealy bug (cm) cassava green spiders, mites, termites and variegated grasshopper are common pests.

**ANIMAL PRODUCTION IN THE TROPICS**

**THE DIRECT ROLE OF LIVESTOCK TO FOOD SECURITY**

**Livestock as an important food source**

Animal products are primarily a source of proteins and essential amino acids, but when they are a major constituent of the human diet they also contribute a significant proportion of total calories. In developed countries they provide more than 30 percent of calories in the diet. In developing countries, however, this proportion is less than 10 percent, but they are a source of essential amino acids that balance the largely vegetable-based proteins.

**Livestockhelp to alleviate seasonal food variability**

Even though milk production is seasonal and surpluses cannot be stored as easily as cereal grains, there are simple technologies that allow herders to keep milk products for weeks or months in the form of clarified butter, curds or various types of cheese. Animals, particularly small livestock, are slaughtered as the need arises. Meat preserved by drying, salting, curing and smoking can be used when other food sources are scarce.

**Livestock as a source of income**

Animal products not only represent a source of high-quality food, but, equally important, they are a source of income for many small farmers in developing countries, for purchasing food as well as agricultural inputs, such as seed, fertilizers and pesticides. In addition, at farm level, cash can be generated regularly from direct sales of livestock products, such as milk, eggs and manure, occasionally from the sale of live animals, wool, meat and hides and from fees for draught power or transport services. Livestock also provide increased economic stability to the farm or household, acting as a cash buffer (small livestock) and as capital reserve (large animals), as well as a deterrent against inflation.

**Livestock as a generator of employment**

Goat, sheep, poultry and rabbit husbandry, especially in backyard production systems, provides an important source of part-time job opportunities, particularly for landless women and children. The livestock-product processing sector has also been identified as a contributor to employment generation and the reduction of rural depopulation. Small-scale milk processing/marketing is labour-intensive (50 to 100 kg per working day) and generates employment and income from the local manufacture of at least part of the equipment required.

**Livestock as a supplier of production inputs for sustainable agricultural development**

In mixed-farming systems, not only can farmers mitigate risks by producing a multitude of commodities, but they can also increase the productivity of both crops and animals in a more profitable and sustainable way. In this context, livestock can make a major contribution to the efficient use of available natural resources.

**Livestock as a source of energy**: Draught animal power like Bovines, equines, camels and elephants are all used as sources of draught power for a variety of purposes, such as pulling agricultural implements, pumping irrigation water and skidding in forests. The current number of animals used for draught purposes is estimated at 400 million. On the other hand, 90 percent of the world's tractors and their implements are produced in industrialized countries and most of those used in developing countries (approximately 19 percent) have to be imported. Animal traction, therefore, avoids the drain of foreign exchange involved in the importation of tractors, spare parts and fuel.

**Livestock as a source of fertilizer and soil conditioner**

Nutrient recycling is an essential component of any sustainable farming system. The integration of livestock and crops allows for efficient nutrient recycling. Animals use the crop residues, such as cereal straws, as well as maize and sorghum stover and groundnut husks as feed. The manure produced can be recycled directly as fertilizer. In addition to the direct contribution of plant nutrients, manure provides important organic matter to the soil, maintaining its structure, water retention and drainage capacity. The value of manure is so well-recognized that some farmers keep livestock primarily for this purpose.

**POULTRY PRODUCTION**

Birds are a group of higher animals with feather covered bodies which reproduce by means of laying and hatching eggs. The term “Poultry” is used to describe any type of domesticated bird kept for meat or egg production such as fowls or chickens, ducks, geese, turkeys, guinea fowls, pigeons and quails. Poultry industry has many branches. The two main branches are egg and table meat production.

**TERMS USED IN POULTRY PRODUCTION**

**Hen**: A matured female chicken generally above 20 weeks of age.

**Cock**: A matured male chicken above 20 weeks of age.  
  
**Pullet**: A young female chicken from 9 to 20 weeks of age.  
  
**Cockerel**: A young male chicken from 5-8 months of age.  
  
**Chick**: A young male or female fowl below 8 weeks of age.  
  
**Day-old chick:** Hatched out chick is called as day-old-chick up to 24 hours.  
  
**Brooding**: The process of rearing the young chick from day old stage to 4 to 6 weeks of age during which, heat is to be provided to keep them warm.  
  
**Broiler**: They are the hybrid chicks having rapid growth and attaining about 1.5 kg weight during the period of 6 weeks of age. Sold for table purpose within 8 to 10 weeks period. They possess a very tender and delicious meat.  
  
**Capon**: It is a young male birds of which testicle are removed.  
  
**Layer**: An egg laying female chicken up to one year after starting the laying of eggs.  
  
**Broody**: A hen which has stopped laying eggs temporarily.  
  
**Clutch**: The number of eggs laid by a bird on consecutive days. A clutch of 3-4 eggs is preferred.  
  
**Moulting**: The process of sheding old feathers and growth of new feather in their place, moulting normally occurs once in a year.  
  
**Culling**: Removal of unwanted bird from the flock is known as culling e.g. old non-laying birds, sick birds and masculine hens are removed.  
  
**Pause**: It is the period between two clutches in which eggs are not laid by hen.  
  
**Hen-day-production:** This is arrived by dividing total eggs laid in the season by the average number of birds in the house.  
  
**Hen-housed-average:** This is arrived at by dividing the total number of eggs laid in the season by the number of birds originally placed in the house.  No deductions are made for any losses from the flocks.

**Chickens**

Chicken (domestic fowl) is the commonest type of poultry and is found everywhere in West Africa. It is well adapted to tropical climatic conditions and can be easily managed. The investment on chickens yield quick returns and the products (meat and eggs) are popular protein sources.

**Breeds of chickens**

There are many breeds of chicken, some are bred for meat, some for their egg-production qualities and others for both egg and meat production (dual –purposes).

The common breeds are;

1. West African dwarf.
2. Exotic (imported) breeds:-These are imported mainly for the purpose of producing fertilized hatch-able eggs. The hens and cocks are raised together at the ratio of 15 hens to 1cock.They must have such qualities as high growth rate, high egg production level and resistance to diseases. Exotic breed could be highly susceptible to diseases, sensitive to feeds and varying environmental factors.
3. Broilers:-They are table birds raised mainly for meat with good management and feeding. They will attain weight of 2kg at an average of 8weeks which is mostly preferred by the hoteliers and fast food industries. They convert feed consumed to meat.
4. Pullets:-These are layers, meant mainly for egg production. It takes average of 4-5months from the day-old chicks (time they were hatched) before they starts laying. They lay between 1-1.5 years depending on the management before you dispose them as spent layers during festive period.
5. Cockerel:-These are cocks mainly for table meat and in breeding farms to service the layers. They take average of 6months on the farms to reach.

**HOUSING SYSTEM IN POULTRY**

**INTENSIVE SYSTEM:** It prevents the birds from having access to pasture and intense sunlight. Feeds, water and all medications are provided for the birds.

**SEMI INTENSIVE SYSTEM: -** Some form of housing is provided, grazing and a form of wandering is allowed but within an enclosure. Their movement is partially restricted while temporary structures are provided as shelter.

**EXTENSIVE SYSTEM OR FREE RANGE SYSTEM: -** Birds are not confined within the building and are allowed to move out. Initial capital requirement is small and the labour involved is very small**,** It also minimizes the incidence of ecto-parasite attack e.g ticks and lice**.**

**THE BROODING HOUSE**

This is a special house wherechicks takes place during brooding stage, the brooders house is constructed in such a way that the sides of the building is covered with polythene sheets, As the animals advance in age the polythene sheets can be gradually rolled up in a stepwise manner to allow inflow of air (ventilation).In view of the climatic condition in the tropics, especially high ambient temperature and high relative humidity. The roof is better covered with asbestos roofing material. The floor of the house should be properly cemented. Furthermore, there should be provision of appliances that provides heat or warmth. The heating devices include high voltage electric bulb, kerosene stoves, coal pots, hoover, and hot water pipe system. The heat provides warmth within the brooding house. The moment the heat being provided is getting unnecessarily high, the chicks react by making sharp sound and at the same time spreading out their wings if the contrary takes place, the chicks are seen clustering around the heat source. As the chicks advance in age, there is a reduction in provision of warmth, consequently the polythene sheet is gradually rolled up until the end of the brooding stage

**INCUBATION:-** this is the act of providing optimum temperature for the fertilized egg to develop into chick. It is done naturally by the brooding hen and artificially in large commercial farms using incubator.

**HATCHING:-**This is the act of liberating fully developed chick from the shell after incubation.

**FEEDING**

Chicks’ diet must be rich in protein of high quality and the crude protein content should not be less than 23% and all essential amino acids must be fully represented to encourage proper growth and also to make them develop resistance against diseases. The animals must be fed ad-libitum and throughout the night which means there must be provision of adequate amount of vitamins and mineral elements especially Calcium, Phosphorus, Copper and Iron. Calcium and phosphorus play a significant role in bone formation or osteogenesis while copper and iron are responsible for blood formation. Zinc is also needed for feather formation.

**POULTRY DISEASES**

Poultry diseases include fowl pox, fowl cholera, chronic respiratory disease, Newcastle, gomboro, fowl typhoid, cocciodiosis. The causative organisms are fungi, bacteria, virus & protozoa. Anti-bacteria drugs, anti-fungal drugs, anti-viral drugs and anti-protozoa drugs will be suitable to treat the afore-mentioned classes of diseases. Consult your veterinary officer for disease diagnosis and drug recommendation.

**AGRICULTURAL PROJECTS, FEASIBILITY STUDY AND REPORT WRITING**

**Definition**

An agricultural project is the smallest unit of an investment activity in crop production, livestock production, aquaculture and processing of agricultural commodities. It can be defined as an identifiable business proposal for committing scarce resources to create economic opportunities and wealth sources capable of generating future income streams. It is also an investment activity in which money is expended to acquire capital assets used in production and processing that yield economic benefit over a long period of time. It has also been defined as a scheme for organising the use of a level of available resources in a specified way in order to achieve a particular result based on the objectives of the investment activity.

**GENERAL CHARACTERISTICS OF AGRICULTURAL PROJECTS IN NIGERIA**

1. A project makes use of scarce resources that have alternative uses.
2. There is a time lag between the commitment of scarce resources and generation of income streams.
3. There is a waiting element due to uncertainty associated with production. For instance, drought, fire outbreak, herdsmen invasion, pests, diseases, fluctuation in price e.t.c.
4. Agricultural projects are subject to great variability as a result of biological, environmental, climatic and other factors.
5. Agricultural production and processing is majorly characterised by small holdings with the exception of few large corporate agribusinesses.
6. Most agricultural projects are time sensitive due to production seasonality.
7. Agricultural projects are complex in nature and require multidisciplinary approach.

**Project cycle**

This is a continuous sequence of how projects are planned and executed. The cycle consists of five distinct stages;

1. Identification/Selection
2. Preparation and Analysis
3. Appraisal
4. Implementation/Monitoring
5. Evaluation

**Project identification/selection**

It is the first stage in the natural sequence of project cycle. It involves finding potential projects which will usually arise from investors, promoters, technical specialists and politicians. Ideas for new projects can be a start up or an expansion of existing agribusiness. The proposal could come from newly identified economic opportunities as a result of government policy, globalisation and other factors. The possible sources of potential projects are,

1. Expansion of existing production
2. Import substitution
3. Economic diversification
4. Export promotion
5. Value addition in agricultural export

Identified projects should agree with the national agricultural sector plan, objectives, targets, policies and regulations.

