NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCES

COURSE CODE: EMT 403

COURSE TITLE: ENVIRONMENTAL ASPECT OF FARMING SYSTEM

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CONTENT PAGE

WHAT YOU WILL LEARN IN THIS COURSE

You are welcome to this Course with;

Course Code: EMT403 and Title: Environmental Aspect of Farming System.

You are beginning this Course with little or no previous understanding of what it entails. It teaches about Farming and Farming Systems carried out in our environment.

This Course is a 3 Unit Course and so it is made up 5 Modules, with each Module comprising of 5 Study Units. It is therefore entirely made up of 25 Units. Your study time for this course is between 1 – 8 weeks. You will find more detailed information about the contents of each unit in the section under the main content.

Each study unit contains the Introduction, Objectives, Main Content, Conclusion and Summary of the topic review. Also contained in each study unit are Tutor-Marked Assignments and References of materials used for developing the study unit. The Tutor-Marked Assignments contains a number of Self-Tests questions that allows or provides you (the student) with the opportunity to check his/her level of progress as he/she works through each topic.

It is advisable that you think very well about these questions. You (the student) are also advised to apply the material you have just read to your own experience in your local government area or state or country.

Some lists of reference books are provided. Efforts should be made by you to ensure that the books apply to your local situation. It is also important that you as students learn the terms or terminologies which you come across as it pertain to this course during the course of study.

The study units, textbooks, learning materials and exercises will allow you to master the topics over a period of 16 weeks. Before looking at the study units or textbooks, you should read this Course Guide thoroughly. The Course Guide actually tells you what and what to expect and these may include;

- The aims and Objectives of the Course
- What the Course covers.
- The Components of the Course.
- The amount of time you need to study the Course successfully.
- How your performance in assignments and examinations will be assessed.
- How the tutorial system works.

You may probably need to refer to this Course Guide throughout the course to clarify important points about studying with the National Open University of Nigeria (NOUN).

COURSE AIMS

Environmental Aspects of Farming System as a course aims to provide you with the basic introduction to farm system and farming systems, relevance of farm-system approach, classification and difficulties of farming systems. Also looked at are the problems and peculiarity of shifting cultivation, characteristics and problems of permanent upland cultivation, irrigation farming system as well as environmental and health implication of irrigation. On a final note, the study examined perennial crop farming, ranching and institutional and environmental requirements of site related systems.

COURSE OBJECTIVES

At the end of this course the student should be able to;

i. Define farm systems and farming systems

ii. Identify some of the relevance / importance of identified farming systems

iii. Know the various classifications of farming systems

iv. State some of the difficulties of farming systems

v. Define and know the challenges and peculiarities of shifting cultivation

vi. State some characteristics and problems of permanent upland cultivation

vii. Define irrigation and explain irrigation farming

viii. Explain some environmental and health implications of irrigation

ix. Discuss perennial crop farming

x. Know the difference between perennial and permanent farming systems

xi. Define and explain ranching

xii. Advance some institutional and environmental requirements of site related systems.

COURSE DESCRIPTION

One of the most important functions of Environmental Aspect of Farming System is to bridge the knowledge gap between the farms and the farming systems. It exposes to the farmers the different types of farming systems that exist and the relevance of the systems in line with providing bumper harvest or increased and improved productivity to the farmers. The farmers are also made to know the possible challenges that accompany the various farming systems so that he/she would know which of them to choose from and practice.

Again, the farmer is also informed of the possibility of farming even in the dry with the aid of irrigation system and the environmental and health implications associated with the various irrigation farming systems.

Ranching which is an area that has to do with the farming of animals is also made known to the student and the farmers. The advantages, disadvantages and the challenges plaguing irrigation system are as well dealt with. The impact of ranching in our contemporary environment is also brought to lime light. The farmers are also educated on the Institutional and Environmental requirements of site related systems.

Perennial agriculture, which is a system of growing or cultivating crop species that live longer than two years without the need for replanting each year. The period of survival and growth differentiates it from annuals, which must be planted each year and biennials, which only live for one or two years. Perennial agriculture differs from mainstream agriculture in that it involves

relatively less attention and are suited to different climatic condition the crops are robust, protect the soil against soil erosion and help to conserve soil water.

Permanent crops are perennial trees, bushes or vine crops like citrus, apples, blueberries, nuts or grapes. Perennial cropping is affected by planting time, soil, climatic, biotic, machinery and management factors. Perennial cropping goal is therefore to produce food without damaging soils while reducing waste. The objectives include to reduce labour, accelerate farm work and the production of farm income. At the end of the study period the farmers or student's knowledge can be measured by;

i. The type of farming and farming systems practiced by him / her.

ii. The rate of overcoming difficulties in the farm.

iii. The farmers ability to farm in the dry through the use of irrigation farming system.

iv. The types of crops be it biennials, annuals or perennials farmed by the farmers.

v. The animals reared and the system adopted by the farmer in rearing his / her animals.

vi. Farmers knowledge level on the institutional and environmental requirements of site related systems.

vii. Their understanding of what perennial agriculture is about and the factors that affects it.

viii. Their knowledge level on the difference between perennial and permanent agriculture and the factors that affect permanent agriculture.

COURSE MATERIAL

In addition to this Course Guide being provided, there are important components of the course. At this time, please ensure that you have all of these materials available and can identify the various components in the course if you do not have the NOU- produced materials, you should

contact the NOU immediately. The textbooks, however, are your own responsibility. These can be obtained from the Academic and professional book centers: The addresses for the branches are in the book list that is sent to you.

STUDY UNITS

Although we have recommended the amount of time you should spend on each study unit, you may prefer to study material in a slightly different way. There is provision to deviate a little from the pattern of the course, but you must complete the practice exercises, assignments and examination successfully. The course is structured so that each unit builds upon previous knowledge. Each unit includes at least some of the ways to help you study Farm System and Farming Systems.

These are:

1. Reading the study unit

2. Reading the textbooks or internet materials used to make up the body of the course material.

3. Testing your comprehension and analytical skills by working through the self- test Questions which appears throughout the units.

4. Completing the practice exercises in each unit.

5. Preparing and writing problem-solving assignment

6. Asking you questions about your own experiences. Your answers help you link your experience to the course material and to Nigerian culture.

If you don't read the study units carefully, you may miss important information.

Your study notes are designed to guide you through your textbooks.

You must read both the study notes and the texts. They are not alternatives to each other. It is also helpful to read as widely as possible. Try to read articles in newspapers and journals, other books on the topic, and related cases. The more you read, the better your appreciation and understanding of the subject will be.

Each unit directs you to read specific pages from chapters in the textbook. You are expected to study and understand the principles and concepts involved. Each unit contains self-test question, usually short ones, providing a duck on your understanding of a technique or principle you have just read about. By attempting these short questions, you will have instant feedback on your progress. You should attempt to answer all the self-text questions before looking at the answers. This will help you to prepare for your assignments and examination. After each self-test there is a question on your own experience.

At the end of each unit there is one practice exercise, which covers all areas you have studied in that unit. It is important to complete all the practice exercises. This will expose you to the types of questions you will be required to answer in assignments and in your final examination and also introduce you to some problems encountered in farming business, organizations and real life situations.

The questions reflect the demands of the unit objectives; they are designed to help you understand and apply those principles covered in the unit.

SET TEXT BOOKS

There are no compulsory textbooks for Farm Systems and Farming Systems.

Read as many textbooks, newspaper/journal articles as well as Internet materials on the subject as possible

COURSE ASSESSMENT

Your assessment for this course is made up of two components, they are:

i. Tutor-marked assignment (TMAs), (which is made up of objectives) and,

ii. A final examination (which is made up of multiple choice and fill-in-the-blank questions for year one and two; or theory questions for year three, four and five as the case may be).

Note that the practice exercise is not part of your assessment but it is important to complete all of them.

TUTOR-MARKED ASSIGNMENTS

This course has three (3) tutor-marked-assignments, and each of them is made up of ten (10) questions each, therefore making a total of thirty (30) questions. Instructions on how to complete them will be made available at the appropriate time.

You will see from the course time table the dates the portal will be opened for the TMAs to be attended to.

Presently, the university has adopted electronic e-TMA which comprises thirty multiple or objective questions.

You can write the assignments using the materials from your study units and textbooks. But it is preferable in all degree level education to demonstrate that you have read and researched more widely than the required minimum. Using other references will give you a different viewpoint and a deeper understanding of the subject. **But do remember that copying from any sources without acknowledgement is plagiarism and is not acceptable.** You must make reference

when you refer to or quote from others' work. The minimum information needed is: author's name, date of publication, title, edition, publisher and place of publication.

The nature of the assignments varies, but they normally consist of either case **studies or questions** relating to the cases, short essays or short answer questions. It is useful to illustrate any theoretical points with examples from your own experience. This allows you to demonstrate your understanding of the application of theory to real life situations.

Below are the total marks allocated to the assignments and to your final examination;

Title Value

TMA = 30%

Exam = 70%

Total = 100%

FINAL EXAMINATION AND GRADING

At the end of this course, a final examination is conducted and it is a three-hour examination with a 70% grading. Review your practice exercises and assignments before sitting for the examination. You will be advised of examination arrangements after you send in your examination registration card.

The final examination for EMT403 Farm System and Farming Systems covers information from all parts of the course. To earn a passing grade for the course you must submit at least three TMAs which earns 30%, and a reasonable score on your final examination (theory examination) and altogether attain a passing grade (i.e. at least score 40%) on these.

Do not hesitate to contact your tutor by telephone if you need help. Here are typical circumstances in which help is necessary. Contact your tutor if:

• You do not understand any part of the study Units or the assigned readings

• You have any difficulty with self-tests or practices exercises

• You have a question or problem with assignments, with your tutor's comments, or grading on an assignment.

To assist you in this course, regular tutorials are organized with your assigned tutor. Very interesting activities are designed for the tutorials. They also give you an opportunity to sort out any problems. You will be notified of their dates, times, and location, together with the name and phone number of your tutor, as soon as you are allocated a tutorial group. We strongly recommend that you attend the set tutorials. They provide considerable assistance in your study of this course and improve your chances of gaining high marks. They also let you meet other learners studying through the NOU.

CONCLUSION

EMT403 Farm System and Farming System is a subject that should interest anybody who is concerned about the quality of life in line with farming of crops and animals either in Nigeria or any Third world Country of Africa. The course has therefore, been designed to help you understand the most complex problems in where farming of crops and animals are concerned of the developing nations with a view of improving yields and welfare of the farmers in the rural areas. It requires both conceptual and analytical skills. You must analyze and apply concepts to understand the nature and philosophy of Farm System and Farming Systems.

Hopefully, you will find it fun, interesting and useful as an administrator or a policymaker (or potential ones) interested in the development of your country.

Good luck, and enjoy the course.

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Unit 4: The Importance, Effects, Advantages and Disadvantages of Irrigation System of Farming

Unit 5: Environmental and Health Implications of Irrigation Farming

MODULE 5: RANCHING

Unit 1: Concept and Definition of Ranching

Unit 2: Herding and Livestock Production

Unit 3: Definition and Concept of Animal Husbandry

Unit 4: Institutional Requirements of Site Related Systems

Unit 5: Environmental Requirements of Site Related Systems

STUDY MODULE

MODULE ONE: FARM SYSTEM AND FARMING SYSTEMS

Unit 1: Concepts, definitions and objectives of farming systems.

Unit 2: Methods and relevance / importance of farming system.

Unit 3: Characteristics and classifications of farming systems

Unit 4: Principles, difficulties/challenges and solutions of farming systems

Unit 5: Factors determining farming systems.

MODULE ONE: FARM SYSTEM AND FARMING SYSTEMS

UNIT 1: Concepts, definitions and objectives of farming systems

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1.0 Introduction

Farms are actually places where different activities take place. These activities include the growing of crops and or the rearing of animals. Sometimes, the crops are grown in one portion of the farm while the animals are reared in another portion. The crops grown could be of only one type (mono cropping farming) or different types (mixed cropping farming). In some cases, the crops being grown is used as food by man, while on the other hand, they could be grown for the purpose of feeding animals. Important to mention that whether it is crops that are grown or animals that are reared, the production process takes the forms or styles as wanted by the farmer. Important to note that any form or style adopted by the farmer, it usually has its own name with associated advantages and disadvantages. It is of interest to note that the analysis of the farm will

depend on the type or style of production process and this will affect the type of policy that it would attract for assistance or development.

2.0 Objectives

At the end of this unit, you (the student) should be able to;

i. Define a farm.

ii. Define farming systems.

iii. Describe the different types of farming systems that are in existence, and

iv. State the objectives of farming systems.

3.0 Main Content

3.1 Concept and Definition of Farming System

A Farm is actually an area of land that is used to grow crops, shrubs and or trees and for the rearing of animals. Adebowale (2018) defined a farm as a system that has inputs that are used for the production process and the produce either eaten in that form or processed into products that are either consumed or sold to the public. Farming utilizes land or water areas as facilities for food production, mainly for agricultural practice or for aquaculture.

A farming system on a larger note is an area of land that has one enterprise or different related enterprises with different resources available within his/her reach to grow crops and rear the animals for the purpose of food and profitability. The crops being grown and animals reared are used to meet the food needs and standard of living of the populace on one hand and lifting the economy Gross Domestic Product (GDP) on the other hand (FAO, 2017). The farm enterprises include crop, livestock, aquaculture, agro-forestry, agri-horticulture, fruit crops etc. it is of note

that the different enterprises yield different levels of income to the farmer. By definition, farming system is a resource management strategy to achieve economic and sustained agricultural production to meet different requirements of farm livelihood while preserving resource base and maintaining a high level of environmental quality. In brief, farming system can also be defined as the organization of the farm and all the enterprises in relationship to each other.

From the aforementioned, farming system as advanced by a Report on Farming System is a set of inter-related agronomic activities that interact with themselves in the farm or a particular agrarian setting. Farming system is actually a mix of different farm enterprises to which the farmers allocate the farm resources in a way to efficiently utilize the interrelated enterprises for the purpose of increasing farm productivity and profitability. Farming system can in brief be said to be a decision making unit comprising the farm household, cropping and livestock system that transform land, capital and labour into useful products that can be consumed or sold.

The framework of a farming system is made up of a complex process with the farmers at the center who takes decisions on how to meet up with his/her aspirations, goals and desired objectives within the limits of technologies available to him/her. Within the context of the farming system, the farmer uses the farm inputs to get or produce his outputs or products. All of these the farmer does within the limits of available technology.

3.2 Objectives of Farming System

There are various for which farmers engage in different farming systems. Some of them according to FAO (2017) are;

i. Increased productivity: Farming systems help to provide the farmer with the opportunity of increasing their farm yields per unit of area and per unit of time. This is possible as a result of the intensification and proper of use of available resources.

ii. Improved potentiality: Farming systems make it possible for organic supplementation of the soil brought about by the effective use of manure and waste re-cycling. This result in the improvement of soil nutrients and later translate to increase in crop productivity.

iii. Increase in profitability: Farming systems generally help the farmer to make use of waste material of one enterprise as an input in another at free or low cost (which ordinarily would have been paid for by the farmer). Through this method, the cost of production is reduced while profitability and benefit now becomes high.

iv. Provision of balanced food: Farming systems provide diverse enterprises which produce different types of food and the food provides different types of nutrients to the household of the farmer. As far as farming systems are concerned, the problem of malnutrition of households is brought under check.

v. Environmental safety: Farming systems involve the use of by-products from other enterprises within the system. This usage has to do with the recycling of waste products from other enterprises. By this act, the use of waste product from one enterprise helps to control pests and diseases that would have emanated from the waste if they were not recycled for use. Also, the recycling of the waste product does not only make the environment a friendly one but also prevents the use of chemical fertilizers for soil fertility.

vi. Cash flow all-round the year: Quite unlike where only one type of enterprise is the practice, and owing to the fact that different crops are produced and harvested at different times of the

year, farming systems help to make produce or products available throughout the year. These when sold makes money available to the farmer all year round.

vii. Saving energy: Farming systems involves the growing of different types of plants otherwise known as bio-gas plants that are used as organic materials which are recycled as organic waste to generate energy. This helps to mitigate the energy crisis.

viii. Meeting fodder crisis: The growing of fodder legume (animal feed for silage) helps to produce the required fodder and this greatly relieve the problem of non-availability of fodder to feed livestock in the farming system.

ix. Employment provision: Farming systems as it implies involves the combination of enterprises and this combinations make it possible for different works or jobs to be provided. People need to be employed for the work to be done. So, through farming systems employment opportunities are generated.

x. Enhancement of input use efficiency: Farming systems go to the extent of providing the farm of efficient utilization of the resources of the farm. This efficient utilization of the resources results in greater input use efficiency and benefit-cost ratio.

3.3 Scope of Farming System

The scope of the farming system is very much all-encompassing as far as activities are concerned. A Report on Framing Systems and Methods stated that the scope of farming enterprises do include production, processing and sale of crops, livestock, fish, poultry, sericulture etc. greater dividends are expected when the entrepreneur (farmer) correctly and carefully combines one or more enterprises with cropping than when he produces a single

enterprise. It is the duty of the farmer to plan the farm for effective integrating of the enterprises to be combined with crop production activity.

4.0 Conclusion

A farm is any piece of land where crops, shrubs and or trees are grown. Different resources within the farmers reach are exploited by the farmers for his/her farm production process. Farming system is actually a decision making unit that comprise of household, cropping and livestock system that transforms land, capital and labour into useful products to the farmer. Farming system is more profitable to the farmer when different related enterprises are combined within the farming system.

The objectives of farming systems are numerous and they underscore the basic reasons why farming systems are practiced. The benefits include the tendency of the system to help the farmer increase his/her farm productivity, profitability, potentialities, cash flow all year round, employment provision for people and enhancement of input efficiency use.

5.0 Summary

In this unit, we have been able to define farm, farming systems and given an elaborate understanding of what farming system encompasses. Also stated were many objectives which underscore the main reasons for the practice of farming systems. We were also able to explain the scope of farming system as it were.

6.0 Tutor-Marked Assignment

i. Define a farm

ii. Define a farming system

iii. Enumerate any four (4) related enterprises that can combine to make a farming system

iv. State five (5) objectives of a farming sustem.

7.0 References

Adebowale, K.E. and Fabunmi, T. (2018). Farming Systems *Lecture Note on PCP505*. Retrieved at: *http://www.unaab.edu.ng*. On 25th April, 2020

Food and Agricultural Organization (FAO) (2017) - Farming Systems. Retrieved at: *www.fao.org>description-en* On 22nd June, 2020

Farming Systems and Methods – Peda.net. Retrieved at: *https://peda.net* On 25th June, 2020

Farming System: Lecture 1: Scope, Importance and Concept Retrieved at: *www.hillagric.ac.m.PDF* On 25th June, 2020

Unit 2: Methods of Farming Systems and Relevance / Importance of Farming System.

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1.0 Introduction

Farming methods are the ways or styles a farmer uses or adopts in carrying out his/her farming operations. Farming methods are of different types and the parameter used in classing farming systems may be related to the size of the farm medium on which farming is done (on either soil or water), type of crop grown, mix-up of the crops, style adopted in growing the crops and rearing the animals and so on. In specific terms, some of the known methods of farming are subsistence farming, commercial farming, shifting cultivation, plantation farming, etc.

The importance of farming system cannot be overemphasized as it provides food, raw material, employment opportunities and income to the farmer and the nation.

2.0 Objectives

At the end of this unit you (the students) should be able to;

i. Identify and explain the methods of farming

ii. Identify the characteristics of each of the farming methods

iii. State the importance of farming system.

3.0 Main Content

3.1 Methods of Farming Systems

Some of the known farming systems according to Farming System: Lecture 1 note, A Report on Farming System in Agricultural Sector and Idodo-Umeh (2015) include;

i. **Subsistence farming:** This is one of the methods of farming that is characterized by farmers farming on small area of land and may sometimes have his farms in small fragments scattered in different places. This type of farming is mainly found among peasant or poor farmers. By characteristics;

- The farmers have or farm n small piece of land.
- They use poor or unimproved inputs for farm production
- They are known to always use crude implements in their farming operation.
- Mixed cropping system is usually the practice where crops are grown.
- Their output is usually small
- Production is mostly for family consumption.
- Their farmers are usually poor due to low output
- Their cost of production is usually low since their farming is carried out on small land area.

ii. **Commercial farming:** Commercial farming is another type or method of farming where farming activities are carried out on a very large scale on a large area of land. Again, the farm is usually located in one particular area of land. Characteristics of commercial farming are;

- The farms are usually large.
- The output from the farm is usually large.
- Production is carried out and mostly sold to the public.
- In economic terms, the farmers are described as rich farmers due to large volume of sales from large production.
- The farms are operated with improved farm machines (mechanized farming).
- Cost of production is usually huge due to large areas that need to be farmed
- Only one major type of crop or animal is usually farmed on the piece of land.

iii. **Plantation farming / agriculture**: this method of farming is the growing of mainly one type of crop on a very large piece of land. Plantation farming is known for the following characteristics;

- ❖ It Involves the growing of mostly one type of crop, which is mostly perennial crop like cashew, mango, timber, rubber, etc.
- ❖ The farming involves the growing of crops on a very large piece of land.
- ❖ Modern and improved technologies are used in carrying out farming activities.
- ❖ Modern inputs like seeds and seedlings are used in carrying out farming operations.
- ❖ The farming involves huge or investment of large capital to set up.
- ❖ The system is carried out with the hands of experts or specialists to make it a success.
- ❖ The system may involve the use of irrigation facilities especially in times of dry season.

iv. **Shifting cultivation:** this is one method of farming where a farmer is expected to farm a particular piece of land, A for a short period of time, say 2 – 3 years and thereafter move to another location or farm B to continue his farming while allowing farm A (that was previously cultivated) to fallow for some years before returning to cultivate it again or never return there again. It is important to note that the system can only be practiced in where the farmer has many plots of land that allows him to migrate from one plot or area to another. Shifting cultivation has the following characteristics;

- ✓ The system of shifting cultivation mainly involves subsistence farming
- ✓ Farming is carried out on a small-scale level
- ✓ Farming is mainly carried out on a small piece of land.
- ✓ The usual method of preparing the land for farming is slash and burning of the debris.
- ✓ The method has a unique method of fertilizing the soil through the ash got from the burning of the debris

v. **Crop rotation farming**: crop rotation farming as the name implies, is the growing of different types of crops on different plots of land in a definite sequence. In practicing crop rotation, the

piece of land is divided into the number of plots or portions the farmers want the rotation to go through. Assume the number of plots is four in number. On each plot, different crops are grown and after harvesting, the crops are shifted in a definite sequence

Some of the advantages of crop rotation are;

- It helps to increase farm productivity.
- The system helps to save money that would have been used to buy fertilizer to improve the soil fertility
- It helps to conserve or improve soil texture and structure
- It helps protect soil macro and micro organisms
- The system also helps to protect and conserve the soil ecosystem.

Accordingly crop rotation is guided by the following principles;

- Deep rooted crops should not follow each other in the sequence.
- Shallow rooted crops should not follow each other in the sequence.
- Crops likely to be affected by the same diseases should not follow each other in the sequence.
- Crops likely to make use of the same type of nutrient should not follow each other in the sequence.
- As much as possible, a leguminous crop should be added in the sequence at least to help add nitrogen (macro nutrient) to the soil naturally.

Find below a good chart showing a 4 – years plan for the sequence of the crops to use and the sequence they should follow

Table1: Showing chart of crop rotation

Year	Crops to grow			
	Plot 1	*Plot 2*	*Plot 3*	*Plot 4*
1	Yam	Maize	Groundnut	Vegetable
2	Vegetable	Yam	Maize	Groundnut
3	Groundnut	Vegetable	Yam	Maize
4	Maize	Groundnut	Vegetable	Yam

vi. **Integrated pest management farming:** this is a particular farming system where emphasis is on pest management. The system/method relies so much on pest observation and prevention. The pest are controlled so that they don't interfere with our crops and animals production process. The pests are actually gotten rid of through the use of other biological organisms. The biological organisms are used to prey on the pests. By so doing, the number of the pests are either reduced or completely eliminated. An example of this kind of practice is the use of lizards to depopulate grasshopper in farms. Also, ladybugs are used to devour aphids in farms.

vii**. Zero tillage farming**: Zero – tillage farming is also known as No – Till agriculture. In this system, only trees and shrubs are cut down while the grasses are not weeded during preparation for planting. In the system, only the spots where the seeds and seedlings are to be planted are slightly weeded. Agrochemicals such as herbicides are used to control the weeds. In such as case, the soil is never broken by farmers and the sprayed deed grasses only return back to the soil as manure.

viii. **Mixed farming:** mixed farming is the type of farming that has to do with the growing of crops and the rearing of animals on the same piece of land. The crops could be annual or

perennial crops while the animals are like ruminants. The animals and plants live symbiotically with each other in the farm. The plants provide the animals with leaves which they feed on. The plants also provide the animals with shelter. In reciprocation, the animals defecate in the farm, thereby providing the plants with manure.

ix. **Mixed cropping:** mixed cropping is a type of cropping system where different types of crops are planted on the same piece of land and at the same time. An effective cropping system should ensure that the crops should not form canopy over one another. Meaning to say that the crops should be of almost same growing rate and height.

x. **Pastoral farming**: pastoral farming is the rearing of animals in a particular area of land. The animals are reared in a fenced piece of land, where they are medicated, fed and served water. Some of the animals kept under this system are cattle, sheep, goats, horses camels, etc.

xi**. Poultry farming:** in this type of farming system, birds are kept in the farm. The birds are kept and maintained either under the intensive or extensive housing system. The birds can as well be reared in cages, batteries, raised floor or open floor. It is in the pens that the birds are medicated, fed and served water. The types of birds raised in poultry farming are; fouls, ducks, ostrich, etc.

xii. **Nomadic pastoralism**: Nomadic pastoralism is a type of farming that involves the rearing of animals in the wild. In this farming, the animals and the shepherd move from one place to another, sometime over several kilometers in search for food and water. . The types of animals reared under this kind of farming system include cattle, sheep and goat.

xiii. **Integrated farming system**: integrated farming system involves a whole lot of specialization as it involves the interrelationship between enterprises in the agricultural activity. The main aim is to maximize productivity of the farm within specific time frame. Integrated

farming system improves the speed of operation of the farm. It also helps to improve the profitability yield capacity of the farm.

xiv. **Irrigated farming system**: this is a system of farming that supplies water to the farm or fields that lack sufficient moisture for crop growth. The supply is either mechanically or manually done. The supplied water helps to increase the moisture content of the soil and as well helps to release the nutrient in the soil for crop growth. The irrigated water also helps to exact a cooling effect on the plant and so helps to reduce transpiration. Toxins are also removed from the plant through the process.

3.2 Relevance / Importance of Farming System

Farming Systems and Methods Report stated that the importance of farming systems has to do with the positive and negative fallouts of the different farming system under consideration. The importance to a large extent would rely on the farming and farming system being practiced by the farmer. Whatever the case here are some of the importance of farming systems;

i. Farming system serves as a source of livelihood to many people in the country, Nigeria in particular and the Africa context in general.

ii. It also serves as a business opportunity in the agricultural sector where many people earn their livelihood.

iii. The system helps to to provide a reliable source of raw materials to the agro-industries like sugar, coffee, tobacco, beverages, etc industries.

iv. The system helps to contribute and improve the Gross Domestic Product of the economy. Apart from oil, farm system is the second largest contributor to the economy.

v. Farming system also helps to provide employment opportunities to the people of the country.

vi. The system could provide beneficial ground for the combined enterprises.

vii. Farming system could help reduce production cost where there is interdependence between enterprises.

viii. Food and other basic needs of man and animals are provided from farming systems.

4.0 Conclusion

Farming methods are the methods or styles a farmer wishes to use in carrying out his farming activities. The methods are of different types and they include; subsistence farming system, commercial farming system, shifting cultivation, plantation farming, crop rotation, etc. the different farming methods require different farm resources and so therefore produces different products.

Farming system is actually a decision making unit that comprise of household, cropping and livestock system that transforms land, capital and labour into useful products to the farmers. Farming systems have much importance among which are the provision of food for human livelihood, business opportunities, raw materials for our agro-industries, contribution of income to individuals and Gross Domestic Product to the economy of the nation.

5.0 Summary

Farming methods has been defined and have been exhaustively discussed. The different characteristics of the different methods were also stated.

In addition, many reasons for carrying out farming methods was stated.

6.0 Tutor-Marked Assignment

i. In five (5) different ways differentiate between subsistence and commercial farming system.

ii. Explain one similarity and two differences between pastoral farming and nomadic pastoralism.

iii. Explain any four (4) principles guiding crop rotation.

iv. State five (5) reasons why farming system is practiced by farmers.

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UNIT 3: Characteristics of Farms and Classification of Farming Systems

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1.0 Introduction

Every farm by its nature is identified by certain characteristics because it is these characteristics that enable the farmers and other visitors to know or have proper and adequate information of the farm. The characteristics which of course provide the information about the farm help in the planning of the farm. The characteristics of the farm as well help in the kind of policy formation that should concern the farm and the farmer.

2.0 Objectives

At the end of this unit, the student should be able to:

i. Describe the broad characteristics of the farm.

ii. Explain the main characteristics of the farms

iii. Briefly explain the basis for classification of farms.

3.0 Main Content

3.1 Characteristics of Farms

Farms are operated by the farmers with different motives in mind. It is the farmers motive that drives his/her sense of action and direction. By and large, every farm has same or similar characteristics. A Report on Farm Characteristics-STARS stated some of the notable **broad characteristics** include:

i. Goal orientation: every farm like earlier noted is operated or carried out for different purposes. The purpose however constitutes the goal of the farm. The goals could vary from farm to farm. However, no matter what enterprise the engages in, be it crop and or livestock production, one of the most primary goal is profit generation. On a large scale, that is, commercial farming goal is geared towards market production and profit whereas for the small-scale farmer, that is subsistence farming, the primary objective could be multi-dimensional and this may include provision of food for the household, selling of surplus to make money, accumulation of wealth and provision of building materials for building of huts (thatched houses). No matter how diverse this could be, it boils to money generation.

ii. Boundaries: if not for anything but for the purpose of safety and security, every farm has boundaries which separate it from its immediate environment. Within this confine, the farmer or farm manager exercises his/her power and control of the resources of the farm. It is assumed that all resources and processing units as well as accommodation unit in the farm area are seen as property of the farm. They are therefore seen as property of the farm and so are supposed to be within the farm manager's control. The boundaries could be shown by fencing or survey plan or some natural objects.

iii. Activities: every farm has different activity that goes on in it. The type of activities depends on the type and method of farming being undertaken by the farm or the farmers. This goes to say that activities of crop production differ from activities undertaken in livestock production. The production process which involves conversion of resources to products as well differs. In the same manner, the processing of farm products into acceptable finished forms as well as the storage and marketing process activities also differs. Most importantly, it is settled that activities take place in all farms and these activities differs from farm to farm.

In a more detailed form, some special farm characteristics that are worthy of note are;

i. Personal details of the farmer: In this particular case, the farmer's details are taken and information required here his socio-economic characteristics which include his age, gender, age, educational level, marital status, etc.

ii. Farm geographical location: The geographical location of the farm is taken and this is done with the use of appropriate survey instruments. It is ideal to take the coordinates of the corners of the farm. The farm needs to be mapped in order to show its boundaries, at least to avoid its encroachment.

iii. Crop(s) cultivated: The crops that are cultivated in the farm needs to be recorded or noted. The cropping system, whether mono-cropping or mixed cropping system, it needs to be recorded. Such recording will enable the farm to know what the output will likely be at the end of the farming season.

iv. Historical land use: this may not be too necessary, but where need be, the historical information of the farm needs to be taken. This will help to guide the farmer on how to manage his farm especially in terms of management.

v. Land tenure system: Land tenure system is the ownership and usage of land. It is important as a characteristic of the farm to know how the land was acquired. Such knowledge would enable him know which kind of farming system to practice, if to use it for annual crops or perennial crops and so on and so forth.

vi. Land form / slope: This is another characteristics that needs to be observed or taken into account. This helps to farmer to know how to plan the farm's use in line with where to place structures and where to farm his crops or establish his processing unit. Ideally, level area is good or preferred for planting of crops, while structures could be constructed across slopes on sloppy or hilly areas.

vii. Accessibility: Accessibility as a characteristics help to show the entering and exit points of the farm the farm. This shows the ease or difficulty with which the farm could be accessed. The easier the access of the farm, the better for the farm and the farmer.

3.2 Classification of Farming Systems

Adebowale (2018) identified classification of farming systems in developing countries to be based on the following criteria. These criteria are;

a. Available natural resources base: The available natural resources base include water, land, grazing area and forest. Other criteria under resource based consideration include climate, landscape (slope) farm size and organization; and

b. Dominant farm pattern of farm activities and household livelihoods: Dominant farm pattern of farm activities and household livelihoods may include field crops, livestock, trees, aquaculture, hunting and gathering, processing and off-farm activities, available farm technologies used(which affect production) and integration of crops, livestock and other activities.

Going further in a more specific and detailed form, farming system has been classified based on different considerations. They are;

i. Classification according to type of rotation: This kind of classification is carried out on the basis on how the different types of crops are rotated with each other. Deep rooted crops should be rotated with shallow rooted crops, how planted fields are rotated with fallowing fields, etc.

ii. Classification according to intensity of rotation between cropping and fallow period: This has to do with the period a piece of land is allowed to grow crops and then allowed to fallow fro a particular period of time before it is allowed to grow crops again.

iii. . Classification according to water supply: This classification of the farming system is based on the consideration of whether the farm is irrigated or rain-fed. Where the farm is irrigated, the type of irrigation is also taken into consideration. This is where a farm is classed as an irrigated farm or a non-irrigated farm.

iv. . Classification according to the cropping pattern and animal activities: This classification is most based on the leading crop and animal activities in the farm. Each activity is assumed to require different climate, soil, inputs, market, and so on. Hence, we may have mono-cropping or mixed cropping farm, ruminant or pig farm, dairy farm, etc.

v. Classification according to implements used for cultivation: This type of classification has to do with the type of implements used for cultivation of the soil. The implements may be simple farm tools like cutlass, hoe, spade, etc, or animal-drawn implements. Other implements may include the use of farm machines that has to do with the use of ploughs, harrows, combined planters and harvesters,

vi. Classification according to degree of commercialization: The classification on this note is based on the destination of the farm output. On this consideration, farms are classified into three groups. The groups are:

- Subsistence farming: this is a situation where the farmer produces with no intention of making sales to the public.
- Partly commercialized farming: this consideration applies to those farmers that have more than 50% of the value of their produce for home consumption.
- Commercialized farming: this is a type of farming system where more than 50% of the value of the farm produce is for sale.

4.0 Conclusion

Every farm is identified by certain characteristics and the characteristics go a far way in providing the required information that is needed by the farmer and the type of policy that should be given consideration in line with production activities of the farm. However, three broad characteristics and several specific characteristics were treated or dealth in the session. In addition, the modalities for classifying farms were also treated. Importantly, classification of farming system were generally based on available natural resources and dominating pattern of farm activities and household livelihoods.

