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1.0 INTRODUCTION

Climate, especially rainfall, is one of the three most important aspects of the physical environment which notably influence Nigerian agriculture. Climatic factors such as rainfall and temperature exhibit seasonal variations, and these are not only critical in determining the cropping patterns and systems, but also critical in determining the length of the growing season. These, in addition to the influence of climate on the occurrence of rain and crop physiological growth, ultimately determine the magnitude of the yields of cultivated crops in the different ecological zones of Nigeria.

2.0 OBJECTIVES

By the end of this unit, you should be able to discuss:

- the components of climate that are of importance to agricultural crop production, and
- the roles these factors play in crop production.

3.0 MAIN CONTENT

3.1 Rainfall

Rainfall is the most important climatic variable, and it has far-reaching influence on agricultural crop production. Its roles in agricultural production include

i. main source of moisture supply to the soil for the activation of plant growth,
ii. replenishment of water in rivers to allow irrigation operation,
iii. build-up of underground water reserves which are later tapped by wells in dry area through seepage and percolation, and
iv. influence on soil/water/plant relationships; soil moisture status has significant direct relevance for plant growth because water balance= total rainfall- (run-off + evapotranspiration).

The amount, incidence, variation and reliability of rainfall determine differences in cropping pattern in various ecological zones in Nigeria. In Nigeria, the rainfall pattern follows a south-north gradation in amount. The latitudinal sequence is disturbed only around Jos Plateau, Mambila Plateau and the foothills of the Cameroon mountains. Two broad cropping patterns are thus, defined based on the variation in total rainfall or other rainfall parameters, namely

i. the perennial tree and root-crop zone in the wetter south, and
ii. the seasonal grain and pulse crop zone in the drier north.

3.1.1 Effects of Excessive Rainfall

Excessive rainfall (when total rainfall is greater than 2540 mm per year in the south) adversely affects crop production through high run-off, soil erosion (most serious effect worldwide), leaching, nutrient losses, waterlogging, vigorous vegetative growth or weed infestation, and general disruption of agricultural activities.

3.1.2 Effects of Inadequate Rainfall

Inadequate rainfall (when total rainfall is less than 101.6 mm per year in the north) makes crop growth impossible for most of the year except, with irrigation.

The seasonality, duration and regimes of the wet season and the number of months of inadequate rainfall per month are more important to agricultural activities than total rainfall. Therefore, crop growth is only sustainable for varying periods in different ecological zones during the

year, essentially in response to the alternating wet and dry seasons of varying duration. Also, the number of months with 1016 mm rainfall is 3-5 months south of Rivers Niger and Benue and more than 9 months in the northern part of Borno State (i.e. dry areas; Sahel savanna zone).

The onset of the rains, regime and duration of wet seepage across ecological zones also influence the timing of planting operation, number and types of crops that can be grown, and seed germination and seedling growth. This accounts for the following conditions:

i. suitability of perennial tree crops (e.g. cocoa, oil palm) and food crops with long growing periods (e.g. white yam, cassava) to most parts of the forest zone with rainfall for 250 or more days;
ii. the possibility of cultivating two consecutive or alternate crops in a year e.g. maize/cowpea;
iii. the cultivation of vegetable crops e.g. melon, pumpkin; and
iv. the predominance of short-season crops (especially cereals such as guinea-corn, millet) in the northern savanna zones with 80-200 rain-days.

Variation in the duration of the wet season determines the variety of crops grown in different zones. Thus, perennial crops such as cocoa, kolanut and oil palm, thrive well in most parts of the forest zone where the rain falls for 250 days, depending on the soil fertile-ity status. In areas with more than 250 days of rain, rubber and oil palm are particularly important and the areas well suited to food crops with long growing periods (e.g. white yam) and others with high rainfall requirement such as rice and cocoyam. Also, two consecutive crops are possible per year, e.g. maize + cowpea. In addition, the duration of rainfall is very significant in the cultivation of some vegetables in the forest zone e.g. melon and pumpkin. Northward (i.e. savanna zone), the wet season shortens (100-200 days) and therefore, cereals and exports crops with short maturity periods occupy a dominant position e.g. guinea-corn and millet.

The onset of rains varies with ecological zones, viz. March in the interior part of southern Nigeria, April in a large part of the Middle Belt and May/June in the Sudan zone. The latter crop is particularly cultivated in drought-prone areas which mark the northern limit of arable agriculture.

Generally, there are distinct regional and seasonal features of rainfall on the basis of soil/water/crop relationships. Every part of Nigeria experiences water deficit varying from a few weeks in the south to several months in the north. This, in addition to the relatively short duration of the rain (80% falls within the first 30 minutes) and high

annual evapotranspiration losses (1000 mm), further deplete the water balance and necessitate irrigation on farmlands in Nigeria. In the south, irrigation is met by sinking wells and harvesting run-off water from smaller streams. Contrarily, in the north there is considerable water shortage and therefore, the water supply is inadequate for large irrigation projects except only in the Middle Belt area. Further north, farmers have adapted to the distinct periods of water cycle by

a) planting fields with high moisture status due to the largest moisture deficit at the onset of rains, and fields with a high deficit later;
b) exploiting the soil moisture status between the end of rains and end of growing season, because the end of rains coincides with the flowering of cotton, bud maturation of groundnut and heading of guinea-corn. Thus, the success of cereal crops in the north depends on the extent to which the water demands match seasonal pattern of water availability. Severe drought, especially in the north, causes a decline in the amount of cultivated land, decline in crop yield, and decline in available food and export crops.