Projects are selected based on the following desirable criteria,

1. Suitable soil and climatic factors
2. Favourable ecological and topographic factors
3. Access to raw materials
4. Favourable government policies and support
5. Proximity to export market
6. Availability of large domestic market
7. Encouraging investment climate such as tax holiday, input and product subsidy

**Project Preparation and analysis**

The second stage in the cycle is the preparation and analysis of the proposed project. It involves all the work necessary to bring a project to a point where it can be carefully reviewed, appraised and analysed to determine the suitability of the proposed project for implementation and commitment of scarce resources. The success of a project depends largely on the quality of preparation undertaking by the technical specialists. Agric projects preparation task require the input of technical experts in a multi-disciplinary team. The specialists in an agric project preparation team include agronomist, agricultural economist, animal scientist, soil scientist, plant scientist, agricultural extension specialist, engineers, financial analyst e.t.c. The first step in the preparation of agricultural project is to carry out a detailed feasibility study – a blue print that will supply enough information to guide the decision to commit resources to project or otherwise. It is the basis for which a proposed project is accepted or rejected.

**Appraisal**

A critical review of all the assumptions made concerning the project budget is undertaken by an independent analyst to ascertain the reality of the assumptions. If serious flaws are discovered, it is essential that the document be discarded and a new blue print should be prepared to replace it. The review appraise the technical, commercial, environmental and financial aspects of the feasibility report to establish reality. Analyst will review input prices, expected output, output prices, market share, industry structure, competition, production technology, availability of manpower, availability of inputs, effective demand for the products, target market, sensitivity to price change, profitability e.t.c.

**Implementation/monitoring**

The stage where scarce resources are committed to a project is that it has been adjudged viable. At this stage implementation is seriously monitored to ensure that actual result reflects the expected result as contained in the blue print or project plan. Budget is closely monitored for variability and deviation since price is a dynamic variable that is determined by prevailing market conditions. A control mechanism should be included in the implementation plan to ensure viability of the project at all time.

**EVALUATION**

At this stage, the actual achievement is evaluated to learn some lessons as regard the entire project cycle.

**CLASSIFICATION OF PROJECT COST AND BENEFIT**

Project cost and benefit can be classified into:

1. Tangible i.e. measurable in monetary terms
2. Intangible i.e. not measurable in monetary terms

**TANGIBLE COST OF AGRICULTURAL PROJECTS**

1. Physical goods: building, factory, machinery, equipment, seed, fertiliser e.t.c
2. Labour: can be hired
3. Land: can be purchased, rented or leased
4. Capital: can be borrowed at an interest rate
5. Miscellaneous: provision made for unanticipated expenses

**TANGIBLE BENEFIT OF AGRICULTURAL PROJECTS**

1. Increase in value of production through cost reduction
2. Increase in revenue as a result of quality improvement
3. Increase in price through change in time of sale as a result of investment in storage
4. Increase in profit margin through investment in processing facilities
5. Reduction in post harvest losses

**INTANGIBLE COSTS OF AGRICULTURAL PROJECTS**

1. Destruction of settlement and family life pattern
2. Environmental pollution as a result of the project
3. Offset of ecological balance and loss of biodiversity

**INTANGIBLE BENEFITS OF AGRICULTURAL PROJECTS**

1. Creation of new job opportunities
2. Better nutrition and sound health
3. Improved community infrastructure and rural development

**FEASIBILITY STUDY AND REPORT WRITING**

**Definition**

A feasibility study is an analysis of the viability of a business idea. It is an investigation of a project to validate the viability of the project by examining it through the technical, economic, commercial, financial and environmental impact lens. It focuses on the rationality or otherwise of the investment required to execute the project. Farmers and processors with business ideas should test the ideas through the conduct of feasibility studies. A feasibility study can be used to develop business plan in agricultural related enterprises.

The feasibility report contains the details of the outcome or result of the feasibility study conducted on an idea. Generally, it is sponsored by idea promoters, technical partners, financiers and it is conducted by technical specialists as individuals or a team depending on the complexity of the project.

**Objectives of a feasibility study**

The objectives of a feasibility study are:

1. Provide evidence in a document form of the technical possibility and commercial viability of the proposed project.
2. To secure government approval and / or licence
3. To secure funding for the project.

**Scope of feasibility study**

**Technical analysis:** it involves identifying all the materials needed to produce an output, the quantity and unit price of the inputs, projected output and unit price, project description, project engineering, project site, soil analysis, water analysis, crops that will thrive well, pest and disease prevalence, cropping patterns e.t.c.

**Economic analysis:** it shows the costs and benefits to the economy. Most external factors that affect the economic as a result of the project are captured in this analysis.

**Commercial analysis:** it entails identifying the past and present trends in input and output market through which the future trends in demand and supply of both input and output can be predicted. It involves industry and competition analysis, market share to be captured, past and projected future prices of both inputs and output e.t.c.

**Financial analysis:** it is done to determine the extent of feasibility of projects using discounted measures of project worth and to ascertain the sensitivity of the project to change in the prices of inputs and outputs. Discounted measures of project worth include Net Present Value (NPV, NPW) Internal Rate of Return(IRR) and Benefit-Cost Ratio.

**Environmental impact assessment:** it is an assessment carried out to show the impact of the project on the environment and measures to avoid or mitigate negative impacts created as a result of the project.

**IMPORTANCE AND USES OF FEASIBILITY REPORT**

Feasibility report is important and can be used for the following:

1. It helps in the identification and choice of projects
2. It helps in making rational investment decisions
3. It aids in efficient resource allocation
4. It helps in time scheduling and project implementation
5. It serves as a planning and technical document to provide guidance
6. It is used for post audit review at the conclusion of project.
7. It helps in securing finance, sponsors and approval for the project

**Steps in conducting feasibility study**

* Engagement and Terms of Reference
* Definition of Project Scope
* Gathering of data
* Analysis of Data
* Consideration of Alternatives
* Budget/Cost Estimate
* Project Team
* Contract Signing
* Actual Study
* Report Writing

**CONTENTS OF A FEASIBILITY REPORT**

The content of a feasibility report include in the following order;

* Chapter 1: Executive Summary and brief description of the project
* Chapter 2: Introduction, Sponsorship, Management and Technical Partners
* Chapter 3: Market and Sales
* Chapter 4: Technical Feasibility, Project Engineering, Resources and Environment
* Chapter 5: Government Support and Regulatory Policies
* Chapter 6; Project Implementation Timelines
* Chapter 7: Financial Evaluation – project cost and revenue estimates
* Chapter 8: Funding Mechanisms
* Chapter 9: Conclusions

**AN EXAMPLE OF A TYPICAL FEASIBILITY REPORT**

A FEASIBILITY REPORT / BUSINESS PLAN FOR THE DEVELOPMENT OF A FOUR HUNDRED HECTARES SOYABEAN PLANTATION AND ESTABLISHMENT OF 20 TONNES PER DAY CAPACITY SOYA OIL EXTRACTION PLANT AT AFE BABALOLA UNIVERSITY FARM, ADO EKITI, EKITI STATE, NIGERIA BY TOYOM AGRIBUSINESS VENTURES AND CONSULTANCY CONFIDENTIALITY AGREEMENT

The undersigned reader acknowledges that the information provided in this business plan is a confidential intellectual property; therefore the reader agrees not to disclose it to a third party without the express written permission of the promoters of the proposed business.

It is acknowledged by the reader that information furnished in this business plan is in all respect confidential in nature, other than information which is in the public domain through other means and that any disclosure or use of same by the reader, may cause serious harm or damage to the promoters of the proposed business.

Upon request, this document is to be immediately returned to the promoters of the proposed business

Signature:

Name:

Date:

**CONTENTS OF A FEASIBILITY REPORT**

1. Executive Summary/ Brief Description of the Project
2. Sponsorship, Management and Technical Assistance
3. Market and Sales
4. Technical Feasibility, Resources and Environment
5. Government Support and Regulation
6. Timelines of Projects
7. Estimated Project Cost and Revenue
8. Funding Mechanism
9. Conclusion

**Executive Summary/ Project Description**

This business plan examines the feasibility of and indeed economic viability of the development of a 400hectares soya beans plantation and the establishment of a soya beans oil extraction plant in Ado Ekiti by Afe Babalola University and Afe Babalola Farmer’s Cooperative Society Limited. The farm will produce about 1,200tonnes of soya beans in a production cycle. The soya oil extraction plant will process about 4,200tonnes of soya beans into edible soya oil, soya cake for livestock industry and soya sludge for soap, cosmetics and paint industry. There is high domestic demand for these products because of our huge population and production constraints leading to shortage of the commodity. Production is currently popular in the North Central and North West with Benue State and Kaduna as the lead producers. Nigeria imports significant quantity of soya beans and its derivatives to augment domestic shortages.

The proposed project will create economic opportunities, impact positively on the people and help conserve scarce foreign exchange. The entire soya to be processed will be sourced locally through direct production, contract farming in Ekiti State and direct purchase from smallholder farmers in other production areas. The project will create market access, improve income of farmers and contribute significantly to food security. It will also generate satisfactory returns for sponsors and investors.

**Sponsorship**

The project is sponsored by Aare Afe Babalola, a legal luminary and founder of Afe Babalola University. Aare Afe Babalola is promoting the productivity of smallholder farmers in Ado Ekiti through the Afe Babalola Farmer’s Cooperative Limited. The University has a Department of Agriculture and experts with many years of experience in the project being proposed. Toyom Agribusiness Ventures & Consultancy will be responsible for the management consultancy of the projects.

**Management**

The management will comprise of a democratically elected Board of Directors at the apex of the organization structure. This will be made up of shareholders and member of the cooperative who have stake in the survival, growth and profitability of the business as well as distinguished agribusiness professionals of proven integrity and vast experience in the project area. The prime objective of the board will be to give strategic directions and policies that will ensure long term success of the organization. The board will ensure that the organization complied with all standards set by regulatory authorities.

The Managing Director/President shall be responsible for the co-ordination of the day to day management of the cooperative business. He is accountable to the Board of Directors; he will mobilize organization resources to achieve set goals. He will manage business risks and focus on wealth creation.

**Technical Assistance**

The university has working relationship with IITA (International Institute of Tropical Agriculture, Ibadan) through an executed MOU. IITA has mandate in Soya beans production and processing and will provide technical assistance in this regard. The University also has a working relationship with BOA (Bank of Agriculture) and we are collaborating on Aare Afe Babalola Annual Agric Expo where the founder appreciate Ekiti Farmers through monetary award to the best 3farmers in each local government area of the 16 L.G.A in Ekiti State and the overall best farmer in the state. Bank of Agriculture has agreed to finance production of the 400hectares of soya through a loan at 9% interest rate (anchor borrower’s scheme) given to the cooperative

The university will fund the processing factory and access finance for the soyaoil extraction equipment from BOI (Bank of Industry) at the rate of 9% . The cooperative will also seek grant from United State Africa Development Foundation(USADF). The University has relationship with commercial banks and will approach one for loan to clear the land which will be leased to members of the cooperative.

The University has a working relationship with Ekiti State Government, Ekiti State Ministry of Agric, Farmers’ Union, Agric Cooperatives and individual farmers. The university will get technical support from this relationship in the area of production through contract farming or outgrower scheme.

The university has working relationships with and linkages to industry players in the project area who will offtake products through a purchase and sale contract agreement. They include Flour Mill of Nigeria Limited, Obasanjo Farms Ltd, Animal Care, Amo Farms, Farm Support and others. The soya oil will be sold through cooperatives and other distribution channels. The soya sludge will be sold to players in the paints and cosmetics industry.

**Market and Sales**

Market orientation: domestic; South West & South East, Nigeria

Market Share: 5% niche market in South West, South East Nigeria

Users of Products: edible oil for human, soya cake for the livestock industry, soya sludge for paint and cosmetics industries in South East.

**Competition analysis**

Benue State alone produced 44% of national output between1999 and 2017. Kaduna State followed with 27% of national output within the period. Taraba, Plateau, Kano, Niger and katsina produced 6% and below in the period. The seven state mentioned above produced 94% of national output within the period. The only places where significant production took place in South West, Nigeria was in Saki West L.G.A. in Oyo State and Akure North L.G.A in Ondo State. Based on this above analysis, competition in terms of production in South West, Nigeria is non- existent Compare to the demand for produce.