5.0 Summary

The study unraveled the different characteristics of farming systems. The broad and the specific characteristics were studied and they form the basis for which the farm's goals, activities and boundaries are made known. The basis for classification of farms was noted to be on criteria

such as; type of rotation, intensity of rotation between cropping and fallow period, water supply. etc.

6.0 Tutor-Marked Assignment

i. Describe in details five (5) specific characteristics of the farms

ii. State (giving three reasons) why every standard farm should have a boundary.

iii. Enumerate five (5) criteria used for classification of farming system.

7.0 References

Adebowale, K.E. and Fabunmi, T. (2018). Farming Systems *Lecture Note on PCP505* Retrieved at: *http://www.unaab.edu.ng*. On 25th April, 2020

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UNIT 4: Principles and Challenges of Farming Systems

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1.0 Introduction

Farming system is guided by many principles and these principles help the farmer and the concerned institution to work or operate within certain framework that allows farmers to produce as much crops and animals that can guarantee food security of the nation. The farming system principles permit the collaboration of farmers, especially the small holders to grow more crops sustainably through effective market system, more collaborative research and committed knowledge sharing. The principles ensure that only the right things are done. It is important to know that the farming system is not without challenges which may emanate from the concerns of input use, climate variation or market related deficiencies.

2.0 Objectives

At the end of this session, students should be able to;

i. Explain the different principles guiding farming systems in Nigeria.

ii. Explain the different challenges confronting the farming in his/her farm.

3.0 Main Content

3.1 Principles of Farming System

There are different principles of farming systems advanced by different authors and this is not unconnected to the type of farming system being practiced. In particular, A Report on Principles – Farming First, A Global Coalition for Sustainable Agricultural Development enumerated the following as principles guiding farming system.

They include;

i. Principle to safeguard natural resources: This principle focuses on land and how it can be effectively used for maximum food productivity. It emphasizes land management and its improvement through the wide spread of adoption of sustainable practices of land use. This can be achieved through conservation of agriculture which can be used to prevent soil erosion and land degradation.

ii. Principle to share knowledge: Knowledge is usually originated from a particular source, usually the research centres. It is of note that so much of the required knowledge to carry out improved farming system already existed. The concern is that this knowledge has not reaaly trickled down to the end users for its use and application. The concern now is how this knowledge could be shared or spread to the remote indigenous communities for them to use and

apply to their farms for increased productivity. They can be achieved by increasing the level of education of the people on crop and natural resources management

iii. Principle of building local access and capacity: This principle involves the development of the farmer and improving their access to what inputs they need for their production. Such can be made possible through securing access to land and water resources, especially for women farmers.

iv. Principle of enabled access to markets: The farmers after producing his/her crops and animals should be able to evacuate them to the market and selling the product at a price where him/herself and the buyer would be happy. The farmer could be kept abreast with this principle of access market by improving small-holder farmers marketing skill through entrepreneurship training.

v. Principle of harvest protection: There is the need for the farmers to be informed of how their harvest could be protected from spoilage. For it has been observed that above 20 – 40 percent of farmers produce usually get spoilt due to lack of government support.

vi. Principle to prioritize research imperatives: This is one principle that encourages more research into agriculture and agricultural activities. Such research needs to be intensified and continuous and also focus on local relevant crops, techniques of crops and their adaptation to climate change.

vii. Principle of risk minimization: Agricultural businesses are often known to be highly prone to risks. This principle therefore emphasizes the need for farmers to minimize the risk of the farm to the most minimum level. This can be assured through ensuring all necessary agronomic and animal farm practices are not spared.

viii. Principle of recycling of wastes and residues: This principle of recycling of wastes and residues takes into consideration that wastes from one farm's enterprise could be used as an input in another enterprise of the same farm thereby reducing the cost of running or operating the farm.

ix. Principle of integration of two or more enterprise: This is another principle that has to do a situation that ensures that an ideal farming system should ensure that two or more inter-related enterprises should be in place. This will help to give room for one enterprise to service another, same labour could be used to operate them and sales and income volume could be boosted and assured throughout the year.

x. Principle of maximum productivity and profitability: Farming system by its nature of allowing two or more enterprises to be in operation and allowing waste from one unit to be a relevant input in a another unit, gives room for all-year-round production and maximum productivity of product to be in place and also ensuring maximum profitability from sales.

xi. Principle of generation of employment: Due to the nature of farming system, many enterprises are usually found in establishing different products accompanied with several activities. This scenario opens avenue for people to come and be employed to work in the enterprises.

3.2 Challenges and Solutions of Farming Systems

Farming system poses a lot of challenges for farmers in our contemporary society of today. The challenges are in line with the type of farming enterprises being practiced by the farmer. With particular reference to Nigerian situation, the Five Major Problems Facing Agriculture in Nigeria-Commodity Port as advanced are;

i. Lack of Storage Facilities: A good fraction of our food produced by our farmers is not consumed immediately after production and the storage facilities are not there for use by the

farmers. This scenario often results as losses to the farmer. The Minister of Agriculture during the Obasanjo regime mentioned that about 30 – 40 percent of food produced in Nigeria is ultimately wasted. This kind of wastage discourages the farmer from meeting up with their farm potentials.

In a bid to revamp the problem, there is need for the government to assist farmers establish centres where agricultural products can be reliably stored and used when necessary. This will go a long way to encourage farmers with their production.

ii. Lack of Modernization / Mechanization: It is of note that most of our farming activities are carried out in small-small fragments of land and as a result, the farming activities are carried out with crude implement and, storage of products are still inadequately done. As a result of use of crude implements in the farming, only little area can be farmed by the farmers thereby resulting to low farm output. In addition, irrigation facilities is almost absent in the farmers farm and this makes farming to be carried out in the raining season with nothing to do in the dry season. Such situation poses a frustration to the farmers.

To ameliorate this problem, government should organize farmers into cooperatives and provide them with farm machines and irrigation facilities that they can use for their farming and storage of surplus products after production.

iii. Lack of Information: Lack of information about agricultural production and practices is a major problem that affects our farmers to a very large extent. Farmers need to know what inputs and technologies that are available for use in the farm. Farmers need to know how to select the right or correct seed variety to get optimum yield, best time to plant, best of farm practices to reduce crop lose and how to partner with the right off-takers to get the best price for their products. Having such knowledge would make them urge for its use.

As a way out of this problem farmers need to be open or educated on new technologies through extension education on how to improve their farming activities. The farmers will need to seek and share knowledge via training and seminar with their farming communities.

iv. Poor Infrastructural Facilities: The infrastructural facilities like good roads, schools, electricity, pipe borne water etc in most communities are either conspicuously absent or in a dilapidating condition. This situation discourages the ruralites from staying in the rural areas where there is abundant lands for agricultural practices. Poor infrastructure discourages potential local and foreign investors from investing in agriculture.

A reliable solution to these problems may involve the fixing of good roads, provision of pipe borne water and electricity among others in the rural areas. It is hoped that such a gesture would go a way to encourage the rural dwellers to remain in their local communities and practice what they perhaps know how to do best, farming.

v. Unavailability of Finance: This is a very serious constraint as most of our farmers are subsistence farmers who produce little or no surplus. As a result they are rated as poor without no money for expansion. Meanwhile, money is needed for almost if not all agricultural activities that take place in the farm. This challenge makes it difficult for local farmers to expand their production capacity and end up remaining poor. Lack of capital also prevents potential farmers from venturing into farming business.

In overcoming this problem, some kind of programmes that could help provide finance to the farmers should be provided by the government. This will help to overcome this challenge in where the farmer is concerned.

vi. Poor Research and Record Keeping: There is unavailability or adulteration of farm records in the farmers' farm. Planning and researching with such records often provides us with poor

results that usually take the farmer and the system nowhere. There is a need for our farms and our farmers to keep proper records that would enable the farmers and research centres plan well for our agricultural system for a better tomorrow.

4.0 Conclusion

Farming system is often guided by some principles. These principles vary from farm to farm as it is known to be guided by the type of farming enterprises that make up the entire farm. However, these principles help to assure maximum productivity of the farm and the income realized from farming operations. Some of the principles are principle to safeguard natural resources, principle to share knowledge, principle of building local access and capacity, etc.

Challenges plaguing the farmer and the farming system was looked into. On a general note, it was observed and noted that farm challenges only but reduce the farmers' farm expectation in terms of farm output and income generation. Solutions to be problems were also preferred. In line with each mentioned problem.

5.0 Summary

This unit studied the principles guiding farmers and farming systems. The principles are different and are in line with the kind of enterprise set up and in operation in the farmers' farm. Challenges faced by farmers in their different farms and these problems are in line with the type of enterprise established or operated by the farmer. Solutions to the challenges were also advanced.

6.0 Tutor-Marked Assignment

i. Identify and discuss five (5) major principles a good farmer needs to abide by in order to make or achieve maximum success in his/her farming activities.

ii. Discuss any four (4) challenges depriving the nation from meeting up with the food needs of her citizens.

iii. Briefly advance the solutions to the problems mentioned in ii. Above

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UNIT 5: Factors Determining Farming System

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1.0 Introduction

Farming as it were is affected by different factors. These factors vary from one farm to another and according to the farming enterprises combined in the farm. The determining factors are grouped into natural factors which are further divided into physical and biological factors and socio-economic factors.

2.0 Objectives

At the end of this unit, the students should be able to;

i. Explain the climatic factors that affect farming system in Nigeria.

ii. State the difference between soil structure and soil texture as factors determining farming system.

iii. Mention and explain the biological factors that are capable of affecting farming system.

3.0 Main Content

3.1 Factors Determining Farming System

The factors determining the farming system a farmer chooses to adopt are of different folds. Adebowale (2017) identified two major factors. The author also stated that these factors have their various divisions. However, the factors can be grouped as follows;

1. The natural factors.

2. The socio-economic factors.

1. **Natural Factors:** Amongst the natural factors we have it further broken down into;

A. Physical Factors, and

B. Biological factors.

A. Physical Factors: The physical factors are comprised of all external conditions and influences that are likely to affect the life and development of the farm (plants grown and animals that are reared)

Again, the **physical factors** are further sub-divided into;

- ✓ Climatic factors
- ✓ Soil factors

3.2 The Climatic Factors

The climatic factors are those factors that are often determined by the average weather condition of an area. They include;

- ❖ Solar radiation
- ❖ Rainfall
- ❖ Temperature
- ❖ Wind, and
- ❖ Relative humidity

i. Solar Radiation: This has to do with solar energy radiated from the sun. The intensity of the sun of an area would determine the type of farming to practice by the farmer. Areas with much sunlight like the Northern areas of Nigeria can seldomly practice growing of crops without irrigation because of the drying effects posed by the sunlight. So, irrigation helps to supply the water needed to cushion the drying effects of the sun. Some areas can also seldomly practice fish farming due to the same drying effect of the sun that can result to excess evaporation of water from the ponds. On the other hand, areas like the Southern part of Nigeria, where average sunlight is experienced can grow crops and practice fish farming.

ii. Rainfall: Rainfall is another major factor that determines farming system practiced by a farmer. Rainfall keeps soil moist and provides the needed water for crop growth, it as well helps to cool the temperature and so helps to guide against excess transpiration that would have resulted to flaccidity (drying) of the plant. The quantity of rainfall of an area goes a far way in determining the type of farming system being practiced by him.

iii. Temperature: Temperature is the coolness or hotness of an area at a particular time. Excess heat leads to excess transpiration and subsequently drying of the plant and so makes it impossible to do well or meet with its potentials. On the other hand, cool or low temperature renders the plant and animals inactive. While we acknowledge that an average temperature is ideal, it is also necessary for us to know that different plants and animals require different temperature range for optimum performance and production. So the farmer would have no choice but to be influenced to grow the type of crops and rear the type of animals to the environment.

iv. Wind: Wind is another serious climatic factor that affects the production level of our agricultural production and so determines the type of farming system practiced by the farmer. The wind is either dry or wet. A dry wind exacts a drying effect on the plants and animals. While a cool wind exacts exact a cooling effect on the organism.

v. Relative Humidity: Relative humidity is the water in the form of water vapour in the atmosphere. Humidity of an area is either high or low, and this determines the type of farming system practiced in an area. Areas with high humidity grow crops and rear animals that are different from those respectively grown and reared by farmers in other areas.

3.3 Soil Factors

The soil factors include:

- ✓ Soil structure
- ✓ Soil texture
- ✓ Soil fertility

- ✓ Availability of mineral nutrients

i. Soil Structure: Soil structure is the vertical arrangement of the different types of soil in a given profile or area. An area with a good soil profile for crop production is an area that has good humus soil in the soil surface. The farm in such an area would be encouraged or influenced to grow crops. While the area with poor soil structure would be encouraged to rear animals in his farm land.

ii. Soil Texture: The texture of the soil is the average proportion of the different types of soil in a given area. A good soil texture has a good proportion of sand and loam properties. Such a soil encourages the growing of crops in an area. On the contrary, poorly textured soil will be used to rear animals.

iii. Soil Fertility: Soil fertility that contains all the necessary nutrients that are required for proper growth of our plants. An area with soils that contains the ideal nutrients for growing of crops will be encouraged to grow crops.

iv. Availability of Mineral Nutrients: The availability of nutrients would help determine the farming system to be practiced. Where there is a good quantity of nutrients available in the soil, the farmer would have no choice but to grow crops. Contrarily, an area that has low mineral nutrients would be influenced to be used for animal production.

3.4. Biological factors

The biological factors are those factors that have life in them. The factors thus include;

- ➢ Crops
- ➢ Livestock
- ➢ Weed

- Pests
- Diseases

i. Crops: An area that is good for crop production would have the farmer being influenced to go into crop production. Such an area would also have the particular type of crop that will produce well in it, and that should be the farmers focus or interest.

ii. Livestock: Livestock has to do with the rearing of farm animals in a particular area. The area whose climatic conditions favour animal rearing would have the farmers of the area being influenced into animal production.

iii. Weeds: Agriculturally, weed is defined as an unwanted plant growing in an area where it is not wanted. The type of weed growing in an area also determine the type of agricultural activity that can be carried out in the area. An area with too much weed would not encourage the growing of crops (due to the fact that it will tremendously add to labour cost) but the rearing of animals. This is because; the weeds can sometimes be used to feed the animals (herbivorous animals).

iv. Pests and Diseases: Pests are insects that cause some nuisance level to plants and animals, while diseases are some kind of physiological deformation of plants and or animals. An area that is known to have good quantity of pests and diseases would disrupt or discourage the growing of crops and rearing of animals. This is because, the prevalence of pest and or diseases will lead to the pathogens leveraging on the plants and animals being reared, thereby reducing the plants and or animals potentials or even killing them. In a nutshell, such an area will not encourage any type of farming to take place.

3.5 Socio-Economic Factors

The socio-economic factors of the farmers are those factors that are bound on the farmers. The Report of Farm Characteristics - STARS Project stated that on a general note, the factors have been broadly grouped into;

- Endogenous factors
- Exogenous factors

i. The Endogenous Factors: The endogenous factors are those factors that are found within the farm family and they are most likely under the farmers' control. These factors either influence the farmers positively or negatively on what type of farming system to he/she hopes to operate. The endogenous factors include; family composition, health and nutrition, educational level, food preference, risk aversion, attitude or goals and gender relations.

ii. The exogenous Factors: These are factors that as well influence the farmers on the type of farming system to adopt. The exogenous factors are not within the control of farmer. So where they stand to favour the farmer, he will practice the farming, but where they don't stand to favour the farmer, he would have no choice but to abandon the farming because the factors are not within his control. The factors include; population, tenure system, social infrastructure, credit, markets, prices, technology, input supply, extension, savings opportunities.

4.0 Conclusion

At the end of this unit, the study found that there are several factors that determine farming systems. These factors were majorly grouped into natural factors and socio-economic factors. The natural factors were further subdivided into physical factors which are made up of climatic factors, soil factors and biological factors. The climatic factors include solar radiation, rainfall, temperature, wind and relative humidity. Going further, the soil factors include soil texture, soil

structure, soil fertility and the availability of soil nutrients. While the biological factors comprised of crops, livestock, weed, pests and diseases. The socio-economic factors are made up of endogenous and exogenous factors which are respectively within and out of the farmers control.

5.0 Summary

This study unit investigated the factors determining farming systems. They were broadly known to include natural factors and socio-economic factors. The natural factors comprised of climatic, soil and biological factors.

6.0 Tutor-Marked Assignment

i. Mention four (4) major climatic factors that can affect the farmer's choice of farmer farming system he/she wishes to adopt.

ii. Enumerate and briefly explain three (3) soil factors that are capable of determining farming his farming system.

iii. Write short notes on endogenous and exogenous factors affecting choice of a farming system.

7.0 References

Adebowale, K.E. and Fabunmi, T. (2018). Farming Systems *Lecture Note on PCP505* Retrieved at: *http://www.unaab.edu.ng*. On 25th April, 2020

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MODULE 2: SHIFTING CULTIVATION

Unit 1: Concept, Definition and Overview of Shifting Cultivation

Unit 2: Basic Features / Characteristics of Shifting Cultivation

Unit 3: Types of Shifting Cultivation and their features

Unit 4: Advantages and Disadvantages of Shifting Cultivation

Unit 5: The Process / Procedure of Carrying Out Shifting Cultivation

MODULE 2: SHIFTING CULTIVATION

UNIT 1: Concept, Definition and Overview of Shifting Cultivation

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1.0 Introduction

Shifting Cultivation is one of the farming methods of farming that has been practiced by man to meet his/her food needs. So, Shifting Cultivation is described as an agricultural system where a

farmer haven farmed a piece of land for a short period of time, say 1 – 3 years abandons the land and goes to another to continue his farming activity. The decision whether to return to the former piece of land after the abandoning period remains his/her decision. The main aim of practicing Shifting Cultivation is to look for an area where there is abundant land with good level of soil fertility that can guarantee him/her (farmer) his intended level of farm production.

2.0 Objectives

At the end of this session, the students should be able to;

i. Define Shifting Cultivation

ii. Explain the reason(s) why farmers engage in the practice of Shifting Cultivation

iii. Explain in a sentence why the practice of Shifting Cultivation is described as harmful to the ecosystem

iv. State the effects of Shifting Cultivation

3.0 Main Content

3.1 Concept and Definition Shifting Cultivation

Shifting Cultivation is known as system of agricultural practice where a farmer farms on a piece of land for a while (which may be a period of 1 – 3 years) and thereafter leaves or abandon the land and goes to another land to continue his/her farming activities or operations (Lar, 2005).

Shifting Cultivation-Wikipedia stated that the system involves clearing a piece of land which is then followed by several years of farming until the soil begins to lose nutrients / fertility. The system is such that the land is farmed until productivity is noticed to be declining through loss of soil fertility. Then the soil is left to regain its fertility through natural means that involves regeneration of the vegetation.

It is of note that Shifting Cultivation is a system that due to its nature is practiced by individual farmer or family. In rear cases it be practiced by a village of small community.

Shifting Cultivation – Science Daily Report advanced that Shifting cultivation is an elusive term to define, since it is perceived and used by different people in different contexts in widely differing ways. Nevertheless, some of the definition here stated; According to FAO Shifting Cultivation is defined as an agricultural or farm system in which relatively short periods of cultivation are followed by relatively long periods of fallow. Shifting Cultivation is also defined as an agricultural system in which plots of land are cultivated temporarily, then abandoned and allowed to revert to their natural vegetation while the cultivator or farmers move to another plot to continue his/her farming activity.

From the definition, Shifting Cultivation is preparing ground in a large plot or area and cultivating mostly food grains and vegetables fruits etc till the soil fertility is lost. Then the field is burnt and cultivation shifted to another place or area. emphases are that the land is left at the point where production from the farm begins to fall or decline and that the period of fallow is usually longer than the period of cultivation.

The main importance or reason why farmers practice Shifting Cultivation is that, it is a farming system that helps to restore soil fertility through long periods of fallowing (Shifting Cultivation – Science Daily). This method of regaining nutrient is preferred to the use of farm inputs like inorganic fertilizers and amendments. During Shifting Cultivation, nutrients are recycled between natural vegetation and crops; and ecological balance is maintained by adopting diverse and complex practices.

Adebowale (2018) pointed out the effects of Shifting Cultivation are of two folds. They are;

i. Forest degradation and deforestation, and

ii. Land degradation.

3.2 An Overview of Shifting Cultivation

Shifting cultivation is an agricultural system in which plots of land are cultivated temporarily, then abandoned and allowed to revert to their natural vegetation while the cultivator of farmer moves on to another plot of land to continue with his/her farming (Shifting Cultivation – Science Daily)

Shifting cultivation is the most ancient system of agriculture in which soil fertility is restored by natural means that involves long periods of fallowing rather than the use of farm inputs like inorganic fertilizers and amendments.

Shifting cultivation as an agricultural system involves an alternation between cropping for a few years on selected and cleared plots. A few years of cropping or cultivation is followed by a lengthy period of fallow. Then the land is assumed to have rested and be able to regain its lost nutrients that were original in the soil before first cultivation started or took place. Shifting Cultivation is a technology that has been practiced in those regions were the population is scanty It is particularly popular in forested and derived savanna areas of tropical Asia where there is expanse of land for cultivation.

Shifting Cultivation refers to a technique of rotational farming in which land is cleared for cultivation mostly with the use of cutlass and possibly other simple farm tools, the debris are then burnt and the land is then farmed on. After some time when the land may have be known to be declining in nutrients availability and subsequently crop productivity, it is then left to regenerate for a period of few years. Another name for Shifting Cultivation is "swidden agriculture" (Shifting Cultivation-Wikipedia)

Shifting Cultivation often involves clearing of a piece of land and cultivating it for the period it can product crop at its peak, followed by several years of wood harvesting or farming until the soil loses fertility (that is the fallow period). Once the land becomes inadequate for crop production or seen not to be meeting up with its potentials, it is then left to be reclaimed by natural vegetation, or sometimes converted to a different long term cyclical farming practice.

Lal (2005) noted that across the globe, Shifting Cultivation is known to be practiced as many as an estimated population exceeding 250 million people derive subsistence from the practice of shifting cultivation, and ecological consequences are often deleterious.

Sadly, Shifting Cultivation is considered devastating and disadvantageous as it does not only cause harm to the ecosystem but also exerts negative impacts on economy. On the contrary, many studies concluded that tribal or practitioners of Shifting Cultivation are part of conservation.

4.0 Conclusion

Shifting Cultivation is known as an age long practice that involves the farmer farming a piece of land and then leaving or vacating the land for another place on the ground of loss of fertility. Amongst the several definitions advanced, Shifting Cultivation is an agricultural system in which plots of land are cultivated temporarily, then abandoned and allowed to revert to their natural vegetation while the cultivator or farmers move to another plot to continue his/her farming activity.

5.0 Summary

This unit examined the concept and definition of Shifting Cultivation. An overview of Shifting Cultivation was also looked at. The effects of Shifting Cultivation that are that they lead to forest

degradation and deforestation, and land degradation. The main importance of practicing Shifting Cultivation is that, it helps to restore soil fertility through long periods of fallowing

6.0 Tutor-Marked Assignment

i. Define Shifting Cultivation

ii. Explain the reason(s) why farmers engage in Shifting Cultivation farm practice.

iii. In one sentence, explain why Shifting Cultivation is described as 'harmful' to the ecosystem

iv. Enumerate two (2) effects of Shifting Cultivation

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UNIT 2: Basic Features / Characteristics of Shifting Cultivation

Table of Content

1.0 Introduction

Shifting Cultivation is a system of farming that has to do with the farmer(s) or cultivator(s) cultivating a piece of land for a short period of time, say 1 – 3 years and then leaving or abandoning the land at the point of experiencing diminishing returns in farm productivity due to nutrient deplenishment and going to another piece of land to continue his/her farming with an intention of either returning or not returning to the previously cultivated land after a long period of time (Shifting cultivation – Wikipedia)The period for which the land is not cultivated is called fallow period. It is within this time that bush will grow back, forest will set or grow again and the leaves that will be falling will be decomposing and forming organic manure on the soil. Through the process, lost nutrients will be restored back to the soil.

2.0 Objectives

At the end of the study of this unit, students should be able to:

i. Know the various characteristics of Shifting Cultivation.

ii. The student will also know the period the farmer can farm their land before leaving it for another land.

iii. The likely period that fallow can stay before the farmer can return back to the abandoned soil if he/she wishes to go back.

3.0 Main Content

3.1 Basic Features / Characteristics of Shifting Cultivation

Just as Shifting Cultivation is an elusive term to define due to the way it is perceived and used by different people in different contexts, so are the characteristics / features viewed and presented by different people and authorities. Going by this affirmation, so many and different characteristics have been advanced by different researchers and authorities. A Report of Main Features of Shifting Cultivation enumerated some of the characteristics / features to include;

"The **essential characteristics** of shifting cultivation are that;

i. An area of forest is cleared, usually rather incompletely: The land is usually very large and it is cleared with a cutlass or slasher. The grasses and shrubs are cut down while the tree-like plants are either left as it were or trimmed and allowed to regenerate to produce either wood or other resources as the case may be. `

ii. The debris is burnt: The rubbish that are gathered are burnt and from this, ash is produced which helps or joins in improving the fertility of the soil.

iii. The land is cultivated for a few years - usually less than five - then allowed to revert to forest or other secondary vegetation before being cleared and used again".

Researchers of shifting cultivation have identified the criteria considered crucial for distinguishing shifting cultivation from other land use practices. Some of the more tangible factors otherwise regarded as the **characteristics of shifting cultivation** are described below.

i. Cultivation of the crops planted is interrupted by a long period of natural fallow. In this case, it is sufficient to say that cultivation of the crops is neither permanent nor continuous.
ii. The cultivation period is usually at variance with the duration of the fallow period, though, the fallow period is relatively longer (usually more than five years).
iii. The fallow period involves the growing of a wide variety of vegetation, but it would typically be some type of forest.
iv. The fallow period may or may not be sufficient to restore soil fertility since the minimum period required to restore fertility would vary from place to place.
v. The population density of the country or a particular place is quite large and higher than the available land areas that would permit the practice of shifting cultivation. Since it involves leaving the farmers farm to another place while allowing the previously cultivated land to grow fallow
vi. Due to increasing distance to reach cultivated plots during the fallow periods of the nearest fields, housing may be semi-permanent, or farmers may have permanent homes in villages and temporary shelter near their fields
vii. A small hut and a temporary storehouse may be maintained near the cultivating fields.
viii. The fallow period is interrupted by only one crop. The fallow period normally varies from 5 to 12 years depending upon altitude. The higher the altitude, the longer the fallow.
ix. The intensity of shifting cultivation rises with population density.

Key Features / characteristics of Shifting Cultivation

I. Rotation of fields: Shifting Cultivation as it were involves the shifting or rotation of the farmer from his/her cultivated farm/field to another fresh and uncultivated land, and may or may not return back to the previously cultivated after the fallow period.

II. Use of fire for clearing the land: The conventional or most common practice in clearing a new land for planting is the use of fire to burn the vegetation and get ready for the farming business. Fire is applied in the field either before or after clearing the field.

III. Keeping or allowing the land fallow for regeneration for a number of years: Shifting cultivation is all about leaving a particular farm after farming it for a period of time and allowing it go fallow and during the period, regeneration of the trees, shrubs and grasses is known to take place.

IV. Use of human labour as main input: Going by the nature of shifting cultivation, trees and some particular plants are left, and for this reason and possibly in addition to the terrain as well as the inaccessibility to cultivated farms, only human labour is likely to be applied in doing work in the farm. Machines cannot access, and the services cannot be afforded by the farmer.

V. Non-employment of draught animals: In most cases the human labour is the only source of labour. The use of animals to do work in the farm or use of animal-drawn implement is not applicable in where shifting cultivation is concerned.

VI. Type of implement used: The type of implement used in shifting cultivation is simple farm tools or crude implements. The system does not allow the use of farm machines and implements. This may by attributed to the terrain, and nature of vegetation.

VII. The type of crops grown: The type of crops grown under the shifting cultivation farming is mixed cropping system. This involves the planting of different types of crops on the same piece of land.

Main features / Characteristics of Shifting Cultivation

Another authority pointed out some of the characteristics of shifting cultivation could be describe/explained;

I. Clearings are made in the rainforest by clearing the grasses and shrubs and cutting down and firing trees (slash and Burn)

II. Largest trees often left because they are difficult to remove and can provide a source of food in the form of fruit and also provide shade for the farmers.

III. Ash is scattered after trees have been burned to fertilise the ground.

IV. Human farm power is majorly used as source of farm labour. It is only in few cases that machines such as chain saws are used especially in the falling down of trees

V. Crude farm tools are majorly used. These include the use of cutlass, hoe and the use of digging sticks in the planting of crops.

VI. There is the planting of Crops in between tree trunks. The crops produce leaves which later drop, decompose and add to the nutrient level of the soil

VII. Shifting cultivation is only possible where there is a low population density in relation to the available land. In a nutshell. Shifting cultivation is sustainable when the population is low.

4.0 Conclusion

The study examined different characteristics of Shifting Cultivation. The characteristics examined are different as they were perceived by different authorities and in different

environments (countries). Important to mention that irrespective of the different perceptions of Shifting Cultivation, the characteristics advanced are not mutually exclusive of one another.

5.0 Summary

This unit examined different characteristics of Shifting Cultivation. The different characteristics have relationship with themselves.

6.0 Tutor-Marked Assignment

i. Mention the possible number of years a farm is likely to farm on a piece of land before allowing to fallow

ii. Mention the number of years a farmer should allow a piece of land to fallow before returning to the farm to cultivate it again.

iii. Explain the types of tools used in Shifting Cultivation and state three reasons why such are the tools likely to be used.

iv. State six (6) characteristics of Shifting Cultivation

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UNIT 3: Types of Shifting Cultivation and their features

Table of Content

1.0 Introduction

The different **forms of shifting cultivation** described are in line with particular environments. Suffice to say that the types of shifting cultivation that exist vary from one region to another region, Some of the common types known are; slash-and-burn type of shifting cultivation, shifting cultivation and vegetative type of cultivation. In addition, Shifting Cultivation is not just a farming system practiced by farmers but it is practiced because of some factors which have also been revealed in this unit.

2.0 Objectives

At the end of this study unit, students should be able to;

i. Know the different types of Shifting Cultivation system.

ii. Explain the types of Shifting Cultivation system.

iii. State the causes or reasons why some farmers must practice shifting cultivation.

3.0 Main Content

3.1 Types of Shifting Cultivation and their features

There are different types of Shifting Cultivation system that exist and being practiced by the farmers. Adebowale (2018) acknowledged that there are actually different types and these are explained below:

i. Vegetation systems:

This is a type of Shifting Cultivation that could be practiced in the forest, savanna or in forest/savanna transition where the fallow land is dominated by forest, bush or grassland respectively. This kind or type of Shifting Cultivation is classed based on the type of vegetation that is found in the area. To a large extent, the prevailing vegetation would determine the type of simple farm tools that would be used to clear the land before farming can commence. Where the land is covered with grass land, then cutlass and possibly hoe will be used to clear land. On the contrary, where the land is covered with tree, then the farmers may need axe, and digger as well as cutlass to fall down trees and clear the shrubs and grasses. This system is well encouraged in where there is low population density. Availability of humid and forested areas also encourages this type of Shifting Cultivation system.

ii. **Migration systems**

Shifting Cultivation as it implies, has to do with a farmer, haven been satisfied with a particular area of land or due to the declining fertility of a particular land needs to move from that particular land to another or new land. He would need to look out for and cultivate a new land. Whenever new land is cultivated, there is a tendency for the farming household to move with

their household to the new farm. The movement could be brought about by different reasons such as distance of farm from their abode and if the distance if transportation of produce (e.g. root crops) is becoming problematic. The prevalence of such challenges gradually results to migration of the farmer and his/her household. Usually the huts are always due for repairs every 2-3 years under forest condition and it is often easier to build a new hut than repairing an old one. The frequency of movement and the distances covered seem to increase with rainfall. The Amazon Basin in Brazil and Philippines in Asia are areas where examples are found

iii**. Rotation systems**

For sedentary cultivators that is, those farmers that don't have the ability to move from where they are, it is of note that a farmer is expected to change his/her farm when the nutrient level of the farm begins to decline and found evident in the low productivity of the farm. Such a scenario would call for the farmer to leave his farm for a definite number of years and allow it to fallow again for a definite number of years for it to naturally regain its lost nutrients. After the fallow period, the farmer then returns to the plot to continue his/her farming/cropping in a regular sequence. However it may have an irregular character, in that the number of years for which the rotation is allowed may vary from one place to another. In the forest zone, 2-4 years of cropping may be alternated with one or three decades of fallow (this actually depends according to availability of land at the farmers disposal). In the savanna of Africa, it could be more complicated when short term fallow period of 1-2 years, medium fallow period of 3-5 years or long fallow period of 6 years or more alternate in a single cycle of land use. Short fallow periods are often associated with lack of labour during the cultivation period while decreasing soil fertility. Long fallow period is associated with an increasing weed growth in the area.

iv. **Clearance system**

This type of Shifting Cultivation is based on the mode of how the land is cleared. The type of clearing depends on the nature of vegetation that is on the land and this has a direct bearing on the climatic condition of the region. A thick forest would demand for the use of a type of tool that is different from the type of tool to use for an area with sparse or grass vegetation. To a large extent, clearing depends on the following:

- Rainfall distribution,
- Vegetation to be cleared,
- Crop grown,
- Cultural background of the population, and
- Available tool.

3.2 Causes of Shifting Cultivation

Shifting Cultivation as a farm practice is carried out by some farmers of particular areas as a result of some factors causing it or due to some reasons. A Report on causes and consequences of shifting cultivation was put forward and stated that the factors are;

i. Traditions of the People: Some ethnic groups and local people have seen it as a tradition and so have traditionally depend or relied on Shifting Cultivation as their own way of farming. The local people see Shifting Cultivation as their way of subsistence agricultural practice.

ii. The Topography of the Area: The topography of some areas where Shifting Cultivation is being practiced is such that it does not allow permanent cultivation. An area with poor topography would quickly lose its soil to erosion if permanently disturbed.

iii. Lack of Alternative Opportunities: Many farmers engage in Shifting Cultivation because they have no alternative opportunities to support Shifting Cultivation accompanied with more promising land use system.

iv. Population Explosion: Shifting Cultivation is again practiced by farmers as a result of population explosion and growth and poverty. Farmers now choose to look out for land that are fertile and be sure can give them the best production to help cushion the effects of their poverty status and of which they know can only be achieved through Shifting Cultivation which needs very little investment.

v. Declining of soil fertility: The farming of a particular area of land would definitely result to declining of soil fertility. The farmer would have no choice but to migrate to another place if he/she has to continue his/her farming where there is good fertility is still maintained.

vi. Unusually high incidence of diseases and pests: Where there is the incidence of pest and diseases causing damage to the crops, the farmer in other to maintain his/her produce would look for another place where he/she is such there is no of such pest and diseases and be assured of the safety of the crops.

