

CHAPTER 9

Environmental Factors Affecting Agricultural Production

OBJECTIVES

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

- â state the environmental factors affecting agricultural productivity.
- â explain inter-relationships among living organisms.

9.1 Introduction

All agricultural activities like crops and livestock distribution and production are affected by several environmental factors. These factors determine and influence the distribution of crops and livestock. Environmental factors also influence the performance and productivity of crops and animals. These explain why some crops and animals yield more in one locality than the other.

9.2 Environmental Factors Affecting Crops and Livestock Distribution and Production

The factors of the environment that influence the distribution and production of crops and animals can be grouped into abiotic and biotic factors. The abiotic factors are further grouped into three major classes as **(a)** climatic factors, **(b)** edaphic and **(c)** physiographic factors. Each of these factors influences agricultural productivity either directly or indirectly

9.2.1 Climatic factors

These refer to all factors or elements of climate such as rainfall, temperature, wind, light, relative humidity, radiant energy, etc. Climate is defined as the average weather condition of a place, measured over a long period of time. Climate is one of the most natural features which control the growth and productivity of plants and animals. It is very important that crops and animals suited to a particular climate be raised there.

Rainfall

Rainfall is defined as the amount and distribution of water precipitated within a given period in a given area. It is a major requirement for the growth and development of crops and vegetation. The seasonal distribution of rainfall is determined by moist and dry wind, respectively. The moist wind blows across the Southwest from the Atlantic ocean while the dry wind blows from the Northeast across deserts and savannahs. The coastal areas have rainy season ranging from eight months to all-the-year round while in the North, rainy season lasts for only three to four months.

EFFECTS OF RAINFALL ON AGRICULTURAL PRODUCTIVITY

The moisture regime determines the distribution and type of crops and animals that can be found in an area. This explains why crops which have adapted to heavy rainfall like rice, cocoa, forest trees and banana are

predominant in the humid southern part of Nigeria that is located in the rainforest belt. Rainfall also determines the type of vegetation that can be found in an area as well as the seasons. For example, there are two seasons in Nigeria often called the rainy and the dry seasons. The seasons determine when a particular crop could be planted and the type of crops to be grown at particular time. In like manner, the predominant vegetation types determine the type of livestock that can be raised in different ecological zones. For example, the presence of tsetse fly in the heavy rainfall areas of the rainforest vegetation zone in Nigeria limits cattle rearing in the area. This also dictates availability of forage for grazing.

However, insufficient rainfall causes crop failure and poor yield while excessive rainfall could lead to serious erosion problems and leaching of nutrients and this seriously affect agricultural productivity.

Temperature

This is defined as a measure of the degree of hotness and coldness of any substance or place at any point in time. It is also described as the heat energy which a body contains at a given time. It is a way of expressing how hot or cold any given period of the day or night is. There is a lot of difference in the environmental temperature of the coastal areas compared to the extreme North. For example, the environmental temperature is extremely high in the northern part of the country during the dry season whereas it is not so high in the coastal areas.

EFFECTS OF TEMPERATURE ON AGRICULTURAL PRODUCTIVITY

- 1.** Environmental temperature affects the distribution of crops and animals. Hardy crops and animals that can withstand the severe heat of the sun are commonly found in the north. This explains why camels, donkeys and other domestic animals are commonly raised in the north. This factor of the environment is also linked to the type of vegetation.
- 2.** Environmental temperature also affects the microbial activities in the soil. Too low or high temperature reduces the activities of microbes and this affects mineralization of organic matter.
- 3.** Environmental temperature is important also for germination of seeds. There is an optimum temperature for germination of seeds.
- 4.** High temperature reduces the performance of crops and livestock. It can cause premature dropping of fruits and sudden death of livestock such as heat stress in poultry.
- 5.** High temperature can also lead to loss of soil nutrients through volatilization.

Wind

Wind refers to air in motion. The different wind currents influence vegetation establishment in Nigeria and also distribute the moist air and dry air conditions.

EFFECTS OF WIND ON AGRICULTURAL PRODUCTIVITY

- 1.** Winds can aid pollination especially in the wind-pollinated flowers as well as the dispersal of fruits and seeds.

2. Winds can also aid the spread of disease pathogens particularly air-borne diseases. For example, many spores of fungi are transmitted by air.

3. High wind velocity may cause wind erosion which is prominent in the northern part of the country.

4. Wind also determines seasons in Nigeria. For example, South-West wind brings the rain while the North-East trade wind leads to establishment of Savannah vegetation. Such winds favour the production of annual crops like cereals and pulses which require a long period of weather for their ripening and harvest.