**Tariff and Import Restriction**

Forex restriction on food importation and zero duty on imported agricultural equipment will favour the project under consideration.

**Market Potential**

There is strong demand for soyabean and soyabean derivatives in the Southern part of Nigeria. The state of infrastructure though not perfect still supports production and trade within Nigeria.

**Profitability**

Weather, biological, chemical, physical and environmental factors such as temperature, sunlight, water, air, soil conditions, varieties of seed, pests, diseases, price fluctuations and other risks e.g. cow invading the farm could affect yield and profitability. However, technical, scientific and financial based solutions will be employed to hedge against risks and safeguard profit. Irrigation option will be factored in to ensure two cycle of production in a year.

**Technical Feasibility**

The projects (production of soyabean and soya oil extraction) are technically feasible. In terms of technology, which involve the crushing of soyabean seed and extraction of oil, the industrial processes are simple and a specialist in oil extraction with more than 20years experience is part of our team. The needed equipment for oil extraction are readily available and our experts have hand on experience in the usage and maintenance of the equipment.

On the soyabean production, we have specialists in mechanization, irrigation, farm management, crop production, weed science, market development, agric extension and accounting as part of our management team. We also have specialists in quality control as part of our management team. The state of infrastructure around the University and generally in Ekiti is adequate and suitable for the location of the farm/firm for efficient production, processing and marketing. Raw materials will be produced and sourced locally.

The major competitors in the South West are GRAND CEREALS and JOF with the Grand Soya oil brand and Executive Chef brand. Grand Cereal has an installed capacity of 150tonnes per day in Lagos and 100tonnes per day in Jos While JOF has a capacity of 120tonnes per day in Akure, ABUAD farms will target a market niche and penetrate through cooperative societies to make our brand popular. From our analysis, integration of production and processing will give us a competitive advantage.

We are implementing our project using best international practices, sustainable production and due consideration for the environment. Although some degree of deforestation will occur, the EIA(Environmental Impact Assessment) report shows little or no damage to the environment as it relates to the issue of climate change. Organic fertilizer will be substituted for chemical fertilizer within three years of farm operations.

**Government Support and Regulation**

The project conform with the economic diversification objective of the government. It also supports foreign exchange and import reduction conservation of government. It creates economic opportunities, market access, improved income for farmers and support food security objective of government. The project will benefit from government intervention fund in the agriculture sector. The project will also benefit from the favourable policy of zero duty for agricultural and equipment import. Restriction of forex for all food products will also widen market opportunity. The project will contribute significantly to employment, output increase, stable price and stable exchange rate.

**Project Timeline**

The project will be completed within 6months preferably between November, 2019 to April, 2020 because land clearing is mostly done in the dry season.

**7.0 Estimated Project Costs and Revenue**

**Fixed Cost**

1. **Land Clearing**

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity** | **QTY** | **₦** | **K** |
| Land Clearing | 1Hectare | 230,000 | 00 |
| Cross cutting | 1Hectare | 20,000 | 00 |
| Rome ploughing | 1Hectare | 50,000 | 00 |
| **Sub total** | 1Hectare | **300,000** | **00** |
| **Total** | 400 Hectare | **120,000,000** | **00** |

**(B) Equipment**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **QTY** | **MODEL** | **USD** | **₦** | **K** |
| Tractor | 1 | YTO-904(90hp) | 24,450 | 8,802,000 | 00 |
| Disc harrow | 1 | IBJ- 3.0 | 3,520 | 1,267,200 | 00 |
| Sub soiler | 1 | IS-200G | 3,250 | 1,170,000 | 00 |
| Soy seeder | 1 | 2BFY-6C | 4,950 | 1,782,000 | 00 |
| Tripper | 1 | 7CX-8T | 9,450 | 3,402,000 | 00 |
| Combine Harvester | 1 | 4YZ-6 | 103,500 | 37,260,000 | 00 |
| Boom sprayer | 1 | 3W-1000L-18 | 6,950 | 2,502,000 | 00 |
| Front loader | 1 | TZ10D | 6,570 | 2,365,200 | 00 |
| **Sub total** |  |  | **159,390** | **57,380,400** | **00** |

**(C) Vehicle**

**Type Model QTY ₦ K**

|  |  |  |  |
| --- | --- | --- | --- |
| **Pick up Truck** | **HILUX** | **2** | **30,000,000 : 00** |

1. **Irrigation**

**Type QTY Model USD ₦ K**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hose Reel** | **1** | **140 – 440MT** | **28,186** | **1,0146,960 : 00** |

**Operating Cost**

|  |  |  |
| --- | --- | --- |
| **Working Capital** |  |  |
|  | **₦** | **K** |
| Ploughing/Ha | 15,000 | 00 |
| Harrowing/Ha | 10,000 | 00 |
| Sub total | 25,000 | 00 |
| **For 400 Ha** | **10,000,000** | **00** |
| Mechanization and storage | 105,000 | 00 |
| **For 400Ha** | **42,000,000** | **00** |
| Input / Ha | 91,825 | 00 |
| **For 400Ha** | **36,730,000** | **00** |
| Area yield insurance | 13,500 | 00 |
| Produce aggregation | 5,500 | 00 |
| Geo Spatial Service | 4,500 | 00 |
| Sub total | 23,500 | 00 |
| **For 400Ha** | **9,400,000** | **00** |
| Interest per hectare | 22,079 | 25 |
| **For 400Ha** | **8,831,700** | **00** |
| Total cost per hectare | 245,325 | 00 |
| **Total cost for 400Ha** | **98,130,000** | **00** |
| Loan principal and interest (cost per Hectare) | 267,404 | 25 |
| **Total for 400Ha** | **106,961,700** | **00** |
| **Irrigation cost for 400Ha (excluding fixed cost)** | **24,018,120** | **00** |

**Amortization**

**₦ K**

|  |  |
| --- | --- |
| **Land clearing amortization (per hectare)** | **30,000 : 00** |
| **Land clearing amortization (400hectare)** | **12,000,000 : 00** |

**REVENUE**

|  |  |
| --- | --- |
| **Yield per hectare 3tonnes@ ₦145000 per tonne** |  |
|  | **₦ K** |
| **Revenue per hectare** | **435,000 : 00** |
| **For 400Ha** | **174,000,000 : 00** |
| **Net revenue for 400Ha(without amortization)** | **67,038,300 : 00** |
| **Net revenue with amortization(400ha clearing)** | **55,038,300 : 00** |
| **2nd Production Cycle** |  |
| **Net revenue** | **43,020,180 : 00** |
| **Net revenue with amortization(400ha land)** |  |
| **Annual Net Revenue ( 1st + 2nd Cycle)** | **98,058,480 : 00** |

**Currency conversion rate:** **₦360.00 to 1USD**

**Funding Mechanism**

ABUAD will provide 400Ha of cleared farmland around the university and lease it to members of the cooperative. ABUAD will also lease 6,000MT capacity silo as equity contribution

Equity investor to provide equity for equipment and vehicles purchase

Where possible equity investor to provide equity for working capital or otherwise secure loan at the rate of 9% through government intervention window at the Bank of Agriculture, Bank of Industry and Commercial banks.

**Conclusion**

The project is technically feasible and commercially viable. It is therefore recommended for funding.

**AGRICULTURAL ENTREPRENEURSHIP**

**Definition**

Agricultural entrepreneurship is the activity of seeking new opportunities for the development of agriculture and agribusiness enterprises as distinct from management. It involve an analysis of the current challenges with a view to identifying innovative ideas that can lead to the development of new processes, technologies, markets and products that will serve as the solutions to the current problem . It is a process of bearing a non-insurable risk to achieve business objectives.

**CONCEPTS IN ENTREPRENEURSHIP**

**Entrepreneur**: an individual who accepts the opportunities and risks that come with creating and operating a business entity. The individual assembles labour and capital to produce goods and services in the expectation of profit in the future. Since the future is unknown, the risk of loss and possibility of gain abound.

**Business entity**: an organisation that seeks to earn profits by providing goods and services.

**Profit**: it is the return on investment or the reward to the owners of businesses for investing their time and money. It is whatever remain after a business expenses are subtracted from its revenues.

Mathematically;

Z = QP – CvQ –Cf

Where;

Z = Profit, Q = quantity, P = price, Cv = variable cost, Cf = fixed cost, QP = revenue

CvQ + Cf = expenses

Fixed cost are costs that are incurred whether production takes place or not while variable cost vary with the level of production.

Profit is generated when favourable transactions are concluded.

**Sales person**: an individual who separates a consumer from his or her money and thereby generates positive financial transactions or cash flows.

**FACTORS OF PRODUCTION**

These are inputs that make production possible such as land, human capital(management and labour) financial capital(cash and assets such as seeds, livestock, farm buildings, farm equipments) water resources e.t.c.

**Isoquant**: a mathematical function that maps all possible combinations of capital and labour that are physically capable of producing a given rate of output while keeping land constant or fixed. The optimal combination of capital and labour that are physically capable of producing a given level of output depends on their relative costs. For example, rent (cost of land and equipments) interest rate (cost of capital) and wages (cost of labour)

**Risk – Return Frontier**: a mathematical function that maps all the possible risk and return combinations of an investment.

**Patent**: it gives the inventor the right to exclude others from making, using or selling the invention for up to twenty (20years) The owner can sell it, licence it for profit or produce without competition.

**QUALITIES AND FUNCTION OF THE ENTREPRENEUR**

1. An entrepreneur must have new ideas and know how to transform these ideas into products, processes and market
2. He should be able to discover business opportunities and pitch his ideas to willing investors.
3. He should be able to evaluate business opportunities and make the best possible decision
4. He should be driven by urge for profit and be able to mobilise resources for business
5. He must be willing to bear risk and take responsibility
6. He must be flexible and adaptable

**Entrepreneurial opportunities in agriculture**

Entrepreneurial opportunities abound in agro-based industries in Nigeria. These industries includes primary production, secondary production ( processing) and tertiary level (marketing). Examples of such industry includes;

1. Arable and permanent crops production
2. Cocoa processing industry
3. Vegetable oil industry
4. Flour and grain milling industry
5. Animal feeds industry
6. Poultry industry
7. Beef industry
8. Pork industry
9. Dairy industry
10. Fruit Juice
11. Rice milling
12. Others

**FARM MANAGEMENT**

A farm is a socio- economic as well as a decision making unit. It is a socio-economic unit because it provides income to the farmer also it forms a source of livelihood to the family. It is a decision making units as it facilitates many alternative uses for the available resources in the form of different crops and livestock enterprises. Each farm has the capacity to produce a given quantity of crops and livestock product. The contribution of each farm unit in the country when aggregated represents the total of production of a nation. The total quantity of agricultural production in relation to population needs, affordability and accessibility determine whether a country is food secured or not.

Thus, the welfare of the nation rests on the performance of several millions of farm units. The development of agriculture is therefore the development of all these individual farm units. Thus, the prosperity of the nation depends on the prosperity of the farmers. The prosperity of the farmers in turn depends on their abilities to make rational decisions in the allocation of resources and adoption of new methods of production. The agricultural sector supplies raw materials to industries and the prosperity of the industrial sector depends partly on the agricultural sector. A farmer is faced with changing operating and varying input/output prices. Hence, a farmer needs managerial skills to be able to maximize his income and other welfare objectives.

Farm management is therefore an application of physical and biological sciences in keeping with the economics of profitable resource allocation for maximizing the farmer’s net farm income. The resources are otherwise refer to as factors of production which includes land, labour, capital, water and management.