4.0 Conclusion

This unit understudied the type of Shifting Cultivation that exists. There are different types of Shifting Cultivation and each of the type has its own characteristics that give it its uniqueness. By and large, there are four major types of Shifting Cultivation and they are vegetation systems, migration system, rotation systems and clearance system. Each of these systems is to an extent influenced by rainfall distribution, vegetation to be cleared, crop grown and available tools. Some of the major causes why farmers of particular areas engage in Shifting Cultivation were as well enumerated.

5.0 Summary

This unit saw the different types of Shifting Cultivation and how they differ from one another. Shifting Cultivation type is highly influenced by the distribution of rainfall, vegetation of the area, crop grown, cultural background of the population and available tools. Causes of farmers practicing Shifting Cultivation was also looked at.

6.0 Tutor-Marked Assignment

i. List the two (2) factors that account for why the farmer may want to engage in rotational system of Shifting Cultivation.

ii. Mention five (5) factors that may determine why a farmer would want to adopt the clearance system of Shifting Cultivation.

iii. List and explain three types of Shifting Cultivation.

iv. State four (4) causes or reasons why farmers in some areas like engaging in Shifting Cultivation

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Unit 4: Advantages, Disadvantages and Prospects of Shifting Cultivation

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1.0 Introduction

Shift Cultivation is a farming system that is known to be practiced by Nigerian farmers and farmers all over the world. The system by its nature has its own advantages and disadvantages as well as its prospects. These are studied or looked at in the course of this study.

2.0 Objectives

At the end of this study, students should be able to;

i. State the advantages of the practice of shifting cultivation

ii. Identify the disadvantages of the practice of shifting cultivation

iii. Enumerate the prospects of the practice of shifting cultivation

3.0 Main Content

3.1 Advantages of Shifting Cultivation

There are various effects of **shifting cultivation** as it is known to involve large scale deforestation. This activity results in undesirable ecological imbalances. A Report on Crop Husbandry stated that the clearance of forest causes deforestation which accelerates soil erosion and also causes irregularity and variability in rainfall distribution. The earlier 15-20 year cycle of **shifting cultivation** on a particular land has reduced to 2-3 years now. This has resulted in large-scale deforestation, soil and nutrient loss, and invasion by weeds and other species. The land under shifting cultivation loses its nutrients and the top soil. With reduction in crop yield, the families start moving to other virgin areas.

With the aforementioned, The Report on Crop Husbandry identified some of the advantages of Shifting Cultivation. They are;

i. Frequent shifting from one land to the other has affected the ecology of these regions. The area under natural forest has declined and the disappearance of native species of medicinal plants and invasion by exotic weeds and other plants having adverse effect on the land.

ii. It is a very useful for the people living in the hills as it has been known as it is the easiest method used by the people in the cultivation of their crops since small bushes and weeds can be easily removed with small simple farm tools.

iii. With Shifting Cultivation, there is good fertility of the soil that guarantees a short period of sowing of crops and the harvesting of the crops.

iv. Through Shifting Cultivation, the used land naturally regains the lost nutrients without any help from modern methods of replenishing the soil.

v. The method of Shifting Cultivation is very much environmental friendly since it does not involve use of any chemical means of replenishing soil nutrients; rather it helps in organic degradation.

vi. Shifting Cultivation due to its nature of farmers moving from one place to another also helps to control or prevent soil borne diseases.

vii. It provides the very easy and very fast method of the preparation of the land for the agriculture.

viii. Shift Cultivation helps to guide against the fear of the danger of flood and the animals which destroy the crops

ix. The land can be easily recycled or regenerated thus; it receives seeds and nutrients from the nearing vegetation or environment

x. Shift farming saves a wide range of resources and provides nutrients because a small area is usually cleared and the burned vegetation offers many nutrients

xi. It helps to ensure more productivity and sustainability of agriculture

xi. It also reduces the rate of environmental degradation.

xii. The farming system is mainly used to practice mixed cropping system and so different and large varieties of crops are produced for the farmers consumption.

xii. In most cases, bush burning is usually the practice in Shifting Cultivation and the burning helps to prevent the infestation of pests and weeds.

3.2 Disadvantages of Shifting Cultivation

Most of the things of the world that have advantages always have their disadvantages. To this end in view, a report on Ecological Problems on Shifting Cultivation pointed out some of the disadvantages of Shifting Cultivation to include;

i. The system of Shifting Cultivation leads to the destruction of forest and in the process, wild plants, medicinal plants and timber is lost.

ii. Destruction of forest results to heavy soil erosion which ends up destroying the soil for crop production or other use.

iii. With population explosion, sooner or later everywhere will soon be taken over by the practice of Shifting Cultivation thereby resulting to degradation or loss of nutrients across without any natural means of replenishing them.

iv. The system involve large scale of deforestation goes a long way in increasing global warming.

v. The system to some consideration is uneconomical since it involves clearing a new land and sometimes moving from one place to another

vi. The system leads to reduction of soil fertility hence the farmer's abandons it for another.

vii. The system disturbs the many eco-systems of the region where it is practiced due to the destruction of forest.

viii. Going by the system of Shifting Cultivatio**n,** Slash and burn is the usual practice and may cause environmental and economic consequences by reducing the growth potential for crops in certain areas, which limits the variety and quantity of agricultural goods farmers can produce.

ix. The system can only be possible with the availability of land, otherwise it will not be possible

x. The system results to low efficiency in labour utilization.

xi. It easily leads to loss of biodiversity

xii. The wild animals loss their shelter through the deforestation process.

xii. Ecology is disturbed and distorted which never restored

3.3 Prospects of Shifting Cultivation

Shifting cultivation systems are ecologically viable as long as there is enough land for long (10–20 years) restorative fallow, and expectations of crop yield and the attendant standards of living are not too high. These systems are naturally suited for harsh environments and fragile ecosystems of the tropics. That is why attempts at finding viable alternatives to shifting cultivation have met with only limited success.

The goal is to restore soil quality, replace what is removed, and respond wisely to what has been changed by natural and anthropogenic perturbations. Payments to farmers for sequestration of carbon and other ecosystem services are good strategies of promoting the adoption of best management practices.

The most attractive feature according to Ecological Report on Shifting Cultivation is that these disadvantages can be managed through:

i. Quality education to help the farmers understand the consequences of shift cultivation and how to manage its use for a better agricultural practice.

ii. Agro forestry otherwise known as taungya which involves growing crops and trees at the same time thus enabling farmers to grow crops and trees at the same time. This method makes it possible that for crops and trees to grow at the same time thereby, preventing soil erosion. crops also benefit from dead organic matter

iii. Shifting Cultivation process also makes it possible for selective logging to be practiced. Through this logs can be provided for wood and as fuel.

iv. The farming method also gives room for certain forest reserves by protecting certain areas from cultivation

v. Afforestation where cut trees are replaced to maintain the health of canopy is also possible even when Shifting Cultivation has taken place. So the land can still be replaced of its cut forest

vi. Close monitoring by use of advanced technology as well as photography to check any activities that take place hence, ensuring sustainability

vii. Instead of the restriction of the method of Shifting Cultivation, the method can be improved and through this a new variety of crop or commercial trees can be grown as an additional crop which increases soil fertility and reduces soil erosion.

viii. Arable land can also be provided to the tribals or natives for carrying out agriculture and also to settle in the area

ix. Providing employment opportunities and income generation on a regular basis through proper utilization of the land resources, i.e. by equitable distribution of waste land among the tribals. But, the various schemes of the Government, under the tribal plan, will have to pump in sufficient resources for proper reclamation and development of the wasteland through agro-forestry and silvi-pasture practices.

x. By encouraging cooperative efforts for carrying out forest-based activities, i.e. basket making, rope making, cane furniture processing of minor forest produce, honey collection, etc. have to be made commercially viable by providing proper marketing facilities. This will help the people to be interested in practice of Shifting Cultivation that will also help them monetarily.

xi. Generating employment opportunities during the lean season of forestry operations will also prevent tribals from shifting to other areas. This form of employments could take different forms.

xii. By ensuring implementation of total literacy campaign; which due to remoteness and un-supportive attitude of tribals, has not been successful. For educating tribal women and children,

services of various non-Governmental organizations and voluntary agencies, besides the regular Government machinery, are on required sustainable basis rather than with a targeted approach.

4.0 Conclusion

The study of the advantages, disadvantages and prospects of Shifting Cultivation revealed that Shifting Cultivation has so many benefits to the farmers in particular and to the eco-system in general. The disadvantages of the farming system are such that discourage the practicing of the system due to its destructive effect to the soil. The Prospects proffer the need for the system of Shifting Cultivation and how the system can be practiced and accommodated in the system without so much of the damages it originally purports to impact.

5.0 Summary

This unit examined the advantages, disadvantages and prospects of the Shifting Cultivation system.

6.0 Tutor-Marked Assignment

i. State five (5) advantages of the practice of shifting cultivation

ii. Identify five (5) disadvantages of the practice of shifting cultivation

iii. Enumerate five (5) prospects of the practice of shifting cultivation

7.0 References

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UNIT 5: The Process / Procedure of Carrying Out Shifting Cultivation

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1.0 Introduction

Shifting Cultivation is a system of farming that involves the farming of a piece of land by a farmer for a short period of time like 1 – 3 years thereafter leaving the piece of land to fallow for a long period of time say from 5 years, during which time the nutrients will naturally return to the soil. The period of which the farmers leave the land to fallow vary from place to place and the type of vegetation that grows on the land, amongst other factors. Most importantly, the land is left for the period sufficient for it to regain its lost nutrients.

The process of carrying out Shifting Cultivation varies from one region to another and on the type of vegetation that is available on the land. However, the process or methods adopted by different farmers are not mutually exclusive of one another. Some of the methods are examined in this unit.

2.0 Objectives

At the end of the study of this unit, students should be able to know the stepwise process of shifting cultivation.

3.0 Main Content

3.1 The Process / Procedure of Carrying Out Shifting Cultivation

The Report on Crop Husbandry and Idodo Umeh (2015) described the process of carrying out Shifting Cultivation. The process was stated to involve a number of stages which are;

i. Each year the farmers or villagers designate an area of land for planting. This would be the area where they would leave for haven abandoned a previously nutrient exhausted land.

ii. The farmers would then remove the dense vegetation that typically covers the land. The type of farm tools to use is subject to the kind of vegetation on the land. Cutlass and hoe are used when the vegetation is not thick while axe and digger is used where the land is composed of sparse vegetation.

iii. Plants that have economic use are spared while those that have economic use are spared.

iv. At this stage, the debris that is cut down are then burnt with fire. The burning is carried out under carefully controlled conditions to avoid fire spread to areas outside the marked area.

v. After the burning, ashes are produced and washed down by rains into the soil to produce the needed nutrients.

vi. The cleared area is then planted with crops which can be supported for a period of three (3) years or less, depending on when declining productivity is noticed.

vii. The villagers of farmers then leave the previously cultivated land uncropped/uncultivated for a long period or many years, usually longer than the period the land was cropped/cultivated.

viii. The villagers will return to the deserted or previously cultivated land after a period of about six (6) years or more to begin clearing the land again.

ix. In the meantime, the villagers or farmers may still care for fruit-bearing trees on the site (remember that those trees were not cut down at the initial time).

In another development, Ecological Problems on shifting Cultivation stressed the sequence could still be followed in the manner detailed below;

- Selecting a forest patch and clear fell the vegetation normally in December and January
- Burning of the vegetation. Small, cut-trunks portion and roots are normally not removed. The herbs, shrubs and twigs and branches (slashed vegetation) are burnt in February and March
- Sowing of seeds, by dibbling, generally of cereals, vegetables and oil seeds in April–May
- Continuing cultivation for a few years
- Abandoning the cultivated site and shifting to other forest sites
- Returning to the former site, and once again practise shifting cultivation on it.

In making the process more concise and in summary, Ecological Problems on shifting Cultivation stated that **six (6)** major steps have been found in the practice of Shifting Cultivation. The steps are;

i. The first step: The selection of fields where the farmer would want to farm his/her crops on. As much as possible the land should be a promising location that has the potentials of having good amount of nutrients and growing the farmers desired crops.

ii. The second step: The second step is the clearing of the fields. The clearing involves the removal of the bush and this is carried out with majorly, simple farm tools. Cutlass is used to clear the shrubs and grasses, while axe and digger is used to remove heavy trees and the likes.

In the process of clearing, trees that are of economic value are retained or left untouched.

iii. Burning of the debris: The third stage involves the set of fire on the cleared bush. Efforts are made to ensure that the fire is controlled so that it does not go out of control. Burning actually takes place in the dry season or when the debris is dried up.

The major advantage which burning provides is that ash is provided from the process and it is washed into the soil and thus provides nutrients for the plant.

Burning may be harmful at this stage because it kills the micro and macro organisms in the soil that support nutrient provision and replenishment.

iv. Sowing in the field: The fourth stage is that stage at which planting of seeds and or seedlings are done. The seeds are usually of different crops because Shifting Cultivation supports mixed cropping farming.

v. Weeding: Weeding of the farm is carried out to allow crops to grow well.

vi. Harvesting: The sixth and last stage is a stage that has to do with the removal of the mature products from the farm.

From this stage, the process repeats itself until productivity begins to drop, that is after about 3 years; and then there might now be need for the farmer to shift from this farm to another location

4.0 Conclusion

The process or procedure of Shifting Cultivation revealed that different authorities have showed the different procedures of Shifting Cultivation. It is clear that the advances of the different authorities are not mutually exclusive of one another. However, the procedures revealed six major steps in the process of Shifting Cultivation. The steps are selection of fields, clearing of the field, burning of the debris, sowing of crops, weeding and harvesting of the crops.

5.0 Summary

Shifting Cultivation is a farming system that involves the movement of farmer from one field to another after sowing for a short time and reduction in yield is beginning to be observed. The procedure involves six different stages.

6.0 Tutor-Marked Assignment

i. Mention two (2) major types of tools used in the Shifting Cultivation system.

ii. Highlight the two (2) advantages and disadvantages of burning the debris during the process / procedure of Shifting Cultivation.

iii. Highlight and discuss the six (6) procedures of Shifting Cultivation.

7.0 References

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MODULE 3: PERMANENT AND PERENNIAL FARMING SYSTEM

MODULE 3: PERMANENT AND PERENNIAL FARMING SYSTEM

Unit 1: Permanent Crop Cultivation

Table of Content

6.0 Tutor-Marked Assignment

7.0 References

1.0 Introduction

Permanent crops are perennial trees, bushes or vine crops like citrus, apples, blueberries, nuts or grapes. The practice is associated with high cost, hence planning is done ahead of time. Perennial cropping is affected by planting time, soil, climatic, biotic, machinery and management factors. Perennial cropping goal is therefore to produce food without damaging soils while reducing waste. The objectives include to reduce labour, accelerate farm work and the production of farm income. This unit also looks at the reasons for permanent farming system which include meeting up with the demand for farming land and the protection against bushfires. Perennial plants are recognized for more conservative use of resources and a sustainable production on marginal lands. However, some of the crops challenges are small seed size, lodging, very low yield of the plant and low production of hybrid varieties. The system is plagued by a drop in water table, its inability to solve the food security problem and possibly a buildup of pest population.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Definition cultivation and permanent cultivation

ii. State the importance of permanent crops

iii. Explain the meaning and objectives of a permanent farming system

iv. Discuss the characteristics of permanent plants

v. Enumerate and explain the challenges faced by permanent crops

vi. Explain the disadvantages associated with permanent agriculture

3.0 Main Content

3.1 Definition and Concept of Permanent Cultivation

Permanent crops are perennial trees, bushes or vine crops like citrus, apples, blueberries, nuts or grapes. Although it represents a small segment in agriculture. By definition, permanent crop is one produced from plants which last for many seasons, rather than being replanted after each harvest, Cultivation on the other hand is an agricultural practice, involving the production of food by preparing the land to grow crops on a large scale (Prem, 2019)

Growing permanent crops is considered high in cost, hence planting permanent crops is considered to be a "high stakes" farming operation**.** To be successful, permanent crop producers must minimize risk as much as possible to ensure successful crop establishment. As with most other high-risk farming operations, it is important to plan ahead.

Planning ahead not only improves the chances of successful permanent crops establishment, but also greatly reduces the amount of personal worrying after it has been planted. Establishment depends on the complex interaction over planting time, soil, climatic, biotic, machinery and management factors. Natural conditions (climate, relief, soil) are fundamental factors that determine the choice for the establishment of permanent crops with economically justified production

Permanent agriculture according to Prem (2019) is defined as an integrated and progressive production system inspired by natural ecosystems. It is also an ethical way of

thinking and a philosophy. *It is built around 'the triple-win solutions' which are taking care of the Earth, taking care of people and sharing resources fairly.*

Reports on Permanent Crop Production (CRP303) stated that the concept of permanent agriculture was thought of as a resilient, stable and sustainable production system. The goal is therefore to produce food without damaging soils while reducing waste. The success of a permanent crop production would depend on the suitability and adaptability to the local conditions such as temperature, humidity and soil. Suffice to say that this kind of agriculture is possible and thrives better with the use of new technologies.

3.2 Permanent crops

Permanent crops are all fruit trees, all citrus fruit trees, all nut trees, all berry plantations, all vineyards, all olive trees and all other permanent crops used for human consumption like tea, coffee or carobs and for other purposes (e.g. nurseries, Christmas trees or plants for plaiting and weaving such as rattan, or bamboo) (Huffstetlerm, 2020).

3.3 Meaning and objectives of a permanent farming system

Huffstetlerm (2020) stated that Permanent Farming System is adapted to ecological, social and economic conditions. According to the author, drawing from the definition in details; means;

Adapted to ecological conditions means: farming methods, which reduce erosion and iron tines soils;

Adapted to social conditions means: the farming methods are acceptable to the farmers and appreciated by the farmers;

Adapted to economic conditions means: the farmers can afford the new farming methods and can increase their income by using the new farming methods.

A Permanent Farming System is mechanized by the use of draft animals in order to:

Reduce labour burden, accelerate farm work, increase the farm area, production and income of the farmers

3.4 Objectives of permanent farming system

The broad objective of permanent farming system according to Prem (2019) is that the system helps in improve the living conditions of farmers.

In detail, it helps in:

i. The farmer having less and easier work,

ii. The farmer having more time for themselves

iii. The farmer having more and better food, and

iv. Having more income being generated from farming activities and are used to meet their domestic functions etc.

3.5 Characteristics of Permanent Plants

The characteristics of perennial plants actually differentiate them from annual plants and provide them with extra resources that, through selection, can be re-allocated to grain production: The report on Permanent Crops Production detailed the characteristics of permanent plants to include;

i. Better access to resources and a longer growing season

ii More conservative use of nutrients

iii. Generally higher biomass production, and;

iv. Sustainable production on marginal lands

3.6 Challenges Faced by Permanent Crops

The production of perennial crops is faced by many challenges which ordinarily would discouraged or impeded the production of perennial crops. Some of the challenges as stated in the reports titled 'Drawbacks and Benefits of Growing Annuals' include;

i. Seed size: Some of the crops have the life cycle of perennials and yet produce seeds that are small in size. This acts as a challenge to farming perennial crops. It requires plenty of time as well as substantial investment for some good quantity to make a good yield. Though at the moment, scientists are trying to increasing the seed size in order to increase yield which would enable perennials to be classified as sustainable agriculture.

ii. Lodging: Another challenge faced by perennial crops, or rather in their development is the phenomenon of lodging. 'Lodging' happens due to crops falling over due to their height which is not supported by their weak stems. This more or less creates a mulching situation. This falling over prevents seeds from producing grain. It makes harvesting difficult too, as the grain has to be ultimately removed from the ground.

iii. Sustained yield: The yield from some of the perennial grains is very low and this makes it a problem. Having the quantity that would make a good yield is a challenge. Again, some of the yields very substantially by dwindling downwards, thus producing low yield that cannot encourage production.

iv. Hybridization: Hybridization is the process of crossing two varieties of crops to form hybrid, that is a new breed. The act of hybridizing is seen as a way out to many of the challenges facing perennial cropping. Sad to note that, this route may take too much time and have lot of genetic problems.

3.7 Advantages of Permanent Agriculture

Permanent crops are usually ligneous crops, that is trees or shrubs, that are occupying the soil and yielding harvests for several (usually more than five) consecutive years.

Importance of permanent crops as advanced by Prem (2019) includes the fact that they are;

i. Usually intended for human consumption

ii. Generally yield a higher added value per hectare than annual crops.

iii. They also play an important role in shaping the rural landscape (through orchards, vineyards and olive tree plantations) and ;

iv. Helping to balance agriculture within the environment.

3.8 Disadvantages of Permanent Agriculture

The practice of perennial farming can result to some disadvantages. These disadvantages may manifest in the following ways:

i. May result to drop in water tables: Perennial agriculture may bring about a negative hydrological impact. Perennials might utilize more rainfall than annuals and this could cause reduced flow to rivers and a drop in water tables.

ii. Cannot solve food security presently: Due to the small nature of the seeds of perennials and their low yield, perennials cannot solve the problem of food security currently. In addition to their small seeds and low yield, these crops are still in the nascent development stage and will take a number of years before achieving the yields similar to annual crops.

iii. **Pest population might increase**: Going by the practice of perennial agriculture, the fields are not left empty at all. If the field is not left for at least some period of time, insect and rodent population will increase. The different measures like burning of debris and stubble may not be

able to reduce the pest population since some of those pests live and survive underground where heat cannot reach**.**

iv. Plant productivity is reduced over time: One of the challenges faced by perennial crops is the reduction in productivity, especially after a few years. The soil's organic matter is built up due to tillage absence and crops may have organic matter to the point that all of the soil's phosphorus and nitrogen is used up. Due to this, the plants' produce will decline till equilibrium is attained between nutrient mineralization and organic matter build up. Or, farmers would have to add fertilizer to the soil.

v. Crop rotation is difficult: One of the disadvantages of perennial agriculture is that crop rotation might become more difficult. This may be as a result of the fact that there are trees and shrubs in the plantation which would make it impossible to crop rotation to take place. If rotation can take place at all, it would beat a slow rate. The slow rate of the crop rotation could lead to pathogen, pests and weeds buildup.

4.0 Conclusion

Permanent crops are perennial trees, bushes or vine crops like citrus, apples, blueberries, nuts or grapes. The cost of planting perennial crops is high and this accounts for why planning is done ahead of time. If not for the factors like planting time, soil, climatic, biotic, machinery and management factors that sometimes adversely affects the system and some of the crops challenges like small seed size, lodging, very low yield of the plant and low production of hybrid varieties the practice of planting perennial crops would have been a good one as it helps to reduce labour, accelerate farm work and the production of farm income amongst others.

5.0 Summary

This study examined permanent crops as perennial trees, bushes or vine crops like citrus, apples, blueberries, nuts or grapes. The cost of planting perennial crops and the factors that affect its production was also considered. The objectives (broad and specific), reasons of its practice and characteristics as well as the challenges that affect the planting of perennial crops were well treated in the unit

6.0 Tutor-Marked Assignment

i. Definition cultivation and permanent cultivation

ii. State four (4) advantages / importance of permanent crops

iii. State the broad / main objective of permanent farming system

iv. State three (3) objectives of a permanent farming system

v. Enumerate the four (4) characteristics of permanent plants

vi. List and explain four (4) challenges faced by permanent crops

vii. Explain any four (4) disadvantages associated with permanent agriculture

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Unit 2: Factors Affecting Permanent Crop Production

Table of Content

1.0 Introduction

Crops are domesticated plants that we grow on our farms, orchards and gardens. These crops vary in their climatic, nutritional requirements and soil needs; susceptibility to pests and diseases conditions, just to mention a few. Therefore, the cultivation and production of crops are based on some basic factors and these factors must be considered in the choice of what type of crop to grow in a particular place. In this unit therefore, you will read and study the general principles of

crop production. Some of the factors that influence crop production that you as students will deal with include: climatic, biological, soil/edaphic, crop nature, technical and economic factors that you need to put into consideration before you embark on a particular crop production, especially where permanent crop production is concerned. In addition, pests and diseases constitute threat to production efforts of farmers; they therefore need to be considered before you finally decide on what type of permanent crop(s) you will produce on your farm, orchard or garden.

2.0 Objectives

At the end of this unit, the student should be able to:

i. Differentiate climate from weather.

ii. Discuss the climatic factors as to how they influence crop production.

iii. Outline the importance of rainfall (water), wind and temperature to the production of permanent crops

iv. Define pests and diseases of crops

v. Mention and describe the different organisms that act as pest to permanent crops

vi. What are edaphic factors?

vii. Differentiate macro nutrients from micro nutrients

viii. Differentiate using characteristics, sandy soil from clay soils.

ix. Mention the economic factors that affect the growing of permanent crops.

3.0 Main Content

3.1 Factors Affecting Permanent Crop Production

Report on Permanent Crops Production indicated that the major factors that influence farmers and agriculturists in their choice of type of crop to grow in their farm include climatic factors,

biological factors, edaphic/soil, and economic variables. Take for example, the crops you find in the southern parts of Nigeria are different from those you find in the northern areas and to an extent require different conditions. Similarly, crops grown in the tropics are different from those of the sub- tropics and so on.

3.2 Climatic Factors

Talking about climatic factors, first, climate is the average weather conditions of a place over a period of thirty five to forty (35- 40) years. On the other hand, the particular condition of a particular place and at a particular time is called weather. Major weather elements are; rainfall/precipitation, temperature, relative humidity, wind, sunlight and solar radiation. These elements affect the growth of plants and in different ways.

Rainfall / Precipitation: Rainfall / precipitation is the release of water droplets from the sky to the earth surface. The total rainfall of any place is the total amount of precipitation that a place gets during a fiscal year of 365 days. In other words, the rainfall may occur during only three of the twelve months of the year. The rains may be evenly distributed within the twelve (12) months of the year or fall within specific months of the year. Crops vary in their requirements for water at different stages of the crop growth and production. While some crops require a large amount of water, some may not withstand nor survive when the precipitation is high.

However, water helps in the following;

- Keeping the soil soft for easy penetration of the roots of plants.
- Water also helps the plant in the uptake of nutrients from the soil.
- Water as well helps in the transportation of materials from one part of the plant to another.

- Water again, helps in keeping the plant turgid.
- It ensures a cooling effect in the plant and this helps to reduce evaporation.

Solar radiation / Sunlight: The solar system is made up of the sun at the centre with satellite objects rotating round it. The sun is at the centre and it is a very large object that is burning away every second. The heat and light generated by the burning sun is emitted to the circling satellite objects round it. The earth is second to the sun and it derives its light and heat energy from the sun. The earth goes round the sun in an orbit that has the shape of an eclipse. The amount of heat and length of the day varies from one period to another and from one region to another. Also, as the earth rotates on its own axis to give day and night, the orbiting of the earth round the sun gives rise to the seasons of the year, that is rainy and dry seasons (in the tropics); while in the sub-tropical areas, there are four seasons - summer, fall/autumn, winter and spring. The sun rises in the east and then sets in the west for a particular day.

Some crops are sensitive to day-length and the amount of heat that is available in the environment. Some crops require longer nights to initiate the process of flowering while some are day-length neutral.

Solar radiation or sunlight combines or reacts with the chlorophytic cells (chlorophyll) to prduce carbohydrates and the process is called photosynthesis. Therefore the amount of food that a particular crop can produce during its growing season is a function of the sunlight available for the crop, and other variables like available nutrients, available soil-water, foliage, presence/absence of diseases.

Temperature: Temperature is the resultant effect of solar radiation on the earth's surface. Temperature is measured in degrees on Celsius or Fahrenheit scale. During the day, when the

rays of the sunlight shine on the direct surface of earth, the temperature is often higher than when it is in the night. Temperature affects the growth of the plant in different ways like;

- It affects the rate of transpiration and where available soil-water is not adequate, high rate of transpiration can lead to wilting of the plant.
- It however, helps in the flow of nutrients and water from one part of the plant to another through the process of transpiration.

Relative Humidity: Relative humidity is the amount of water in the form of water vapour in the atmosphere. Relative humidity affects the assimilation, absorption, transportation and transpiration reactions taking place in crops.

- Most crops perform optimally when the relative humidity is low. Others crops like forage and those grown for their vegetative parts perform optimally when relative humidity is high.
- Disease causing organisms perform optimally when the relative humidity is high. Thus high relative humidity is not good for optimum crop performance.

Winds: All crops and indeed all living things need air. *Air in motion is called wind*. The wind may be mild or strong. Wind can also be how, warm or cold. Hot or warm wind has more devastating effects on the plant, while cool wind has beneficial effects on the plants.

Strong winds as storms and cyclones cause damage to crops depending on the nature of the crop. Tender shoot crops as rice, wheat, maize, oats, and rye easily log (fall off) with the slightest storm . In plantation crops like rubber, banana, plantains, strong winds cause heavy damage. Gentle wind (breeze) is good for crops as it encourages good transpiration

3.3 Pests and Diseases:

Crops respond to other environmental variables that do not constitute climatic elements. Permanent crop – Wikipedia stressed that these variables include pests and diseases.

Pests are small insects and animals that damage crops either on the field when growing or cause damage to crop products when they are in the store. Pests range from small insects as bugs, butterflies, locusts, midges, aphids, caterpillars to medium to large animals as rats, rabbits, grass-cutters and antelopes.

- Some underground worms attack crop roots e.g. nematodes. They all cause physical damage to crops - roots, shoots, leaves, flowers, tubers, stems and seeds/fruits.
- May it be known that some pests like butterfly has beneficial effect on the plant in that they help in the pollination of the flowers of plants.

Diseases: Diseases are microscopic organisms in crops and they cause an abnormal condition, discomfort or harmful condition in the plant. Diseased crops are crops that cannot perform all the necessary biological functions at the optimal level of the crop. Oftentimes, the crops exhibit symptoms of stress dysfunction due to the disease. In some cases, dysfunction may be due to non-availability of some necessary nutrients.

Causal agents or organisms of crop diseases are of three major groups. These organisms are responsible for crop diseases. The organisms are:

- Viruses,
- Bacteria, and
- Fungi.

Viruses: They have no definite shape. They change forms and cause malfunction in crop nucleus, cytoplasm, protoplasm and tissues. This malfunctioning is through change in the

original nature of the crop plant so affected. They attack crop chromosomes and Deoxyribonucleic acid (DNA). There are different types of viruses and they are all very difficult to control because they constantly change form. They cannot live on their own and as a result, they cannot perform basic biological activities by themselves because they lack the parts that perform these basic functions. However, as they gain entrance into any living tissues, they take over all the biological functions and distort as many of the processes as possible and at last cause severe damage in the affected part(s) of the plant. Examples of virus attack on crops are: cassava mosaic virus (CMV), and rosettes in groundnuts.

Bacteria: These are living microorganisms that attack crops. Once they attack a crop, they rapidly multiply and make colonies on the crop parts so attacked. The parts so affected become damaged. Sometimes the damaged parts cannot perform their normal function. In very common cases, the resultant effect is the death of the crop parts so affected.

The bacteria can be divided into two major groups and these are:

Aerobic - these are the ones that need oxygen to perform.

Anaerobic - they are those ones that do not need oxygen to perform.

Fungi: Fungi are non-green plants and as such they cannot manufacture their own food. They live on other plants to be able to perform their normal biological activities. They feed on the attacked dead parts of the plant, or they feed directly from the nutrients that the crops require or feed on the food reserves of the crops.

They are of different types of fungi. Irrespective of type, they all thrive better when the relative humidity is very high. This is because the available moisture assists in the rapid decay of the affected parts e.g. black pod disease of cocoa.

3.4 Edaphic / Soil Factors: Edaphic factors are also known as soil factors. Permanent crop – Wikipedia stated that Soil is the medium on which crops grow and maintain their existence. Since soil varies in its composition, component constituents, its nature and reactions, so do different crops perform differently on different soils. Crops like other plants manufacture their food from simple chemical elements through the use of sunlight reacting with carbon-dioxide and water to form carbohydrates.

Other nutrients needed for the process are Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, Potassium, Magnesium, Calcium, and Sulphur in fairly large quantities, hence they are called marcro-elements. On the other hand, some elements as zinc, molybdenum manganese, boron, are needed in small quantities are therefore called micro / trace elements in crop nutrition.

Most of these elements are often present in the soil. However, they are not always available to the crops. The availability (rate of release) to the crops depend on very many variables as: soil acidity, soil water, soil air, and other soil properties (soil physics) as texture, structure, porosity, soil-water-air mixture, etc.

In the following sub-units, you will read about some of the above identified variables of the soil.

Soil Fertility: A soil that contains large quantities of crop nutrients is said to be fertile. As mentioned earlier, a soil that is rich in macro and micro - elements in required quantities by the crops is a good soil for crop production. The most crucial of these elements include: Nitrogen (N), Phosphorus (P), Potassium (K), Iron (Fe), Magnesium (Mg), Molybdenum (Mo), Manganese (Mn). and Zinc (Zn). In all, sixteen (16) chemical elements are needed for crop growth and development. These Are Nitrogen, Phosphorus, Potassium, Calcium, Sulphur, Magnesium, Boron, Manganese, Zinc, Iron, Molybdenum, Sodium, Copper, Chlorine, Aluminum, And Silicon. Six (6) other elements are known to stimulate crop growth under certain

conditions - these are: cobalt, arsenic, selenium, lead, lithium, and vanadium. Carbon and additional oxygen are drawn from the air. Oxygen and hydrogen are supplied in water. All the above elements can be present in the soil, the rate at which they are made available to the crops depend on the soil acidity.

Soil acidity and alkalinity: Soil acidity can be described as a measure of the acidity and alkalinity of the soil. When the concentration of hydrogen ions $[H]^+$ is higher than the hydroxyl ions $[OH]^-$, the soil is said to be acidic. On the other hand, if the reverse is the case then the soil is said basic or alkaline. But if the concentrations of both the hydroxyl and hydrogen are the same, the soil is said to be neutral. The acidity and alkalinity is measured with the pH Scale, numbering 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14 and Crop nutrition is optimal when the soil pH is neutral. When the soil is acidic, some elements are easily released to the crops while some are tied up. A reversed condition occurs if the soil is alkaline. When the soil pH is 7, the soil is said to be neutral.

The soil acidity increases as the scale moves from neutral position (7) to one. On the reverse, soil alkalinity increases as the scale moves from neutral position (7) to fourteen.

Soil Physical Characteristics Soils are made of physical particles of rocks and minerals matter. The level of integration of the particles determines the nature of soil. The rock particles are classified into aggregates as small stones, sand, coarse particles and fine particles (silt and clay). Similarly, the broken down organic matter can be classified into groups based on size. The organelle is the fine particle size usually called organic matter colloids. Since reactions take place at the surfaces of the particles, the available soil nutrients will depend on the particle surface area compared with the mass / volume of the particle concerned. Soil particles come together to form soil aggregates of different shapes and forms. These aggregates determine the

air-space and water spaces available in the soil. These latter conditions determine the suitability of the soil medium for crop adaptations. For instance, porous soil or sandy soil has large air spaces and thus larger water spaces in the aggregates. Porous soil in turn allows free flow of water particles through the soil with little or nothing retained in the soil for crop use later. This type of soil aggregate encourage leaching of soil nutrients.