5. Also, the establishment of the savannah vegetation favours the rearing of animals like cattle, goats and sheep.

Relative humidity and its effect on agricultural productivity

This refers to the amount of moisture or water vapour present in the atmosphere within a given period of time. This is the presence of water in the gaseous form in the atmosphere. The occurrence of water in both the visible and invisible form has a pronounced effect on the transmission of solar radiation. Relative humidity results in the formation of rain. It affects the performance of crops and animals and affects their growth rate. For example, cocoa will not grow well under low relative humidity while high relative humidity affects food intake and the productivity of farm animals.

High humidity in poultry houses causes mouldiness of feed and litters. High relative humidity also favours the growth of disease pathogens. It also determines the type of crops growing in an area.

Sunshine and solar radiation

This is a measure of the amount of heat and the period during which the sun rays are received at a place. In Nigeria, the sunshine distribution is zoned with the sunshine hours increasing from the coast inland. The sunshine distribution pattern directly influences the vegetation in different parts of Nigeria because crops require optimal light or sunshine to do well. Sunlight is necessary for photosynthesis. In southern Nigeria, the presence of cloud at certain seasons of the year reduces the amount of sunshine reaching the crops thereby affecting crop yield at such a season. For example, cowpea produces pods without seeds while the tubers grow vegetatively without much tuber yield in such cloudy days. Light affects the rising and roosting of animals. The period of light available to crops per given period of day is described as photoperiod and this determines the productivity of cultivated crops. This is the reason why light-loving crops such as tomatoes, lettuce, groundnut, cowpea, onions, carrot and sweet pepper are produced well in northern Nigeria. Farmers should have a basic knowledge of the biology of any crop they want to plant so as to cultivate it where it will get sufficient sunshine.

Sunshine and solar radiation are very important in agricultural productivity because it could cause heat stress in animals and this reduces their growth and production. Solar radiation is a very important source of farm power and is utilized in drying of crops.

9.2.2 Edaphic factors

Edaphic factors refer to all soil factors that affect agricultural production. These include soil texture, soil pH, soil fertility, soil structure and

topography. All these factors influence the crop to be planted in an area.

(a) Soil class or type: There are different classes or types of soil such as sand, clay and loamy soils. Each of these soil types has different nutrient levels. For example, loamy soil is very rich in soil nutrients, hence it is best for agriculture.

The type of soil in an area also determines the type of crop or agricultural activities that can be carried out on such land. Each soil class has its peculiar characteristics. For example, sandy soil encourages leaching; it is a light soil and is gritty to feel. Sandy soils cannot be shaped or molded into shapes and are generally described as light soils. Clay soils on the other hand are heavy soils with finely packed particles. They retain moisture and are very difficult to work with. They can be molded into different shapes without breaking. Loamy soils are intermediate between these two extremes and this is why they are considered best for agriculture.

(b) Soil fertility: A fertile soil is one which contains plant nutrients in adequate amount and correct proportion. Fertile soil aids the production of food and cash crops. It determines the type of crops to grow on the land.

(c) Soil pH: The pH of a soil is a measure of the degree of acidity or alkalinity of a soil sample. It can also be described as a measure of the concentration of hydrogen ions (H) in the soil or a medium. It is a major environmental factor affecting agricultural productivity. A soil is described as acidic when its pH is less than 7 or when it has a high concentration of hydrogen ion. When the pH is 7, such soil is described as a neutral soil. When the pH is greater than 7, it is alkaline. Soil acidity is caused by many factors including leaching of plant nutrients, use of acidic fertilizers, nutrient uptake by plants and presence of sulphur in the soil. The pH of a soil in an area also determines the type of crop that can be grown there. For example, only acid tolerant crops like oil palm, swamp rice, sugarcane, rubber, cocoa, banana and many others are found in such soils.

Similarly, crops like millet, sorghum, cotton, groundnut, cowpea, onion are found in regions with predominantly alkali soils while crops like cassava, yam, maize, potato thrive well on neutral soils. Low pH reduces the population of some useful soil organisms such as bacteria and earthworms by killing them or by forcing them to migrate to less acidic soil sites. Low soil pH may also have adverse effects on the roots of plants by hindering the rate of root absorption of minerals ions. It also causes toxicity to plants and animals in the soil. Low soil pH also affects the availability of soil nutrients to plants.

(d) Soil texture: This is defined as the relative proportion of the various particles of the soil. It refers to the degree of coarseness or fineness of the various soils in an area and the level of soil fertility. Soil texture affects the population of soil organisms and also influences tillage practices to be adopted by the farmer.

(e) Soil structure: This describes the way in which the different particles of the soil are packed together or arranged. It also refers to the shape and arrangement of primary particles to form compound particles. The soil structure has a direct effect on crop yield because it determines the fertility and water-retention capacity of the soil. It also determines the level of soil aeration and percolation.

The arrangement of soil particles also determines the population level of soil organisms.

9.2.3 Physiographic factors

Physiographic factors relate to all conditions of the earth's surface such as the shape and the terrain of the land in relation to the underlying rocks of the earth's surface.