**CHARACTERISTICS OF AGRICULTURE THAT AFFECT MANAGEMENT**

**DECISIONS**

The management of a farm is much more difficult generally than the management of industrial enterprises. This is due in most cases to the special characteristics of agricultural enterprises. Some of these include;

***Production uncertainly- climate variation.***

This can manifest in various ways. For instance, under rain fed agriculture the yield of crops will depend upon the amount of rainfall recorded during the crop season. Total crop failures can result if rain does not fall at all, or if it does not fall at the right time. Excessive rainfall may also cause leaching, erosion and flood. There may also be outbreak of diseases which could wipe out a whole livestock on a farm.

***Price changes***

The inputs which the farmer uses and the output which he produces are both subject to wide fluctuation in prices. Though this occur in other enterprises, they are more difficult to deal with in farm planning. For instance, increase in wages cannot easily be absorbed in agriculture since the famer cannot easily increase his price to match the increase in costs.

***Government Action and Policies***

Management decisions must be taken after careful consideration of government policies and their impact on agriculture.

***Risks and uncertainties***

Apart from production uncertainties, there are other risks and uncertainties such as sickness, death e.t.c.

**FARM MANAGEMENT DECISION**

Farm management implies decision making process. Several decision need to be made by the farmer as a manager in the organization of farm business. The management decisions are broadly classified into organizational management decision, administrative management decision and marketing management decisions which are discussed below.

The organizational management decisions are sub divided into operational management decision and strategic management decision.

1. Operational management decision – day to day activities
2. What to produce
3. How to produce
4. How much to produce.

(ii) Strategic management decision:- This involve long term investment decisions.

1. Size of farm
2. Machinery and Labour Programme
3. Construction of farm buildings
4. Irrigation, conservation and reclamation programme

2. Administrative management Decision

1. Financing the farm business
2. Supervision
3. Accounting
4. Adjusting the farm production programme

3. Marketing Management Decision

(i) Buying (ii) Selling

**CHAPTER EIGHT**

**AGRICULTURAL EDUCATION**

Agricultural education is the process by which organizations support people engaged in agricultural production to solve their problems and to obtain information, skills, and technologies to improve their livelihoods and well-being (Birner, 2006). Agricultural education is synonymous to Agricultural extension which is defined as the accessibility of farmers, their organizations and other market actors to knowledge, information and technologies; which facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions and assist them to develop their own technical, organizational, management skills and practices (Christoplos, 2010).

**Extension Science**

Extension science can be defined as a body of knowledge that accumulates experience and research findings with respect to extension, and borrow insights from other disciplines and fields of endeavour which seems pertinent to extension. Extension science could be viewed as a science which seeks to help extension professionals improve their work.

**Key Components of Extension Science**

**Diffusion of innovation**

Diffusion process can substantially enhance the effect of extension and lead to rapid innovation in agriculture, health behaviours and other areas. But one cannot automatically expect that an innovation introduced among a few will diffuse to every body. Such a strategies only works if all the conditions required for diffusion applies.

Extension science can make these conditions explicit and provide extension work with the knowledge that helps them create such conditions.

Diffusion research could tell its prospective utilizers little about the conditions which diffusion could be expected to work but at the time that was not obvious. Extension workers and progressive farmers attract each other like magnets. It means that those who adopt the innovation offered by extension workers relatively early tend to be favourite target clients of extension workers; these farmers will on their part request extension workers to come and assist them.

In other words, the more modern the farmer, the more important to his succession; according to Rolling (2008), reasons for this common observation includes;

1. Progressive farmers have relatively larger hold up so that production target set by extension can be reached with relatively little effort through relatively few farmers
2. Progressive farmers demand assistance. They complain if they are neglected and some are powerful enough to affect the career of the local extension worker
3. they usually have the economic means to try new ideas

**Resistance to change**

Resistance is a form of stability affecting people and organizations, especially when faced with opportunities for change. Extensionist as change agents demands change from their clienteles. Within the change management literature, there is some material on anti-resistance tactics, although the topic is often ignored or skimmed over. It is important to note that resistance should not be seen as something to be overcome, but as something to be understood and accommodated. Many people in technology change management talk about overcoming resistance. Technology change is seen as a battle between the forces of progress (i.e. the champions of technology) and the forces of resistance. This echoes a popular theme in psychotherapy, where the therapist is supposed to overcome the resistance of the patient - resistance is interpreted as a sign of hostility on the part of the patient.

In terms of sources of change a society can be taken to be a system which is comparable to any living system. And that any living system is in a state of dynamic equilibrium and from time to time certain parts of the system fail to function well implying that all the parts do not always keep up with the expected equilibrium. The parts are the social institutions which keep the system in a balanced state but when they fail to function because of shortage of energy or some form of shock, this slows down the system and brings it into a sort of homeostasis until the former equilibrium is re-attained.

The source of change can be external and internal. External is from weather, climate or other links with external environment including other social systems. Internal sources will include things that can be traced to what occurs within the system itself, like leadership changes, invention, discovery or reorganization.

**Factors influencing acceptance or resistance to change**

These are factors in the change, in the society, characteristics of target or a combination of these.

* Relative Advantage: The extent to which an innovation is superior to what it is meant to replace. This may be explained in economic and social terms. Those that show immediate relative advantage are easily accepted.
* Cost: relative advantage may be high but cost too high, hence they will adopt more slowly.
* Complexity: The extent to which an innovation is relatively difficult to understand. Simple innovation tend to be more readily adopted than complex ones e.g. keeping farm records is more complex than adopting new variety of seeds.
* Visibility: Innovation varies in extent to which results are easily seen. Demonstrations that show what will happen after adopting an innovation prompt more adoption.
* Divisibility: Extent to which an innovation can be tried in parts or limited scale.
* Compatibility: Extent of consistency to existing cultural values, norms and past experiences of adopter. Western Nigerian farmers adopted yellow maize variety and refused to plant it the following year because it produced yellow pap which the people weren’t used to. In the north, sharper stalked guinea corn was introduced out of double yield but it was rejected because the stalk is not useful for building fences and feeding animals like the traditional variety. When an innovation conflicts with existing behavior or existing values, it can be rejected out rightly or readjusted or people may simply rationalize the acceptance of the change.
* Additive or substitutive: An innovation which is merely addition innovations are more readily adopted than substitutive.

Agricultural extension is commonly identified with activity whereby agricultural extension workers interact with and teach farmers improved farming practices, new techniques and more productive or more efficient technologies or packages of technologies.

The different approaches found in the various extension systems, use a variety of strategies and a large array of methods and techniques.

Several approaches have been tested, and adopted by countries in Africa to improve technology dissemination process among farmers.

There are common characteristics which all extension approaches share:

* All function through non-formal education
* All have content related to agriculture
* All use communication techniques and aids
* All seek to improve the capabilities of rural people.

Each of these approaches can be characterized by the following dimensions:

* The basic assumptions made by those who established it. This refers to the problems and issues perceived that require a particular strategic approach to solve them. The assumptions are influenced by the views of the nature of the human, technical biological, physical, social, cultural, administrative, political, and diplomatic ecosystem in which extension will function.
* The purposes which it is designed to achieve. “Purpose” refers to the underlying principles of the basis for the approach. It also determines what it is supposed to achieve, the goals.
* The way in which the control of program planning is carried on, and the relations of those who control program planning to those who are the main target audience for the program.
* The nature of the field personnel including such aspects as their density in relation to clientele (ratio of field staff to clientele), levels of training, reward systems, origin, gender and transfers.
* The resources required, and various cost factors, such as the heavy reliance on manpower compared with more use of mass media etc.
* The typical implementation technique used in executing the program.
* The variables or outputs by which the system measures its success. That is, which kinds of criteria are used to determine whether or not the system is doing what it was designed to do

Some of the extension approaches utilized in Nigeria include;

**Training and Visit (T&V)**

T&V is one of the earlier approaches that focused on transfer of technology using a top-down, one-size-fits-all approach. This approach was introduced after the department of agricultural extension services (DAES) had been organized under the unified extension systems (UES) concept. Existing extension organizations were merged into a single national system. This approach was designed on the assumption that farmers lack technical knowledge for increasing productivity, hence the solution was therefore to provide them with modern technical knowledge. The approach is based on a set of managerial and organizational principles that are of broad applicability and which, when applied together, constitute an extremely powerful managerial tool.

**Participatory Approaches**

The passive role of farmers in the T&V approach necessitated the promotion of participatory approaches where the need for empowerment of the farmer will be paramount. In this approach the role of the extension agent is to facilitate an in-depth situation analysis by the farmers themselves at the onset of their working relation. Once farmers have become aware of the causes of their problems and have identified the most pressing ones, the extension agent provides technical knowledge and technologies, which may be useful to address the problems identified.

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**Farmer Field Schools (FSS)**

FFS is a participatory method of learning, technology development, and dissemination based on adult-learning principles such as experiential learning. Farmer field schools (FFS) were introduced into sub- Saharan African in the mid-1990s. They are being used in at least 27 SSA countries (Braun, Jiggins, Roling, van den Berg & Snijders, 2005). FFS originated from Asia, where it was developed to promote integrated pest management (IPM) programs. Farmers meet regularly for the duration of an entire cropping season. They learn by observing what is happening on the field, by discussing in groups what they have observed, and by hands-on management of the field from pre-planting to harvest. Through group interactions, attendees sharpen their decision-making abilities and are empowered by learning leadership, communication and management skills.

Some of the participating farmers are selected to receive additional training so as to be qualified as farmer-trainers, who then take up training responsibilities (for some fee, possibly paid by their community) with official backup support such as training materials. This approach aims to increase the technical competence of farmers concerning a single crop (e.g. rice, cassava, maize) or livestock, and to strengthen the social competence and confidence of farmers. Technical competence of farmers is increased by:

Hands-on learning about agro-ecosystem concepts;

Experiential learning in small groups: group members observe the happenings on the field, reflect together, decide together, and observe the results during later meetings;

Combining farmers' knowledge with scientific ecological knowledge.

Social competences of farmers are fostered by:

1. Group discussion and reflection processes;
2. Presenting and explaining small group decisions to a larger audience;
3. Energising exercises for group building.

The FFS addresses the problem of accountability in two ways:

i) The trainers who conduct the field school are bound by a strict timetable of sessions within a pre-specified curriculum, which can be easily verified by supervisors.

ii) Continuous interaction with a cohesive group of trainees creates accountability to the group, which is enhanced by the participatory nature of the training methods. Accountability is presumed to be even greater when farmer-trainers who are members of the same community administer the training. These features are thus expected to ensure the quality and relevance of the service (knowledge) provided to the farmers.

**RURALITY, COMMUNITY AND DEVELOPMENT**

According to Olawoye (2010), a multi-factor conceptualization of rurality, more validly captures the empirical nature of rurality, recognizing that differences between rural places is often a matter of degree. Among the most significant indicators of the degree of rurality are:

* Proportion of the population engaged in agricultural production as the primary source of income which is normally very high,
* Level of infrastructural development which is very inadequate,
* Population size and density: this is the total number of people in a geographical area over total land area per time. It is found that the people are few compared to the land that they occupy.
* Perception of residents toward their community is normally seen to be government oriented, as many of them believe development projects should come from the governmental bodies and not from within their communities.

The above indicators are pertinent to distinguish the degree of rurality among rural communities but rural communities have the following characteristics in common;

* High number of people depend on Agriculture as the primary source of income and largely practiced at a subsistence level of production to ensure food security for their families and communities.
* The level of infrastructural development in terms of access road, educational and health facilities and pipe borne water supply etc. is very inadequate and this shows that these areas are poorly equipped.
* High rate of illiteracy among the rural people.
* Traditional conservatism, including health beliefs and practices.
* About 70% of Nigeria's population live and work in the rural communities with a very high fertility rate (Federal Office of Statistics, 1997).
* Women do not enjoy a great deal of parity in decision making*.*

**RURAL AREA**

Rural area is the seat of wealth of Nigeria, as it houses the bulk of the natural resources in the country (e.g) forest reserves, large expanse of land, big water bodies, mineral resources, masses of rock etc. Rural areas of Nigeria accommodate more than 70 percent of the population, living and cultivating the soil to make out a living (Ihimodu, 2003). Rural people are exploited greatly in the country as the mineral resources discovered in the rural areas are used in the development of urban areas to make them more cosmopolitan.