Clayey soil on the other hand has very small air spaces and water in its aggregates. Water does not flow through it easily. Besides, whatever water is available is held very tightly to the surface of the clay particles at the expense of the crops. Because of slow downward flow of water (percolation) this type of soil aggregate encourages heavy surface run-off leading to surface erosion.

Physical characteristics of the soil determine which types of soil are prone to flood, swamp, erosion, leaching, etc. These in turn determine what types of crops the soil can support.

Soil Texture: This is the nature of fineness or roughness of the soil. Better put, it can be described as the amount of sandy, silt and clay particles in a particular soil. It therefore goes to say that a soil with much sandy particles is described as sandy soil while a soil sample with much clayey particles is described as clay soil. As earlier noted, these soils grow well different crops.

Soil Structure: Soil structure is the relative arrangement of the different types of soil in a given soil profile. A sample or area may have clay soil on the top while some other areas may have sandy particles at the top of the soil. The type of the soil on the top will determine the type of crop to grow.

3.5 The Nature of Crops: Huffstetlerm (2020) noted that crops vary in their needs for water, nutrients, sunshine and day length, and agronomic management strategies. For example, water is very critical in the growth and production of sugar care, bananas, plantains, rubber and to some

extent, oil palm and pawpaw. Whereas in the production of cotton, groundnut and beans (legumes in general), sunshine and day-length are the most critical. Therefore, in the selection of what to grow, you must bear in mind the variables which encourage the crops to perform optimally. Unless, you are prepared to create a micro-climate or environment, like a greenhouse environment for the crops of your choice, you should as a matter of importance check through the list of crops that perform optimally in the (selected) environment where you intend to grow the crops. For example, swamp rice requires pre-nursery and nursery operations in the production of the rice seedlings; upland rice does not require pre-nursery and nursery operations. Most tuber crops do not perform well in swamps or water logged areas. Similarly, most cereals require heavy sunshine, moderate water / rainfall and well drained soils. The following two units will deal extensively on the nature and types of crops we grow in our environment.

3.6 Economic Factors: Besides the innate characteristics of the crops and the environmental factors as climate and soil physical characteristics, other variables that influence permanent crops production are the economic factors as stated by Permanent Crop - Wikipedia. The report noted that economic factors encompasses so much.

Economic factors include such variables as labour, which has to do with the available manpower to do work in the farm. The more they are, the more crops that are produced, all things being equal.

Supply of tools and materials, are another group of factors that affect the production of crops. A good supply will guarantee good level of production.

Market forces as supply, demand and price: Demand is the quantity of goods consumers are willing to buy at a particular price, place and time. While supply is the quantity of commodities

suppliers or producers or farmers are willing to supply to the market at a particular time, price and place. When the demand for particular crop is high, producers will produce more and then sell at a high price. On the contrary, when the demand is low, producers will produce little or small quantity. Then suppliers or farmers will supply less of such crops to the market at a relatively low price.

The farmer must consider the demand for the crop produce that he/she intends to produce on his/her farm. The farmer must also consider the total demand for the crop / produce compared with the total supply of the produce in your immediate community. This is necessary as the total demand and supply of the produce will eventually determine its market price. The price at which you sell your produce will determine your total turnover in the enterprise and this goes a long way in determining the gain of the farm and dictates how far he/she will be in the business of farming.

3.7 Technical Factors

Permanent Crops Production (CRP303) indicated that supplies of inputs as seeds, seedlings, improved stock are considered very important in any production activity in agricultural enterprise. Sources of energy for farm work include human beings (you and I), machines such as tractors, ploughs, small machines, motors, solar energy, wind energy, water energy, animal power (as bulls, work horses and donkeys), electrical energy, chemical power, etc.

The supply of the above forms of power in right quantities and qualities at the appropriate time are critical to successful farm operations and determine the level of success that are assured of type of crop to produce. The commonest source of energy amongst them all, is the human power. As at today in Nigeria, the supply of human labour at the critical period of production is indeed a

crucial issue. This is mostly because agricultural operations are quite timely and limited to time. At the critical periods, the available farm hands cannot go round the required activities of the period. Lack of necessary farm hands at the required time may lead to loss in the productivity of the crops so grown.

Where relevant farm hands are inadequate, farmers are expected to augment with power from other sources. Such other sources include animal power, mechanical power from machines as tractors and small engines. The supply of these is also inadequate and highly constrained by availability of funds. Where funds are available farmers are advised to own personal sources of mechanical energy or share with other farmers. Farmers are advised to source for funds that assist in the purchase of farm power.

Conclusion

The study unit reveals that crops vary in their climatic, nutritional requirements and soil needs; susceptibility to pests and diseases conditions, nature of the crop and economic factors that influence the growth of the crops. The cultivation of crops is therefore dependent on the above mentioned factors if success is a considered paramount. The climatic factors include rainfall, wind, relative humidity, temperature and pest and diseases. The soil/edaphic factors include soil fertility, soil acidity and alkalinity, soil physical characteristics, soil texture and structure while the economic factors include labour, supply of tools and materials and market forces of demand, supply and prices of the crops produced. The prices to a good extent determine the turnover and how far the producers would be in the business of farming permanent crops

Summary

In this we have read about the major factors that influence farmers and agriculturists in the selection, cultivation and production of crops in any given environment. You have also read

about climatic factors, edaphic/soil, and economic variables which influence the nature of crops that are found in particular area and zone of the world. For example, the crops you find in the southern parts of Nigeria are different from those you find in the northern areas. Similarly, crops grown in the tropics are different from those of the sub- tropics as the Mediterranean or the temperate regions of the world.

6.0 Tutor-Marked Assignment

i. Differentiate climate from weather.

ii. Discuss four (4) climatic factors as to how they influence crop production.

iii. Outline four (4) importance of rainfall (water) to the production of permanent crops

iv. Outline three (3) importance of temperature to the production of permanent crops

v. Define pests and diseases of crops

v. Mention and briefly explain the operation of fungi, bacteria and virus on permanent crops

vi. What are edaphic factors?

vii. Differentiate macro nutrients from micro nutrients. Give six (6) examples of each.

viii. Mention four (4) characteristics of sandy and clay soil.

ix. Explain how demand and supply can determine price of crops produced by farmers.

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Unit 3: The Elements of Permanent Farming System

Table of Content

1.0 Introduction

A permanent farming system is a farm, where you crop every year continuously and forever without shifting to another farm. Due to its nature, there is need for extra efforts by farmers to

apply some measures that would help the soil to continue to be productive and free from wind and water erosion. Permanent farming is being practiced due to insufficient land to meet demands. However, the land could be worked with farm animals just to reduce farm labour and to improve farm yield. Permanent farm land is highly predisposed to fire, wind and water erosion. This unit however advanced measures of how to overcome any of the above menaces

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Define soil conservation
ii. Write short notes on the enemies of the soil.
iii. Know the reasons why farmers practice permanent farming system.
iv. Know some of the reasons why some farmers would like to use draft animals to do work in their farms.
v. Explain why farmers need to protect the soil against fire incidence
vi. Explain the different ways through which fire outbreak can be avoided in the farm
vii. Discuss in detail, the reasons why a farmer need to protect the soil against erosion
viii. Know how to break the power of the wind in our environment.
ix. Spell out several relevance of planting of crops on ridges

3.0 Main Content

3.1 The Elements of Permanent Farming System

A permanent farming system is a farm, where you crop every year continuously and forever without shifting to another farm.

The new permanent farming system has a lot of elements as stated by Glover and Reganold (2010), and all geared towards improving permanent farming system. The improvement can be achieved through:

i. Making Contour Bonds (trig ridges) along contour lines to prevents erosion;

ii. Planting of permanent and seasonal crops, reinforcing the contour bonds and producing a lot of food.

iii. It also brings about producing increasing income;

iv. Small ridges prepared by oxen between the contour bonds to prevent erosion and provide optimum growing conditions for seasonal crops;

v. Mixed cropping and crop rotation of seasonal crops conserves the soil, protects the crops against diseases and guarantees good yields;

vi. Planting of legumes in order to improve the soil fertility for higher yields;

vii. The use of oxen for farm work just to reduce the labour burden on man and accelerate farm work;

viii. With the draft oxen, you can increase the size of your farm, your production and your income;

ix. Keeping of draft oxen in the cowshed during the night protects the oxen and allows the production of cowdung;

x. Use of cowdung and green manure reduces the expense of mineral fertilizer, improves the soil and increases the yields, and

xi. Vegetable gardening improves the family diet and produces additional income by marketing of surplus vegetables.

3.2 Reasons for Practicing Permanent Farming System

There are many reasons why farmers practice or get engaged in permanent farming system. The reasons and importance are used interchangeably. The report on Permanent Crop Establishment narrated that the reasons include;

i. Due to population explosion, there is scarcity of land for farming. This system helps in meeting up with the demand for farming land.

ii. The system helps to reduce or ease farm labour especially when a farmer is when shifting to a new farm. This is because, the farmer would have a lot of work to do in terms of clearing and destumping.

iii. Such a permanent farm is better protected against bushfires;

iv. A permanent farm allows continuous production and this helps in producing continuously and thus ensuring food security.

v. This type of farming creates the best use of land; by simply planting those permanent crops that are sure will do well in the land.

vi. Due to the fact that permanent farm is usually a large one and centered in one place, it therefore reduces transport or walking time of the farmer, and

vii. After some time, the farmer knows his/her permanent farm very well and with this knowledge, he/she can know which crops to grow on which plot of his/her permanent farm.

3.3 Reasons why Farmers Use Draft Animals in Permanent Farms

The traditional ways of farming which involves the use of cutlasses and hand-hoe is tedious and not very efficient. To overcome the level of inefficiency in farming can be achieved with the use of draft animals. With the use of draft animals most of the farm operations like clearing,

plowing, harrowing, planting, ridging, weeding, moulding and transportation can be mechanized. In a precise manner, Permanent Crop – Wikipedia stated that with the use of draft animals the farmer can;

i. Reduce the labour burden on the farmer and farm work therefore becomes easier;

ii. Accelerate working operations by having the farm work becoming faster;

iii. Use of draft animals can help to increase the size of the farmers farm land, thus leading to increases in production of the farm;

iv. Keeping and use of draft animals can produce manure which can be used in improving of soil fertility (without buying and use of mineral / inorganic fertilizer) and consequently increase in yields of the farm, and

v. The farmers that own the work animals can do contract labour to help other farmers and consequently increase their own farm income.

3.4 Conservation of the soil

The soil is a living thing like man, animal and plant. So there is need to protect it using proper or recommended management techniques. Conservation of soil means, keeping its power active or keeping it fertile in order to produce food. If you don't protect it against "soil diseases" or if you overwork your soil without adding soil food (nutrients), it will have no Power or ability to produce crops well and such soil will ‘die’. Among the different enemies of the soil, the most important are fire and erosion.

3.5 Need to Protect the Soil against Fire

Destruction of soil by fire can be caused by the farming method applied by the farmer. Such fire can burn the organic matter of the soil. Due to the devastating effects of fire, there is need to protect the soil against fire. Some of the reasons according to a report on Principles of Permanent Agriculture why the soil should be protected against fire are:

i. Fire can destroy the crops in the farm if not controlled. This will result to losses and drop in yield of the farm. Large outbreak can lead to food insecurity.

ii. Fire can also destroy the sheds of animals. This condition will lead to shortage in animal source of protein intake.

iii. Fire also destroys organic matter (grass, crop debris, etc.) in the soil. This organic matter are very important as food / nutrients to the crops / plants and need not to be burnt or should be protected.

iv. Fire will also destroy the life in the soil such as microbes which act like a stomach and change organic matter into plant food. The microbes help in the decomposition of organic matter of the soil for its use.

v. Fire can as well destroy the structure of the soil. The soil will lose its strength and will easily be carried away by wind and water; and

vi. Fire can attack and destroy the texture of the soil, thereby making loamy fertile soil into sandy unfertile soil.

3.6 Measures of How to Protect the Soil against Fire

There are different measures that can be applied by the farmer that could help to protect the soil against fire and its devastating effects. Some of the measures include:

i. Practicing fire dressing to avoid bush fire in your farm. This involves keeping away any material that can burn from the farm.

ii. If you clear your farm at the beginning of the dry season the organic matter can be buried and this will help to guide against fire outbreak, bush fire cannot enter your farm because bare soil cannot burn.

iii. Crop residues (like maize stalk, rice straw, etc.) should not be left in the farm after harvesting of crops has been carried.

3.7 Need to Protect the Soil against Erosion

Apart from fire, erosion can destroy your soil. Permanent Crop Establishment Report stated that we have different types of erosion; these are water and wind erosion. If the soil is carried away by water, we call it water erosion. If the soil is carried away by wind, we call it wind erosion.

Only running water on slopy land can carry away soil. Again, the steeper the slope, the more power the water develops and the more soil it washes away. We have to stop the power of running water to prevent water erosion. This can be achieved through:

i. To stop running water on a slope, we have to cultivate along contour lines (contour line is an imaginary line running across the slope) and build dams or ridges along the contour lines.

ii. A contour line is an imaginary line running across the slope, where all points on this line are on the same level of altitude. This means: If you make a dam according to this line, water will stop and will not continue in any direction but will seep into the soil.

iii. Do not cultivate in the direction of the slope. Water flows fast between the ridges and carries away the soil; Plant along contour lines when ridges are made across the slope water cannot run and carry away the soil.

iv. The soil can also be mulched to protect it from direct hit of the rain drops that could cause splash erosion.

v. Making of terracing across slopes can also help in breaking down water currents, thus reducing erosion and its impact.

vi. Apart from permanent crops which guarantee a long-term income, you can plant seasonal crops that are also fast-growing like: beans, soya beans, ground nuts, corn, bitter leaves, pepper, okra, etc. to help protect the soil against erosion before the establishment of the permanent crops, and;

vii. Farmers should also practice the style of planting on ridges made across slopes. This practice helps to prevent erosion between the contour bonds.

3.8 How to Protect the Soil against Wind Erosion

Wind can impact on the plant or crop positively when it is gentle and cool. On the other hand, wind can be dangerous and can attack the soil when;

- It is powerful
- The soil is bare, and
- When the soil structure is damaged.

To break the power of the wind,

i. The farmers have to establish wind breaks. This involves the planting of tall trees that would grow and break the strength of the wind. The trees can be establish at the comers of your farms Trees and hedges can also serve as a living fence for your farms, to protect them against destruction by cattle.

ii. A well-established contour bond with permanent crops can reduce the power of the wind.

iii. In addition, one can plant crops that can help to mulch the soil. With that, the soil will not be exposed and so wind cannot be able to do any harm to it.

iv. Planting of crops that can form canopy on time would as well help to cover the soil from being attacked by strong wind.

v. The practice of mixed cropping system with a high plant population and double cropping to have a good soil protection would go a long way in protecting the soil from wind erosion.

3.9 Planting on Ridges

Ridges are defined as the lines along which two sloping surfaces meet which diverge towards the ground. Where farm is concerned, a ridge is like a raised or tilled soil along certain line.

Ridges help to protect the crop against flood and also improve the yield. The different ways ridges help to protect the plants and improve its yield according to Glover and Reganold (2010) are:

i. Ridges provide the crops with a better seed bed.

ii. With ridges, air and water are stored better in the soil. They both help to promote the growth of the crop.

iii. Growing crops on ridges make the crops to germinate better;

iv. Ridges also make the roots of the young plants to develop better.

v. Ridges can easily be filled with a lot of manure for higher yields.

vi. Weeding is easier on ridges, especially when you use the ridger.

vii. The soil on ridges dries off faster and prevents especially fungal diseases from spreading.

viii. Harvest of root and tuber crops is easier when crops are planted on ridges.

ix. Planting on ridges is another way of controlling soil erosion.

4.0 Conclusion

A permanent farming system is a farm, where a farmer crops every year and forever without shifting to another farm. The system impacts much pressure on the soil but can be remedied through the application of manure and the use of draft animals to help reduce farm labour. The soil is affected by wind and water erosion and this do destroy the soil texture and structure as well as its nutrient level. Nevertheless the menace of soil erosion can be controlled by planting of cover crops, planting of trees and plant crops along contour lines.

5.0 Summary

The study examined elements of permanent farming system and the reasons why farmers engage in permanent farming together with ways through which soil properties and its nutrients can be conserved and protected from water and wind erosion.

6.0 Tutor-Marked Assignment

i. Define soil conservation

ii. Mention the two (2) enemies of the soil.

iii. Advance five (5) reasons why farmers practice permanent farming system.

iv. Explain five (5) reasons why some farmers would like to use draft animals to do work in their farms.

v. Suggest five (5) reasons why farmers need to protect the soil against fire incidence

vi. Explain four (4) different ways fire outbreak can be avoided in the farm

vii. Discuss five (5) reasons why a farmer need to protect the soil against erosion

viii. Explain five (5) strategies that can be employed to break the power of the wind in our environment.

ix. Spell out five (5) importance of planting of crops on ridges

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Unit 4: Perennial Agriculture

Table of Content

1.0 Introduction

Perennial agriculture is the cultivation of crop species that live longer than two years without the need for replanting each year. The period of survival and growth differentiates it from annuals, which must be planted each year and biennials, which only live for one or two years. Perennial agriculture differs from mainstream agriculture in that it involves relatively less attention and are suited to different climatic condition the crops are robust, protect the soil

against soil erosion and help to conserve soil water. In this unit, you shall be learning about climatic conditions of perennial crops and some of their different classes and examples together with the crops characteristics, characteristics and challenges faced by the crops. The advantages and disadvantages were as well dealt with.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Define the term "perennial agriculture"
ii. Know the main difference in terms of tilling the soil, and nature of seed viability between perennial agriculture and mainstream agriculture
iii. Identify some examples of perennial herbs, perennial vegetables and perennial fruits.
iv. State the characteristics of perennial plants.
v. Identify the different types of perennial vegetables.
vi. Explain the challenges faced by perennial crops
vii. Mention the advantages and disadvantages of perennial agriculture

3.0 Main Content

3.1 Definition and Concept of Perennial Agriculture

Perennial agriculture is defined as the cultivation of crop species that live longer than two years without the need for replanting each year. Simply put, a perennial is a plant that comes back year after year. The period of survival and growth differentiates it from annuals, which must be planted each year and biennials, which only live for one or two years (Report of Permanent Crop - Wikipedia)

Where tilling of the soil is concerned, perennial agriculture differs from mainstream agriculture in that it involves relatively less tilling and in some cases requires less labour and fewer pesticides, and by so doing, perennial crops helps to maintain or even improve soil fertility. Perennial crops used in perennial agriculture are grown worldwide in various climates and are adapted to local environmental stressors.

Based on their nature of seed viability, perennial plants do not have to be reseeded or replanted every year, so they do not require annual plowing or herbicide applications to establish.

Perennial crops are robust; and so are able to protect soil from erosion and improve soil structure. They increase ecosystem nutrient retention, carbon sequestration, and water infiltration, and can contribute to climate change adaptation and mitigation. Overall, they help ensure food and water security over the long term.

The key here is that you won't have to reseed or replant these plants each year to enjoy a harvest of food. Just plant your garden or orchard once, and your plantings should last for several years, maybe even several decades.

3.2. Climatic Conditions and Examples of Perennial Crops

It must be stressed that while perennial crops are many in number, it must be noted that all of them known as perennials may not grow in all locations. In your local climate, plants that come back year after year may not be able to survive year after year in another location. To this end in view, Prem (2020) stated that different climatic conditions favours different perennial crops. No one perennial crop can acclimatize in all regions but to specific regions. There is therefore the need for farmers to check for compatibility of what perennial crop to grow in line with your region before

you go ahead with your operation. Below are some examples of perennial herbs, fruits, nuts and vegetables (Prem, 2020).

Perennial Herbs include; Chives, **Fennel, Garlic, Ginger, Lemon Balm, Mint, Onions** (Potato onions, Shallots, Egyptian onions, Japanese bunching onions, Welsh onions, and Chinese leeks), **Oregano,**

Perennial Vegetables include; Artichoke (Jerusalem, also known as Sunchokes), **Asparagus,** Radicchio, **Rhubarb, Spinach, Sweet Potato,** Tree cabbages/Tree Collards, Water Cress, Yams

Perennial Fruits; Apples, Apricots, Avocado, Blackberries, Cherries, Currants, Dates, **Fig,** Grapes, Lemons, Limes, Nectarines, Olives, Oranges, Peaches, Pears, Strawberries,

Perennial Nuts; Almond, Chestnut, Macadamia, Pecan, **Walnut.**

3.3 Characteristics of Perennial Plants

The characteristics of perennial plants actually differentiate them from annual plants and provide them with extra resources that, through selection, can be re-allocated to grain production:

i. Perennials have better access to resources and this is due to their ability to withstand varying climatic conditions.
ii. They have a longer growing season,
iii. They have a more conservative use of nutrients
iv. Perennials generally have a higher biomass production, and;
v. Sustainable production on marginal lands

3.4 Types of Perennial Vegetables

Plants generally come in three types (Report of National Garden Association). These types are Annual, Biennial, and Perennial.

i. **Annuals:** These crops require only one year to complete their life cycle. They are crops that live for a single growing season and they are to produce and then die back at the end of the season and that forms the end of the crop. Most of the vegetables you find in the grocery store come from annual plants

ii. **Biennials**: These are those crops that require two years to complete their life cycle. They are those crops that store energy in taproots in the first year and then send up a seed head in the second year. Example of such crop includes carrots. Most gardeners just grow those as annuals anyway, since the harvestable part develops in the first year.

iii. **Perennials:** These crops complete their life cycle in more than two years. These are another set of perennial plants. They are long-lived plants that set down roots for decades, if not centuries.

3.5 Challenges faced by Perennial Crops

Perennials are crops which do not have to be planted every year. The only problem right now is that these crops have low yields. Prem (2020) advanced some of the challenges. Take a look at some of the ***challenges faced by perennial crops***:

i. Size of seeds: The sizes of most of the seeds of perennials are very small in size. These small sizes make it difficult for a good level of yield to be achieved by the growers. Suffice to say that, only small yield can be got from a lager plot.

ii. Lack of habitat for wildlife: Due to the fact that most of our food grain crops are annual crops, e.g. legumes, cereals and oilseed crops including wheat, rice and maize. They are replanted every year which requires a lot of expensive pesticides and fertilizers and leave very little habitat for wildlife.

iii. Expensive nature of the system: As a result of the fact that most perennial crops are annual crops, (e.g. legumes, cereals and oilseed crops including wheat, rice and maize) they are therefore replanted every year which requires a lot of expensive farm tools to open up new lands, clear existing land, apply pesticides and fertilizers, etc. All of these contribute to making the system an expensive one.

iv. Low yield: The yield from a large area of land at the end of the growing season is usually small and this results to food insecurity to the people in particular and the nation in particular.

v. lack of public support and funding: One of the main challenges is the lack of public support and funding. This has made it impossible for government to fund researches that could help to increase the sizes and development of the different seeds which in long-run can help increase the yield of the plants in question.

vi. Climate change: Climate changes are yet another of the challenges for today's farmers, who are forced to adjust their production to increasing risks from weather extremes (such as hail, drought, heavy rain, and soil erosion). Climate changes are not only responsible for adverse weather conditions, they also cause the instability in farm commodity prices

3.6 Advantages of Perennial agriculture

Some of the reasons which stand as advantages of growing perennial crops as advanced by Glover and Reganold (2010), and Prem (2020). They are as follows;

i. Preservation of soil nutrients: Perennials have the ability to preserve soil nutrients. This is as a result of the fact that the farm or land is not tilled each year and as such makes it possible for macro-organisms to thrive well in the soil, in addition to the decomposition of organic matters in the soil that all join to preserve the soil fertility.

ii. Conservation of funds: As a result of the fact that the crops are not planted each year and that the plant has a way of improving soil fertility naturally, it makes it the system require less investment by farmers in terms of buying farm chemicals like fertilizer, and pesticide. They can also turn out to be more profitable to farmers, as they don't have to buy seeds every year. Through this, funds of the farmers are conserved.

iii. Provision of shelter to animals: Animals can benefit from greater shelter provided by perennials. This is possible because the plant itself does not die but continue from one year to another and so the canopy produced can be taken advantage of by the animals.

iv. Helps to reduce global warming: Perennial crops grow from year to year, they are not cleared neither are they burnt by fire. This act of keeping the land green makes it possible for the system to reduce global warming.

v. Control of soil erosion: One of the benefits of planting perennial crop is that it helps to rreduce soil erosion. Annual farming leaves fields fallow in between growing seasons and offers less root mass throughout the growth cycle. The shed leaves from the plants and the canopy formed by the crops make it impossible for the soil to be carried away by erosion. This has become important because erosion destroys topsoil which then pressures microbial and plant populations.

vi. Protection of water bodies: Another benefit of conversion to perennial is reduced chemical runoff. Farming chemicals such as fertilizers and pesticides are not completely absorbed by crops when they are applied and the excess most times migrates into water bodies like rivers, seas, lakes etc. The migration of the chemicals into water causes water pollution which is harmful to aquatic life.

vii. Better conservation of fresh water: Perennial plants also conserve freshwater better than annuals plants. Annual crops lose up to five times more water than perennials . This means that annual fields require more irrigation which threatens fresh water sources and consequently biodiversity in certain ecosystems.

viii. Conservation of fossil fuel: Perennial agriculture uses less fossil fuel than annual agriculture. Annual systems require fields to be tilled and replanted more often than perennial systems. This incurs a higher fuel usage due to farm machinery. Since the system does not demand steady use of farm machines, it therefore helps to save available fuel and pollution of the environment.

ix. Perennials are better nutrient competitors: Perennial plants are usually better competitors than annual plants, especially under stable, resource-poor conditions. This is due to the development of larger root systems which can access water and soil nutrients deeper in the soil and to earlier emergence in the spring.

3.7 Disadvantages of perennials agriculture

Some of the disadvantages of perennials agriculture as pointed out by Glover and Reganold (2010), and Prem (2020) include;

i. Drop in water tables: The negative hydrological impact is one of the predicted disadvantages of perennial agriculture. Perennials might utilize more rainfall than annuals and this could cause reduced flow to rivers and a drop in water tables.

ii. Cannot solve food security presently: Perennials cannot solve the problem of food security currently. These crops are still in the nascent development stage and will take a number of years before achieving the yields similar to annual crops.

iii. Pest population might increase: If the fields are not left empty for at least some period of time annually, insect and rodent population will increase. The burning of stubble may reduce population pest population and outbreak of diseases. Moreover, those pests which live underground will survive burning, whereas tilling the soil destroys their habitat.

iv. Plant productivity is reduced over time: One of the challenges faced by perennial crops is the reduction in productivity, especially after a few years. The soil's organic matter is built up due to tillage absence, and crops may have organic matter to the point that all of the soil's phosphorus and nitrogen is used up and this would lead to decline in productivity in production. Remedying this odd situation would amount to farmers having to add fertilizer to the soil.

v. Crop rotation is difficult: One of the disadvantages of perennial agriculture is that crop rotation might become more difficult. Though crop rotation is possible, it takes more time. The slower rotation rate could lead to pathogen, pests and weeds buildup.

4.0 Conclusion

Perennial agriculture is the cultivation of crop species that live longer than two years without the need for replanting each year. The period of survival and growth differentiates it from

annuals, which must be planted each year and biennials, which only live for one or two years. Perennial crops are found world-wide and are affected by different climatic conditions. They are actually of different types, that is, annuals, biennials and perennials. In spite of the challenges facing the production of perennial crops, they are also of numerous benefits to the soil and man.

5.0 Summary

The study examined the concept of perennial crops and the main focus was the characteristics, types and challenges of the crops. Some examples were mentioned in addition to some challenges faced by the crops, the advantages and disadvantages of the crop to the soil and man.

6.0 Tutor-Marked Assignment

i. Define the term "perennial agriculture"

ii. Mention the difference between perennial and mainstream agriculture in terms of;

   a. Tilling the soil, and

   b. Nature of seed viability

iii. Mention four (4) examples in each case of perennial herbs, perennial vegetables and perennial fruits.

iv. State four (4) characteristics of perennial plants.

v. Identify and explain the three different types of perennial vegetables.

vi. Explain four (4) of the challenges faced by perennial crops

vii. Mention four (4) advantages disadvantages of perennial agriculture

viii. Mention four (4) disadvantages of perennial agriculture

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Unit 5: Systems of Soil Conservation and Improvement

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1.0 Introduction

This unit examines how the soil can be conserved and improved in terms of fertility for crop growth and productivity. There is the need for the soil to be well taken care of if it must continue

to meet up with its potentials of crop yield. The study unraveled the different ways like the use of manure, organic farming, mixed cropping, crop rotation and use of mineral fertilizer, through which the soil can be conserved and improved. The use of manure involves the production of cowdung and how it can be used for soil improvement. The process of making and use of mixed cropping system, compost and green manure as a means of improving soil fertility was as well examined. The study x–rayed upland and low land habitat. This was done in line with their characteristics, importance, problems and challenges as it affect agricultural production.

2.0 Objectives

At the end of the study of this unit, the students should be able to;

i. What conservation of the soil is.

ii. The factors that are likely to determine the quantity of cowdung a farmer can produce.

iii. The stages involved in making cowdung.

iv. Describe the process of making compost manure

v. Some of the necessary precautions to be taken in order to make a good compost

vi. Describe some of the process of burying organic manure in the soil.

vii. Define mixed cropping system and state the advantages associated with the system.

viii. Enumerate the characteristics that differentiate upland from lowland habitat.

ix. State the importance of upland habitat to the farmer in particular and ecosystem in general.

x. Identify the problems and challenges associated with upland habitat.

3.0 Main Content

3.1 Conservation and Improvement of the soil

Conservation of the soil is all about preserving or protecting the soil's fertility for good productivity. It as well has to do with the wise use of the soil with the intention of not allowing it to get deplenished of its nutrients, while using it for crop production.

To allow permanent farming activities on a farm with good yields, you have to improve the soil so that it can produce to meet up with its potentials. Conservation and improvement of the soil for steady and high yields can be achieved in different ways such as the use of manure, organic farming, mixed cropping, crop rotation and use of mineral fertilizer (Ekohwo, 2015.

For a farmer who operates a mixed farming system, that is where crops are animals are kept in the same farm, it could also be the use of draft animals to do work in the farm, such farmer would be able to produce dung which is the most important manure that could be used to improve soil fertility. This dung is free of charge because it is produced by his draft animals and it replenishes the soil nutrient of the soil naturally without much are do. When applied sufficiently on the farm, dung will improve the soil and increase the yields of the crops. The crops will produce more food for man and animals.

3.2 How to Produce Cowdung

To produce cowdung, it is necessary to keep the animals in a cowshed during the night to collect faeces and urine. Keeping the animals in a cowshed will help the farmer to keep safe or gather the dung from animals that would have been lost if they were allowed to roam around.

Ekohwo (2015) noted that the quantity of produced or generated cowdung depends mainly on:

- the size of your cattle

- the feeding of your cattle

- the amount of litter in your cowshed

From the fore going, it is obvious that a larger animal produces more dung than a smaller one, a well-fed animal produces more dung than a poorly fed one and allow enough grazing time during the day and add 10 kg of fresh grass every day, when you put your oxen into the cowshed.

Making of cowdung starts with:

i. Putting the litter (material used as bedding for animals) and urine into the cowshed and;

ii. Allow it to get mixed with the dung,

iii. Allow it to rot and then produces manure.

iv. Dry litter must be added every day. This is because litter provides dry bedding for your animals and increases the amount of manure you produce.

Advantages of the use of cowdung as a source of manure helps the farmer to save a lot of money that would otherwise have been used to procure fertilizer.

In addition, it will improve the yields of the crops.

Before the cowdung can be brought to the farm, it must be rotten.

3.3 How to Produce Compost Manure

Compost is prepared from all organic waste materials (including kitchen waste, weeds, grass, crop residues, etc.) and it can be used to improve crop yields. Compost can be used as organic fertilizer on the farm and especially in the garden.

The process of making compost manure includes;

i. Choose a cool place for the establishment of your compost heap.

ii. Peg a square with 4 poles at a distance of 2-3 metres. OR Dig a pit into which the waste materials would be thrown into.

iii. Throw all available organic waste materials on the ground within the four poles.

iv. When the layer of organic matter is about one hand span high, you spread a thin layer of humus soil or manure.

v. You continue to put organic matter (1 handspan) and manure (thin layer) until your compost heap is about 1 metre high.

Caution must be taken to ensure that;

* the compost is kept moist throughout.

* For proper mix of the compost, the heap can be turned from one heap, A into B, C and D. that is four heaps.

* In addition, adding well rotten compost to manure and organic wastes speeds up the rotting process.

* Compost must be kept moist even in the dry season, you have to water your compost and protect it against the sun. This can be done by covering your compost heap with leaves or grass and leave it for some time to rot before applying to the field. After we are sure that rottening has taken place, the heap can then be turned into another heap or pit.

For complete rotting, you have to turn your compost after some time (4-6 weeks after complete establishment). Mix the organic matter and put the outer layers inside and the inner layers of the compost outside. Especially when you use your compost for gardening, it needs complete rotting.

3.4 How to produce Green Manure

Green manure is manure from special manure plants or crop residues.

Many Green Manure Plants do not produce direct food, but they improve the soil. Green manure has been proved to be a good source of soil fertility management. This has been demonstrated from improved yield in crops planted on soils just after applying green manure.

Some popular green manure plants are; Tephrosia, Sesbania, Crotalaria, Leucaena, Pidgeon Pea, Calapagonium, Centrosema, etc.

3.5 How to bury Organic Matter

To avoid loss and improve the decomposition of organic matter from plant drop, we have to mix the organic matter with the soil.

The oxen farmer is able to achieve this purpose by;

*Using the cart (animal or man drawn implement), to transport the manure to the farm.

*The roller cutter which could be used by the farmer to clear and perhaps chop plant residues into small easily decomposed parts; and

*The ridger for this exercise. He uses the ridger to bury the organic matter into the soil

The buried organic matter gives humus to the soil. We call this organic farming. It improves your soil and the following crop will produce a lot of food.

3.6 Mixed Cropping

Mixed cropping is the planting of two or more crops on the same field or piece of land at the same time. To keep the soil in balance of nutrients, we are required to combine (mix) crops that

are exhaustive and require different nutrients (which make the soil poor) and those that have the capability to replace or replenish the soil of nutrients (with crops which improve the soil).

Some of the crops that make the soil poor are: maize, rice, wheat, yam, cassava, cocoyam, potatoes, etc. On the contrary, those crops that are capable of improving the soil nutrients include legumes like: ground nuts, beans, soya beans, peas, etc.

