SUBJECT:

AGRICULTURAL SCIENCE

TOPIC

ENVIRONMENTAL FACTORS AFFECTING AGRICULTURAL PRODUCTION

CLASS

SS3

BEHAVIOURAL OBJECTIVES

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

- State the environmental factors that affecting agricultural productivity.
- Explain inter- relationships among living things.

INTRODUCTION

Environmental factors affecting agricultural production are grouped into three major classes.

These are:

A. Climatic factors

B. Biotic factors

C. Edaphic factors.

CLIMATIC FACTORS AFFECTING AGRICULTURAL PRODUCTION

(A) **RAINFALL**

Rainfall is defined as the release of excess condensed water vapour in the atmosphere into the earth.

i. It determines the distribution of crops and animals.

ii. It is necessary for seed germination.

iii. Excessive rainfall leads to leaching of nutrients and causes soil erosion.

iv. It helps to dissolve nutrients in the soil, thereby making the nutrients available to crops.

v. It determines the seasons in Nigeria, i.e., rainy and dry seasons.

vi. It determines the vegetation types in Nigeria- savanna in the north and forest in the south.

vii. The seasons also determine the type of crops to be grown.

viii. Vegetation types in turn determine the types of livestock that can be raised in the different ecological zones.

ix. Insufficient rainfall causes crop failure and poor yield.

WAYS IN WHICH HIGH RAINFALL AFFECTS AGRICULTURAL PRODUCTION

i. High rainfall prolongs the cropping Season.

ii. It increases the problem of plant diseases

iii. It determines the type of crop to be grown.

iv. It increases the incidence of erosion or flooding.

v. It encourages thick forestation, thus increasing the incidence of pest e.g. tsetse flies infestation.

vi. It encourages the growth of disease causing organisms (pathogens).

vii. It increases leaching of plant nutrients or soil acidity.

(B) **DROUGHT**

This is defined as lack of or insufficient rainfall in an area. Effects of drought on plant growth and development:

i. Delay in flowering reduction in flowers/flower abortion.

ii. Poor crop establishment.

iii. Leads to a reduction in leaf area.

iv. There is a reduction in cell size and intercellular volume.

v. Several physiological processes may decrease due to the dehydration of protoplasm.

vi. Water stress produces important changes in carbohydrate and nitrogen metabolism of plants.

vii. Possible death of plants / crop failure.

viii. Lower resistance / prone to diseases.

(C) **TEMPERATURE**

Temperature is defined as the degree of hotness or coldness of a place.

i. Temperature is necessary for germination of seeds.

ii. Too hot or too cold temperature do not favour plants and animals growth.

iii. High temperature affects evapo-transpiration, and reduces the performance of livestock.

iv. High temperature leads to loss of soil nutrients through volatilization.

v. High temperature may be harmful by causing premature dropping of fruits and sudden death of livestock, e.g., heat-stress in poultry.

vi. High temperature reduces the performance of livestock.

D. **WIND**

Wind is defined as air in motion.

i. High wind velocity may cause wind erosion.

ii. It aids seed and fruit dispersal.

iii. It can aid pollination and spread of diseases.

iv. It helps in the distribution of rainfall and changes in seasons, e.g., rainy and dry seasons.

v. It determines seasons in Nigeria. For example, South West Trade wind brings rain while North East Trade wind brings harmattan or dry season.

E. **SUNLIGHT/SUNSHINE:**

Sunshine is the amount of heat and the period the sun's rays are received at a place.

i. Sunlight is necessary for photosynthesis.

ii. It affects evapo-transpiration.

iii. It affects the productivity of crops to length of day, i.e., photo-periodism.

In other words, light divides plants into two photo periods:

(I) **Long Day Plants:** These plants require longer day light of between 13-15 hours of sunlight, e.g., millet, sorghum, guinea corn.

(II) **Short Day Plants:** These plants require shorter day light period of between 8-10 hours of sunlight, e.g., cocoa, kola and oil palm.

BIOTIC FACTORS AFFECTING AGRICULTURAL PRODUCTION

(A) **SOIL ORGANISM:**

i. These include bacteria, fungi, earthworm, rodent and termite.

ii. Some, like bacteria and fungi, can cause diseases.

iii. Some aid aeration of soil, percolation and fertility.

iv. Some, like the root nodule bacteria can fix nutrients directly to plants and soil.

v. Some open up wounds on plants or animals for other pathogens to enter.

vi. Some reduce the quality and quantity of crops, e.g., potato and yam.

(B) **PESTS**

i. These include insects, rodents, birds and some mammals.

ii. They reduce the yield of crops and animals.

iii. They also reduce the quality of crops and animals.

iv. Some are vectors or carriers of diseases.

v. They reduce the income of the farmer

(C) **PARASITES**

i. They include ticks, liver flukes tapeworms, dodder, mistletoe and lice.

ii. Some transmit diseases.

iii. They reduce the quantity or yield of produce.

iv. They also reduce the quality of produce

v. They may cause the death of plants and animals.