Rural people enjoy little development in their communities as many of them are very ignorant of the benefits of community-driven development or people-oriented approach to development and relies heavily on the government for developmental projects. Rural area is a place where people are closely knitted in culture and social behaviours, which serve as the hallmark of the harmonious relationship and co-existence of the rural populace. The major occupation in the rural area is agriculture.

Most rural communities have a larger proportion of elderly and children, with relatively small population of people of working age (20-40 years) which is resulting in a higher [dependency ratio](http://en.wikipedia.org/wiki/Dependency_ratio) on the elderly. Rural population trends are particularly subject to change due to their migration patterns. People in the urban centres now move to rural areas as cost of living in urban centres increases by the day due to the world’s economic recession. Rural population is very dynamic in nature.

**Rural Health**

Health is an important aspect of life which affects individuals, families and social networks of people. It determines the ability to work, adapt to different situations, relate and socialize effectively within a family and social group.Rural health or rural medicine is the [interdisciplinary](http://en.wikipedia.org/wiki/Interdisciplinary) study of [health](http://en.wikipedia.org/wiki/Health) and [health care](http://en.wikipedia.org/wiki/Health_care) delivery in the context of a [rural](http://en.wikipedia.org/wiki/Rural) environment or location (Wikipedia, 2009). Nigeria's health policy which has identified primary healthcare as its fulcrum, defined a three tiered referral system for the management of patients.

A network of primary healthcare centres in proximity to where people live, offering care of relatively low technology, is the first level of care from which patients gain entry into the healthcare system. Seriously ill patients beyond the management competence of primary healthcare workers are referred to secondary level general hospitals from where referrals are made to tertiary health facilities. The objective of the policy was to provide access to primary as well as secondary and tertiary health care, through a functional referral system.

Nigeria’s national health policy was adopted in 1987 and revised in 1996. Its objective was to provide the population with access to public health centres, as well as to secondary and tertiary care through a functional referral system. Primary health care services include health education, adequate nutrition, safe water and sanitation, reproductive health including family planning, immunization against major infectious diseases, provision of essential drugs, and disease control.

**Health Determinants**

Determinants of health are a combination of elements that influence health status. These include: Income and Social Status, Education and Literacy, Employment/Working Conditions, Social Environments and Physical Environments, Personal Health Practices and Coping Skills, Healthy Child Development, Health Services available, Gender and Culture of the people. These factors absolutely represent complex interactions between, social and economic factors, individual behaviour and physical environment. Although determinants of health are elements set out to generally interpret health outcomes in any population, these may greatly differ across geographical locations but very similar among rural communities. Health status comparisons are typically assessed through rates of life expectancy, morbidity, and mortality. It is found that life expectancy rate is significantly higher in urban areas when compared to rural areas.

**Health Determinants**

Education and Literacy

It is widely acknowledged that the level of literacy among persons living in rural locations is very low in comparison with the urban centres. A major cause of illiteracy is the economic condition of the people, most of the people living in the rural areas are poverty stricken, cannot afford to send their children to school and most of the children are put to farm work or practice of craftsmanship at young ages. Obviously, the rural populace suffers from very low productivity, social and economic retrogression due mainly to ignorance, which is also a direct consequence of either inadequate or total lack of information provision to them.

Hence, their social exclusion from active participation in national development efforts when their numerical strength is considered in relation to the potentiality of what positively significant contributions they stand to make in the society generally. Their exclusion from the main-stream of events shows a great marginalization and backwardness to the nation’s progress. The fact that information has always played an important role in human life and as a basic human need is never a subject of controversy. Information and ideas agreed upon by subject-matter experts are basic human needs and it will not be out of place to state that free and equal accessibility to such information and ideas by every member of the society irrespective of racial, religious, geopolitical and socio-economic status becomes more foundational. Every human society either urban or rural had been found in literatures to be considerably dependent on various types of information, though at different levels, for their existence, survival and growth on a daily basis.

The need to adequately inform every segment of a society could not have been unconnected to the realization of the essence of information and knowledge as veritable democratic tools for national development. It is no gain saying that an un-informed society cannot be free while a society devoid of freedom can hardly endure.

**Income and Social status**

Occupation of the rural folks is mostly primary in nature. For instance, farming, lumbering, fishing, quarrying etc. are the major activities offered by the rural people. Most of the industries concentrate and are being sited in the urban centres. These available occupations in the rural areas offer a low profit capital and the few elite among the rural populace are exploiting the illiterates among them to their advantage because they know the hidden intricacies and intrigues for better production. The fewer wage offered by the jobs in the rural areas are not much desired but those engaging in them are compelled to fate because they have no alternative ways to survive in the rural communities.

Rural communities are mainly agrarian communities when compared to urban communities which engage mostly in paid employment. The rural workers earn less income than the urban communities. Elite capture also affects government intervention programmes in boosting the economic base of the rural populace as most programmes are not properly planned, implemented, monitored and evaluated to allow them meet up with the set goals. These can lead to caprice and disbelief by the rural populace in subsequent government intervention programmes and consequently, set-backs in rural communities.

**Employment and working conditions**

Those living in rural areas also experience higher rates of unemployment. The Nigerian unemployment report 2011 prepared by the Nigeria Bureau of Statistics shows that the rate is higher in the rural areas (25.6 percent) than in the urban areas (17.1 percent) (NBS, 2011). The lumbering, farming, fishing, and artisan labour forces are still prevalent occupations in the rural areas which are often accompanied with greater health and safety hazards due to exposure to long working hours, harsher climates, and task related physicality.

The rural food processors like garri and fufu processors are now eroding the culture of food safety measures, by embarking on shorter fermentation periods in processing and drying of the fermented cassava on bare grounds. Such health and safety hazards can explain the higher rates of life threatening injuries that are reported from the rural workforce. The seasonality of the agricultural activity which the rural folks are engaged in results to seasonal unemployment and the small scale business industries are been wiped off by the demand for the technological products from the urban centres thus causing structural unemployment.

**Personal health practices and coping skills**

The culture of the rural people is constrained with belief systems and socio-economic characteristics, leaving them with no choice than more patronage of traditional homes over modern health systems of hospitals and clinics. Rural people are more disposed to herbal homes because of their beliefs in their ethno-medical knowledge and affordable cost for cure of diseases. Rural health of the people is challenged with smaller system of modern health resources which make them vulnerable to health related problems.

The rural area of the nation had always recorded high diseased conditions and mortality rate from time immemorial as a result of poor attentive medical facilities. Traditional medicine is still an important component of the health care system in rural communities. It accounts for a substantial percentage of their overall expenditure. In Nigeria, the ratio of traditional to modern health practitioners is estimated to be higher than the latter.

**Physical and Social environment**

There is a predominance of communicable diseases in the rural areas, particularly those related to inadequate environmental sanitation and poor hygiene complicated by malnutrition, cholera outbreak and tuberculosis among others. There is wide-spread contamination of drinking and cooking water sources by guinea worm and other parasites in the rural areas, causing physical disabilities and resultant loss in income. Local ecological problems constitute great impediments in this area. Nigeria's water and sanitation, living and housing conditions in the rural areas are in a more deleterious situation at present than a few decades ago as a result of burgeoning population of family households and crowding of households as factors affecting disease control in rural and remote locations.

Insufficient waste water treatment and lack of paved roads have led rural populace into far depth of irretrievable poverty. Violence by the husband, lack of support from in-laws and family preference for a male child are strongly associated factors for depression among pregnant women in the rural areas. Distance is crucial to the use made of health services, as most orthodox health centres are sited in distant locations to people’s homes, rural people are faced with the challenge of covering long distances from their homes to access the primary health care facility. This hinders timely care for those seeking succor to any health emergency and obstetric complications. In Nigeria, scarce data on the availability, distribution, and trends in human resources for health (HRH) has been a barrier to effective HRH planning. The urban centres are prosperous areas which are disproportionately home to the country’s skilled health care work force.

**Healthy Child Development**

The majority of the world’s poor are rural. They represent the majority of the world population and make up over 70% or 840 million, of the world’s poor (Food Agriculture Organization, 2001). Every single day, Nigeria loses about 2,300 under-five year olds and 145 women of childbearing age. This makes the country the second largest contributor to the under–five and maternal mortality rate in the world (www. Unicef.org/Nigeria/children-1926 html). Childbirth is related to mark mortality among Nigerian women. Similarly, a woman’s chance of dying from pregnancy and childbirth in Nigeria is 1 in 13 (Ogunjimi et.al, 2012).

The rural women are more vulnerable to maternal mortality. Although, many of these deaths are preventable, the coverage and quality of health care services in Nigeria continue to fail women and children. Malnutrition is the underlying cause of morbidity and mortality of a large proportion of children under-5 and beyond in Nigeria as farming parents select the high yielding farm produce for sale and feed on the junks. The children are not well fed as a result of poverty and non-cognizance of the effect of adequate and balanced diet to the child. It accounts for a great part of deaths of children in rural areas.

Children who lose their mothers are at an increased risk for death or other problems, such as malnutrition. Men are primarily responsible for all decisions about pregnancy and childbirth, including the use of prenatal and delivery services. The extensive hostility which often exist between traditional birth attendants and midwives, do result in rumors, deliberate attempts to discourage women from seeking higher levels of care, and refusals to accept referrals or treat patients, and these seriously affect good maternal care in the rural areas.

At the moment, we have very few doctors and specialists in the rural areas, while there is an upsurge in urban centres. The health status of the Nigerian rural child is far from desirable. Nigeria, like many other developing countries, particularly in Africa, is still far from reducing mortality among children to the low levels recorded in industrialized countries. This is partly because both the health system in Nigeria’s rural areas and the health status of rural children are in a deplorable state. Nigeria’s overall health system performance was ranked 187th among the 191 Member States of the World Health Organization in 2000.

Nigeria’s available information indicates that malaria, acute respiratory infection (ARI), measles, diarrhoea, tuberculosis (TB), and HIV/AIDS/STIs account for a disproportionate share of ill-health and deaths. The underlying factors include childhood malnutrition, poor immunization status, household poverty, and food insecurity. Other factors are maternal illiteracy, poor living conditions (housing, water, and sanitation), and poor home practices for childcare during illnesses.

**Health Services available**

The National Health Policy was designed in the year 1987 to bring about a comprehensive health care system through Primary Health Care Scheme approach to promote, protect and restore good health system in Nigeria. It is also put in place to prevent and rehabilitate the prevailing health problems using available resources judiciously so that individuals and communities can be assured of good living system, social well-being and sustainable productivity. The local government runs the primary health care services delivery in compliance with the framework of the National Health Policy. Primary Health Care (PHC) by policy arrangements is within the purview of Local Government, based on the residual operation of Local Government Authority.

Primary health structures are unarguably the first points of call for the sick and injured persons. They undertake mild healthcare cases like treatment for malaria, fever, cold, nutrition disorder, among others. They are specially for milder health problems and health education. They also handle infant, maternal and pregnancy matters. Other health issues in their care are family planning and immunization. Primary health centres emphasize health care and are involved in record keeping, case reporting and patients referral to higher tiers. Primary health centres are known within the system by content of health centre, maternity home/clinic and dispensaries.

The scheme has been making appreciable progress but the death toll among the rural populace increases from preventable diseases, as a result of the un-affordability of health costs, non-accessibility of orthodox health facilities, bad attitude of health professionals to sick persons, distant site from people’s homes, making sick persons result to prayer houses and traditional homes for succor, while some go to the extent of doing without any assistance at all. The pregnant women patronize traditional birth attendant more than the skilled birth attendant.