Advantages of Mixed Cropping System

i. Mixed cropping system helps in the conservation of soil fertility.

ii. Since the crops used in mixed cropping system are different, their root systems also differ and as such will require different layers of the soil better, that means: they use the available water and nutrients better.

iii. Mixed crops with different preferences for nutrients, use the different minerals available in the soil better.

iv. Mixed cropping results in a higher plant population per unit area and increases yields.

v. The system helps in the control of soil erosion and suppresses weed growth.

vi. Mixed cropping system reduces the risk of pests and diseases infestation.

vii. Mixed cropping diversifies the food supply since different types and quality of crops are produced and through this different quality food to meet the family diet.

viii. Mixed cropping reduces the risk of complete crop failure. If one crop fails, the other crops can still produce enough food for the farmer family.

3.7 Upland and lowland

Upland and lowland are portions of plain that are conditionally categorized by their elevation above the sea level. Lowlands are usually not higher than 200m (660 ft), while uplands are

somewhere around 200m (660 ft) to 500 m (1,600 ft) above sea level. And sea level is a land or an area of land lying above the level where water flows or where flooding occurs (Upland and lowland - Wikipedia)

3.8 Characteristics of Upland and Lowland Habitat

Upland habitat according to Upland and lowland Wikipedia has the following characteristics;

i. Upland habitats are cold because they experience lower temperatures, high rainfall and are windy

ii. The habitat is clear.

iii. The habitat is rocky.

iv. The rivers are fast-flowing in mountainous areas.

v. Upland areas are high above sea level.

vi. They are often (but not always) mountainous, and;

vii. They usually consist of igneous rocks.

The characteristics of Lowland habitat according to Upland and lowland Wikipedia are;

i. Lowland habitats are warm.

ii. They have slow-flowing rivers.

iii. The habitat is found in relatively flat lowland areas,

iv. The water found in lowland areas are frequently coloured by sediment and organic matter.

3.9 Importance of Uplands

Upland vegetation ecosystems are important both to man and the system he leaves in. These woodland, grassland, and shrubland habitats offer vital ecosystem services. In specific terms, Upland and lowland Wikipedia, stated that upland areas help in;

i. They help conserve soil.

ii. They also help to store carbon.

iii. The habitat as well helps to ensure proper cycling of nutrients

iv. Upland habitat helps to recycle energy, and;

v. Water is also conserved through this habitat.

vi. They also provide a variety of wildlife habitat.

3.10 The problems of upland Habitat

Wikipedia of Upland and lowland as well stated that the problems of upland land farming have resulted in the following;

i. Degradation of the soil since it is continually being used and poorly cultivated for agricultural purposes

ii. It has also resulted to world-wide soil erosion.

iii. Upland habitat has led to the contributions of tropical land-use change to global climatic warming.

iv. Upland habitat has also been blamed or decried for the rapid rates of land clearance and deforestation in a number of cases or situations.

v. In some cases, the habitat has presented a picture of looming environmental disaster, which has spelt doom for the people.

vi. Poor use of the soil has led to consequent losses of productivity

3.11 Challenges faced by Upland Agriculture

Several challenges have been faced by the rapidly growing populations. Upland and lowland Wikipedia pointed out some of the challenges to include;

i. The deforestation of forest: Upland agriculture has led to the deforestation of the forest and this has brought about reduction in forest and its resources for agricultural expansion.

ii. Establishment of roads: Roads are actually constructed to create access for people. Due to increasing population and urbanization, there is an increase in the construction of roads to provide access for farmers and settlers, both to the logged-over land itself and to distant markets.

iii. Demands for cash to meet domestic needs: The demand for cash by the farmer to meet domestic needs such as paying for consumer goods, children's education, and for agricultural inputs which have become a necessity in the face of continuing declines in yields, has made it impossible for the farmer not to have enough cash to meet up with challenges in cultivation of crops.

iv. The unsafe use of pesticides: The unsafe use of pesticides (many of which are banned elsewhere in the world), often used at rates well above those recommended has contributed to the degradation or collapse of the forest and soil fertility loss.

v. Poor topography of the soil: Most of our lands are either hilly, slopy or exist as valley. Such topography are described as poor and not too good for upland agriculture. Here, they give rise to rapid loss of topsoil and accompanying rapid declines in soil fertility.

vi. Creation of erosion menace: The creation of erosion has led to the degradation of land and ths make such land unfit for agricultural purpose.

4.0 Conclusion

Conservation of the soil involves protecting the soil’s fertility for good productivity. It involves the wise use of the soil so that it will continue to meet with its potential in terms of productivity. Soil’s conservation can be achieved through application of organic manure, green manure,

practice of mixed cropping and crop rotation systems as well as application of mineral fertilizer. The use of the systems mentioned above have their advantages which actually supersedes their disadvantages.

In where upland and lowland are concerned, lowlands are usually not higher than 200m (660 ft), while uplands are somewhere around 200m (660 ft) to 500 m (1,600 ft) above sea level. Upland has much importance such as its ability to conserve the soil, recycling of nutrients, and water conservation. Continuous use of upland habitat has led to soil degradation, soil erosion and losses of productivity

5.0 Summary

This unit examined Systems of Soil Conservation and Improvement. It looks into how the soil fertility can be conserved for improved productivity. In achieving this, some of the methods that can help in improving the soil like the use of organic manure, green manure, crop rotation, etc were taken into consideration. The study also differentiated (using their characteristics) upland from lowland. Upland was seen as somewhere around 200m (660 ft) to 500 m (1,600 ft) above sea level, while lowlands are usually not higher than 200m (660 ft). The study as well treated some of the importance, problems and challenges of upland habitat.

6.0 Tutor Marked Assignment

i. What is soil conservation?

ii. Sate three (3) factors that can determine the quantity of cowdung a farmer can produce.

iii. Describe the stages involved in making cowdung.

iv. Describe the step – by – step process of making compost manure

v. Describe any two (2) processes of burying organic manure in the soil.

vi. Define mixed cropping system.

vii. Enumerate four (4) advantages associated with mixed cropping system.

viii. Enumerate four (4) characteristics that differentiate upland from lowland habitat.

ix. State four (4) importance of upland habitat to the ecosystem.

x. Identify four (4) challenges associated with upland habitat.

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MODULE 4: IRRIGATION FARMING SYSTEM

Unit 1: Concept, Definition and Principles of Irrigation Farming

Unit 2: Types / Methods and Challenges of Irrigation Farming

Unit 3: Factors Determining Types of Irrigation Farming and Source of Irrigation Farming

Unit 4: The Importance, Effects, Advantages and Disadvantages of Irrigation System of Farming

Unit 5: Environmental and Health Implications of Irrigation Farming

MODULE 4: IRRIGATION FARMING SYSTEM

Unit 1: Concept, Definition and Principles of Irrigation Farming

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1.0 Introduction

Irrigation is the act of artificially supplying water to the farm through different means. This can be done through the use of sprinkler, flooding, etc. The essence of irrigating our farms is to ensure that the crops have adequate quantity of water for the crops growth and development. Irrigation is necessary and has become important because rainfall cannot be predicted by man and so, irrigation helps to bridge the needed water. Also, farming cannot be done in the dry. Irrigation to this end helps to make farming possible during the dry season. Through irrigation, farming throughout the year is possible and food security is therefore guaranteed.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Define Irrigation

ii. Discuss the principles guiding effective irrigation practice in our farms.

3.0 Main Content

3.1 Concept of Irrigation Farming

Irrigation is a method of applying controlling the amount of water you supply to plants at regular intervals for agriculture (Iwena, 2018). The author stated in simple words that, it is when you supply water to plants to help them grow well when there is not enough rain. You can pump irrigation water from rivers, lakes and wells. The farmer can as well allow it to flow to the fields by the force of gravity along pipes or open canals. Irrigation water is needed for the plants as it helps the plants to grow well, help to control the heat that affects the plant, it makes it to be turgid, thus giving it strength, it also helps in the transportation of materials in the plant, and so on. Water may reach the plant through rainfall. But sometimes the rain may be off-season, hence it has to be supplied through

one artificial means or the other. This is necessary so the plant can be able to meet up with its potentials and meet up with food surplus that guarantees food security.

3.2 Definition of Irrigation Farming

Irrigation is the artificial application of water to the farm / land for the purpose of agricultural production (Iwena, 2018). Effective irrigation will influence the entire growth process from seedbed preparation, germination, root growth, nutrient utilization, plant growth and regrowth, yield and quality.

Irrigation is also defined as the artificial application of water to the soil for plants to utilize for their growth and development. Through the process of irrigation, the plants are able to meet up with their potentials, all things being equal.

3.3 Principles of Irrigation Farming

Irrigation farming is guided by some set of rules that really make it effective (Report on Irrigation-Principles and Practice). The report emphasized that these set of rules ensure that irrigating the farm is carried out at optimum, ensuring maximization of benefits and avoiding to the barest minimum any hazards or negativities that may emanate from the practice. Some of the guiding principles are:

i. Cost of Operation: Irrigation is of relatively low cost when compared to the cost of running the entire farm. This is necessary so that many farmers can take advantage of the practice and benefit from what it offers. Again, once in operation it should be readily available for use as needed.

ii. Little technical background: Irrigation practice needs the farmer to have little technical knowledge for use of the system. To this end in view, the farmers must understudy the

farming system to know the level of technical knowledge that is within his reach and that will determine the kind of irrigation system to adopt.

iii. Wind direction consideration: Although the practice or water is vulnerable to the wind. For this reason, oscillators may be useful when "rough irrigating" large blocks of garden beds, e.g., prior to planting cover crops, and when irrigating large garden spaces. Oscillators ensure the spread of water on lager area of land.

iv. Poor uniformity of water distribution: In the course of the distribution of water via irrigation practice, there is bound to be relatively low uniformity of water distribution and high rates of evaporation, especially in hot and/or windy situations

v. Takes time for water to cover area: The water that comes from the pores can take time to adjust and "dial in" to provide full, even coverage of the desired area. SO the system calls for patience from the farmers.

vi. Inconsistence in distribution of water: The irrigation water is inconsistent in distribution pattern and due to its vulnerability to wind, may cause some of the plants / crops not served water, thereby making the crops be subject to "drift" and thus increased disease incidence if they are prone to fungal disease of the leaf canopy (as a result of lack of water)

vii. Inability to determine water quantity: The required water to be ideal for irrigating a field is difficult to calculate or determined. Irrigation practice is difficult to determine in terms of rate of water to use and the time water should run. Such is difficult or time consuming to accurately determine output/distribution, thus leading to over-watering or under-watering. For example, the adjustability of oscillators means the same device could water

a 4’ x 12’ section or a 30’ x 30’ section. So an irrigation set of the same duration will deliver very different amounts to these two garden plots.

viii. Existence of different oscillators: It is important to note that there exist different types of oscillators. These differences in quality of oscillator brands exist in their useful lifespan, adjustability, and distribution uniformity. All of these vary widely, and it can be difficult to know quality until you’ve invested considerable time and energy.

4.0 Conclusion

Irrigation is the artificial application of water to the farm / land for the purpose of agricultural production. The act of irrigating our farms is important because it helps to ensure the plants meeting up with its potential and ensuring food security of the nation. Different principles like cost of operation, demand of farmer’s little technical background knowledge, wind direction consideration, etc stand to guide the effective performance of the irrigation system.

5.0 Summary

Irrigation is the artificial application of water to the farm / land for the purpose of agricultural production and its importance cannot be overemphasized. However, different principles are bound to ensure the effective functioning of the irrigation system.

6.0 Tutor-Marked Assignment

i. Define irrigation farming

ii. List five (5) principles guiding the effective function of the irrigation practice.

iii. Discuss the five (5) principles (mentioned above) guiding the effective function of the irrigation practice

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Unit 2: Types / Methods and Challenges of Irrigation Farming

Table of Content

1.0 Introduction

This unit showed or expressed and explained the different types of irrigation systems that are prevalent in our farms. These types are surface, sprinkler, drip/trickle, surface, subsurface, furrow and manual irrigation system. The types are governed by different factors for optimum performance. The major types however have different sub-types and they all influenced by different factors in the different environments. The choice of type is that of the farmer or the manager and this is in line with the facilities within the farmers reach. The challenges that plague the establishment and operations of the different irrigation systems were as well looked into.

2.0 Objectives

At the end of the study, the student should be able to:

i. Enumerate different types of irrigation system that could be practiced by a farmer.

ii. Explain the different types of farming systems enumerated above.

iii. State the advantages and disadvantages of the drip/trickle irrigation system.

iv. Explain the effects in each case of under and over-water in the course of irrigation farms.

v. Explain major challenges plaguing irrigation systems in our farms.

3.0 Main Content

3.1 Types / Methods of Irrigation Farming

The key to maximizing irrigation efforts is uniformity of the spread of water across the area of the farm under cropping. The producer of the water, who stands as the farmer, has a lot of control over how much water to supply and when to apply it but the irrigation system determines uniformity. Deciding which irrigation systems is best for your operation requires knowledge of equipment, system design, plant species, growth stage, root structure, soil composition, and land formation. To this end in view, to choose an irrigation method, the farmer must know the advantages and disadvantages of the various methods. He or she must know which method suits the local conditions best. Unfortunately, in many cases there is no single best solution: all methods have their advantages and disadvantages. Testing of the various methods - under the prevailing local conditions - provides the best basis for a sound choice of irrigation method. Iwena (2018), and report on Irrigation-Principles and Practices stated that there are basically **different types of irrigation system tied with their various advantages and disadvantages. The author and report also importantly stated that numerous subclasses exist within each of these basic types as they are detailed below. These include:**

- Flooding irrigation
- Surface irrigation
- Sprinkler irrigation

- Drip/trickle irrigation
- Subsurface irrigation
- Furrow irrigation
- Manual irrigation

i. **Flooding Irrigation System**: Flooding system is a system of irrigation that allows a wide spread of water from a particular source. The system is operated in two major different ways. These ways are; Wild flooding and Controlled flooding.

Wild flooding is a method of irrigation that involves turning or pumping the water onto natural slopes without much control or prior preparation. The system involves a usual waste of water, and unless the land is naturally smooth, the resulting irrigation will be quite uneven. Wild flooding is used mainly for pastures and fields of native hay on steep slopes where abundant water is available and crop values do not warrant more expensive preparations.

Controlled flooding on the other hand involves the use of borders, checks, or basins. It is relatively inexpensive because it requires minimum of preparation.

Water is brought to the field in permanent ditches and distributed across the field in smaller ditches spaced to conform to the topography and rate of flow. As shown in the figure below

Water is brought to the field in permanent ditches and distributed across the field in smaller ditches spaced to conform to the topography of the soil and rate of flow. Under ideal conditions, the ditch spacing and flow rate should be such that the water will just infiltrate in the time it is flowing across the field

The use of flooding method of irrigation generally involves a divide of the field / paddock into portions or bays separated by parallel ridges/border checks. Water flows down the paddock's slope as a sheet guided by ridges. On steeply sloping lands, ridges are more closely spaced and

may be curved to follow the contour of the land. Border systems are suited to orchards and vineyards, and for pastures and grain crops. The water is channeled to the area occupied by the crops and it is in that same location that percolation of the water takes place.

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ii. **Surface irrigation System:** In surface irrigation, water is allowed to move over and across the land to be irrigated. Surface irrigation involves the construction of ditches or channels on the surface of the soil. It is the channels that carry water to the farm. The water may be supplied to paddocks through the channels. Supply of water takes place as long as the farmer wishes. The system is used to supply close planted crops like onion, rice, carrot etc. A necessary condition is that the soil should be a clay-loamy soil which may not permit quick drainage of the water into the soil. This system permits excess loss of water.

iii. Sprinkler irrigation System: This is a popular method of or supplying water to the field/farm. Sprinkler irrigation is the use of sprinkler in the supply of water to the field. The system operates in such a way that pipes carry some amount of water to the fields and then sprays it directly over the crops with high-pressure sprinklers.

The sprinklers are of different types and that determines their usage. We have;

Center-pivot sprinkler systems: A center-pivot sprinkler is a self-propelled system in which a single pipeline supported by a row of mobile towers is suspended 2 to 4 meters above ground. Water is pumped into the central pipe and as the towers rotate slowly around the pivot point, a large circular area is irrigated. Sprinkler nozzles mounted on or suspended from the pipeline distribute water under pressure as the pipeline rotates. The nozzles are graduated small to large so that the faster moving outer circle receives the same amount of water as the slower moving inside. Below shows *Centre-pivot sprinkler system*

Image source: tlirr.com

Hand move sprinkler systems: Hand move sprinkler systems are a series of lightweight pipeline sections that are moved manually for successive irrigations. Pipes carrying water are connected to a water source and the pipes could be carried with the hand. On the sprinkling end, there may be the sprinkling device that helps to sprinkle the water. Labor requirements are higher than for

all other sprinklers. This is because the human power must be available to be carrying and directing the pipes

Solid set / fixed sprinkler systems: Solid set /fixed refers to a stationary sprinkler system. Water-supply pipelines are generally fixed (usually below the soil surface) and sprinkler nozzles are elevated above the surface. Solid-set systems are commonly used in orchards and vineyards for frost protection and crop cooling. Solid-set systems are also widely used on turf and in landscaping

Travelling gun sprinkler systems: Travelling gun systems use a large sprinkler mounted on a wheel or trailer, fed by a flexible rubber hose. The sprinkler is self-propelled while applying water, travelling in a lane guided by a cable. The system requires high operating pressures for the flow of water not to be interrupted.

Side-roll wheel-move systems: Side-roll wheel-move systems have large-diameter wheels mounted on a pipeline, enabling the line to be rolled as a unit to successive positions across the field. Crop type is an important consideration for this system since the pipeline is roughly 1 (one) meter above the ground. The benefit of this system is that you can control the amounts of water.

This is displayed below:

Image source: fredrobertssprinklerservice.com

iv. Drip/trickle irrigation: With this type, the drip lines take water near the root zone of plants and release it drop by drop. Going by the way it operates, this method is the most water-efficient of irrigation.

Find below the figure that shows how it works

Image source: innotation.io

Advantages of the Drip/trickle irrigation:

i. Increased water use efficiency since water expels in droplets.

ii. Better crop yield because there is hardly any form of excess or under-water application.

iii. Uniform and better quality of the produce.

iv. Efficient and economic use of fertilizer is assured because leaching is guided against.

v. Less weed growth since water drops exactly at the point where the root is.

vi. Minimum damage to the soil structure as it helps to guide against soil erosion.

vii. Avoidance of leaf burn due to saline soil

viii. More preferred to use in area with undulating soil and slow permeable soil

ix. Low energy requirement (i.e.) labour saving as it does not require man to move along with it.

x. High uniformity suitable for atomization

The disadvantages of the Drip/trickle irrigation are as follows:

i. Clogging of drippers may occur and when it does, water can hardly flow and then the system is truncated.

ii. Chemical precipitation may occur in the pipes since water movement in the pipes is very slow.

iii. Salt accumulation may as well occur at the points where dropping of the water takes place

v. Subsurface irrigation System: This is another method or irrigation where by the irrigation practice takes place under the surface of the soil. The system involves the laying of perforated pipes under the surface of the soil. In practice, as water is supplied through the pipes, it begins to come out through the pores and thereby irrigating the soil. The figure below shows sub-surface irrigation system.

Advantages of Subsurface irrigation

i. Subsurface irrigation is such that the operation does not interrupt with the farm operations.

Subsurface irrigation

ii. Subsurface irrigation results in a minimum loss of water via evaporation

iii. Surface wastage of water is very minimal or brought to the barest minimum.

iv. The system requires little field preparation and labour

Disadvantages of Subsurface irrigation

i. The system is more expensive to construct and maintain.

ii. There are cases where there could be blockage of the pores and this might not be easily detected by the farmer or manager

iii. The system requires some level of improved technical knowhow.

iv. It may be difficult for the farmer to know the quantity of water to use in operation, thus resulting to over or under-water usage

vi. Furrow irrigation system: This system comprises a series of small, shallow channels used to guide water down a slope across a paddock. Furrows can also be described as a narrow ditch between rows of plants. Furrows are generally straight, but may also be curved to follow the contour of the land, especially on steeply sloping land. This method is typically used to grow row crops or bed between the furrows, spaced from 1 meter apart. Actually, the spacing of furrows are determined by the spacing of the crops. Small furrows have been used to grow forage crops. Furrows do vary from 3 – 12 inches deep and may be as long as 1500ft long. The figure below shows the furrow irrigation system.

Advantages of furrow irrigation system

i. Only a small area of the soil is wetted during the process of irrigating the soil.

ii. Evaporation is correspondily reduced. That is to say the system helps to minimize water loss.

iii. The water quantity that is needed to irrigate a field can be easily predicted and known.

Advantages of furrow irrigation system

i. The system requires some level of technicalities.

ii. The system can be seen to be more expensive to construct at least when compared to flood irrigation system.

iii. Much water is required to flow the system.

iv. The system cannot be operated inland with hilly or sloppy topography. In other words, the system is quite choosy in land consideration.

vii. Manual irrigation: This is the type of conventional system of irrigation that takes place in our backyard gardens of farms. This type uses buckets or watering cans to convey water from where it is plenty or from its source to the point or plants /crops it is to be applied on. The system involves the use of reliable source of water and human labour. Find below the figure of how manual labour operates:

Image source: theorchardgarden.blogspot.com

Advantages of manual irrigation system

i. Manual irrigation system does not require technical skill to operate it

ii. Water is very much economically used

iii. Evaporation is greatly minimized

iv. Leaching (loss of nutrients through washing down the soil) is greatly reduced

.

v. It is a cheap method of irrigation practice to carryout

Disadvantages of manual irrigation system

i. The method cannot be used to irrigate a large area of farm.

ii. It involves the direct and too much involvement of human labour

iii. Due to man's nature, irrigating the farm may not be properly carried out.

iv. In the event of pest outbreak, the system cannot be used.

v. The quantity of water applied per stand may not be in commensuration of the plant needs, such may be the case where tree crops are to be irrigated.

3.2 Challenges of Irrigation Farming

Irrigation farming is faced with some challenges. These challenges according to Iwena (2018) make the irrigation system chosen by farmers not to function to its peak or expectations. It is as well makes any chosen irrigation system adopted for practice by the farmer(s) not to function to its full potentials. Notably, some of the challenges are:

i. Availability of ridges: The ridges formed which are supposed to channel water from source to the farm sometimes posed as obstruction to the functioning of the irrigation system. The ridges sometimes interfere with the movement of implements needed for the functioning of the

irrigation system. As many as the areas occupied by ridges and field channels go a far way in the disruption of the system. The method impedes surface drainage.

ii. Labour shortage: The labour requirement is of two folds. They are the skilled and unskilled labour required for the construction and operation of the irrigation system. The skilled Engineers or technicians as well as the unskilled workers are unavailable. Their unavailability pose a serious challenge to those who would have wanted to construct an irrigation facility in their farms.

iii. Type of crop planted: The type of crop that is being planted is another factor that render challenges to irrigation farming. There are some types of crops and cropping system that do not allow particular irrigation system to be constructed in the farmers plot and so discourages the farmer from carrying out the system.

iv. Unsuitability to some crops: There are some types of crops that do not do well in irrigated farms. Such crops are not suitable for irrigation use because they are sensitive to wet soil conditions around the stem.

v. Chance of backflow into water source: There are instances where the water that is being pumped may experience a backflow. This condition may arise due to a technical issue, and once not detected on time may end up resulting to damages to the crops that were supposed to be irrigated.

vi. Insoluble fertilizers are not suitable: There are some types of fertilizers that are not suitable for the use of irrigation practice. Such fertilizer include super phosphate. In this instance, the use of irrigation does not help matter in dissolving the fertilizer for the uptake of plants roots.

vi. Corrosive effect of fertilizer: There are some instances where corrosion of the tube or pipe supplying water may become corroded. In a gradual process if not checked, it will lead to the destruction of the pipe and a collapse of the system.

vii. Destruction of the pipe line: In some cases, fertilizers like phosphate may get precipitated in the pipe line and dripper due to pH reaction and this will lead to serious effect such as destruction of the system6. High cost

viii. Malfunctioning of the irrigation system: While irrigation has provided a number of important benefits, some potential drawbacks are imminent. Such drawbacks may include over watering or under-watering of the farm. In any of the cases, there effects that emanates from it. these are expressed in details below:

Under-watering may result in:

- Loss in market value through yield reduction
- Reduction in fruit size and quality

Over-Watering may result in:

- Unwanted vegetative growth
- Losses of valuable water to the water-table
- Irrigation water travelling over soil can cause erosion. The excessive displacement of the top soil can also affect soil fertility (and hence crop yields), it may also clog drainage ditches and streams (silting), harm aquatic habitats, foul waters used for recreational activities, and increases the need for water treatments.
- Irrigation can cause pesticides, pathogens and weeds to spread during irrigation
- Cause runoff
- Increased operational costs (labour, pumping, cost of water)

- Leaching of nutrients (eg. salt, phosphorus) may lead to algal growth, salinity an nitrate build ups (poisoning) elsewhere in the catchment
- Downgraded product quality and reduced yield.
- Higher operational costs for the producer (hence, reduced profits)
- Pressure on water resources with the Increasing demand for water use by urban dwellers

4.0 Conclusion

The study examined the different types of irrigation system that are prevalent in our farms. The study also found that different conditions actually influence the different types of irrigation systems in our farms. The types discussed were seven in number, though some of them also have sub systems under them. What is paramount is that different conditions suit different types of irrigation systems. The unit revealed some of the limitations or challenges plaguing the construction and use of irrigation systems in our farms.

5.0 Summary

The unit unraveled the different types of irrigation systems that are prevalent in our farms. The sub-types of the major systems were also studied. The factors affecting the functioning of the different irrigation systems were also disclosed.

6.0 Tutor-Marked Assignment

i. List five (5) types of irrigation systems a commercial farmer can construct and practice in his/her farm.

ii. Discuss the five (5) types of irrigation systems mentioned above, a commercial farmer can construct and practice in his/her farm.

iii. Mention three (3) different advantages and disadvantages of drip/trickle irrigation system.

iv. Explain, giving four (4) reasons why the drip/trickle irrigation system would be preferred to the flooding irrigation system.

v. State two (2) effects of under and over-watering of our farms.

vi. Explain five (5) major challenges plaguing irrigation systems in our farms.

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Unit 3: Factors Determining Types of Irrigation Farming and Source of Irrigation Farming

Table of Content

1.0 Introduction

Irrigation system adopted by a farmer is affected by different determining factors. These factors are major six in number and they include natural conditions, type of crops planted, type of technology, previous experience with irrigation, required labour inputs, costs and benefits consideration. Amongst these factors, climatic factors seem to be the one that greatly affects the farmers choice more than the other factors. The source of water of the irrigation system was also considered and the study found that water source plays significant role in the choice of irrigation system to be adopted by the farmer. The basic reason as unraveled by the study was due to the sediments and possibly salt deposits in the water, based on its source. The timing and quantity of water to be applied to the farm was as well considered. This is termed irrigation scheduling.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. List and discuss the major factors that are considered in the choice of irrigation system to adopt by a farmer.

ii. Explain of the natural factors under consideration in choosing irrigation method to adopt in a farm.

iv. Explain the reasons why source of water to irrigation is important in choosing type of irrigation to use in farming of crops.

v. The concerns of irrigation scheduling.

3.0 Main Content

3.1 Factors Determining Types of Irrigation Farming

In choosing an irrigation system, the Engineer or farmer must bear in mind that there is a huge diversity in the types of irrigation technologies/systems used, and the use or application of the different types of these irrigation systems are subject to been determined by different factors. A report on The Practice of Irrigation-Food and Agriculture stressed that the suitability of the various irrigation methods, i.e. surface, sprinkler or drip irrigation, flood, subsurface, furrow, etc depends mainly on the following factors such as;

- Natural conditions
- Type of crops planted
- Type of technology
- Previous experience with irrigation
- Required labour inputs

- Costs and benefits consideration

The above major mentioned factors are discussed below:

A. NATURAL CONDITIONS

The natural conditions are those factors that man have no cause to and has very little or nothing to do about it. Such factors are *soil type, slope, climate, water quality and availability*, and they have the following impact on the choice of an irrigation method:

Soil type: Taking the different types of soil into consideration and their characteristics,

Sandy soils have a low water storage capacity and a high infiltration rate. They therefore need frequent but small irrigation applications, in particular when the sandy soil is also shallow. Such soil would drain water fast and so suggest that under these circumstances, *sprinkler or drip irrigation* are more suitable than surface irrigation.

On loam or clay soils all three irrigation methods like surface, *sprinkler and drip irrigation systems* can be used, but surface irrigation is more commonly found. *Clay soils* with low infiltration rates are ideally suited to surface irrigation.

When a variety of different soil types is found within one irrigation scheme, *sprinkler or drip irrigation* are recommended as they will ensure a more even water distribution.

Slope: Farming on a land that is on a sloppy terrain, the best type of irrigation system is the *sprinkler or drip irrigation* are preferred to other types of irrigation system. These systems make it possible for water to be distributed and slowly percolate the soil without any tendency of soil erosion. An exception to the use of other systems like surface irrigation could be used when rice is grown on terraces on sloping lands.

Climate: Climatic factors like wind, especially when it is a strong wind can disturb the spraying of water from sprinklers. Under very windy conditions, drip or surface irrigation methods are preferred. In areas of supplementary irrigation, sprinkler or drip irrigation may be more suitable because of their flexibility and adaptability to varying irrigation demands on the farm.

Water availability: Water application efficiency is generally higher with sprinkler and drip irrigation than surface irrigation and so these methods are preferred when water is in short supply. Efficiency of water usage in irrigating the farm must be taken seriously due to the fact that such water could be costly if it is to be bought or in short supply in where there is scarcity.

Water quality: Water quality actually depends on the source of the water and its composition. In a situation where the available water for use contains sediments, the preferred type of irrigation system is surface irrigation. The reason being that if sprinkler system is used, the sediments may clog the drip or sprinkler irrigation systems. In addition, if the irrigation water contains dissolved salt, drip irrigation is particularly suitable because less water would be applied to the soil than with surface irrigation method. Sprinkler systems are more efficient than surface irrigation systems in leaching out salts.

B. TYPE OF CROP

This is another major determinant of the irrigation system that should be used in a particular farm or land. The type of crop could be tree crop, shrubs or vegetable crops. Surface irrigation can be used for all types of crops. In particular, due to the huge sum involved in establishing sprinkler and drip irrigation per hectare, they can be used for high value cash crops such as vegetables and fruit trees. They are seldom used for the lower value staple crops due to the incidence of cost – benefit consideration.

Drip irrigation is suited to irrigating individual plants or trees or row crops such as vegetables and sugarcane. Sprinkler may be suitable for upland rice while flooding system may be suitable for lowland rice.

C. TYPE OF TECHNOLOGY

The level of technology looks at the skill level of the manager or farmer and the technicalities of the irrigation system under investigation. While some methods are simple to use, others are difficult or complicated. The type of technology affects the choice of irrigation method to be chosen or used.

In general, drip and sprinkler irrigation are technically more complicated methods. The purchase of equipment requires high capital investment per hectare. To maintain the equipment a high level of 'know-how' has to be available, Also, a regular supply of fuel and spare parts must be maintained which - together with the purchase of equipment - may require foreign currency.

Surface irrigation systems on the other hand, usually require less sophisticated equipment for both construction and maintenance (unless pumps are used). The equipment needed is often easier to maintain and less dependent on the availability of foreign currency. The farmer, after his considerations would make up his mind on what best method to use, giving the available resources.

D. PREVIOUS EXPERIENCE WITH IRRIGATION

Experience, they say is the best teacher. While some farmers have good and reasonable experience, others may not have. A farmer would gladly jump and adopt an irrigation system he/she was used to and refuse or reject a system he was not used to before.

The choice of an irrigation method also depends on the irrigation tradition within the region or country. Introducing a previously unknown method may lead to unexpected complications. It is

not certain that the farmers will accept the new method. The servicing of the equipment may be problematic and the costs may be high compared to the benefits.

E. LEVEL OF TECHNOLOGY: Different levels of technologies are required for different types of irrigation systems. Amongst the different types of irrigation systems, basin irrigation system is the simplest of the surface irrigation methods. Especially if the basins are small, they can be constructed by hand or animal traction. Their operation and maintenance is simple.

On the other hand, irrigation systems like furrow irrigation - with the possible exception of short, level furrows -requires accurate field grading. This is often done by machines. The maintenance - ploughing and furrowing - is also often done by machines. This requires skill, organization and frequently the use of foreign currency for fuel, equipment and spare parts.

F. REQUIRED LABOUR INPUTS: The required labour inputs for construction and maintenance of irrigation systems depend heavily on the extent to which machinery is used.

In general it can be stated that to operate the system, basin irrigation requires the least labour and the least skill and that is why if required labour is the item under consideration, the farmer would quickly opt for that system it favours. For the operation of furrow and border irrigation systems more labour is required combined with more skill. On a normal day, the systems requiring high labour involvement and skill would be turned down by the farmer.

G. COSTS AND BENEFITS CONSIDERATION: Cost and benefits considerations take into account the different items that constitute costs and the different items that as well constitute benefits as far as the irrigation system he/she wishes to adopt. At the end of all considerations, the farmer chooses that system that sees to having the benefits outweighing the costs. Otherwise the system would be abandoned.

3.2 Source of Irrigation Farming

Report on Irrigation, Soil and Water stated that vast majority of irrigation water use is pumped directly from a water source that may be connected to river, creek, channel, drag line, hole, dam or bore. The source of the water would also go a long way in determining the type of irrigation system to use in the farm. While some of the source may have sediments, others may have salt in the water. To this end in view, the farmers decision would be based on the composition of the waterm and the best irrigation method that suits it.

3.3 Irrigation Scheduling

Irrigation scheduling is the process by which an irrigator determines the timing and quantity of water to be applied to the crop/pasture. The challenge is to estimate crop water requirements for different growth stages and climatic conditions.

To avoid over or under watering, it is important to know how much water is available to the plant, and how efficiently the plant can use it. The methods available to measure irrigation scheduling include: (i) plant observation, (ii) feel and appearance of the soil, (iii) using soil moisture monitoring devices; or (iv) estimating available water from weather data.

4.0 Conclusion

The different factors that determine the type of irrigation system to use in the farms were considered. In the course of this, the study found that there are basically some factors that actually determine the choice of the farmers in the type of irrigation system chosen to be adopted. These factors are six namely; natural conditions, type of crops planted, type of technology, previous experience with irrigation, required labour inputs and costs and benefits consideration. The source of water of the irrigation system was also found to play significant role

in the choice of the system to irrigation system to adopt. This is premixed on the ground that some sources have sediments while others have salt deposits. Irrigation scheduling was as well considered as the process by which an irrigator determines the timing and quantity of water to be applied to the crop/pasture.

5.0 Summary

This unit studied the different factors determining the type of irrigation system to adopt in his/her farm. The factors are six in number and they include natural conditions, type of crops planted, type of technology, previous experience with irrigation, required labour inputs and costs and benefits consideration. The source of water of the irrigation system was also found to play significant role in the choice of the system to irrigation system to adopt. The timing and quantity of water to be applied to the crop/pasture is an important factor as far as the choice of irrigation system to be considered.