(D) **DISEASES:**

i. They may be diseases caused by viruses, bacteria, fungi, protozoa, etc.

ii. They cause reduction in yield of crops and animals.

iii. They can cause the loss or death of plants and animals.

iv. The cost of control increases the cost of production.

v. They cause reduction in farmer's income.

(E) **WEEDS:**

i. They compete with crops for space, water, nutrients and sunlight.

ii. Some weeds can harbour diseases and pests.

iii. They reduce the yield of crops.

iv. Weed control increases the cost of production.

v. Weeds cause poor growth of crops.

(F) **PREDATORS**

i. These are birds, rodents and praying mantis.

ii. Some are beneficial in agricultural production.

iii. Some are used to control some harmful pests of crops and animals.

iv. Some feed on farm animals. For example, hawks feed on chicks.

(G) **HUMAN ACTIVITIES:**

Human activities include the influence of man on the production of plants and animals.

i. His activities may improve the fertility of the soil if he uses fertilizers and manure.

ii. There could be increase in yield if he practises crop rotation.

iii. There could be increase in yield if he controls pests and diseases.

iv. Increase in yield or production can also be enhanced if he gets rid of weeds from his farm.

INTER-RELATIONSHIP AMONG LIVING THINGS

There are inter-relationship among living things in a particular environment.

These inter relationship include the following:

(I) **COMPETITION**

Competition involves the interactions among two organisms of the same or different species in which one outgrows the other and survives while the other can neither grow nor survive.

Competition is often based on limited environmental resources which can be in short supply such as food, water, nutrients, gases, light and space.

During competition, one organism controls one or more of these resources which enable it to grow and survive while the other neither grow nor survive leading to its elimination.

When the competition is between members of the same species, it is called **intra-specific** competition while it is called **inter-specific** competition if it is between members of different species.

EXAMPLES OF COMPETITIVE ASSOCIATIONS

(a) **Flowering plants and grasses:** The flowering plants due to its size and numerous branches and leaves are capable of eliminating the grasses by depriving the grasses of nutrients, space and sunlight. The grasses may eventually be eliminated because they have no access to these resources.

(b) **Domestic fowls and the young chicks:**

The adult domestic fowls are capable of eliminating the young chicks by depriving the chicks of food in the pen. The young chicks may eventually die because they may not have access to the limited food available in the feeders. The stronger and bigger fowls eat the food first and it is only when the adult fowls are satisfied that the young chicks can eat.

(II) **PARASITISM**

Parasitism is a feeding relationship association between two organisms, in which the parasite lives in or on the body of the host deriving benefit from and causing harm to it while the host loses in the process.

In other words, Parasitism is a close association between two organisms in which one, known as the parasite lives in or on and feeds at the expense of the other organism which is known as the host.

The parasite benefits from the association while the host usually suffers harm or may die.

EXAMPLES OF PARASITISM

(a) **Man and the tapeworm:** The tapeworm is a parasite that lives in the Small intestine of man where it derives the benefits of a habitat, protection and food. The man who is the host suffers because he loses to the tapeworm part of the food he has eaten and digested.

(b) **Mistletoe and flowering plant:** The mistletoe is a plant parasite that lives on other larger flowering plants. The mistletoe benefits because the host gives it support and raises it up to a position from which it can receive sunlight.

The parasite also absorbs water and mineral salts from the host while the host suffers harm by losing to the parasite part of the water and mineral salts that it has absorbed.

(III) **SYMBIOSIS**

Symbiosis is a close association between two organisms in which both of them benefit from each other.

Symbiosis is a beneficial association and each member is called a symbiotic.

EXAMPLES OF SYMBIOTIC ASSOCIATION

(a) **Alga and fungus in lichen:**

A lichen is made up of two organisms namely, a fungus and a green alga which live in a close association.

In this association, the alga benefits because the fungus encloses and protects it from physical damage and from drying up.

The alga also uses some of the water absorbed by the fungus while the fungus benefits by using part of the food manufactured by the green alga.

(b) **Flowers and insects:** Insects obtain food from flowers in the form of pollen and nectars while in return, the insects bring about cross-pollination in the plant they visit, thus enabling plants to reproduce sexually.

(IV) **COMMENSALISM**

Commensalism is a relationship or an association between two organisms of different species, in which one, the commensal benefits or gains while the other, the host, is not adversely or significantly affected in any way, i.e., it is not harmed, it neither loses nor gains.

In other words, commensalism is an association between two organisms living together in which only one (commensal) benefits from the association while the other is neither benefited nor harmed.

EXAMPLES OF COMMENSALISM

(a) **Remora fish and shark:**

The remora fish attaches itself to the body of a shark which carries it about. The remora fish feeds on the food particles left over by the shark. By so doing the remora obtains food, protection and shelter from the shark, whereas the shark is neither harmed nor benefited as a result of the presence of the remora fish.