In 2008, the average maternal mortality rate was between 1000 and 1500 deaths per 100,000 live births in rural areas. The State of the World Children Report 2009 stated that 1 out of 9 global maternal deaths occurred in Nigeria. (Inter-agency Group for Child Mortality Estimation, 2010). These statistics gave the Nigerian government un-comprising wake up call to stop too many women dying during pregnancy and child birth with the weak health care workforce to support them. In 2009, the Nigerian National Primary Health Care Development Agency took the action of expanding women’s access to skilled health care workers in rural and sub-urban areas with the establishment of Midwives Services Scheme. This initiative seeks to provide an emergency stop gap to the human resource short of skilled attendance at our primary health care system.

The use of health services depend as much on the availability, accessibility, affordability and the socio-economic characteristics of the users. Distance is crucial to the use made of health services, as quick accessibility and adequacy of transport network may influence timely care for those seeking succor to obstetric complications and finally, maternal mortality. Quality health is a fundamental right of Nigerian Citizenry as recognized by the Nigerian government. Despite its desire to ensure a more equitable distribution of resources between rural and urban centres, glaring disparities are still obvious.

**Gender and Culture**

Rural communities generally uphold patriarchal views of family, high involvement in agricultural practices and traditional sex- role ideologies subjecting women, which represent the majority of the rural poor to long hours of work on farm, off-farm and experience of difficulty in allotting time to rural development programmes. Women and men encounter many constraints in accessing health services in rural areas, but women face particular challenges based on their reproductive and care giving roles.

These include a lack of accessible, affordable, and adequate health services (e.g. clinics, hospitals, reproductive health/family planning and counseling). Women’s low status in society, lack of access to and control over resources, limited educational opportunities, poor nutrition, and lack of decision-making power contribute significantly to adverse pregnancy outcomes. Violence by the husband, lack of support from in-laws and family preference for a male child are strongly associated factors for depression among pregnant women in the rural areas.

Government policies that introduced user fees and increased private services rendered health services less accessible for many of the world’s rural poor, particularly women over the past decades. The non-affordability of the health costs for ailing people increases their reliance on Traditional medicine and spiritual homes as last resort to their ailing situations. There are deeply rooted belief systems that attribute disease and ill-health to supernatural forces (spiritual beings). This results in seeking help from spiritualists, which leads to delays in seeking appropriate care and worsening conditions of ailments.

Native concoctions are administered in some circumstances, resulting in liver failure and death in children. Food taboos still exist, rendering pregnant women and children weak with dire consequences of malnutrition. Colostrum is considered dirty for babies to ingest, thereby denying them infection protective factors. The poor educational and economic status of women worsens the situation.

**FARM HAZARDS**

Hazard is the potential of a natural or non-natural agents causing harm to an individual, environment or plant. Farming hazard is the harm done to crops or livestock flock through natural agents like air and water, biological agents like virus, fungi, bacteria and pathogens likewise chemical agents like pesticides and herbicides, causing losses to the farmers. Hence, limiting the productivity and expected farm income of farmers.

According to Cole (2006), Park (2011), and Idio and Adejare (2013), occupational hazard in agricultural sector could be classified into seven: (i) climate: dehydration, heat cramps, heat exhaustion, heat stroke, and skin cancer; (ii) Snakes and insects: injurious bites and stings; (iii) Tools and farm equipment: Injuries, cuts, and hearing impairment; (iv) Physical labour: musculoskeletal disorders, e.g. pain and fatigue; (v) Pesticides: poisonings, neurotoxicity, reproductive effects, and cancer; (vi) Dusts, fumes, gases, particulates: Irritation, respiratory tract, allergic reactions, respiratory diseases such as asthma, chronic obstructive pulmonary disease, and hypersensitivity pneumonitis, and (vii) Biological agents and vectors of disease: Skin diseases, fungal infections, allergic reactions, malaria, schistosomiasis, sleeping sickness, leishmaniasis, ascariasis, and hookworm.

Farmers are exposed to various farm hazards, which include; environmental, physical, chemical, biological and health. Several studies reported that the adverse health hazards of the pesticides’ usage as a series of chronic end-points including prostate cancer (Settimi *et al*., 2006), neurotoxic (Kamel and Hoppin, 2004); immuno-toxic (Galloway and Handy, 2003), developmental effect (Colborn, 2006) and reproductive defect (Yucra *et al*, 2006). Farmers are vulnerable to physical injuries and risks of farming, acceptable to many as fate and constraints of farming. These could cause mental and physical suffering to farmers and their families, as it involves huge financial losses and even death of affected farmers in some cases.

Farmers experience in farming plays a huge role in mitigating farming hazards for profitability venture. Adesoji and Kerere (2013) reported that knowledge of farming-related hazards is expected to be acquired from farming experience. However, farmers farming experience seem not to be efficient in farming risk management but offers coping strategies to farm hazard management. Efficient farm hazard management requires crop and livestock insurance which however seems non-effective among subsistence dominant subsistent farmers in the nation, as the legislation fails to capture and benefit lot of them. However, there is little evidence that these efforts have been effective (Lehtola *et al.,* 2008).

**VULNERABILITY OF CROP FARMERS TO FARM HAZARDS**

Nnadi et al (2013) reported that access to credit is severely restricted for a large part of the rural population, mainly because banks do not think that the economic and financial preconditions are met to expand their portfolio of agricultural loans. Crop farmers are however constrained with access to agricultural credit, as many subsistent farmers highly concentrated in the rural areas have little or no farm assets that guarantee collateral for loan acquisition. This makes rural household farmers vulnerable to adverse weather effects that result in unexpected income shocks.

They often reduce their income risk by diversifying and choosing low-risk activities or technology which usually have low average returns (Nnadi et al, 2013). Microfinance, which provides access to credit without formal collateral has opened access to loans for millions of poor people, but has not reached most agricultural activities (World Bank, 2007). Many of the farmers diversify into livestock production as mitigation strategy against farm income losses and a coping strategy for crop losses without a livestock insurance designed for the farmers by the government.

**FARM SAFETY PRACTICE**

Farm safety reduces the exposure and vulnerability of farmers to farm hazards and health hazard that reduce farmers’ productivity. Olowogbon *et al* (2013) found that farm safety is a focal issue for improved agricultural productivity; with the expansion of agricultural technology, causing a growing health concern for agricultural workers. It is established that Nigerian farmers have little or no knowledge of health and safety as it relates to agriculture (Olowogbon *et al*.,2013).

Agriculture is largely practiced in a crude and unsafe manner with traditional farm tools among dominant subsistent farmers, feeding the nation and producing for export. Seventy percent of the population lives in rural areas where farming is their primary occupation (Okuneye, 2002; National Population Commission, 2006; Nwachukwu, 2009). Farm safety and health concerns of farmers are either not adequately considered by the government or undertaken by farmers through indigenous knowledge which seems non-efficient for appropriate risk mitigation. Poor farmers in developing countries tend to adopt safety-first behaviour, basing their production decisions on a survival strategy that minimizes the likelihood that their revenue will fall below a certain level (De Janvry *et al*., 1991).

Chris (2008) reported that agricultural practice is operated on a deep seated culture of unwise risk taking and lack appreciation of the role of good health and safety management. Farming is mostly concentrated in the hands of ageing rural population, with little or no access to crop, animal and health insurance, unschooled with low risk management practices. Farm operators are exposed to hazard ranging from environmental, physical, chemical, biological, ergonomics, biological and psychosocial hazards thereby leading to investment losses and disorders such as musculoskeletal disorder and diseases like carcinogenicity, psychiatric disorder, asthma and pneumonitis (Mostafa, 2003).

After construction sector, agricultural sector has the worst record for work related fatalities and one of the worst for occupational ill health and injuries (Chris, 2008). Farm losses reduces youthful population in farming, reduces farm labour, low mitigation of shock and risks, impeding food security and causing food shortages in the country. Agricultural risks cover not only crop production and animal husbandry but also, processing, storage, packaging, irrigation and pest management. Farmers are faced with inappropriate and affordable technologies and a poor private sector linking small scale producers and processors with the end users. Farmers are also, constrained with poor credit facilities and high interest rate, making agricultural investments risky and financially unattractive with inability to analyse the cost- benefit returns from the farm activity other than resulting to prayers to God.

**POST HARVEST MANAGEMENT**

Post-Harvest Management is the management of a crop from the time and place of harvest to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for having the crop.

**AIM OF A FARMER**

This to increase the production of food crops and to ensure the sale of the food crops at good prices. Farmers strive to safe guard postharvest losses through traditional methods with low improvement as result. Inadequate knowledge of better post harvest losses reduction and poor crop practices are major contributors to postharvest losses in the marketing chain of food crops. Extension services are required to strengthen the capacity of growers, collectors, transporters, wholesalers and retailers on post harvest handling to change their attitudes and to improve their knowledge base on postharvest practices.

**ELEMENTS OF POST-HARVEST MANAGEMENT**

Harvesting: The time of harvesting is determined by the degree of maturity of crops. With cereals and pulses, a distinction should be made between maturities of stalks (straw), seedpods and seeds and all that affect successive operations, particularly storage and preservation.

Pre-harvest drying: Mainly for cereals and pulses; extended pre-harvest field drying ensures good preservation but also heightens the risk of loss due to attack by (birds, rodents, and insects) which is encouraged by weather conditions, not to mention theft. On the other hand, harvesting before maturity entails the risk of loss through moulds and the decay of some of the seeds.

Packing: All the agricultural crops should be packed to reduce the loss. It can be pre-packing, bulk-packing (garden activity) packaging or final-packing (after processing activity).

Transport: Much care is needed in transporting a well matured harvest of crops in order to prevent detached grains as an example from falling on the road before reaching the storage or threshing place. Collection and initial transport of the harvested crops thus depend on the place and conditions where it is to be stored, especially with a view to threshing.

Post-harvest drying: The length of time needed for full drying of grains and other crops that can be dried from post harvest gain depends considerably on weather and atmospheric conditions. In structures for lengthy drying such as cribs, or even unroofed threshing floors or terraces, the harvest is exposed to wandering livestock animals and the depredations of birds, rodents or small ruminants. Apart from the actual wastage, the droppings left by these predators often result in higher losses than what they actually eat. On the other hand, if grain is not dried enough, it is vulnerable to mould and can rot during storage. Moreover, if grain is too dried, it becomes brittle and can crack after threshing.

Milling: This applies especially to rice if milling takes place a long time (two to three months) after the grain is matured and harvested, it can cause heavy post harvest loss. During winnowing, broken grain can be removed with the husks and is also more susceptible to certain insects like flour beetles and weevils. When grain is too dried before milling, loss of weight is attracted and hence a loss of money at the time of sale is experienced.

Threshing: If harvested crop is threshed before it is dried enough, this operation is wrong. Also, if grain is threshed when it is too damp and then immediately heaped up or stored (in a granary or bag), it will be susceptible to attack from microorganisms, thus limiting its preservation.

Storage:Applied better to the more perishable food items such as fish, meat, some fruits and vegetables. Storage facilities must be adequate for effective, long-term storage of harvested crops and carcass of livestock animals. Closed structures (granaries, warehouses, hermetic bins, silos), ensuring cleanliness, maintenance of good room temperature and humidity is particularly important. Damage caused by pests (insects, rodents) and moulds can lead to deterioration of facilities (e.g. mites in wooden posts) result in losses in food quality and food value as well as food quantity.

Ripening:It is a storage activity in preserving some tree crops like plantain and orange into other processed forms like juice in fruit companies and locally as fried plantain in the case of plantain.

Processing: It helps to refine the food product into a form with potential for long shelf life, better taste as value addition to the initial food product. Example is plantain processed to plantain chip. It reduces the vulnerability of harvested food crops to insects and micro-organisms.

Marketing:Marketing is the final and decisive element in the post-harvest system which involves bargaining power based on the size and quality of food product. It can occur at different points in the agro-food chain, harvesting or processing points. Moreover, it cannot be separated from transport, which is an essential link in the agro-food chain system.

Distributing: Involves supply to the different consumers in different markets either by the farmer or retailer.