6.0 Tutor-Marked Assignment

i. List the different six (6) major factors that are considered in the choice of irrigation system to adopt by a farmer.

ii. Discuss any four (4) out of the factors that are to be considered in the choice of irrigation system to adopt by a farmer.

iii. Explain any four (4) of the natural factors under consideration in choosing irrigation method to adopt in a farm.

iv. Explain, giving two reasons why source of water to irrigation is important in choosing type of irrigation to use in farming of crops.

v. Briefly explain what irrigation scheduling is about.

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Unit 4: The Irrigation System of Farming

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1.0 Introduction

Irrigation system of farming has to do with the channeling of water from its source where it is in abundant quantity to the farm where it is scarce and to be used for crop production. The crops that are planted needs water for growth and development. Water makes it possible for farming to be carried out all round the year, thereby making it possible for the productivity to be increased and as well improving the farmers farm income. Irrigation of the farm helps to claim and make it possible for unsuitable grounds to be put into good farm use. Above all, if not for water photosynthesis wouldn't have been possible. The use of irrigation in our farms produces both

positive and negative outcomes. On the negative, irrigation of the farm can result to erosion on the farm land, destruction of some crops (when not controlled), and possible creates some outbreak of pests and diseases that can lead to health issues.

2.0 Objectives

At the end of this unit, the student should be able to;

i. Narrate the reasons why a farm should practice irrigation system in his farm

ii. Explain the relationship between irrigating a farm and the process of photosynthesis

iii. Explain the positive and negative effects of irrigating our farms.

iv. Know different measures of how to reduce the adverse effects of irrigation systems in our farms.

v. State the advantages and disadvantages of the farmer's use of irrigation system in our farms

3.0 Main Content

3.1 Importance of Irrigation Farming

Irrigation system of farming has to do with the channeling of water from its source to the farm where it is to be used for crop production (Report on Irrigation Management Importance, Irrigation and Drainage). Also stated by the report, the water is conveyed from area of plenty to area of scarcity. The report further stressed that as irrigation of the farm is carried out, it impacts on the crops in various ways amongst which are:

i. Irrigation keeps moisture in the soil. Moisture is necessary for the germination of seeds. It is only when the seed that is planted have moisture that the embryo can germinate and grow within the expected time.

ii. Water supplies two essential elements to the crops. They are hydrogen and oxygen. These are very vital in crop production.

iii. Irrigation is necessary for the absorption of mineral nutrients by the plants from the soil. Irrigation makes it possible for water to be in the soil so that the nutrients that are in the soil can be taken up through absorption process.

iv. It is important for the growth of the roots of the crop plants. Irrigation makes it possible that both the roots system and the shoot system would uptake water and become enlarged in size (growth)

v. Plants contain 90% water which gives turgidity and keeps them erect

vi. Water is an essential part of protoplasm (cytoplasm and nucleus)

vii. It regulates the temperature of the plant system and that of the soil, through this transpiration and evaporation is reduced.

viii. It is essential to meet the transpiration requirements otherwise, a scenario described as flaccidity (drying up) will occur in the plant.

ix. It serves as a medium for dissolving the nutrients present in the soil for ease of absorption by the plant.

x. It is an important ingredient in photosynthesis. That is to say, without irrigation / water there will be no manufacturing of food.

3.2 Effects of Irrigation Farming

Irrigation farming is connected to so many outcomes. A Report on Environmental Considerations in Irrigation acknowledged that the outcomes are the effects which are either positively or negatively related to the farmer or his crops. Some of them are:

Positive impacts

- ✓ It produces a turgid state for the plants, a situation needed for healthy growth.

- ✓ Creates more opportunities to use of land. It allows for those land that ordinarily wouldn't have permitted its use to be useful.
- ✓ Makes the crops to grow well and actualize their potentials thereby helping a nation to meet up with its expected food security.
- ✓ It helps to grow forest in deserts thereby reducing desertification.

Negative Impacts

- ✓ Reduced downstream drainage and groundwater quality. The sipping or percolation of water into the soil goes a long way in reducing the quality of the ground water.
- ✓ Increased cost of production. Some irrigation systems are expensive to construct and at the end of the day it contributes to the farms wealth and spread as a cost on the farm.
- ✓ Can result to outbreak of pests and diseases on the crops. Irrigation can bring about stagnation of water which can provide a breeding ground for pests and diseases for the plant.
- ✓ It can produce an environment where pest and diseases can thrive well against man's health
- ✓ Reduced river flow. Irrigation can bring about stagnation of water which can provide a breeding ground for pests and diseases that can affect man in one way or the other.
- ✓ Waterlogging may occur in certain areas or on certain types of soil (clay soil) and this can again provide a breeding ground for pests and diseases, and as well prevent good farming from taking place.
- ✓ Soil salinity. Salts may concentrate on the soil as a result of irrigation materials (like metal pipes) used for the irrigation system.

- ✓ Affected downstream water users. A continuous flow of water for irrigation purpose may end up affecting the water that is available for use by the people.
- ✓ Land subsidence may occur. This is a situation where the land may become less active due to its continuous use in taking advantage of the presence of irrigation system.
- ✓ Soil erosion may result from excess flow of water.

3.3 Alternatives to mitigate the negative impacts of irrigation projects

The Report on Environmental Considerations in Irrigation mentioned that there are measures that could help to either reduce or eliminate the adverse effects of irrigation development. Below are some of the measures:

i. Locating the irrigation project on the site or farm where negative impacts are minimized or bought to the barest minimum.
ii. Improving the efficiency of existing projects so that the irrigation facility will be efficiently used. Doing this will ensure minimum wastage of water
iii. Developing small-scale, individually-owned irrigation systems as an alternative to large-scale, publicly-owned and managed schemes. It is believed that such an individually owned system would be properly managed.
iv. The use of sprinkler irrigation and micro-irrigation systems are seriously advocated for, as this would go a far way to decrease the risk of waterlogging, erosion and inefficient water use;
v. Treatment of water in where appropriate is advocated (in where water is scarce), as this will make more water available to other users;

3.4 Advantages of Irrigation Farming

The advantages of irrigation system are enormous. They are:

i. Irrigation allows primary producers / farmers, to *grow more pastures and crops*. Losses of water will occur due to evaporation, wind drift, run-off and water (and nutrients) sinking deep below the root zone. This loss will be replenished by irrigation water.

ii. Producers can then *achieve higher yields* and meet market/seasonal demands especially if rainfall events do no occur.

iii. To produce *higher quality crops/pastures* as water stress can dramatically impact on the quality of farm produce

iv. Irrigation system helps to *lengthen the growing season* (or in starting the season at an earlier time).

v. Irrigation assures the farmers of having reliable *'insurance' against seasonal variability and drought.*

vi. Irrigation assures the livestock farmer to stock more animals per hectare and practice tighter grazing management due to the reliability of pasture supply throughout the season

vii. Regular supply of water via irrigation helps to maximize benefits of fertilizer applications. Fertilizers need to be 'watered into' the ground in order to best facilitate plant growth.

viii. Irrigation makes it possible for farmers to use areas that would otherwise be 'less productive'. Irrigation can allow farmers to open up areas of their farms where it would otherwise be 'too dry' to grow pasture/crops. This also gives them the capability to carry more stock or to conserve more feed.

ix. The availability of irrigation facility helps to save cost that would have been spent on feed buying on production in animal farm. This it does by providing reliance on supplementary

feeding (grain, hay) in grazing operations due to the more consistent supply & quality of pastures grown under irrigation

xi. Irrigation makes it possible to improve the capital value of the farmer's property. Since irrigated land can potentially support higher crops, pasture and animal production, it is considered more valuable. The value of the property is also related to the water licensing agreements or 'water right'.

xii. Irrigation system assures farmers of greater benefits to than costs. Irrigation system brings about more than benefits than cost. This may result from the more effective use of fertilisers and greater financial benefits as a result of more effective agricultural productivity (both quality and quantity) and for 'out of season' production are likely.

3.5 Disadvantages of Irrigation Farming

i. Excessive seepage and leakage of water. These create marshes and ponds all along the channels. The marshes and the ponds after some time become breeding areas for mosquitoes.

ii. It lowers the temperature and makes the locality damp due to the presence of irrigation water.

iii. Excessive seepage into the ground raises the groundwater. And so causes waterlogging of the area.

iv. Irrigation facility adds to initial cost of production of the farm.

v. The presence of irrigation facilities may add to the overhead cost of running the farm. This is so because, the farm may go on to employ the services of an Engineer for the purpose of maintenance of the facility.

vi. The system may provide a breeding ground for vectors that can cause diseases to man.

vii. Irrigated farm may not be able to store or conserve soil fertility due to leaching of the nutrients.

4.0 Conclusion

This unit looks at the various importance of irrigation system to the farm and the farmer. On the overriding, it helps to ensure that crops growth throughout the year is guaranteed, improves the yield of the farm, increases the income capacity of the farmer and adds value to the crops quality and quantity, amongst others. The effects of irrigation system were also looked at. There are both positive and negative effects of irrigating a farm and these were well spelt out. The advantages and disadvantages were also considered.

5.0 Summary

The study examined the importance of irrigating a farm, the effects that may emanate from the irrigation system as well as the advantages and disadvantages associated with irrigation facilities in farm.

6.0 Tutor-Marked Assignment

i. Explain eight (8) importance of irrigating a farm

ii. Explain the relationship between irrigating a farm and the process of photosynthesis

iii. Explain four (4) positive and negative effects of irrigating our farms.

iv. State four (4) measures that could be put in place to minimize the negative effects of irrigation systems in our farms.

v. State four (4) advantages and disadvantages of the farmer's use of irrigation system in our farms.

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Unit 5: Environmental and Health Implications of Irrigation Farming

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1.0 Introduction

This unit studies the environmental implications of irrigation farming. Irrigation farming, due to its nature which involves the drawing of water from its source to the farm has a lot of implications or impacts. These impacts are either of direct or indirect impacts. An increased evaporation in irrigated areas leading to temperature change of the area and It can as well lead to increase levels of rainfall downwind of the irrigation are some of the direct impacts, while water logging, soil salinization, ecological damage and socio-economic damage are the indirect

impacts. Some adverse effects created are reduced downstream flooding and reduced shipping routes due to reduced water. Irrigation use in the farm as well lead to health implications like providing good and nutrient filled food for the populace. Irrigation system makes it possible for food to be available to man even in off-season, provides quantity and quality of food to man and helps a nation be assured of food security. Its use also results in outbreak of pests, disease and proliferation of vectors that can cause malaria, bilharzia and night blindness in man. The vectors transmit organisms that cause sickness and severe cases leading to death in man. The vectors can be effectively controlled through immunizing of the population against the vector and the use of curative drugs, controlling the population of the vector through use of chemical and educating the populace of how to reduce contact with the vector

2.0 Objectives

At the end of this unit, students should be able to:

i. State what environmental impacts of irrigation focuses on

ii. State the impacts of irrigation from a hydrological point of view

iii. Describe direct effects of irrigating our farms

iv. Explain elaborately, what indirect effects of irrigation of farms are

v. Analyze the different ways how irrigation of farms have adversely affected our environments

vi. Explain the positive and negative ways irrigation has impacted on the human population

vii. Explain different health related sickness that irrigation of farms can cause

viii. Describe measures that can guarantee the control of diseases that can result from the use of irrigation facilities in our farms

3.0 Main Content

3.1 Environmental Implications of Irrigation Farming

The Environmental Impacts of Irrigation –Wikipedia noted that environmental implications of irrigation farming relate to the changes in quantity and quality of soil and water as a result of the practice and use of irrigation. This stems from the fact that irrigation systems deal with redirecting water from rivers, lakes, and underground sources. This also has to do with how use of irrigation impacts on the natural and social conditions in river basins and downstream of an irrigation scheme or project. The report also identified with the fact that, on a global perspective, total irrigated land worldwide occupies about 16% of the total agricultural land. The water are drawn from rivers, ponds, underground water etc return back to the rivers and this ends up polluting the rivers which of cause may enter the seas and so on, and this may cause some adverse effects on environmental ecology.

An irrigation scheme often draws water from the river and distributes it over the irrigated area.

According to the report from a hydrological result, some of the environmental impacts of irrigation are that:

- the downstream river discharge is reduced
- the evaporation in the scheme is increased
- the groundwater recharge in the scheme is increased
- the level of the water table rises
- the drainage flow is increased

In addition, irrigation water used for agricultural purposes may also cause adverse effects / impacts on the surrounding environment and Environmental health of the people.

The impacts are caused as a result of the installation and operation of the irrigation scheme. Interesting to point out that these impacts are of two fold. They are the direct and indirect impacts.

3.2 Direct Environmental Impact of Irrigation

The original sources of irrigation water are rivers, lakes boreholes, etc. and the use of irrigation system means or deals with redirecting water from rivers, lakes, and underground sources. This redirecting of the water has a direct impact on the surrounding environment. A Report of Environmental Impact of Irrigation stressed that the direct impacts of irrigation may revolve around;

i. increased evaporation in irrigated areas leading to temperature change of the area and this situation can cause instability in the atmosphere, as well as increase levels of rainfall downwind of the irrigation.

ii. It can as well lead to increase levels of rainfall downwind of the irrigation.

iii. Increased groundwater level in irrigated areas,

iv. Decreased water flow downstream of sourced rivers and streams.

These changes to the climate are a direct result of changes to natural moisture levels in the surrounding atmosphere

3.3 Indirect Environmental Impact of Irrigation

Irrigation systems also have an indirect impact on the surrounding environment. These indirect effects may not be as immediately noticeable as the direct issues. Additionally, these effects take a longer time to develop and produce longer-lasting changes. Report of Environmental Impact of Irrigation stated that irrigation can result in the following indirect impacts:

Waterlogging:

Waterlogging occurs when the soil becomes oversaturated with water, promoting anaerobic conditions (absence of oxygen). Such situation results in a condition called *anaerobiosis*, and this causes plant roots to become unhealthy due to a number of chemical reactions, including a reduction in soil iron and manganese oxides. Obviously, the plants under such environment cannot be able to do well.

Soil Salinization:

Soil salinization happens when the salt content in soil increases above normal, naturally occurring levels. Irrigation draws a significant amount of water from an area, moving it to agricultural or landscaped lands. The area that has lost a significant amount of water is often left with concentrated salt levels in the decreased water levels left behind. High salt levels make it difficult for plants to absorb the necessary amount of water and nutrients from the soil.

Ecological Damage:

Ecological damage can take the form of reduction of water in rivers, deforestation, temperature change, erosion etc. With the practice of irrigation, ecological change amongst other indirect impacts takes longer to occur. One of the most significant causes of ecological damage is in reduced downstream river flow. When river flow is dramatically reduced, it can lead to disappearing wetlands and flood forest ecosystems. Additionally, it results in insufficient drinking, industrial, and municipal water supplies. Because less water finds its way into the ocean, coastal erosion may occur, which damages coastal ecosystems such as mangroves and their habitats. In addition, saltwater makes its way from the ocean into estuaries in increased amounts, which significantly changes the ecosystem and habitat of these water ways as well.

Socioeconomic Damage

Reduced water flow can also have other less obvious effects on socioeconomic health. Specifically, irrigation may lead to decreased fishing and shipping opportunities. Water that has been extracted for agricultural purposes leads to reduction in available water in water bodies. The reduction has threatened the local fish populations which causes an imbalance in the natural food chain. Over extraction of water from water bodies also affects local human populations, who rely on fishing as a source of dietary protein and economic activity. Where such is the case, the income of such households is greatly affected. Shipping opportunities are also affected as large ships and other water transportation vehicles are left with no alternative.

3.4 Adverse Impacts

The use of irrigation system leads to reduced downstream river flow and this may cause any of the following negative impacts:

i. Reduced downstream flooding
ii. Disappearance of ecologically and economically important wetlands or flood forests
iii. Reduced availability of industrial, municipal, household, and drinking water
iv. Reduced shipping routes due to reduced water.
v. Reduced fishing opportunities for those communities who depend on fishing activities for their economic livelihood.
vi. Reduction in the protein intake of fish populations due to reduction of fishes in water bodies emanating from reduced water.
vii. Reduced discharge into the sea, which may have various consequences like coastal erosion and salt water intrusion in Delta's and estuaries

3.5 Health Implications of Irrigation

Irrigation has impacted on the health of man in different ways. A report on Impact of Irrigation on Nutrition, Health and Gender noted the following as issues that can emanate from use of irrigation facility in our environment or farm.

First, the use of irrigation creates salinization which has to do with the presence of concentrated salt in the soil. This condition of the soil deprives plants from doing well and this leads to malnutrition among people of the affected areas.

Secondly, the reduction of water in water bodies results in reduction of fish population, thus creating inadequate quantity of fishes for the people. This condition can lead to a disease condition called quashiokor.

On the other hand, irrigation when properly used leads to;

Availability of or improved access to fresh vegetables and animal sources of food. The consumption of such foods can improve the peoples nutrition and health, particularly that of children. Consumption of iron-rich foods, such as dark green leafy vegetables, can reduce incidences of anemia. Iron deficiency is a risk factor for maternal mortality and is responsible for many deaths. Vitamin A–rich foods (such as orange-fleshed sweet potatoes, pumpkins, and so on) can reduce night blindness and susceptibility to illness. Deficiencies of vitamin A and zinc cause have caused many deaths, respectively. Furthermore, access to greater quantities of nutritious food can reduce incidences of underweight and wasting.

In addition, irrigation interventions may also lead to greater water availability within the household. Access to greater volumes of water can result in better hygiene and sanitation practices and better health overall.

3.6 Effects of Irrigation System on Farm Productivity

Both large and small-scale **irrigation** offers the potential to expand production in the farm. Such expansion can translate into the following:

i. Availability of food during the lean or off-season. The foods cut across plant and animal sources and they provide man with different nutrients that are needed for growth and development.

ii. Availability of food in good quantity ensures improved benefits in income

iii. Increase in food also guarantees a nations food security.

iv. During the rainy season, irrigation can pose a risk on production by causing reduction in production due to availability of too much water coming from rainfall and irrigation water.

3.7 Effect of irrigation System on Water Cycle

The use of irrigation involves drawing water from different water sources and using it to supply the farm. In doing such, man alters the water cycle through water use demand. Irrigation water quantity is so much that it affects the source from which it is drawn.

This cause changes in water supply by affecting evaporation and runoff. "Pumping surface water for irrigation depletes surface water but enhances groundwater. Pumping groundwater for irrigation has the opposite effect.

In a nutshell, irrigation on water cycle has to do with pumping or supplying irrigation water to the farm / field, the supplied water may face evaporation to the sky which will condense in the atmosphere and drop as rain which flows into water bodies and again extracted and resupplied again as irrigation water.

3.8 Water-Borne and Water-Related Diseases

Water-borne or water-related diseases are commonly associated with the introduction of irrigation (Report of Impact of Irrigation on Nutrition, Health and Gender). **The diseases most directly linked with irrigation** are those vectors (disease carrying organisms) that proliferate in the irrigation waters and they include *malaria, bilharzia (schistosomiasis)* and *river blindness (onchocerciasis).*

Other irrigation-related health risks include those associated with increased use of:

- Agrochemicals,
- Deterioration of water quality, and
- Increased population pressure in the area.
- The reuse of wastewater for irrigation has the potential, depending on the extent of treatment, of transmitting communicable diseases.

The population groups at risk include:

- Agricultural workers,
- Consumers of crops and meat from the wastewater-irrigated fields, and
- People living nearby.

Sprinkler irrigation poses an additional risk through the potential dispersal of pathogens through the air.

The diseases mentioned above can be caused or may likely occur or be introduced or have an increased impact in irrigation schemes where:

- ✓ Soil drainage is poor, drainage canals are either absent, drainage canals are badly designed and possibly poorly maintained.
- ✓ Rice or sugar cane crop is cultivated.

- ✓ Night storage reservoirs are constructed
- ✓ Borrow pits are left with stagnant water
- ✓ Canals are unlined and have unchecked vegetation growth

3.9 Effects of Irrigation System on Public Health

Irrigation of farms has actually resulted to some health issues. Impact of Irrigation on Nutrition, Health and Gender pointed out some of the likely diseases. They are:

Malaria: Malaria is by far the most important disease, both in terms of the number of people annually infected, and whose quality of life and working capacity are reduced, and in terms of deaths. Worldwide, some 2000 million people live in areas where they are at risk of contracting malaria. Among Continents, Africa is the worst hit. Unfortunately, Drug treatment has become difficult due to the build-up of resistance to insecticides by the vectors.

Bilharzia (schistosomiasis): Bilharzia is an infection caused by parasitic worms or blood flukes of certain species of the genus *Schistosoma*. Adult parasites live in the blood of mammals, but their life cycle requires a phase of asexual multiplication within a fresh-water snail host. The flukes infect humans who enter their exposed skin in water, usually through swimming, bathing or wading. There exists either urinary or intestinal *schistosomiasis*.

This disease infection is particularly common in children who play in water inhabited by the snail intermediate host. Severe infection in childhood leads to long-term damage to bladder, kidneys and liver, which may cause death many years after the original infection. Infection at any age may make people feel unwell and reduce working capacity. The disease is almost as wide spread as malaria, but rarely causes immediate death. An estimated 200 million people are infected and the transmission occurs in some 74 countries. The type and extent of health

complications associated with *schistosomiasis* appear to vary with species and strain of parasite and by the characteristics of the human population.

***River blindness (onchocerciasis)*:** This is another type of disease that occurs in areas where there is practice of irrigation. Irrigation causes wetness of the area that makes the vegetation of the area to flourish and provides hiding for the vector called *tsetse fly.* The disease causes sleeping sickness for the victim. This results to dullness / weakness of the victim and reduction in the victims capacity to do work. Severe cases can lead to death.

3.10 The Control of the Water-Related Diseases

Impact of Irrigation on Nutrition, Health and Gender pointed out some of the measures that could help in the control of the water-related diseases. These can be effected in a number of ways, some of which are:

- *Measures aimed at the pathogens*: This involves the immunization of the population and the administration of prophylactic or curative drugs;
- *Measures aimed at reducing vector densities or vector lifespan*: Sure measures would involve the application of chemical, biological and environmental controls that wouuld be able to check the growing rate of the vectors.
- *Measures to reduce human/vector or human/pathogen contact*: This is an education programme that needs to be taught to the people on how they could reduce or eliminate contacts with the vector. This can be achieved through health education, personal protection measures and mosquito proofing of houses.
- *Maintaining flood flows*: Maintaining flood flows downstream of the dams to ensure that an adequate area is flooded each year, among other reasons, for fishery activities that

would guarantee the availability of fishes and its associated products for human consumption and assurance of protein intake.

4.0 Conclusion

This unit studied the environmental implications of irrigation farming. Irrigation farming involves the conveying of water from its source to the farm. Irrigation of farms has some positive effects like making food available in good quality and quantity to the people, makes farming possible throughout the year, thus increasing the wealth or farm income of the farmer and it as well guarantee the nation of its food security. Contrarily, some of the negative effects are reduction of the flood plains, increases in soil erosion, water logging, and salinization. The use of irrigation facility results in outbreak of pests and diseases and the proliferation of vectors that can cause malaria, bilharzia and night blindness. Severe cases of this ill conditions can lead to death in man. The vectors can be effectively controlled through immunizing of the population against the vector, controlling the population of the vector and controlling human contact with the vector.

5.0 Summary

This unit studied the environmental implications of irrigation farming and its direct and indirect impact on the environment and man. The effect of irrigation on farm productivity, water cycle and health implications on man was also studied. Water-Borne and water-related diseases were considered, from which sicknesses like malaria, bilharzia and night blindness were discovered as some of the sicknesses that can develop from irrigation use. The control of the disease causing organisms were as well advanced.

6.0 Tutor-Marked Assignment

i. State what environmental impacts of irrigation focuses on

ii. State four (4) impacts of irrigation from a hydrological point of view

iii. Describe four (4) direct effects of irrigating our farms

iv. Explain elaborately, four (4) indirect effects of irrigation of farms

v. Analyze in four (4) different ways how irrigation of farms have adversely affected our environments

vi. Explain four (4) positive and four (4) negative ways irrigation has impacted on the human population

vii. Explain three (3) different health related sickness that irrigation of farms can cause

viii. Describe four (4) measures that can guarantee the control of diseases that can result from the use of irrigation facilities in our farms

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MODULE 5: RANCHING

Unit 1: Concept and Definition of Ranching

Unit 2: Herding and Livestock Production

Unit 3: Definition and Concept of Animal Husbandry

Unit 4: Institutional Requirements of Site Related Systems

Unit 5: Environmental Requirements of Site Related Systems

Unit 1: Concept and Definition of Ranching

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7.0 References

1.0 Introduction

Ranch is a farm that is usually large and used for the breeding and raising of cattle, sheep, or horses on rangeland. Ranching is the activity that involves the operation of running a large farm, especially one used for raising animals like cattle, horses, or sheep

Ranching systems specializes in one or more livestock species and producing mainly live animals for slaughter, wool and milk. The farm is different from a ranch in terms of The purpose, worker's nomenclature, Nature of job and their focus. Benefits of ranching are in the forms of maintaining the health of grasslands and improves soil quality with manure. The success of ranching is plagued by the huge amount needed to start it and harsh weather condition. On a global trend, the business of ranching seen threatened due to reduction in grazing land resulting to overgrazing on the available land unfavourable weather conditions and lack of appreciation and the imposition of unfavourable regulations by government authorities

2.0 Objectives

At the end of the study of this unit, the students should be able to:

i. Define Ranching

ii. Differentiate a farm from a ranch

iii. Exhaustively state the benefits of ranching

iv. State the reasons why ranching is not encouraged in our contemporary society.

v. Narrate the issues plaguing the success of ranching in Nigeria.

vi. Explain the factors threatening the survival of ranching in our world of today

3.0 Main Content

3.1 Concept and Definition of Ranching

Ranch is a farm that is usually large and used for or devoted to the breeding and raising of cattle, sheep, or horses on rangeland (Ranch from Wikipedia, the free Encyclopedia). Ranching is the activity that involves the operation of running a large farm, especially one used for raising animals like cattle, horses, or sheep

Ranching, as a farming method or system is the raising of livestock (particularly cattle) farming, husbandry, or the activity of gathering livestock together so that they can be counted or branded or sold.

Ranch from Wikipedia, the free Encyclopedia stated that Ranching systems consist of labour-extensive enterprises specializing in one or more livestock species and producing mainly live animals for slaughter (for meat, skins and hides), but also for wool and milk. The animals are kept in captivity in an large but enclosed land, where they are fed or grazed, provided water and medicated. Animals kept in a ranch grow faster than those ones left to roam about or raised in the wild. Reason for this is that most of their energy is conserved and used for growth.

3.2 Difference between Farm and a Ranch

The food items you find in a grocery store, vegetables and the meat included, are a result of the hard work of farmers and ranchers. These individuals tirelessly work at a farm or a ranch to provide you with high-quality food items. Farm and ranch are the two most important terms to understand in the agricultural sector.

We must establish that a farm, as well as a ranch, are both a large lot of land but they differ in that, while some people use these terms farm and ranch interchangeably, others ponder upon the question, “what is the difference between a farm and a ranch?” in answering this question certain

attributes or factors must be taken into consideration as pointed out by the report on Difference Between Farm and Ranch - The Ultimate Guide. The factors are:

i. *The purpose*: A farm is a land where a farmer grows crops and livestock for dairy (milk) products. A ranch, on the other hand, is a land where livestock such as sheep, cattle, goats, and pigs are raised.

ii. *The worker's nomenclature*: Farmers are known to work in the farms while Ranchers work in the ranch

iii. *Nature of jobs;* In the farmer vs. rancher comparison based on their nature of work, the first thing to consider is the type of tasks and jobs each of them is associated with. Farmers divert all their attention to growing crops, while ranchers worry about winter feed and the market prices.

iv. *Based on Expertise:* A farmer has expertise in counting bushels and bales while a rancher possesses expertise in counting heads and tails.

v. *Their focus:* The focus of people working on a farm is to keep the soil fertile for growing healthy crops. While the focus of a rancher is to maintain the grazing grass as it is essential for the livestock animals.

3.3 Benefits / Importance / Advantages of Ranching

With the global population expected to exceed 9 billion by 2050 and income levels rising, demand for beef is increasing and will continue to grow. Yet beef production requires a lot of land, water and energy, and generates considerable waste. It is thus essential to improve its sustainability globally.

There are many ways of beef production and when sustainably managed, it can achieve conservation benefits. These benefits according to a report on 'Ranching, National Geographic Society' can manifest in the forms;

i. Grazing maintains the health of grasslands,

ii. Improves soil quality with manure, and

iii. Preserves open space and wildlife habitat.

iv. Additionally, carbon is sequestered in the grasses and soils of grazing lands.

v. Beef production also provides social benefits by sustaining livelihoods and community vibrancy in rural areas where grasslands dominate. This may involve the use of people to do grazing and get paid for it.

vi. Ranching provides health animals that provide man with meat and dairy products and through this, consumers are assured the choices for a safe, affordable and sustainable diet.

vii. Rangeland provides habitat for insects that are valuable for pollination.

viii. Cattle reduce the dry grass that could fuel wildfire.

ix. Grazing improves the habitat for the Bay checkerspot butterfly, a threatened California insect.

x. Animals raised in the ranch also supply materials, such as leather and wool, for clothing, furniture, and other industries.

xi. Some ranches offer tourist facilities to the people of the area. Some of these sites are working ranches that allow guests to help out in real ranching activities. Others focus on horseback riding, offering lessons and trail rides. Still others allow visitors to hunt native or imported animals.

xii. Ranching is a way of life and contribute strongly to the Gross Domestic Product of the economy of some countries.

In Africa, most ranches are wildlife ranches. Wildlife ranches, also known as game ranches, maintain healthy populations of species such as rhinoceros, elephant, leopard, and antelope. People pay a fee to hunt these animals on the ranch. Wildlife ranches also appeal to

ecotourists. Ecotourism promotes traveling in a way that has minimum environmental impact and benefits local people.

xiii. The diversity of plants and animals is greater on grazed, managed grassland than on unmanaged grassland.

3.4 Disadvantages of Ranching

To everything or process that have advantages, there are bound to be disadvantages. Some of the disadvantages according to a report on 'Disadvantages of Ranching Farming' include;

i. The main disadvantage is the amount of money it takes to even start. Land, **cattle**, tractors/equipment, feed, and fencing are very expensive especially if you're trying to do it all at once.

ii. Another disadvantage is the weather of the region. There are cases where a good weather all of a sudden turn unfavourable. At such times, the farmer may loss some of his animals thereby resulting to losses

iii. Nature is also a disadvantage to ranching. Nature is something man cannot control and so the nature of some areas like falling of a kind of disaster like flood, drought, etc would adversely affect the animals when they occur and thus cause him to losses

iv. Ranchers clear large swaths of forest in order to create pastureland for their cattle. This clear cutting reduces habitat for native species such as monkeys, tropical birds, and millions of species of insects not found anywhere else in the world.

v. Most of Amazon rain forest has been cut down, much of it for cattle ranching and this creates the scenario of deforesting our forest leading to loss of medicinal and valuable species of plants.

vi. Overgrazing is a threat throughout areas of ranching and of the land do adversely affect the environment. The practice destroys the structure and texture of the soil. The loss of

valuable topsoil also takes place resulting to reduction in the agricultural productivity for crops and grazing lands.

vii. Compaction of the soil from animal hooves further degrades the land. Some of the animals like cattle have heavy, flat hooves that flatten the soil and reduce its ability to absorb water and nutrients.

viii. Livestock ranching also contributes to air and water pollution. Runoff from ranches can include manure, antibiotics and hormones given to the animals, as well as fertilizers and pesticides. Chemicals from tanneries that treat animal hides can also seep into water.

ix. Ranching is also a major contributor to global warming. In fact, livestock are responsible for more greenhouse gas emissions than transportation. Carbon is released when forests are cleared for pastureland. Manure produces nitrous oxide, which has 296 times the warming potential of carbon dioxide.

3.5 Types of Ranching System

Ranching is of different types and these types produce different products. So before a rancher establishes his/her ranch, he/she must first establish or determine what his/her desired or expected products are likely to be. To this end in view, Ranch from Wikipedia the free encyclopedia stated that ranching may take any of the following forms:

i. **Cattle ranching:** In cattle ranch, there might exist other types of animal in the ranch but the most dominating animal in the ranch is cattle. This is the most common type of ranching that exists and it is established for the purpose of meat production to assist in meeting the protein intake of the people

ii. **Dairy ranching**: In dairy ranching, there are animals of different types but predominantly dominated by cattle and the main purpose of keeping the animals is for production of milk and milk products.

iii. **Sheep and/or goat ranching:** This is a ranch meant for the keeping of animals like sheep (e.g. the Karakul breed of sheep) and goat. Though the animals could be rarely eaten as meat because its main purpose is for production of industrial materials like wool and skins used for production of clothing materials, and/or other products.

3.6 Issues of Ranching

Previously, many farmers allow or set their cattle and sheep loose to roam the prairie (a large area of grassland with few, or no trees). Most of the lands where the animals graze are owned by the government. This was the so-called *open range*. Ranchers only owned little expanse of land that could allow for homestead (subsistence) production and sources of water. For this reason of lack of space, the ranchers are always quick to gather steers (male cattle) for sale. Sooner or later, the open range system soon came to an end. Rutherford (2016) explained several factors were responsible for this, namely;

i. Reduction in grazing area: The invention of barbed wire in 1874 gave rise to farmers fencing off their fields (cropping land) to protect them from being destroyed by livestock. This limited access to grazing land and the scenario over shortage of land and water rights resulted to conflicts between farmers and ranchers, thus resulting to reduction of animals being raised.

ii. Overgrazing was also a problem. As more and more ranchers grazed their animals on the open range, there was now the problem of overstocking which resulted to degradation of the quality of the land. Grasses did not have time to grow on the open range, especially in winter and this consequently affected animal production

iii. Unfavorable weather condition: Animals are raised in the open and so exposed to the vagaries of weather. Unfavourable weather condition (especially a very harsh weather) can cause some of the animals that are not too strong to give away. For example, the winter of 1886-1887, one of the harshest ever recorded, killed hundreds of thousands of cattle that were already weakened from reduced grazing. Many large ranches and cattle organizations went bankrupt..

iv. Difficulty in doing the job: Most ranches are usually very large in area and for this reason the rancher finds it difficult in going round the ranch and knowing what is happening in the ranch. In ameliorating this issue, some of the ranchers use horses as working animals to be going round the ranch. The size of ranch now poses a problem to the number of animals the rancher would want to keep. Horses are also strong and responsive, making them excellent herding animals.

v. The use of ranching animals for sports:
The sport of rodeo (sports involving skills with horses, cows and other livestock) developed from the skills required of cowboys and ranch horses created an issue in discouraging the ranchers from raising animals in the ranch.

vi. Attack on the animals: During ranching, there are times where the animals come under attack and during such attack, some of the animals may be killed thereby having their number reduced thereby resulting to shortage. In overcoming this ugly situation, several types of dogs have been bred for their herding abilities. Many of these highly intelligent, agile animals are simply called shepherds; Australian shepherds and German shepherds are probably the most familiar. These dogs help to protect the rancher and his animals.