A common example of these factors is the topography. This is an important factor which affects agricultural production because it enables the farmer to choose lands even those which are slopes for intensive farming. Steep and gentle slopes however give rise to soil erosion except if planting and other farm activities are carefully planned out to take care of such slope problems. Such sloped terrain is not good for agricultural production.

Biotic factors affecting agricultural production

The biotic factors affecting agricultural production are the living factors of the environment. These include predators, parasites, soil microorganisms, pests and disease pathogens.

(a) Predators: Predators are organisms that feed on another organism usually of a different species. This group of organisms is involved in the regulation of the population of other organisms (prey) in the ecological system. Most often, the predators are larger than the preys and they kill the other organisms for food. The predators help to balance nature by checking over-shooting population of animal species which feeds on the farmers' crop. Some predators are used to control some pests of crops and animals. Some predators are problems to farmers as they feed on farm animals. For example, hawks feed on chicks.

(b) Parasites: A parasite is an organism that lives in or on another organism called the host. They derived benefits (food and nourishment) from the host while the host is harmed or injured during the association. They can live inside the host as endoparasites such as tapeworm, liver fluke and ascaris. They may also live outside the host as ectoparasites such as ticks, lice and mites. Parasites are of economic importance to the farmers because they cause economic loss to his crops and animals. Cost of controlling parasites also increases cost of production. They may even cause death of crops or animals. Parasites can also be plants such as parasitic weeds like dodder and mistletoe.

(c) Soil organisms: These are living organisms inhabiting the soil. They are made up of plant and animal representatives. Examples include bacteria, fungi, earthworm, rodent, termite, algae and protozoa. They are of economic importance in agricultural production because some of them cause diseases in farm crops and animals, e.g., bacteria and fungi. Some microorganisms like the root nodule bacteria can fix nutrients directly to plant and soil. Also, fungi can help in humus formation and the decomposition of plant materials. Some soil organisms also aid aeration of soil, percolation and fertility through their feeding activities. For instance, the earthworms make holes and galleries in the soil. This action increases soil aeration. Some soil organisms such as nematodes also reduce the quality and quantity of crops. Some insect parasites such as lice act as vectors of diseases.

Activity 1: Go out and observe your immediate environment and observe keenly the various components of the environment. Measure out a 2x2 square meter area and list out the different biotic factors that you can see. Count each species you

encounter such as insects, spiders, birds, amphibians and mammals. Record your findings in a histogram. Identify the predators and parasites in your collection. Describe how the preys avoid their predators.

Summary

- ◆ All agricultural activities like crop and livestock distribution and production are affected by several environmental factors.
- ◆ These factors influence the distribution and performance of crops and livestock.
- ◆ The factors of the environment that influence the distribution and production of crops and livestock animals can be grouped into abiotic and biotic factors.
- ◆ The abiotic factors are further grouped into three major classes as (a) climatic factors, (b) edaphic (c) physiographic factors.
- ◆ Each of these factors influences agricultural productivity either directly or indirectly.
- ◆ The biotic factors of agricultural production are the living factors of the environment and these include predators, parasites, soil microorganisms, pests and disease pathogens.

Essay Questions

1. Explain the term rainfall briefly and enumerate four effects of wind on agricultural productivity.
2. (i) What is temperature? (ii) Describe four effects of temperature on agricultural productivity.
3. Explain the following briefly. (a) Soil fertility (b) Soil pH
4. Describe two ways by which low pH can affect agricultural productivity.
5. Define a predator. List four examples of predators and describe two characteristics of predators.
6. Define a parasite. Mention two major types of parasites based on where they are found on their host.
Enumerate two disadvantages of parasites to the host.

Objective Questions

1. The factors of the environment that influence the distribution and production of crops and livestock can be grouped into
 - (a) abiotic and biotic factors.
 - (b) amniotic and abiotic.
 - (c) chaotic and biotic.
 - (d) predators and parasites.
2. The amount of moisture or water vapour present in the atmosphere within a given period of time is called
 - (a) relative geography.
 - (b) relative humidity.
 - (c) distant relations.
 - (d) relative humility.
3. The following are components of abiotic factors except
 - (a) climatic factors.
 - (b) edaphic factors.
 - (c) physiographic factors.
 - (d) physiological factors.

4. The way the different particles of the soil are packed together or arranged is best described as

- (a) soil arrangement.
- (b) soil structure.
- (c) soil texture.
- (d) soil detection.

5. The soil structure has a direct effect on crop yield because

- (a) it determines the fertility of the soil and water-retention capacity of the soil.
- (b) it determines the level of soil aeration and percolation.
- (c) it determines the population level of soil organisms.
- (d) all of the above.

Answers to Objective Questions

1. (a) 2. (b) 3. (d) 4. (b) 5. (d)