**POST-HARVEST LOSSES**

Postharvest activities include [harvesting](http://en.wikipedia.org/wiki/Harvesting), handling, [storage](http://en.wikipedia.org/wiki/Food_storage), [processing](http://en.wikipedia.org/wiki/Food_processing), [packaging](http://en.wikipedia.org/wiki/Packaging), [transportation](http://en.wikipedia.org/wiki/Transportation) and [marketing](http://en.wikipedia.org/wiki/Marketing).

Not only are losses clearly a waste of food, but they also represent waste of human effort, farm inputs, investments and scarce resources such as water. Post-harvest losses for tree crop produce are however difficult to measure. Post harvest losses or waste would be minimal when it is well handled indigenously and with improved practices. There can be losses in food quality, as measured both by the price obtained and the nutritional value the food poses to the consumer, as well as in quantity.

**ON-FARM CAUSES OF LOSSES**

Pre-harvest production practices may seriously affect post-harvest returns. Plants need a continuous supply of water for [photosynthesis](http://en.wikipedia.org/wiki/Photosynthesis) and [transpiration](http://en.wikipedia.org/wiki/Transpiration). Damage can be caused by too much rain or [irrigation](http://en.wikipedia.org/wiki/Irrigation), which can lead to plant decay, too little water and irregular water supply lead to growth cracks. Insufficient plant nutrients can affect the quality of fresh produce, causing stunted growth or discoloration of leaves, abnormal [ripening](http://en.wikipedia.org/wiki/Ripening) and a range of other factors. Excessive [fertilizer](http://en.wikipedia.org/wiki/Fertilizer) can harm the development and post-harvest condition of plants produce. Good crop husbandry is important for reducing losses.

**CAUSES OF LOSSES AFTER HARVEST**

[Fruits](http://en.wikipedia.org/wiki/Fruits) and [vegetables](http://en.wikipedia.org/wiki/Vegetables) are perishables as they contain 65 to 95 percent water. When food and water reserves are exhausted, produce dies and decays. Increases in physiological changes can be caused by high temperature, low atmospheric [humidity](http://en.wikipedia.org/wiki/Humidity) and physical injury. Such injury often results from careless handling, causing internal bruising, splitting and skin breaks, thus rapidly increasing water loss. [Respiration](http://en.wikipedia.org/wiki/Cellular_respiration) is a continuing process in a plant and cannot be stopped without damage to the growing plant or harvested produce.

Plants use stored starch or sugar and stops when their reserves have exhausted, leading to ageing. Respiration depends on a good air supply. When the air supply is restricted [fermentation](http://en.wikipedia.org/wiki/Fermentation_%28food%29) instead of respiration can occur. Poor ventilation of produce also leads to the accumulation of [carbon dioxide](http://en.wikipedia.org/wiki/Carbon_dioxide). When the concentration of carbon dioxide increases it will quickly ruin the plants produce.

Fresh produce continues to lose water after harvest. Water loss causes shrinkage and loss of weight. The rate at which water is lost varies according to the product. Leafy vegetables lose water quickly because they have a thin skin with many pores. Potatoes, on the other hand, have a thick skin with few pores. Produce must therefore be kept in a moist atmosphere.

Diseases caused by [fungi](http://en.wikipedia.org/wiki/Fungi) and [bacteria](http://en.wikipedia.org/wiki/Bacteria) cause crop losses. This is often the result of infection of the produce in the field before harvest. Quality loss occurs when the disease affects only the surface. Skin blemishes may lower the sale price but do not render a fruit or vegetable inedible. Fungal and bacterial diseases are spread by microscopic [spores](http://en.wikipedia.org/wiki/Spores), which are distributed in the air and soil and via decaying plant material. Infection after harvest can occur at any time. It is usually the result of harvesting or handling injuries.

Ripening occurs when a fruit is matured. Ripeness is followed by [senescence](http://en.wikipedia.org/wiki/Senescence) and breakdown of the fruit. The category “fruit” refers to products such as sweet pepper and tomato. Non-climacteric fruit only ripen while still attached to the parent plant. Their eating quality suffers if they are harvested before they are fully ripe as their sugar and acid content does not increase further. Examples are [citrus](http://en.wikipedia.org/wiki/Citrus), grapes, and pineapple. Early harvesting is often carried out for export, minimize loss during transport but a consequence of this is that the flavour suffers.

[Climacteric](http://en.wikipedia.org/wiki/Climacteric_%28botany%29) fruit are those that can be harvested when matured but before ripening has begun. These include banana, melon, papaya, and tomato. In commercial fruit [marketing,](http://en.wikipedia.org/wiki/Agricultural_marketing) the rate of ripening is controlled artificially, thus enabling transport and distribution to be carefully planned. [Ethylene](http://en.wikipedia.org/wiki/Ethylene) gas is produced in most plant tissues and is important in starting off the ripening process. It can be used commercially for the ripening of climacteric fruits.

However, natural ethylene produced by fruits can lead to in- storage losses. For example, ethylene destroys the green colour of plants. Leafy vegetables will be damaged if stored with ripening fruit. Ethylene production is increased when fruits are injured or decaying and this can cause early ripening of climacteric fruit during transport.

Damage in the marketing chain

Fruits and vegetables are very susceptible to mechanical injury. This can occur at any stage of the marketing chain and can result from poor harvesting practices, such as the use of dirty cutting knives; unsuitable containers used at harvest time or during the marketing process, e.g. containers that can be easily squashed or have splintered wood, sharp edges or poor nailing; over packing or under packing of containers; and careless handling of containers. Resultant damage can include splitting of fruits, internal bruising, superficial grazing, and crushing of soft produce. Poor handling can thus result in development of entry points for [moulds](http://en.wikipedia.org/wiki/Moulds) and [bacteria](http://en.wikipedia.org/wiki/Bacteria), increased water loss, and an increased respiration rate.

Losses directly attributed to transport can be high, particularly in developing countries. Damage occurs as a result of careless handling of packed produce during loading and unloading; vibration (shaking) of the vehicle, especially on bad roads; and poor storage, with packages often squeezed in to the vehicle in order to maximize revenue for the transporters. Overheating leads to decay, and increases the rate of water loss.

In transport it can result from using closed vehicles with no ventilation; stacking patterns that block the movement of air; and using vehicles that provide no protection from the sun. Breakdowns of vehicles can be a significant cause of losses in some countries, as perishable produce can be left exposed to the sun for a day or more while repairs are carried out.

At the retail marketing stage losses can be significant, particularly in poorer countries. Poor-quality markets often provide little protection for the produce against the elements, leading to rapid produce deterioration. Sorting of produce to separate the saleable from the unsaleable can result in high percentages being discarded, and there can be high weight loss from the trimming of leafy vegetables. Arrival of fresh supplies in a market may lead to some existing, older stock being discarded, or sold at very low prices.

**Avoiding losses**

Losses can be avoided by following good practices as indicated above. There is also a wide range of post-harvest technologies that can be adopted to improve losses throughout the process of pre-harvest, harvest, cooling, temporary storage, transport, handling and market distribution. Recommended technologies vary depending on the type of loss experienced. However, all interventions must meet the principle of cost-effectiveness. In theory it should be possible to reduce losses substantially but in practice this may be prohibitively expensive.

**FOOD LOSS**

Food loss:Food loss refers to total modification or decrease of food quantity or quality which makes it unfit for human consumption. Loses are measurable reduction in foodstuffs and may affect either quantity or quality. They arise from the fact that freshly harvested agricultural produce is a living thing that breathes and undergoes changes during post-harvest handling. Loss should not be confused with damage, which is the visible sign of deterioration, for example, chewed grain and can only be partial. Damage restricts the use of a product, whereas loss makes its use impossible.

Moisture content: In bio-chemical terms, organic products are composed of dry matter and water. The moisture content is the amount of free water within a given product and is expressed either as a decimal proportion or a percentage. For example, with cereals, 13 percent moisture content is considered a guarantee of satisfactory grain preservation. In agriculture, moisture content or humidity rate is usually indicated as a proportion of the moist product; i.e. the moisture content is the proportion of the weight of moisture to the total weight of dry matter and moisture.

Damage:Damage is a clear deterioration in the product, e.g. broken or pitted grain, which affects more its quality than its quantity and can in the long-term result in a definite loss. Both damage and loss should be quantified in terms of weight and cost.

**TYPES OF LOSSES**

Direct and indirect losses:Direct loss occur when the disappearance of a foodstuff is caused by leakage (for example, spillage from bags) or consumption by pests (insects, rodents, birds), whereas indirect losses occur when a reduction in quality leads to the consumer's refusal to purchase.

Weight loss: Weight loss can be caused by leakage, during transport for example, if sacks have holes or are insecurely attached. It is often the result of prolonged infestation and consumption by insects, rodents and birds or poor packaging. Weight loss from pests is not immediately apparent and may deceive an inexperienced purchaser. It can be checked by taking an equivalent amount of clean, healthy cereal, milling the two samples and weighing the flour from each. The poorer sample will produce less flour. This method can also be used to check whether the weight is really correct, for it is easy to increase it by moistening the grain or adding foreign bodies such as pebbles, earth or waste material.

Quality loss:Quality criteria cover a wide range and are concerned both with external features, shape, and size and with odour and taste. The cultural factors that can influence diets and food habits must also be borne in mind. The cleanliness and healthy condition of a product are primary concerns for the market and correspond to what is referred to as a "sound, legal and merchantable" product in commercial law. For example, if a trader takes a handful of grain from a sack, he can quickly see if it releases dust and work out if this is the result of insect infestation.

Similarly, a bad smell can arouse suspicions that rodents have been at the grain, verifiable by the presence of rat or mouse droppings and hair. Many other objects can be mixed in with a foodstuff and reduce its value: bad grain, scraps of straw or other plant residue, soil, pebbles, bits of glass, etc. All such objects are hard to remove but some of them represent a greater risk of contamination than others: the soluble excreta of pests, oils, pesticides, pathogenic organisms spread by rodents and toxins from fungi and moulds. It goes without saying that the presence of foreign bodies, which can distort the weight of a batch being sold, also affects the quality and thus the market value of a product.

Seed viability loss: Seed set aside for sowing, like any product used for reproduction, is preserved with great care in order to maintain its full germinative potential. As noted above, the protein-rich grain heart can be a favourite target of certain pests. Atmospheric conditions also play a part, as they can weaken the seed's productive potential; variations in light, temperature and humidity, leading to excessive respiration, are particularly responsible here.

Commercial loss: Commercial loss is the translation of the various types of loss listed above into economic and monetary terms. Although the price of a foodstuff is usually based on weight, many other factors play a part. This applies especially to the qualitative elements emphasized above, starting with cleanliness and purity, which will be all the more sought after if supplies are abundant in the market place. Reference to abundance brings us to the key economic factor of the supply-and-demand situation at a given moment

Irreducible losses and compensation: While loss of weight during drying is normal and measurable, there are other, said "irreducible" losses, which arise basically from respiration of the product and mechanical rubbing of grain against itself, as well as the breakage inevitable with certain machines. It should therefore always be remembered that losses, whether pre-harvest or post-harvest (i.e. in production, distribution, storage or marketing) cannot be materially reduced to zero and that they have to be compensated for through extra production. The production increase rate must be progressively higher than that of losses, if such compensation is to be adequate, so that compensation for a 20 percent loss will require 25percent more production, for a 40 percent loss, 66 percent more and for a 60 percent loss, 150 percent more.

**CAUSES OF POSTHARVEST LOSSES**

Losses occur due to:

1. Lack of reliable maturity indices;

2. Poor handling of fresh produce;

3. Poor transportation and/or lack of packaging during transportation;

4. Inappropriate/inadequate packaging;

5. Poor temperature and humidity control around the produce;

6. Inappropriate postharvest treatment

**REDUCING POST HARVEST LOSSES**

**Suberisation and curing**

Potatoes, sweet potatoes, yams and several other roots and vegetables have the ability to heal skin wound when held at moderately warm conditions and high humidity for several days after harvest. The self-healing of wounds, cute and bruises is known as curing. There are two steps in the curing process.