3.7 Threats to Ranching

There are threats to the long term viability of cattle ranches in the different countries where they are found or established and these threats put all these benefits (of ranching) at risk. Huntsinger (2017) Some of the notable threats include:

i. Development purpose: Some of the ranches are being sold for the purpose of advancing development of the area. The sale of the ranch for development is very attractive for a rancher who isn't making a sufficient profit on the land.

ii. Dividing of ranch into parts: There are cases where the original of a ranch after passing on, may now transfer the ranch to the children (via inheritance). These children on their own may not all be interested and soon begin to share or split the land into parts. Also, the division of a ranch for inheritance purposes can make it difficult to keep a ranch intact and in the business of raising cattle.

iii. Lack of appreciation: The public misunderstanding of and a lack of appreciation for ranching is another factor that is threatening the system. A person or even the government that does not appreciate the need for ranching would not want to promote or encourage its establishment. Such scenario would soon make ranching go extinct.

iv. Imposing unfavourable regulations: Regulations governing the system of ranching are made by the government. Sometimes when the regulations made by the government are not favourable, aren't needed and not valuing, creates a demoralizing and frustrating effects amongst the ranchers and this leads to discouraging them from continuing the ranching business.

v. Much of the land grazed by ranchers is public's own and grazing is supported by public and environmental agencies. The same government sometimes makes laws that would or may not

permit further grazing on the land, thereby frustrating the efforts of the ranchers who may later reduce the herds

3.8 Terminologies Associated with Ranching

There are different terms/terminologies that are peculiar to ranching as a system. Some of them are:

A ranch is an area of land, including various structures, given primarily to the practice of ranching, the practice of raising grazing livestock such as cattle and sheep most often applies to livestock-raising operations

Ranching is also a method used to raise less common livestock such as horses, elk, American bison or even ostrich, emu, and alpaca.

Ranches generally consist of large areas, but may be of nearly any size.

Ranchers, **cattlemen**, or **stock growers** are people who own or operate a ranch are called

Rangeland is an open land used for rearing animals but must importantly, the animals are not under any restriction.

Herding is the practice of caring for roaming groups of livestock over a large area.

Cowboys are men who join ranchers and care for animals toward favorable grazing areas.

Livestock provide meat for human and animal consumption.

Grazing land is a land used to grow grass and shrubs used for the purpose of feeding animals.

4.0 Conclusion

Ranch is a farm that is usually large and used for the breeding and raising of cattle, sheep, or horses on rangeland. Ranching systems specializes in producing different types of animals but most common is cattle which is used as meat to meet protein need of man, wool and skin. The

word ‘farm’ is different from a ‘ranch’ in terms of the purpose, worker’s nomenclature, nature of job and their focus. The benefits of ranching outweigh the demerits, as it helps in the maintenance of health grasslands for animal grazing and as well improves soil quality with manure. The operation of ranch is limited by some factors like; the huge sum needed to establish the ranch and seasonal harsh weather condition

5.0 Summary

Ranch is a farm that is usually large and used for the breeding and raising of cattle, sheep, or horses on rangeland. These animals produce meat, dairy, wool and skin for man’s use. The purpose, worker’s nomenclature and their focus are some of the factors used to differentiate a farm from ranch. Several importance of ranching were advanced and the study also found that the importance outweigh the demerits of ranching.

6.0 Tutor-Marked Assignment

i. Define Ranching

ii. In four (4) instances, differentiate a farm from ranch

iii. Exhaustively state eight (8) benefits of ranching

iv. State four (4) reasons why ranching is not encouraged in our contemporary society.

v. Narrate four (4) issues plaguing the success of ranching in Nigeria.

vi. Explain any four (4) factors threatening the survival of ranching in our world of today

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Unit 2: Herding and Livestock Production

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1.0 Introduction

Herding is the practice of caring for roaming groups of livestock over a large area of land and the animals are cared for against predators and natural dangers by Cowboys. The animals raised in ranch are mainly cattle's and they are raised in different ways. Beef production produced benefits like social benefits, meat, income, ability to convert energy, provision of nation's wealth and the control of fire disaster. On the contrary, beef provision is expensive, with a prolonged period of gestation with a high level of risk involved in the production. Generally, beef

production has led to conversion of habitat, polluted water bodies, degradation of the soil and climate change. However, cattle production would have increased if not for issues like expansion challenges cyclical lower prices, input volatility, continued economic volatility, animal health and poor weather conditions

2.0 Objectives

i. Define herding,

ii. State the factors the herders must guide against during herding.

iii. Identify the major functions of the ranchers in the ranch.

iii. What is beef production?

iv. State the advantages and disadvantages of beef production.

v. Explain the impacts of beef production

vi. Explain the issues confronting beef production.

3.0 Main Content

3.1 Herding

A Report on Non-traditional Production Systems defined herding as the practice of caring for roaming groups of livestock over a large area of land. The report acknowledged that Cowboys are responsible for herding and maintaining the health of animals across different ranches. The Cowboys often ride on horses to do work in the ranch in the course of caring for the herd made of either or both of cattle and sheep. Cowboys are known as *vaqueros*. In Australia and New Zealand, they are called *jackaroos*.

Ranchers and cowboys take care of the cattle's and the other animals toward favorable grazing areas. Herding also involves keeping the herd safe from predators and natural dangers of the landscape.

3.2 Beef Production

Beef production has to do with the raising of cattle in ranches and this is for the purpose of producing meat for food. There are many ways beef production can be carried out. This can be done either through open range or ranching. When ranching is sustainably managed, it can go a long way in achieving conservation benefits. Cattle feed by grazing on the grassland. Grazing maintains the health of grasslands, improves soil quality with manure, and preserves open space and wildlife habitat.

3.3 Advantages of Beef Production

The Advantages and Disadvantages of Small Beef Production Industry Report stated that the production of beef is of numerous importance to man and the economy. These advantages cannot be overemphasized as they include:

i. Provision of social benefits: Beef production provides social benefits by sustaining livelihoods and community vibrancy in rural areas where grasslands dominate.

ii. Provision of sustainable diet: By working with producers as well as companies and their supply chains to improve the sustainability of beef production, efforts are made to ensure that consumers have choices for a safe, affordable and sustainable diet.

iii. Ability to convert energy: This is one of the most important advantages of beef production. Cattles are ruminants and so have the ability to eat plants and grasses (herbivorous) and convert them into beef for man to eat as meat.

iv. Provision of by-products: Cattles produces by-products that are industrially processed and used for the production of products like cosmetics, film, buttons, leather, violin strings, medicine for insulin and cholesterol, etc.

v. Control of fire disaster: Cattle production helps the environment by reducing the risk of range fires. Through the grazing of the land, the length or height of grasses and plants are kept low that would not support fire outbreak and spread.

vi. Maintaining the Ecosystem: Through the constant grazing of the grasses and plants, old plants and grass are grazed down and thereby helping to keep the rangeland healthy.

vii. Safe ground for bees: Rangelands have provided the safest ground or place for bees and they have continued to do well there.

viii. Meat production: Cattle is known to be the largest producer of meat needed by man in the community.

ix. Income provision: Cattle is a very large size of animal and when successfully reared to maturity can be sold for good sum.

x. Number of herd: Cattle can be reared in small number and this would not have any adverse effect on the animals been reared.

xi. Provision of nation's wealth: The production of beef helps to provide a good level of Gross Domestic Product to a nation. This can be in the form of tax or otherwise.

3.4 Disadvantages of Beef Production

Despite the advantages mentioned of beef production, the Report of The Advantages and Disadvantages of Small Beef Production Industry also pointed some of the disadvantages to include:

i. Level of risks: The production of cattle involves as many risks as possible. The risks starts from the calving stage to the stage of maturity.

ii. Unstable efficiency: The efficiency of a beef animal in terms of production and otherwise is not as stable as that of other livestock.

iii. Gestation period: The gestation period for cattle is about 283 days, that is between 9 – 10 months. This period is described as very long before the owner can begin to benefit.

iv. It is expensive to start: The production of cattle is expensive. Apart from the fact that they feed on plants, the medication and other necessary attention demanded by the animal is expensive and this makes it difficult for the poor to venture into the business.

3.5 Impact of Beef Production

The production of beef (cattle) has produced several distinct and significant impacts on the environment. The Report of Ranching, National Geographic Society stated that most of these impacts have great hazardous effects on the environment. Some of these impacts are:

i. Habitat Conversion: As the production of beef seemed to be in the increase, the land area meant for this purpose also seemed to be in the increase. More and more agricultural lands are used to raise the cattle than any other domesticated animal. In addition, the land to plant the grasses and crops for the animals is also on the increase. This has led to the deforestation and overgrazing of the land. In so doing, there is a gradual conversion of the habitat meant for all into mainly growing cattle.

ii. Water pollution: The pollution of water sources have been on and this have been sometimes caused by disposal of cattle production waste that were not properly treated. Sometimes the sediments that come from poor grazing management go a long way in contaminating surface water and ground water. Meanwhile, the growing of cattle requires so much of water, part of

which is used to take care of the animals; the other left is used to grow the grasses and crops used to feed the animals.

iii. Industrial pollution: Globally, the production of cattle and its by-products have been on the increase. As a result, more and more cattle's are being slaughtered and more by-products are being produced and this has led to the production of leather from leather industries. When the waste from the slaughterhouse and tanneries which are rich in organic matter, heavy metals and caustic solutions are not appropriately or properly treated, will lead to industrial pollution.

iv. Soil degradation: Cattle as a matter of fact are heavy animals with hooves that go a long way in supporting soil degradation. Degradation of the soil can result from the turning of forest into pasture, overgrazing of the land and over farming the land with grasses and crops for the animal which will gradually lead to the removal of the top soil.

v. Climate change: The production of cattle leads to a considerable effect on climate change as research has showed that about 7% - 18% of greenhouse gases (methane, nitrous oxide and carbon dioxide) are produced by ruminant animals.

vi. High level of consumption: Going by the size of cattle, they are expected to eat much. To this end in view, cattle has been said to consume so much of the grains produced globally, thereby depriving man of the quantity that is due him.

3.6 Issues Facing Beef Producers

The beef producers have been faced with so many challenges in the course of producing the cattle's under their watch. The challenges according to Rutherford (2016) militate against the successes of beef production. Some of the challenges according to the author are:

i. Expansion Challenges: At times, the farmer may want to expand his herd (in number) and this may not be possible due to the lack of space. A lot of space is needed for the production of cattle and this is out of reach of the farmer. Having this problem at hand will constraint the farmer from expanding his farm.

ii. Cyclically Lower Prices: Cyclical lower prices have to do with having the prices of the cattle going up at a period of time and falling at another time. Such scenario does not make the farmers have steady price of how to trade the business. At point where price is low, the farmers are not happy and then they are not encouraged in the business.

iii. Input Volatility: Inputs are the resources that are used in the production of cattle. These inputs are most times scarce and out of reach, they are of various prices that are also not stable. This ill condition makes it difficult for the farmer to plan for his farm, thus constituting a challenge to him.

iv. Continued Economic Volatility: The economies of nations are not stable and this affects the prices of goods and services in the nation. This will affect cattle producers in a number of ways, but particularly as the beef business continues to aggressively work to expand export markets. Such volatility will not permit the people to plan and get things done in an ideal manner.

v. Animal Health: Animal health is an important factor as far as cattle rearing is concerned. Morbidity and mortality, particularly with stockers and cattle feeders, remains an ongoing concern. There is a need for special care in terms of medication and proper feeding of the animals. There is still an advocacy by the industry to push for bigger, fast growing cattle

vi. Consumer Retailer Perceptions: This has to do with the way or reasoning of the retailers. The retailers want to see the price of cattle as that different from what the producers would want to see for. The retail prices are conditioned or perceived by consumers to drop as against the price

of production, thus keeping the producers in a tight corner of producing and making no profit, if losses don't end up being the case at the end of the day.

vii. Political Uncertainty: Countries are usually faced with political uncertainty in their policies. On-coming government may be coming in with a policy that may make a ban or deprivation of one input or the other as it concerns cattle production. Where such policy does not favour the farmer, a problem is created. This accounts for why farmers are steadily at panic as governments change, reason being that the political risk for beef producers will be high.

viii. Veterinary Feed Directive: This has to do with how the animals could be appropriately fed and medicated since this has not been the case, hence seen as a challenge. Also, efforts should be on ground to ensure that the improved feeds and medication continue to be in place.

ix. Poor weather conditions: Adverse weather condition is one of the factors posing issues to the development of cattle production in most communities. This constraint is beyond the control of man and as a result when adverse weather condition prevails, the farmer ends up losing some of their herds. For this reason, beef producers will be well advised to plan and prepare now for that eventuality

4.0 Conclusion

Herding is the practice of caring for roaming groups of livestock over a large area of land which could be a ranch or a range where they are taken care of by ranchers or cowboys. Beef is the main product of cattle and the production gives rise to beef production, social benefits, income to farmers, ability to convert energy which couldn't have been possible by man, provision of nation's wealth and the control of fire disaster. Cattle production brings about negative effects like conversion of habitat, pollution of water bodies, industrial pollution, degradation of the soil

and climate change. Inability to expand in space, continued economic volatility and poor weather condition are some of the issues limiting the growth of ranching business.

5.0 Summary

This unit studied herding, ranching and how animals are cared for by the rancher / cowboy. Major animals produced in the ranch are cattle's and they have produced man with many advantages and of course some disadvantages. Ranching has so much impacted on the environment and faced with some issues.

6.0 Tutor-Marked Assignment

i. Define herding, and state two (2) factors the herders must guide against during herding.

ii. Identify two (2) major functions of the ranchers in the ranch.

iii. What is beef production?

iv. State the eight (8) advantages and four (4) disadvantages of beef production.

v. Elaborately explain four (4) impacts of beef production

vi. Explain five (5) issues confronting beef production.

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Unit 3: Definition and Concept of Animal Husbandry

Table of Content

1.0 Introduction

Animal husbandry is a branch of agriculture concerned with the care and management of livestock. The feeding, breeding, housing and health care of livestock are some of the major concerns of animal husbandry. Some of the advantages of animal husbandry are the developing of high yielding breeds of various domestic animals through cross breeding, production of food products like milk, eggs and meat and the provision of income among others. Ranches are either small or big in size and this is based on the land area used for the ranching. Ranch profitability

can be assured through ensuring good ranch size, maintaining a good ratio of cattle per worker, increasing the carrying capacity of the ranch, maintaining a low debt to equity ratio, cutting down of overhead cost and ensuring good marketing strategy to disposing of products. However, management strategies could be improved through maintaining vegetative cover, avoiding overgrazing, selecting cattle with efficient performance and reducing wastewater.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Define animal husbandry

ii. State the advantages of animal husbandry

iii. Define what size of land constitute a small ranch

iv. Define what size of land constitute a big ranch

v. Describe the factors that contribute to ranch profitability

vi. Explain the factors that could be put in place to ensure a good management practices in ranching.

3.0 Main Content

3.1 Definition and Concept of Animal Husbandry

Animal husbandry is a branch of agriculture concerned with the care and management of livestock (Ranch. From Wikipedia, the free encyclopedia). The Report stressed that Animal husbandry deals with the feeding, breeding, housing and health care of livestock for getting maximum benefits. The main types of animals kept under animal husbandry are domestic animals. The practice of animal husbandry takes into consideration animal domestication and improvement of the animals through cross breeding high yielding breeds with a view to get well

developed animals that would also make available to man various animal products like eggs from poultry, milk from dairy products, meat from beef, wool, button and other industrial material from the animals that produce them.

3.2 Advantages of Animal Husbandry

i. Animal husbandry helps us in developing high yielding breeds of various domestic animals through cross breeding.

ii. Animal husbandry increases the availability of various food products such as milk, eggs and meat, which are obtained from domestic animals.

iii. People practice animal husbandry for economical purpose like provision of income.

iv. Animal husbandry helps in proper management of the domestic animals. This could be in terms of providing proper feed, proper shelter and protection against diseases to the domestic animals.

v. Thus, animal husbandry increases the availability of various food products such as milk, eggs and meat, which are obtained from domestic animals.

vi. Animal husbandry helps in raising the living standard of farmers. As a result of higher production of animal products, the income of farmers increases.

vii. Animal husbandry helps in systematic disposal of animal wastes. Thus, it helps in maintaining healthy environment.

viii. Animal husbandry also helps in producing animals that meet the farmers desire. This is achieved through research.

3.3 Considerations of What Makes a Ranch

This has to do with how many acres can be considered as a ranch. A write up of 'How many acres is considered a ranch' noted that in considering an area as a ranch, we must establish that some ranches are small, medium while others are big ranches.

There are significant economies of size in ranching.

A **small ranch might be as small as a hundred acres**, and specialize in training or breeding stock. However, small ranches run by people with off-farm jobs can be very profitable if they keep it simple, and keep overhead low. On the other hand, unless there are sources of income besides cattle, small ranches struggle to be profitable and sustain a good standard of living.

A **middle sized to big one can be ten thousand acres or more, with a few a hundred thousand acres or more**. Sometimes these so called ranches operate on government owned land or privately owned land. These sizes of ranch actually make good income (due to large size) from their production. In case of disease outbreak, the disaster is usually tremendous leading to much loses.

3.4 Smallholder Dairy System

Smallholder dairy systems may be characterized as mixed systems whose principal output is milk for sale. In smallholder dairy system, there is the integration of livestock production along line with the growing of subsistence crops. The subsistence crops include, maize, beans and potatoes, and of cash crops, including coffee, tea and pyrethrum. Besides engaging in crop farming and keeping other livestock, smallholder dairy farmers also typically keep two or three dairy cows with their offspring.

In most small ranches, the herds are composed of 80 percent female cattle and 20 percent male (mainly young males).

Breeding bulls are not important in this system and represent less than 1 percent of the total herd. In where ranching system is concerned, land ownership is private rather than communal and livestock management varies from family to family, with some families keeping grade cattle under improved management regimes involving stall feeding, use of concentrates and disease control

3.5 Keys to Ranch Profitability

Due to the current trend of price hike in goods and services, the prices of fuel and equipment have risen significantly faster over time than the market value of cattle. In a bid to reduce the cost of production of cattle in line with meeting up with some level of profitability in the cattle business (ranching), there is a need for an adjustment of some key production factors. It is hoped that such adjustment will go a long way in ensuring a profit driven business. Teichert (2013) established that some of the key factors the ranchers need to pay attention to in order to balance the trend of ensuring a profitable venture are;

i. **Ranch size:** There are significant economies of size in ranching. For the business of ranching to be profitable, the size of the ranch should be large enough to accommodate as many cattle as possible. This should be like **a hundred thousand acres or more**. Where the ranch is small, then the rancher should have other sources of income besides cattle, small ranches struggle to be profitable and sustain a good standard of living. **However, small ranches run by people with off-farm jobs can be very profitable if they keep it simple, and keep overhead low.** In fact, they can compete very well with medium-sized ranches where the operators only work on the ranch.

ii. **Cows per worker:** This has to do with the number of cows that should be cared for by a worker. Better put, it is the ratio of cow per worker. As much as possible, the ratio should be as

wide as can be managed. Many ranches have more costs that align with the number of workers than with the number of cows. The number of cattle per worker should be between 800 -1,200 cattle to a worker. That keeps labor, housing, equipment and horse cost per cow quite low. Maintaining such ratio will ensure a good level of profitability.

iii. **Acres per cow:** Acres per cow talks about the carrying capacity of the ranch. It's usually much less expensive to increase carrying capacity by developing stock water, adding fence and managing grazing than by purchasing more land. As you add cows, you don't have to add people or other overhead. In so doing, the cows are increased while the manpower remains the same, thereby increasing the profitability of the ranch.

iv. **Fed feed versus grazed feed:** Cattle's are fed with industrial feeds and pasture from grazed fields. It's been observed that feeding the ranch with pasture is cheaper than feeding it with industrial feeds. Though, there are very few situations where grazing (pasture feeding) more and feeding (industrial feeds) less won't be more profitable. Some ranchers have a way of balancing feeding and grazing in the field. What is of concern is that ranchers should strike a balance to know how to care for the ranch in terms of feeding and maintain a good level of profitability. As a suggestion, grazing should be carried out more than feeding.

v. **Keep debt-to-equity ratio low**: The debt – to – equity ratio is a ratio that shows the liquidity ratio of the ranch. The ratio is either low or high. A low ratio means the ranch is doing well financially and this is expected to be the desire of the rancher. A low ratio can be maintained when and only the costs of the ranch are kept as low as possible. Low debt gives you the flexibility to change and adapt to new circumstances and to use new ideas. While the debt may be due to outside causes, too much debt in relationship to size is ultimately

the reason that most businesses fail. They get in too deep before recognizing that changes are needed.

vi. **Cut overhead to the bone.** Most ranches have too much stuff – equipment, buildings and facilities. It just doesn't take very much stuff or many people to run a good-sized ranch. All of these have their cost and they are on the ranch. It then becomes important that the stuff to be kept by the rancher should be that just a little above what is needed, just to reduce cost and increase benefits.

vii. **Improve gross margin:** Gross margin is total dollar / naira returns minus direct costs. Total returns come from how many units you're able to sell and how well you sell them. In addition to selling well, gross margin is driven by the wise use of inputs. Don't use the input if you aren't confident it will pay for itself, plus make a profit. Generally, gross margin can be more improved when there is efficiency of inputs (like feeds, supplements and healthcare products) use and wastage brought to be barest minimum. All of these will effectively lead to increase in profit margin.

3.6 Improving Management Practices

Management is characterized by grazing within the fixed boundaries of the ranch. Ranches are generally commercial enterprises, with generation of a cash income as the primary function of the livestock raised on them. In addition to its management and production objectives, there are a number of best management practices that according to Ranch. From Wikipedia, the free encyclopedia, if adopted broadly, can measurably reduce environmental impacts and possibly improves the ranch's profitability. These practices include:

i. Maintaining vegetative cover: Maintaining vegetative cover will help to reduce soil erosion, soil micro and macro organisms and improve soil texture and structure. All put together, it helps in the production of pastures for the animals.

ii. Avoiding overgrazing: Overgrazing is allowing too many animals to graze within a limited area of land. Overgrazing leads to messing up of the land, flooding and leading to death of the plants and crops used as pasture. For this reason, it should be avoided.

iii. Protecting riparian areas: Riparian areas are areas around the bank of streams or rivers. It is thus advised that such areas should not be used for ranching purposes because they are more susceptible to erosion menace and contamination of water bodies.

iv. Selecting for cattle that are more efficient: It is wise and common knowledge that the prolific performance of the cows differ amongst themselves. Again in health consideration, some are healthier than others. These major factors amongst others should be taken into consideration when the rancher is forming or making up his / her herd.

v. Reducing waste and disposing of waste in the least harmful ways: Wastes are bound to generate from the farming process. It has become necessary that the waste being generated should be brought to be barest minimum through efficiency in resource use. Also any generated waste, should be properly disposed off. This should be, in other to avoid the development or spread of any disease condition in the ranch.

vi. Using chemicals and antibiotics judiciously: This has to do with the wise or recommended use chemicals and antibiotics. The chemicals and antibiotics have their good sides. But suffice to say that these chemicals and antibiotics also have their negative sides when uncontrollably used. Such scenario will lead to adverse effects and so should be prevented.

vii. Reducing wastewater: This scenario points to the fact that water should be judiciously used. Taking into consideration that waste water may run down into water bodies and contaminate it, it becomes necessary that water should be efficiently used to guide against wastage and its possible consequences.

viii. Reducing soil compaction: A compact soil cannot grow crops and pasture well or in the way it was supposed to grow crops and of cause pasture. Soil compaction can be reduced by avoiding overgrazing of the land. Avoiding soil compaction will enable crops and pasture.

ix. **Heterosis,** or hybrid vigor, has so many advantages that it deserves consideration on most ranches. Remember, heterosis is most effective where selection is least effective – traits of low heritability that include reproduction and survivability. Using the advantages of both selection and heterosis, while combining the best aspects of two or more breeds, makes for really good cattle.

x. Be careful in the **selection of bulls and the seedstock provider**: The seedstock provider is your genetics supplier. He should thoroughly understand your objectives and be able to provide the bulls to meet those objectives. Remember, the bulls determine what the herd will be in a few years, unless you are buying replacement cows or heifers.

xi. **A good culling program:** A good culling program combined with an effective, low-cost heifer development program will result in very few cow problems, as well as a short calving season with uniform calves that are very marketable. It will also reduce the need for labor to handle cattle problems.

xii. **Marketing of products:** Marketing is trading off what has been produced for a price. This must be attended to continuously, so always be thinking about how to sell each

animal to its highest and best use. This doesn't imply that you sell animals individually, however. You can group similar animals and ages to sell to best advantage. Selling should be done at the best time possible that would yield maximum profitability.

4.0 Conclusion

Animal husbandry is a branch of agriculture concerned with the care and management of livestock. It actually deals with the feeding, breeding, housing and health care of livestock for getting maximum benefits such as egg, milk, meat, wool, button and other industrial material production. Animals are reared in ranches which could be as small as hundred acres or as large as a few hundred thousand acres or more and the advantages derived from ranching include the developing high yielding breeds of various domestic animals through cross breeding and for economical purpose like provision of income. Profitability in the ranching business can be ensured through engaging in large size of ranch, ensuring a ratio of not less than 800 cattle per worker, increase the carrying capacity of the ranch, ensure a good proportion of the feed and pasture that are used to feed the animals, cut down overhead of the ranch and keeping down the debt to equity ratio. Maintaining vegetative cover, avoiding overgrazing, protecting riparian areas, selecting more efficient cattle, reducing waste and disposing waste in the most harmful manner, reduction of wastewater, reducing soil compaction, ensuring a good culling programme, and good marketing of products are some of the strategies of maintaining and improving management practices.

5.0 Summary

Animal husbandry is a branch of agriculture concerned with the care and management of livestock. It actually deals with the feeding, breeding, housing and health care of livestock for

getting maximum benefits such as egg, milk, meat, wool, button and other industrial material production. The advantages of ranching, measures to ensure and promote profitability in the ranching business as well as strategies of maintaining and improving management practices were detailed

6.0 Tutor-Marked Assignment

i. Define animal husbandry

ii. State five (5) advantages of animal husbandry

iii. Define what size of land constitute a small ranch

iv. Define what size of land constitute a big ranch

v. Describe five (5) factors that contribute to ranch profitability

vi. Explain five (5) factors that could be put in place to ensure a good management practices in ranching.

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Unit 4: Institutional Requirements of Site Related Systems

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1.0 Introduction

Institutional control is a measure put in place to control exposure to contaminants at sites where the remedial action will not meet a residential standard. The control ensures that control checks through legal actions are in place to make sites owners comply with rules and regulations when establishing their sites or projects. At times where the originally stated guidelines fail, there would be remedial action guidelines. These guide lines are institutional controls and they are of two major types namely; Physical and Legal controls. The guidelines are guided by nine

characteristics namely; Defense in depth, Complementarity and consistency, Foresight, Accountability, Transparency / visibility, Feasibility, Stability through time, Iteration, and Follow-through and flexibility. Implementing institutional control is well plagued by some challenges like difficulty in enforcement and lack of mechanisms for modification and termination in times of changes in the future.

2.0 Objectives

At the end of the study of this unit, students should be able to;

i. Define the Institutional Control

ii. Explain the need for a Remedial Action

iii. State reasons why Remedial Action is sometimes necessary in a site

iv. Discuss major types of Institutional Controls

v. Briefly explain characteristics of Institutional design

vi. State challenges faced in the implementation of Institutional Controls

3.0 Main Content

3.1 Definition of Institution

The Maine Bureau of Health report stated that an Institution is an established organization that is dedicated to education, public service or culture. The building that houses such an organization is also known as an institution. There are different institutions, and this depends on what function they are meant for. The report also narrated that in where agricultural projects or any similar or related projects are concerned, there are major rules or guidelines that are bound to be followed, otherwise success cannot be achieved.

Institutional Control, according to Maine Bureau of Health is defined as a measure to control exposure to contaminants at sites where the remedial action will not meet a residential standard. Institutional controls require a legal mechanism to ensure notification and maintenance of the controls, and to provide a trigger for additional review should the conditions at the site change. Examples of institutional control include the erection and maintenance of fence to restrict access, a prohibition of the taking of groundwater, limiting site use of industrial activities etc.

3.2 Remedial Action Guidelines

Before the issue of Remedial Action Guidelines come into play, there is usually first, Guideline. Where these Guidelines fail or do not provide expected results, that is when the Remedial Action Guidelines take place. The Guidelines provide that all sites where project is taking place conform to standards. Going by the put forward of Maine Bureau of Health., the Remedial Action Guidelines ensure that there is proper remediation of hazardous substances that would have otherwise results to expectations that are below standard. The Remedial Action Guidelines, otherwise called a draft, are considered to be used when a site-specific risk assessment has not been conducted.

The guidelines take into consideration concentrations of naturally occurring substance, and that action is taken when contamination level of the substance under consideration exceed background concentrations. On a general note, the guidelines provide that institutional controls be used on a case-by-case basis.

3.3 Importance of Remedial Action Guidelines

The importance of the Remedial Action Guidelines are that;

i. The guidelines allow the use of institutional controls, provided that adequate notice is given to future owners or operators of the site and that oversight and maintenance of the institutional control are enforceable.

ii. The guidelines as well ensure that institutional controls shall be designed in a manner that they remain protective for the life of the selected remedy. That is to say the guideline will stand to protect exactly that which it stands for.

iii. The guidelines is also designed to be protective of human health by direct exposure.

3.4 Types of Institutional Controls

There are basically two types of institutional controls as advanced by Maine Bureau of Health**,** and these are;

i. Physical controls, and

ii. Legal controls.

The physical controls include signage, fencing, or installation of other barriers. These various forms of physical controls have their functions as far as the site is concerned.

The signage could mean the signpost that is designed to show information about the site. These signposts are usually of various sizes, colour, design and position placed. This site, may due to instructions from her professional body of affiliation dictates how the post should be placed or positioned.

The fencing should from its own way restrict people or animals from having access into the site. This is still to protect the site from theft of site's properties and also to protect the workers of the site, among others.

Other barriers may include the installation of a gate to restrict entrance into the site when it is closed.

Legal controls: In where Remedial Action Guideline is concerned, institutional control is known to appear in various forms such as Restrictive Covenants, Easements and Deed Restrictions.

Restrictive Covenants are agreements to do or not to do a particular thing, a binding agreement between two or more parties. Importantly, an agreement is ensured to be in place. Restrictive covenants simply shows or agrees to be in place a law restricting a particular someone or preventing the installation or establishment of a project in a particular place. Such restrictions may include prohibiting well drilling or evacuations on a site, limiting a site's future use to nonresidential purposes, prohibiting a site from been used for a school, etc.

Easements: This is another form Legal control can take. It could have been part of the restrictive covenant or it can stand alone. Easement is a legal right of one person to use another person's property, it shows or have in place of one to cross a part of the property or to gain access to something in the property. All of these are necessary so that the people concerned would know their bounds and this will help to guide against conflict.

Deed Restrictions: Deed restrictions last in perpetuity (perpetual) and run with the land unless the document specifically provides otherwise.

3.5 Characteristics of Institutional Design

Institutional requirements in site management is such that go with the believe that a "one-size-fits-all" formula for institutional management is not advocated in this study. Instead, institutional management should be tailored to the needs and conditions of each site. However, some of the characteristics of institutional management as indicated by LonLong-Term Institutional Management of U.S. Department of Energy Legacy Waste, which makes site management a successful one are stated below. They include:

i. Defense in depth

ii. Complementarity and consistency

iii. Foresight

iv. Accountability

v. Transparency / visibility

vi. Feasibility

vii. Stability through time

viii. Iteration, and

ix. Follow-through and flexibility

i. Defense in depth: In the defense in depth, the issue of layering and redundancy are brought to book. “Layering,” as used in this study, refers to using more than one element to accomplish basically the same purpose; “redundancy” refers to having more than one organization responsible for basically the same task. The concept applies more broadly to the total system of institutional management for the site as well. Similarly, organizations such as the site owner, local citizens groups, and regulatory agencies might all have the right and responsibility to oversee the ongoing management of a site and to ensure to a large extent that safety measures are upheld or performed. Redundancy requires careful coordination and mutual trust to avoid chaos.

ii. Complementarity and consistency: “Complementarity and consistency” as the phrase is used here, implies that the site and its owner should have measures on how to carry out work and these measures should be complementary to one another and display a high level of consistency in approach.. It is only when the measures are complementary that site work can be adequately carried out. It is also particularly important to guard against cases where the day-to-day incentives for agency management personnel and contractors run counter to official agency policy. it is important to have the agency's official reward system (e.g., salary increases,

promotions, contractor bonuses) reinforce that policy rather than being based on other factors that are politically popular or easy to quantify.

iii. Foresight: “Foresight” refers to anticipating how the components of the system will work, individually and together, and making preparations in a timely fashion.. On the other hand, a barrier system of multiple layers, coupled with monitoring equipment that could detect a failure in the first line of defense before the second is threatened, might reflect better foresight and reduce long-term costs in accordance with the old adage that “an ounce of prevention is worth a pound of cure.” Similarly, preparations for legal use restrictions and appropriate systems of enforcement need to be made well before property transfers are conducted. Foresight sometimes may be constrained by uncertainty, but it should be employed to the greatest extent possible.

iv. Accountability: “Accountability” means both “answerable” and “capable of being explained.” As used here, it refers to the ability of both the human and the technical components of the site's management system to be monitored and, if necessary, corrected through renewed remediation activities, enforcement, or other means. If people responsible for various site management and oversight tasks cannot be held answerable to the interested and affected public for their actions or non-actions, or if the site's remedial technologies and its physical environment do not perform as expected, yet that deviation goes unnoticed and unexplained, the efficacy of the site's protective system is likely to erode over time.

v. Transparency / visibility: “Transparency/visibility” as used here refers to having site disposition decisions that are not only rational, but also clearly articulated and readily accessible to public scrutiny. People need to understand both the site disposition decision and its rationale to be able to evaluate effectively whether the site's protective system is working as anticipated.

Without this transparency, the public still may be able to evaluate whether the system is failing, but only after the failure has become evident or more serious.