(b) **Man and intestinal bacteria:**

Some bacteria in the large intestine of man feed on digested food there. The bacteria receive food and protection from the man whereas the man neither gains nor suffers any disadvantage from the presence of the bacteria.

(V) **PREDATION**

Predation is a type of association between two organisms in which the predator kills the other, called the prey and directly feeds on it.

The predator which is usually larger in size and always stronger than the prey benefits by deriving its food while the prey is completely eliminated.

EXAMPLES OF PREDATION

(a)**The hawk and chicks of domestic fowls:**

The hawk is the predator that catches, kills and eats the prey (young chicks) of domestic fowls. The hawk is stronger and bigger than the chicks. The hawk benefits while the chicks are completely eliminated.

(b) **The lion and goat:**

The lion is the predator that catches, kills and eats the prey (goat). The lion is stronger and bigger than the goat. The lion benefits while the goat is completely eliminated.

EDAPHIC FACTORS AFFECTING AGRICULTURAL PRODUCTION

(A) **Soil pH**

i. It affects the growth of plants.

ii. It also affects the availability of soil nutrients to plants.

iii. It affects the presence of soil microorganisms.

iv. It causes toxicity to plants and animals in the soil

(B) **Soil Texture**

i. It determines the type of soil in an area.

ii. It determines the level of soil fertility.

iii. It determines the type of crops to be grown.

iv. It affects the level of leaching and erosion.

(C) **Soil Structure**

i. It determines the fertility of the soil.

ii. It determines the water-retaining capacity of the soil.

iii. It determines the level organisms

(D) **Topography**

i. Topography refers to the shape of the land in relation to the underlyıng rocks of the earth's surface.

ii. Steep and gentle slopes give rise to soil erosion.

iii. Steep and gentle slopes may also aid the weathering of rocks.

(E) **Soil Fertility**

i. Fertile soil aids the production of food and cash crops.

ii. Fertile soil leads to the production off forage crops and plants for grazing.

iii. It minimizes the use of fertilizers and manures.

iv. It leads to multiplication of beneficial soil organisms.

(F) **Soil Types**

i. Soil types include sandy, clay and loamy

ii. Loamy soil is rich in soil nutrients, hence it is the best soil for agriculture.

iii. Sandy soil does not contain enough nutrients, hence it cannot support crop growth.

iv. Sandy soil encourages leaching and prevents soil erosion.

v. Clay soil encourages water-logging and erosion but prevents leaching of plant nutrients.

(G) **Soil Erosion**

Soil erosion is defined as the wearing away of soil by means of natural agents such as water, ice or glacier, wind and animals

Erosion takes place for a long time and it is greatly influenced by the following factors:

- Climate
- Soil properties.
- Vegetation.
- Human activities
- Topography

- Agents of Soil erosion: Agents of soil erosion are mainly water and wind.

(a) **Water:** Rainwater tends to run off the surface of the soil in deforested or overgrazed areas, thereby removing the top soil.

Run-off is the rainwater which does not sink into the soil but flows away over the surface of the soil into streams, rivers or oceans.

(b) **Wind:** Wind is capable of moving large quantity of soil and sand. The faster the wind moves, the more it can carry.

Wind-caused erosion occurs in dry areas where the soil bare and loose.

TYPES OF SOIL EROSION

There are four major types of erosion. These are:

- **SPLASH EROSION:** Splash erosion is the removal of top soil from a small area due to the forceful fall of rain. The soil particles scattered by the rain-drops will succeed in blocking soil pore spaces against percolation, resulting in sheet erosion.

- **RILL EROSION:** Rill erosion occurs when raindrops falling on the soil surface cause the gradual removal of soil particles in suspension along narrow tracks or channels either already existing or caused by the rainwater itself.

- **SHEET EROSION:** When raindrops cause particles to block soil pores against percolation, floods follow. When the flood water flows uniformly over a piece of land, especially over a gentle slope, the fertile surface soil over the whole Piece of land is washed away.

- **GULLY EROSION:** Gully erosion occurs when rain water does not all sink into the soil and part of it runs off over the soil surface, removing soil particles along its way.

  Gully erosion is worse if the speed of the run-off is high, if the land is sloppy and the soil is loose.

PREVENTION AND CONTROL OF SOIL EROSION

Soil conservation practices that can be used to control erosion on a gentle slope:

i. Contour ploughing.

ii. Ridging across the slope.

iii. Construction of drainage channels.

iv. Cover-cropping/Afforestation/High density planting.

v. Strip cropping.

vi. Mulching.

EVALUATION

1. Discuss the environmental factors affecting crops and animal distribution and production:

- Climatic factors: e.g., rainfall, temperature, light, wind etc.
- Biotic factors: e.g., predators, parasites, soil micro-organisms, etc., interrelationship such as competition, parasitism, mutualism (symbiosis) etc.
- Edaphic factors: Soil pH, soil texture, soil structure, soil type, etc.

THANK YOU FOR WATCHING!!!