First is suberisation - the production of suberin and its deposition in cell walls. The second is the formation of a cork cambium and production of cork tissue in the bruised area. The new cork tissue seals the cut or bruised areas and helps prevent the entrance of decay organisms. The healing of injuries received in harvesting and handling prolongs the storage time and reduces the incidence and spread of decay in storage.

The storage life of onions and garlic is extended by exposure to warm dry conditions for several days to dry the outside akin and prevent the ingress of spoilage organisms. This process is also known as curing although physiologically it is rather different and causes about 5% weight loss. Curing is carried out in the field when weather conditions are suitable; otherwise the product is subjected to forced circulation of warm dry air when first put into storage.

**Genetic control of shelf life**

Each variety of a horticultural crop has a limited storage life even under optimum storage conditions. The potential storage life is partly under genetic control and can be manipulated by breeding. Plant breeders should be encouraged to include potential storage life as one criterion in their programme for breeding improved varieties of roots, tubers, fruits and vegetables. This is particularly needed with the breeding programmes in tropical climates where refrigerated storage capacity is in short supply. This should be a high priority method for reducing losses in horticultural products. Farmers should be encouraged to grow varieties that hare long storage life.

**Shortening the time between harvest and consumption**

In developing countries a considerable amount of produce is wasted because of poor transportation systems and poor marketing procedures. Much produce is spoiled because it is stored beyond its inherent shelf life before marketing is completed. Spreading the harvest season by growing varieties that mature at different times, and staggering the planting dates of annuals and reducing the number of steps between producer and consumer are methods that can be used to shorten the time between harvest and consumption

**Processing**

Considerable quantities of fruit and vegetables are processed by dehydration, canning and freezing in developed countries. In developing countries small amounts of these commodities are processed for local consumption although large volumes of some commodities are processed for export (e.g., canned pineapple). Canning and freezing require a high capital cost, high energy costs and expensive packaging and are unsuited for widespread use in less developed countries. Dehydration or sun drying is the simplest and lowest cost method of preservation and should be more widely used in developing countries because it converts a perishable commodity into a stable item with long storage life. Some excellent quality dehydrated products can be made from roots and tubers; this kind of processing should be encouraged.

**Heat treatment**

Some of the organisms that cause rotting are inhibited or killed at elevated temperatures that are below the injury threshold of the product. For example, hot water dipping of mangoes at about 50°C for a few minutes kills many pathogens without adversely affecting the quality of mango. Heat treatment is however not a desirable procedure for most fruits and vegetables. When applicable, very rigid temperature controls are needed.

**Sanitation**

All handling, storage, cleaning and washing equipment for horticultural products should be kept in a sanitary condition in order to minimize the risk of spreading infection. Diseased or damaged units should be sorted out and properly disposed of because their presence promotes the growth of fungi and bacteria. Insects infesting cull piles may fly to good produce and introduce pathogenic organisms and increase losses. Wash water should be changed at regular intervals before it becomes heavily contaminated with fungi and bacteria and spreads infection. In some cases the wash water is treated with chlorine or some other chemical in order to reduce the count of viable organisms.

**Use of chemicals**

A number of chemicals may be applied to horticultural products in order to obtain a desirable post-harvest effect. Most of these are applied after harvest, but a few are applied in the field in order to obtain a specific post-harvest response. For example, the sprouting of onions in storage can be delayed by spraying the onions with maleic hydrazide (MH) in the field while the tops are still green.

Post-harvest chemicals are classified into groups below. Many of these are not used commercially and are of research interest only:

1. Fungicides which prevent or delay the appearance of moulds in the product. Examples are, sodium orthophenylphenate (SOPP), benomyl, thiabendazole (TBZ), sodium hypochlorite, and sulphur dioxide (SO2). Methyl formate (Erinol), ethyl formate and (in some countries) ethylene oxide are frequently applied to dried fruits to kill infestations of insects and moulds. Sulphur dioxide and benzoic acid are frequently, and propionic acid, ascorbic acid or sorbic acid sometimes, added to processed fruit products, especially juices, to inhibit the growth of yeasts and moulds.

2. Chemicals that delay ripening or senescence. Examples are: the kinins and kinetins that delay chlorophyll degradation and senescence in leafy vegetables, gibberellins that retard the ripening of tomatoes and hold citrus fruits on the tree beyond normal maturity, and auxins that delay physiochemical deterioration of oranges and green beans.

3. Growth retardants that inhibit sprouting and growth. Examples are maleic hydrazide which is applied pre-harvest and inhibits sprouting in a number of stored commodities, e.g., onions and potatoes.

4. Chemicals that hasten ripening and senescence. Examples are ethylene and compounds such as Ephephon that release ethylene, abscising, ascorbic acid, ß hydroxyethyl hydrazine (BOH), acetylene and substances that release acetylene such as calcium carbide, and certain alcohols and fatty acids.

5. Chemicals that may hasten or delay ripening and senescence depending on the dose and the commodity on which they are used. Examples are 2, 4-D; 2, 4, 5-T; indoleacetic acid (IAA) and naphthalene acetic acid (NAA).

6. Metabolic inhibitors that block certain biochemical reactions that normally occur. Examples are cycloheximide, actinomycin D, vitamin K, maleic acid, ethylene oxide, and carbon monoxide.

7. Ethylene absorbants. These delay ripening and senescence because they remove the ethylene produced by the fruit. They are usually placed in close proximity to the commodity and leave no residue on it. An example is potassium permanganate- impregnated alumina or vermiculite.

8. Fumigants to control insects or sometimes moulds. Ethylene dibromide and methyl bromide are the most commonly used fumigants.

9. Colouring: The use of artificial colours is sometimes permitted in order to improve the appearance of a fruit. In warm climates ethylene is used to degreen lemons, oranges and tangerines imparting a brighter colour to the skin. Ethylene is a naturally occurring metabolite of ripening fruits.

10. Food additives. A number of compounds are permitted to be added to processed horticultural products for preservative or functional effect. The major preservatives are sulphur dioxide, benzoic acid or benzoates, and sorbic acid or sorbates. Functional additives include antioxidants, colouring, flavouring, thickeners, emulsifiers, etc.

**Losses due to micro-organisms may be reduced by:**

1. Refrigeration

2. Improved handling procedures

3. Pre- and post-harvest chemical control

4. Preventing contamination during the washing process

**FOOD PRESERVATION**

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms. Some methods, however, use benign bacteria, yeasts or fungi to add specific qualities and to preserve food (e.g., cheese, wine). While maintaining or creating nutritional value, texture and flavour is important in preserving its value as food. This is culturally dependent, as what qualifies as food fit for humans in one culture may not qualify in another culture.

Preservation usually involves preventing the growth of bacteria, fungi, and other micro-organisms, as well as retarding the oxidation of fats which cause rancidity. It also includes processes to inhibit natural ageing and discolouration that can occur during food preparation such as the enzymatic browning reaction in apples which causes browning when apples are cut. Some preservation methods require the food to be sealed after treatment to prevent recontamination with microbes; others, such as drying, allow food to be stored without any special containment for long periods.

Common methods of applying these processes include drying, spray drying, freezing, vacuum-packing, canning, and preserving in syrup, sugar crystallisation, food irradiation, and adding preservatives or inert gases such as carbon dioxide. Other methods that helps to preserve food, and also add flavour, include pickling, salting, smoking, preserving in syrup or alcohol, sugar crystallisation and curing.

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**METHODS OF FOOD PRESERVATION**

**Preservation by Drying**

One of the oldest methods of food preservation is by drying, which reduces water activity sufficiently to prevent or delay bacterial growth. Drying also reduces weight, making food more portable. Most types of meat can be dried; a good example is beef biltong. Many fruits can also be dried; for example, the process is often applied to apples, pears, bananas, mangoes, papaya, apricot, and coconut. Drying is also the normal means of preservation for cereal grains such as wheat, maize, oats, barley, rice, millet and rye.

**Preservation by freezing**

Freezing is also one of the most commonly used processes commercially and domestically for preserving a very wide range of food including prepared food stuffs which would not have required freezing in their unprepared state. Cold stores provide large volume, long-term storage for strategic food stocks held in case of national emergency in many countries.

**Vacuum packing Food preservation**

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, slowing spoiling. Vacuum-packing is commonly used for storing nuts to reduce loss of flavor from oxidation.

**Food preservation using sugar**

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel), angelica and ginger. The use of sugar is often combined with alcohol for preservation of luxury products such as fruit in brandy or other spirits.

**Canning and bottling food preservation**

Canning involves cooking food, sealing it in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of sterilization. Various foods have varying degrees of natural protection against spoilage and may require that the final step occur in a pressure cooker. Fruits such as tomatoes require longer boiling and addition of other acidic elements. Low acid foods, such as vegetables and meats require pressure canning. Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened.

**Pulsed Electric Field Processing**

Pulsed electric field (PEF) processing is a method for processing cells by means of brief pulses of a strong electric field. PEF holds potential as a type of low temperature alternative pasteurization process for sterilizing food products. In PEF processing, a substance is placed between two electrodes, then the pulsed electric field is applied. The electric field enlarges the pores of the cell membranes which kills the cells and releases their contents. PEF for food processing is a developing technology still being researched. There have been limited industrial applications of PEF processing for the pasteurization of fruit juices.

**High pressure food preservation**

High pressure food preservation refers to high pressure used for food preservation. "Pressed inside a vessel exerting 70,000 pounds per square inch or more, food can be processed so that it retains its fresh appearance, flavour, texture and nutrients while disabling harmful microorganisms and slowing spoilage."

**DRYING**

Drying or Dehydration

Drying or dehydration is the removal of the majority of water contained in the fruit or vegetable and is the primary stage in the production of dehydrated fruits and vegetables. Several drying methods are commercially available and the selection of the optimal method is determined by quality requirements, raw material characteristics, and economic factors

Drying preserves foods by removing enough moisture from food to prevent decay and spoilage. Water content of properly dried food varies from 5 to 25 percent depending on the food. Successful drying depends on: enough heat to draw out moisture, without cooking the food; dry air to absorb the released moisture; and adequate air circulation to carry off the moisture.

 When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavor, texture and color of the food.  If the temperature is too low in the beginning, microorganisms may grow before the food is adequately dried. If the temperature is too high and the humidity too low the food may harden on the surface. This makes it more difficult for moisture to escape and the food does not dry properly. 

Food drying is a very simple. It requires a safe place to spread the food where dry air in large quantities can pass over and beside thin pieces. Sun is often used to provide the hot dry air. Dry, clean air including dry cold air from any source will dehydrate food. Draping food over branches or spreading it on wide shallow baskets on the roof is an old widespread tradition still in use around the world. Many other arrangements have been used to support a thin spread of food pieces. Some options that have been used are to thread the pieces on a cord or a stick and hang it over a fire, wood stove or from the rafters. Or one can bundle herbs or strawflowers and suspend them from bushes or a door knob or nails in rooms with good ventilation.

Drying is an excellent way to preserve food and solar food dryers are an appropriate food preservation technology for a sustainable world."Actually, solar food drying is one of the oldest agricultural techniques related to food preservation, but every year, millions of Naira worth of gross national product is lost through spoilage.  Reasons include, ignorance about preservation of produce, inadequate transportation systems during the harvest season (mostly climate related), and the low price the rural farmer receives for products during the harvest season.

Drying of crops can change this trend and is useful in most areas of the world, especially those without a high humidity during the harvesting season.  If drying of produce were widely implemented, significant savings to farmers would be achieved.  These savings could help strengthen the economic situation of numerous developing governments as well as change the nutritional condition in these same countries.  Unfortunately many of the areas that could benefit from solar drying technology lack adequate information related to how to employ this technology and which technology to use under specific conditions.