One of the characteristics of what appear to be relatively reliable organizations seems to be a high degree of openness and visibility such that errors can readily be seen and understood to be problematic by a wide range of people, and those people are reasonably free from suppression of dissent." Under such circumstances there can be a significant increase in the probability that an error will be detected and corrected. This approach runs counter to the tendency to favor organizational secrecy or to solve problems by putting them "out of sight, out of mind." Not only are transparency and visibility needed for an open analytic-deliberative process involving citizens as well as regulators and management personnel but transparency and visibility can improve system safety and lay the groundwork for accountability.

vi. Visibility: "Feasibility" refers to having an institutional management system that is technically, economically, and institutionally possible to implement within a specified time period. If, for example, the disposition decision calls for a remedial technology that has not yet been fully developed or tested, the system will not be feasible unless this limitation is overcome.

vii. Stability Through Time: "Stability" refers to the likelihood, based on reasonable estimates, that the components of the site management system and the system as whole will continue to perform as expected. A continued, stable investment in resources must be assumed to accomplish this stability. Stability may be much more likely with some elements, specifically those requiring a minimum of upkeep, monitoring, oversight, and enforcement. In some cases, measures that increase stability may lead to decreased flexibility, particularly in terms of institutional performance.

viii. Iteration: This has to do with repetition or revisiting site disposition decisions. it is desirable to periodically reconsider both how well the site's protective system is working and whether it can be improved. Iterability is thus motivated by both caution and optimism. While pressure for expanded use of the site and nearby resources (e.g., water) may be the greatest impetus to revisit site disposition decisions, iterability should be routinized. In other words, it should be integrated into the total site disposition decision process. It is hoped that this will help to clear all odds or bottlenecks and come out with better site management.

ix. Follow-Through and Flexibility: Given the impossibility of establishing a “best” solution in advance for the vast majority of sites, it is obvious that there will also be a need for more systematic iteration or reconsideration on a periodic basis. The need for iteration coupled closely with follow-through mechanisms is thus a matter of both caution and of optimism. The challenge is that, even though experience to date has provided some evidence of success, there is little evidence that present-day institutions can be counted on to provide follow-through to act on new information with the degree of long-term reliability and rigor that current contamination problems require. Under the circumstances, perhaps the best that can be done is to plan more carefully about the kinds of approaches and institutions that could be developed to do a better job, as noted earlier, keeping in mind at all times the importance and preferability of minimizing regret.

3.6 Challenges of Implementation of Institutional Controls

Irrespective of the good sides of institutional controls as to how it affects man and sites or projects, it is regrettable that enforcement is almost or completely a problem. LonLong-Term Institutional Management of U.S. Department of Energy Legacy Waste advanced ways through which the anticipated challenges can plague the system under control.

- ✓ Enforcement of the institutional control is key or important to ensure that the control must be maintained to ensure that it is protective of human health and the environment.
- ✓ Sometimes the government or owner of site who are supposed to play some oversight function(s) in ensuring the implementation of institutional controls are seen not taking this serious. So with that in place, it becomes difficult for the guidelines to be implemented.
- ✓ Frequently, there are cases or times where financial assurance mechanism is utilized to cover costs of enforcement. Such should not be the case.
- ✓ In some cases if not most cases, the institutional controls do not specify mechanisms for modification and termination if circumstances change in the future. This ought not to be the case, as it is expected that mechanisms for modifications should accompany changes in sites as long as the project last.

4.0 Conclusion

Institutional control is a measure put in place to control exposure to contaminants at sites where the remedial action will not meet a residential standard. The control ensures that control checks through legal actions are in place to make sites owners comply with rules and regulations when establishing their sites or projects. In circumstances where the originally stated guidelines fail, guidelines are in place to redress the situation and these are the remedial action guidelines which are again carried out through legal processes. The implementing the guidelines are identified with some challenges

5.0 Summary

This unit studied the Institutional control of management of site and the study was highlighted under various sub-topics for further understanding of what it entails. The sub-topics were definition of Institution, remedial action guidelines, importance of remedial action guidelines, types of institutional controls, characteristics of institutional design, challenges of implementation of institutional controls.

6.0 Tutor-Marked Assignment

i. Define the Institutional Control

ii. Explain the need for a Remedial Action

iii. State three (3) reasons why Remedial Action is sometimes necessary in a site

iv. Discuss the two (2) major types of Institutional Controls

v. Briefly explain five (5) characteristics of Institutional design

vi. State four (4) challenges faced in the implementation of Institutional COntrols

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Unit 5: Environmental Requirements of Site Related Systems

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7.0 References

1.0 Introduction

The production of goods in firms or companies or organizations creates one kind of impact or the other on the environment. These impacts are managed by The Environmental Management System. An Environmental Management System is an approach, a planned and organized way of doing things. It is any planning and implementation system that a company or organization employs to manage the way it interacts with the natural environment. Meanwhile, there are two main types of Environmental Management System, namely; British Standard Institution's and; European Union's EMAS (Eco-Management and Auditing Scheme, which allows ISO 14001 to serve as its core. In where the impact is concerned, certain factors like environmental compliance, pollution prevention, conservation, protection of historical and cultural sites, and protection of flora and fauna are taken into considerations. Adopted organization production techniques ensure the reduction of waste disposal cost, reduce raw material cost and improve public relations/image, amongst other. Some of the potential benefits of implementing an Environmental Management System include; financial improvement, retaining site asset value, and productivity improvement. However, some of the involvements of Environmental Management System are the development of an environmental policy, an environmental improvement programme and defined roles and responsibilities for all employees. There are a number of advantages to undertaking environmental management and these include cost savings, ensuring legislative compliance and anticipating future legislation. For an organization to function successfully, such must state her objectives and targets and the targets

must meet the SMART (specific, measurable, achievable, realistic and time-bound) criteria. Environmental Management system is governed by ten major elements amongst which are environmental policy, environmental requirements and voluntary initiatives, objectives, structure responsibilities and resources, to mention but a few. By and large, the impacts on the environment are of four types, namely direct, indirect, cumulative and induced impacts.

During a project design, the Environmental Impact Assessment (EIA) should be undertaken as part of the feasibility study. The environmental assessment team should work closely with the technical planning and design group to ensure that environmental considerations are integrated into the project design. Representatives of the executing agency should participate as members of the environmental assessment team and this is for the purpose of increasing their understanding of the environmental issues and will help build institutional capacity in Environmental Impact Assessment. The main steps in the EIA process are Screening, Scoping, Prediction and mitigation, Management and monitoring and Audit. Public participation is encouraged in project formulation and execution. It is believed that this will bring about wide acceptance of the project by the people and check divergence from reality.

2.0 Objectives

At the end of the study of this unit, students should be able to:

i. Define Environmental Management System and briefly explain what the system hopes to achieve.

ii. Know the reasons why the engagement of cleaner production techniques is important in an organization

iii. Explain the benefits associated with a firm or organization implementing the environmental management system

iv. Know the merits why an organization needs to undertake environmental management.

v. Define the term ‘Objectives’ and state the significance of setting objectives in project execution by an organization.

vi. Know all the targets that need to be met in the course of project execution.

vii. Understand the main elements of environment management system.

viii. Know the types of environmental impacts that can take place in the course of project execution.

ix. Define the term ‘environmental impact assessment’ and know the steps / process of carrying out an EIA.

x. Know the reason why the beneficiaries of a project need to be incorporated in the planning and execution of a project.

3.0 Main Content

3.1 Concept and Definition of Environmental Management System

As far as production of goods is concerned, there is every certainty that there is bound to organization’s impact on the environment (A report on Environmental Considerations). These impacts could be positive or negative. The Environmental Management System helps to manage the negative impacts created during the production process. According to the Environmental Considerations report, Environmental Management System (EMS) helps sustainable businesses implement systems that help reduce an organization's impact on the environment while improving operating efficiency. An Environmental Management System is a systematic approach to managing your organization’s impacts on the environment. Suffice to say that every organization needs an environmental management system. Organizations with an EMS have an explicit commitment to continual environmental improvement.

An Environmental Management System is an approach, a tool, a set of procedures, a planned and organized way of doing things - i.e., a *system. It is any planning and implementation system that a company or organization employs to manage the way it interacts with the natural environment*. An Environmental Management System is built around the way a company operates, around its production processes and general management system, and not around its emissions, effluents and solid wastes.

There are many **types of** Environmental Management System. Two well-known are the;

i. British Standard Institution's and;

ii. European Union's EMAS (Eco-Management and Auditing Scheme, which allows ISO 14001 to serve as its core

The **environmental considerations** are those factors that may include but are not limited to, environmental compliance, pollution prevention, conservation, protection of historical and cultural sites, and protection of flora and fauna.

It is obvious that **cleaner production techniques are good business for industry because they**

- ✓ Reduce waste disposal cost.
- ✓ Reduce raw material cost.
- ✓ Reduce health, safety and environment (HSE) damage cost.
- ✓ Improve public relations/image.
- ✓ Improve company's performance.
- ✓ Improve local and international market competitiveness.
- ✓ Help comply with environmental protection regulations.

On the negative, cleaner production techniques can increasing problems of;

- ➢ Air and water pollution

- Ozone Depletion
- Global warming
- Landscape degradation
- Solid and liquid wastes
- Resource Depletion
- Acidification of the natural and built environment
- Visual pollution, and
- Reduced bio-diversity.

3.2 Potential Benefits of Implementing an Environmental Management System

A report of Every Organization Needs an Environmental Management System explained the Potential benefits of implementing an Environmental Management System, and they are as follows:

i. Financial improvement: It helps the manager to identify opportunities to reduce waste and thus reduce raw material, utility and waste disposal costs. This therefore leads to increased profits, reduced risk of fines for non-compliance with environmental legislation, lower insurance premiums as risks and liabilities are reduced.

ii. Retaining site asset value: EMS makes room for more easily obtainable bank loans and attracting shareholders and investors.

iii. Productivity improvement: Improved process control by ensuring fewer rejects, less rework, higher yields and as well ensures reduced use of raw materials and consumables.

iv. Sales and marketing improvement: Environmental Management System makes possible for improved products of the organization and provides the environment for competitive advantage thereby bringing about increased sales.

v. Management improvement: Environmental Management System helps management to keep in place environmental issues and continual improvement and keeping ahead of environmental legislation as well as better relations with regulators.

vi. Public relations improvement: Environmental Management System makes it possible to ensure improved relations with local community and environmental groups. This results in improved public image.

vii. Personnel and training - Environmental Management System helps to ensure improved working environment, reduced potential for environmental incidents and increased employee motivation and environmental awareness.

viii. Peace of mind: Environmental Management System also ensures conformity to legal requirements, avoiding penalties for pollution and avoiding bad publicity from pollution incidents.

3.3 Involvements of Environmental Management System

This brings to question "what does an Environmental Management System (EMS) involve"? Every Organization Needs an Environmental Management System report stated that an effective EMS includes or involve

i. An assessment of how your organisation's activities, products, processes and services might affect the environment;
ii. The development of an environmental policy;
iii. An environmental improvement programme;
iv. Defined roles and responsibilities for all employees;
v. A training and awareness programme;
vi. Written procedures to control activities with a significant environmental impact;

vii. A controlled system of records;

viii. Periodic auditing to ensure effective operation; and

ix. A formal review by senior management.

3.4 Advantages to Undertaking Environmental Management

There are a number of business advantages to undertaking environmental management. The central message of this learning material is that Environmental Management will make good business sense and improving our environmental performance and can improve our business performance. There are a number of advantages to undertaking environmental management and these include:

i. Cost savings: The system brings about process efficiency and this leads to improving the efficiency of existing processes, optimizing the performance of existing processes, minimizes the use of raw materials and energy and the production of waste. It also reduces the use of raw materials and energy and reduced waste production. All of these help for the environment and the reduced resource costs and waste disposal costs. They are good for the business as it helps to economically stabilize the business.

ii. Ensuring legislative compliance: Undertaking environmental management ensures that the organization complies with relevant environmental legislation. By compliance, a company or a firm can avoid the possibility of being fined by the regulatory authorities for noncompliance and the adverse media publicity and public criticism & outrage that can accompany such fines.

iii. Anticipating future legislation: Environmental management creates an awareness of likely changes in environmental legislation and thus allows companies to plan for these changes and make appropriate investment decisions. If a company or an organization is not aware of proposed legislation it may make investments that are futile when the new legislation is enacted. Prior

knowledge of likely changes allows a longer time period over which to make the necessary investment and prevent possible cash flow problems.

iv. Reduced environmental risk: Environmental risk is the single largest hidden risk for many companies. By undertaking environmental risk assessment as part of the environmental management process it is possible to reduce the risk of the occurrence of events that could have adverse environmental consequences. Banks, insurance companies and investors all base their decisions on an assessment of risk. The higher the risk, the less likely a bank is to lend, the less likely investors are to invest and the higher insurance premiums are likely to be. Therefore a reduction in environmental risk is likely to be viewed favorably by all these parties, putting a company in a better position to obtain loans and insurance cover and to attract investment.

v. Meeting supply chain requirements: An increasing number of large organizations are requiring their suppliers to demonstrate sound environmental management and are prepared to delist those that fail to do so. In some cases having an environmental policy is not considered sufficient proof of sound environmental management and evidence is required that a company is taking action to meet the commitments set out in their policies. Hence, undertaking effective environmental management will increasingly be necessary to gain or maintain supplier status with large organizations.

vi. Improved relations with regulators: Environmental management helps a firm's regulators to have more confidence in the firm or company. This may make the regulators take a more "hands-off" approach to regulation. This may ne manifested in the form of reduction in the number of inspection visits required per year.

vii. Improved public image and community relations: By publicizing its efforts to improve environmental performance, a company can improve its public image, thereby enhancing its

position in the market place. And by demonstrating sound environmental management, a company can reassure the local community about its activities and thus build up good community relations

viii. Increased market opportunities: Lower production costs can be sure to emanate from environmental management and good public image resulting from publicizing good environmental performance can result in a company increasing sales and gaining a larger market share.

ix. Employee enthusiasm: Undertaking environmental management can generate a lot of enthusiasm within a company as it allows employees to express their environmental concern in a practical way by contributing towards improving environmental performance.

3.5 Objectives, Targets and Elements of Environmental Management System

Setting objectives and targets in an organization just as it is in Environmental Management System (EMS). The aim / objective of an Environmental Management System is to manage environmental issues so as to achieve continual improvement. An EMS does not guarantee improved environmental performance because even with it (EMS) in place, accidents and incidents can still happen. However, it does allow quick detection, mitigation and, if necessary, remediation of any pollution incident. To bring about continual improvement, you need to set specific objectives broken down into realistic targets. These should be based on the information collected during your initial review and should aim to address your significant environmental aspects.

Objectives are the goals that the organization sets for itself for achieving improved environmental performance. They indicate the organization's aim regarding particular significant issues. For example, an objective could be to reduce waste going to landfill.

Targets provide interim (temporary) points on the way to achieving objectives.

One objective can have several targets or ways of achieving the objective.

Objectives and targets can be used to motivate employees and measure cost savings. Setting objectives and targets is based on the information obtained during the initial review and the identification of significant environmental aspects.

When you set objectives and targets, it is important to:

- ✓ Identify the individual or department responsible for ensuring that they are met;
- ✓ Identify someone to oversee the implementation of changes to ensure that targets are met; and
- ✓ Ensure that the measures taken do not indirectly create another significant environmental aspect.

Identifying the opportunities to improve performance requires communication with the environmental management team. The team members are the ones who know the processes and they will probably have ideas for improvement.

When setting targets, it is necessary for the management to be **SMART**. All targets should meet these criteria (SMART):

- ❖ Specific – each target should address one issue only;
- ❖ Measurable – your targets should be expressed quantitatively, for example 10% reduction/unit;

- ❖ Achievable – your targets must be something you can achieve. For example, a zero waste target may not be achievable for every organisation;
- ❖ Realistic – your targets should be challenging but not overly ambitious. Remember they can always be revised once they have been met; and
- ❖ Time-bound – your target must be assigned an end date for delivery.

It is important that agreed objectives and targets are communicated to all staff. Staff awareness and acceptance of these objectives and targets are essential to their success.

3.6 Main elements of environmental management system

There are Top 10 elements of environmental management system. These elements ensure maximum and economic benefits from an environmental system. These elements can apply to many different **environmental management system** model. The elements are:

i. Environmental Policy: This is the first step of the elements and it has to do with a reflection of how the organization feels about the environment, identifies environmental of processes and products and ensure compliance with environmental requirements. There is also a need to commit organization to prevent pollution, reduce environmental risks and share information with external stakeholders.

ii. Environmental Requirements and Voluntary Initiatives: In this scenario, employees should be made to understand their roles in meeting environmental requirements, identify management and manufacturing policies that affect the organization's ability to meet requirements and identify and work with programs that encourage preventing disaster or disaster.

iii. Objectives/Targets: This involves the setting up of environmental objectives in line with complying with environmental requirements. Additionally, make objectives specific to

the organization, set time frames to meet objectives and keep update as environmental requirements evolve.

iv. Structure, Responsibility and Resources: This has to do with the assurance of the fact that the organization has the resources to meet up with her objectives, make managers responsible for the environmental performance of their units and develop procedures for attaining objectives.

v. Operational Control: This involves the establishment and follow-up of procedures to ensure proper waste management hierarchy. There is as well need to establish simple procedures to measure and report environmental impacts of processes and products.

vi. Corrective and Preventive Action and Emergency Procedures: There is need to document procedures for identifying, correcting and preventing mistakes. Emergency procedures to minimize or eliminate adverse environmental accidents or emergencies.

vii. Training, Awareness and Competence: the training of staff whose roles affect meeting objectives. In addition, make certain staff capable of carrying out required duties. The training should be mandatory to include disaster prevention methods.

viii. Organization Decision-Making and Planning: The life-cycle of the product is used to identify the impact of the products in the environment. Employees are also empowered to make pollution prevention improvements that do not require significant resources.

ix. Document Control: It involves the documentation of steps to meet objectives. Such is either manually of electronically done. The documentation of all pollution prevention suggestions.

x. Continuous Evaluation and Improvement: This involves the conduct of periodic objective based audits of the organization. It also involves the use of audits to assess pollution prevention efforts.

3.7 Importance of Environmental Management System

Setting up an **environmental management system** (EMS) will provide the organization with a framework through which its environmental performance can be controlled and improved. The importance cannot be overemphasized as they include:

It is a mechanism for defining environmental responsibilities for all staff, helping them to understand the environmental impact of their activities and individual actions;

i. Ensures that all operations have procedures that minimize their impacts;
ii. Records environmental performance against set targets;
iii. Can be audited; and
iv. Will help you identify opportunities to reduce waste and thus reduce your operating costs.
v. It ensures that improvements continue through ongoing maintenance and monitoring of the system.
vi. An EMS also ensures that environmental performance and other related issues are raised regularly with senior management, and that the momentum for making improvements is maintained.

3.8 Significance of Environmental Aspects

Identifying and understanding your organization's environmental aspects and impacts will help you to reduce adverse impacts on the environment.

Preparing a list of aspects and impacts will also help you identify opportunities to reduce waste and thus achieve significant savings through reduced raw material purchase and waste disposal costs.

The most important issue is to recognize and record your organization's environmental aspects and impacts, and decide which ones are significant for your business. Aspects deemed significant for your organization are the ones your environmental management system will seek to control.

Identifying significant environmental impacts: Having established which aspects have or can have an impact on the environment, the next task is to assess which are significant for your organization.

This will help you to decide the key issues for your EMS to address and prioritize your actions for improvement.

Assessing significance will allow you to make effective use of your resources.

It will enable you to concentrate on taking action to reduce major impacts and avoid having to try to deal with all impacts.

3.9 Types of Environmental Impacts

There are different types of environmental impacts. These are the impacts which the organization has on the environment. These impacts are generally four in nature.

- Direct Impacts
- Indirect Impacts:
- Cumulative Impacts:
- Induced Impacts:

Majorly, they are two in number. These are the Direct and Indirect impacts.

Direct Impacts: Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component. For example, a discharge of any industry from the treatment plant into a river may lead to a decline in water quality in terms of high biological oxygen demand or rise of water toxins. This will directly impact on man, his animals like fishes and even the plants.

Indirect Impacts: Indirect impacts on the other hand are those effects that do not impacts directly on the environment or on man. The indirect impacts are also known as secondary or even third level impacts. An example of indirect impact is the decline in water quality due to rise in temperature of water bodies receiving cooling water discharge from a nearby industry.

This may in turn lead to secondary impact on aquatic flora in that water body. It may also further cause reduction in fish population.

Reduction in fish harvests would affect the income of fishermen. This is a third level impact which may be considered as induced impact.

3.10 Overview of Environmental Assessment Requirements and Procedures

Environmental Assessment Mandate (official / authoritative command)

1. The need to address environmental degradation: The mandate of environmental assessment as far as firms are concerned, takes into consideration environmental degradation that has taken place over time and this is as a result of rapid population growth, dramatic changes in production and consumption patterns, and massive rural to urban migration. The mandate states that unless environmental degradation is arrested, by the firms or companies, the growth rates necessary to reduce poverty will not be sustained and the millennium development goals will not be achieved. The Longterm Strategic Framework (LTSF) may emphasize the need to increase efforts to

address environmental degradation so that poverty can be reduced or eliminated and sustainable development achieved.

2. The Environment Policy: The policy mandates the consideration of environment in all aspects of the project's or firm's operations. Environmental Considerations under the firm or company operations outline environmental assessment procedures and requirements. These environmental assessment guidelines are prepared to facilitate the implementation of the Environment Policy.

3. Designed guidelines: These guidelines are designed for use by company's or firm's staff and clients to provide guidance on how to fulfill company's or firm's environmental assessment requirements. These guidelines are also prepared to guide consultants who need to know firm's or company's policies and procedures in preparation of an initial environmental examination (IEE) or an environmental impact assessment (EIA) report for a project under consideration.

4. The guidelines update: There is guidelines update for the existing environmental assessment guidelines adopted earlier. They take into account the lessons learned from implementing company's or firm's existing and previous guidelines. They served as useful guide for identifying impacts, and designing mitigation measures and monitoring requirements for specific projects.

3.11 Environmental Impact Assessment.

Environmental Impact Assessment (EIA) is carried out during the project design and it should be undertaken as part of the feasibility study (Report of Environmental Impact Assessment Process). The report stressed that; *The environmental assessment team should work closely with the technical planning and design group to ensure that environmental considerations are integrated into the project design.* Representatives of the executing agency should participate as members of the environmental assessment team. Their participation in field work, public

consultations and report writing will increase their understanding of the environmental issues and will help build institutional capacity in Environmental Impact Assessment. In general, the environmental assessment team will:

(i) Coordinate with government concerned and environment agencies;

(ii) Prepare a project description, define the study area, collect environmental baseline data, prepare site maps, and other relevant maps for the study area;

(iii) Identify potential environmental impacts based on the information obtained on the proposed project and the baseline environmental conditions of the study area;

(iv) Identify alternatives and analyze the environmental impacts of each alternative and propose measure to avoid or prevent impacts;

(v) Estimate the magnitudes of environmental impacts and assess the significance of the impacts

(vi) Recommend environmental mitigation (relief) measures and estimate the mitigation costs;

(vii) Prepare an Environmental Mitigation Plan to be implemented by the executing agency during project implementation, operation and abandonment;

(viii) Prepare the Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) reports;

(ix) Conduct public consultation and ensure information disclosure; and develop plans for public consultation and information disclosure during project implementation;

(x) Assess the executing agency's capacity to undertake an environmental review of the environmental.

3.12 Environmental Impact Assessment Process

Environmental Impact Assessment Process according to its report; is a systematic approach to examining and managing the impacts of a project on the environment. The EIA process makes

sure that environmental issues are raised when a project or plan is first discussed and that all concerns are addressed as a project gains momentum through to implementation. Recommendations made by the EIA may necessitate the redesign of some project components, require further studies, suggests changes which alter the economic viability of the project or cause a delay in project implementation.

To be of most *benefit it is essential that an environmental assessment is carried out to determine significant impacts early in the project cycle so that recommendations can be built into the design and cost-benefit analysis without causing major delays or increased design costs.* To be effective, once implementation has commenced, the EIA should lead to a mechanism whereby adequate monitoring is undertaken to realize environmental management. An important output from the EIA process should be the delineation of enabling mechanisms for such effective management.

The way in which an EIA is carried out is not rigid: it is a process comprising a series of steps. The main steps in the EIA process are:

i. Screening
ii. Scoping
iii. Prediction and mitigation
iv. Management and monitoring
v. Audit

Screening

Screening is the process of deciding on whether an EIA is required. *Screening often results in a categorization of the project and from this a decision is made on whether or not a full EIA is to be carried out.* This may be determined by size. Alternatively it may be based on site-specific

information. For example, the repair of a recently destroyed diversion structure is unlikely to require an EIA whilst a major new headwork structure may. Guidelines for whether or not an EIA is required will be country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full EIA. All major donors screen projects presented for financing to decide whether an EIA is required.

The output from the screening process is often a document called an **Initial Environmental Examination or Evaluation** (IEE). The main conclusion will be a classification of the project according to its likely environmental sensitivity. This will determine whether an EIA is needed and if so to what detail.

Scoping

Scoping occurs early in the project cycle at the same time as *outline planning and pre-feasibility studies. Scoping is the process of identifying the key environmental issues and is perhaps the most important step in an EIA.* Several groups, particularly decision makers, the local population and the scientific community, have an interest in helping to deliberate the issues which should be considered, and scoping is designed to canvass their views.

Scoping is important for two reasons. First, so that problems can be pinpointed early allowing mitigating design changes to be made before expensive detailed work is carried out. Second, to ensure that detailed prediction work is only carried out for important issues. It is not the purpose of an EIA to carry out exhaustive studies on all environmental impacts for all projects. If key issues are identified and a full scale EIA considered necessary then the scoping should include terms of reference for these further studies.

A major activity of scoping is to identify key interest groups, both governmental and non-governmental, and to establish good lines of communication.

The main EIA techniques used in scoping are *baseline studies, checklists*, *matrices* and *network diagrams*. These techniques collect and present knowledge and information in a straightforward way so that logical decisions can be made about which impacts are most significant. *Risk and uncertainty* are discussed further in the section *managing uncertainty*.

Prediction and mitigation

Once the scoping exercise is complete and the major impacts to be studied have been identified, prediction work can start. This stage forms the central part of an EIA. Realistic and affordable mitigating measures cannot be proposed without first estimating the scope of the impacts, which should be in monetary terms wherever possible. It then becomes important to quantify the impact of the suggested improvements by further prediction work. Clearly, options need to be discarded as soon as their unsuitability can be proved or alternatives shown to be superior in environmental or economic terms, or both. It is also important to test the "without project" scenario.

An important outcome of this stage will be recommendations for mitigating measures. This would be contained in the Environmental Impact Statement. Clearly the aim will be to introduce measures which minimize any identified adverse impacts and enhance positive impacts. Similarly, feasibility studies may indicate that some options are technically or economically unacceptable and thus environmental prediction work for these options will not be required.

By the time prediction and mitigation are undertaken, the project preparation will be advanced and a decision will most likely have been made to proceed with the project. Considerable expenditure may have already been made and budgets allocated for the implementation of the project. It is important to assess the required level of accuracy of predictions. *Expert advice*, particularly from experts familiar with the locality, can provide quantification of impacts that cannot be modelled. Various techniques are available to remove the bias of individual opinion.

Management and monitoring

The part of the Environmental Impact Statment covering monitoring and management is often referred to as the **Environmental Action Plan** or **Environmental Management Plan**. This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation. The term 'institutional' is used here in its broadest context to encompass relationships: established by law between individuals and government; between individuals and groups involved in economic transactions; developed to articulate legal, financial and administrative links among public agencies; motivated by socio-psychological stimuli among groups and individuals

The purpose of monitoring is to compare predicted and actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be very accurately predicted. The results of monitoring can be used to manage the environment, particularly to highlight problems early so that action can be taken. Monitoring should not be seen as an open-ended commitment to collect data. If the need for monitoring ceases, data collection should cease. The Environmental Management Plan needs to not only include clear recommendations for action and the procedures for their implementation but must also define a programme and costs. Mitigation and management measures will not be adopted unless they can be shown to be practicable and good value for money.

Auditing

In order to capitalise on the experience and knowledge gained, the last stage of an EIA is to carry out an **Environmental Audit** sometime after completion of the project or implementation of a programme. It will therefore usually be done by a separate team of specialists different from that

working on the bulk of the EIA. The audit should include an analysis of the technical, procedural and decision-making aspects of the EIA.

Technical aspects include: the adequacy of the baseline studies, the accuracy of predictions and the suitability of mitigation measures.

Procedural aspects include: the efficiency of the procedure, the fairness of the public involvement measures and the degree of coordination of roles and responsibilities.

Decision-making aspects include: the utility of the process for decision making and the implications for development.

The audit will determine whether recommendations and requirements made by the earlier EIA steps were incorporated successfully into project implementation. Lessons learnt and formally described in an audit can greatly assist in future EIAs and build up the expertise and efficiency of the concerned institutions.

3.13 Public Participation

Projects or programmes have significant impacts on the local population. Whilst the aim is to improve the wellbeing of the population, a lack of understanding of the people and their society may result in development that has considerable negative consequences. More significantly, there may be divergence between national economic interests and those of the local population. For example, the need to increase local rice production to satisfy increasing consumption in the urban area may differ from the needs as perceived by the local farmers. To allow for this, public participation in the planning process is essential. The EIA provides an ideal forum for checking that the affected public has been adequately consulted and their views taken into account in project preparation.

The level of consultation will vary depending on the type of plan or project. New projects involving resettlement or displacement will require the most extensive public participation. As stated before, the purpose of an EIA is to improve projects and this, to some extent, can only be achieved by involving those people directly or indirectly affected. The value of environmental amenities is not absolute and consensus is one way of establishing values. Public consultation will reveal new information, improve understanding and enable better choices to be made. Without consultation, legitimate issues may not be heard, leading to conflict and unsustainability.

The community should not only be consulted they should be actively involved in environmental matters. As the EIA progresses, public consultation is likely to be decreased though it is important to disseminate information. The publication of the draft *Environmental Impact Statement* (EIS) will normally be accompanied by some sort of public hearing that needs to be chaired by a person with good communication skills. He/she may not be a member of the EIA team.

There are no clear rules about how to involve the public and it is important that the process remains innovative and flexible as the views of people affected by the plan are likely to be heard through some form of representation rather than directly. It is therefore important to understand how decisions are made locally and what are the methods of communication, including available government extension services.

Information dissemination can be achieved using a number of mechanisms including the broadcasting media, in particular newspapers and radio. Posters and leaflets are also useful and need to be distributed widely to such locations as schools, clinics, post offices, community centres, religious buildings, bus stops, shops etc. The EIA process must be seen to be fair.

The public participation/consultation and information dissemination activities need to be planned and budgeted. The social scientist team member should define how and when activities take place and also the strategy. It is important to note that public participation activities are often reported as a separate section of the final EIA.

3.14 Managing Uncertainty

An Environmental Impact Assessment involves prediction and thus uncertainty is an integral part. There are two types of uncertainty associated with environmental impact assessments. They are;

- That associated with the process. In this case, the uncertainty is whether the most important impacts have been identified or whether recommendations will be acted upon or ignored.
- That associated with predictions. This type of uncertainty has to do with the uncertainty is in the accuracy of the findings.

The main types of uncertainty and the ways in which they can be minimized are summarized as follows:

• Uncertainty of prediction: this is important at the data collection stage and the final certainty will only be resolved once implementation commences. Research can reduce the uncertainty;

• Uncertainty of values: this reflects the approach taken in the EIA process. Final certainty will be determined at the time decisions are made. Improved communications and extensive negotiations should reduce this uncertainty;

• Uncertainty of related decision: this affects the decision making element of the EIA process and final certainty will be determined by post evaluation. Improved coordination will reduce uncertainty.

The importance of very wide consultation cannot be overemphasized in minimizing the risk of missing important impacts. The significance of impacts is subjective, but the value judgements required are best arrived at by consensus: public participation and consultation with a wide sector of the community will reduce uncertainty.

The accuracy of predictions is dependent on a variety of factors such as lack of data or lack of knowledge.

The results of the EIA should indicate the level of uncertainty with the use of confidence limits and probability analyses wherever possible. Sensitivity analysis similar to that used in economic evaluation, could be used if adequate quantifiable data are available. A range of outcomes can be found by repeating predictions and adjusting key variables.

EIA enables uncertainty to be managed and, as such, is an aid to better decision making. A useful management axiom is to preserve flexibility in the face of uncertainty.

3.15 Information checklist on Environmental Impact Assessment

Information checklist requirements on projects is a vital document that shows the requirements needed for the execution of a project. The following are some of the items that need to available in the course of project execution:

- Environmental Impact Assessment (EIA) legislation, regulations, orders and directives that are used in the country or region;
- Information on any proposed changes to the legislation, regulations, orders and directives that are used in the country or region;
- Guidelines, agreements or memoranda of understanding that apply to EIA;
- Agreements or means of resolving conflicts where more than one set of EIA arrangements apply to the project;

- Information about how the EIA system addresses any responsibilities that the country has under the international environmental agreements;
- Reviews and analyses of the strengths and weaknesses of applicable legal, policy and institutional arrangements;
- Contact names and telephone numbers of people, agencies, organisations and environmental information/data resource centres able to provide assistance and information regarding national EIA arrangements and developments; and
- Other resources that may be available such as videos, journal articles, computer programmes, lists of speakers, case studies.

4.0 Conclusion

The production of goods in firms or companies or organizations creates one kind of impact or the other on the environment. These impacts are managed by The Environmental Management System. The concerns of the impact are majorly environmental compliance, pollution prevention, conservation, protection of historical and cultural sites, and protection of flora and fauna.some of the techniques adopted by organizations help to reduce waste disposal cost, reduce raw material cost and improve public relations/image, etc. Some of the potential benefits of implementing an Environmental Management System include; financial improvement, retaining site asset value, and productivity improvement. The SMART agenda is a sure to be in implementation for an assurance of organization's success.

Environmental Impact Assessment (EIA) should be undertaken as part of the feasibility study for every project and this should involve the direct participation of the benefiting people. Also, the executing agency should provide experts who should participate as members of the environmental assessment team for the purpose of increasing their understanding of the

environmental issues and will help build institutional capacity. The main steps in the EIA process are Screening, Scoping, Prediction and mitigation, Management and monitoring and Audit.

5.0 Summary

The study examined the environmental requirements of site related systems. The study was of the view that every firm or company or organization exacts one kind of impact or the other on the environment in the course of production. These impacts are managed by the Environmental Management System and this is done to reduce the risks involved in waste disposal cost and other costs of the production process. However, maximum success is assured when the management maintains and incorporates the SMART agenda in projects planning and execution. Environmental Impact Assessment (EIA) should be undertaken as part of the feasibility study for every project and this should involve the direct participation of the benefiting people. In addition, a wider acceptance of project is guaranteed when the beneficiaries of the projects are carried along in the planning and execution stages.

6.0 Tutor-Marked Assignment

i. Define Environmental Management System.

ii. Briefly explain what Environmental Management System hopes to achieve.

iii. Explain six (6) reasons why the engagement of cleaner production techniques is important in an organization

iv. Explain six (6) benefits associated with a firm or organization implementing the environmental management system

v. State six (6) advantages why an organization needs to undertake environmental management.

vi. Define the term 'Objectives'

vii. State three (3) significance of setting objectives in project execution by an organization.

viii. Discuss the five (5) targets that need to be met in the course of project execution.

ix. Mention the ten (10) main elements of environment management system.

x. Discuss the four (4) types of environmental impacts that can take place in the course of project execution.

xi. Define the term 'environmental impact assessment'

xii. Expatiate the steps / process of carrying out an Environmental Impact Assessment.

xiii. Explain the reason why the beneficiaries of a project need to be incorporated in the planning and execution of a project.

7.0 References

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