3.2 Temperature

Temperature is one of the major factors limiting the distribution of plants and animals on a global scale. It is of secondary importance in influencing evapotranspiration, photosynthesis and soil warming. The effects of temperature on farming system include

i. rapid soil organic matter (SOM) decomposition due to high microbial activities and increased rates of biochemical reactions,
ii. high temperatures render built-in fallows ineffective,
iii. high temperatures enhance the incidence of pathogens and pests,
iv. high night temperature favours high respiratory rates and exhaustion of plant assimilates, resulting in low net assimilate accumulation and poor crop yield, and
v. effects on plant life processes such as seed germination, pollination, flowering, fruiting, ion uptake, leaf growth and cell enlargement.

In Nigeria, air temperature is not limiting to crop growth. Thus, variations in regional and seasonal distribution are of local importance to agriculture. The higher mean annual temperature in the north than in the south encourages higher evapotranspiration, thereby lowering the water balance level. Higher evaporation rates from water surfaces in rivers and lakes in the Sudan and Sahelian zones caused by high temperatures also deplete water resources and render them inadequate

for irrigation system. However, higher night temperatures in the forest zone reduce potential photosynthesis below that of the savanna. This influences crop productivity in the different zones. Soil temperatures are more important to plant growth than air temperatures. In potatoes, optimum soil temperature for tuber growth is 17^0C whereas no growth occurs at soil temperatures greater than 29^0C. Pertinent features of temperature in Nigeria are that day temperature is higher inland except in highland areas; diurnal temperature range increases with distance from the sea, especially in the north; and mean daily temperature for January (peak of dry season) decreases northwards. However, farmers have adapted to these problems by early crop harvesting, mixed cropping, mulching, minimizing run-off/erosion, organic matter supply in decaying residue, high nutrient supply, suppression of weed growth, and protection and shading of soil.

3.3 Solar radiation

Surface reflectivity over different agricultural crop surfaces, net radiation (photosynthetically-active radiation, PAR) and energy budget and relationship of solar radiation to dry matter production and economic yields, all have implications for agricultural crop production . Solar radiation is essentially important during photosynthesis, which utilizes visible light to produce dry matter from water and CO_2. Thus, dry matter production depends on incoming solar radiation and the type of plant that is exploiting it under normal conditions. Solar radiation is very important in determining the final yield of some crops in areas of adequate water supply e.g. sugar-cane and lowland rice.

3.4 Relative humidity

This is the ratio between the amount of water vapour actually held in the air and the maximum possible amount that can be held at a particular temperature. It is a measure of the dampness of the atmosphere. Differences in relative humidity are more critical to the unpleasant climate of West Africa than high temperature. The coastal areas are under the South-west Monsoon winds for most of the year; hence, they have higher relative humidity of about 100% especially during the dry season. High relative humidity increases disease incidence on cropped farms and reduces the crop's ability to intercept solar radiation. Contrarily, low relative humidity leads to high evapotranspiration and transpiration which eventually cause wilting of crop stands. In Nigeria, farmers use different stand geometry and leaf arrangement to maximize light interception in order to adapt the crops to relative humidity.

3.5 Daylength/Photoperiod

This indicates the length or duration of sunlight hours per day. It is variable due to the apparent movement of the sun either on the northern or the southern hemisphere. These trends also affect wind movement and rainfall occurrence. Daylength affects flowering and tuber formation, vegetative development, seed germination (e.g. some rice and soybean varieties that are sensitive to photoperiod), and timing of agricultural operations such as planting, harvesting and type of crops to plant. On the basis of photoperiod, there are three groups of plants, namely long-day plants (those that flower under daylength of less than 14 h., e.g. Irish potato, wheat, barley, oat); short-day plants (those that are induced to flower under daylength of less than 10 h., e.g. sweet potato, maize, soybean); and day-neutral plants (those that are not induced by daylength e.g. cowpea). However, most tropical crops are highly sensitive to daylength, and therefore are identified in two groups:

i. those with critical daylength of less than or equal to 121/4 h. e.g. *Corchorus olitorius*; and
ii. those with critical daylength greater than or equal to 121/4 h. e.g. *Phaseolus lunatus*.

3.6 Winds and Ocean Currents

These climatic variables strongly influence rainfall occurrence and duration of the rainy season. The predominant air masses in West Africa are the equatorial maritime air mass (moisture-laden south west monsoon winds, SWM) and the tropical continental air mass (dry and dusty north-east trade/harmattan winds, NET). The meeting point of these two air masses is called the Inter-Tropical Front (ITF), whose relative dominance brings in rain (northward movement) and harmattan (southern movement). Rain falls only in areas lying south of the ITF. The northward movement of the ITF occurs in February when the NET starts to retreat and being replaced by the advancing SWM. In July, most areas south of latitude 20^0N fall under the influence of rain-bearing wind from the south. In August, the ITF reaches its inland limit and remains stable for a few weeks before moving coast-ward. In January, the ITF is near the coast once more while the NET again becomes the dominant winds. Other winds of importance to agricultural production include sea breezes, land breezes and ocean currents. The ocean currents are three, namely the Cold Benguella current, Guinea counter-current and the Cool Canary current. The currents influence climatic conditions through the winds blowing over an area; winds blowing over a warm current are usually moisture-laden while those blowing over a cold current usually have a cooling effect on the coast, arising from the formation of fog instead of rain.

4.0 CONCLUSION

In this unit, you have learned about the influence of climatic factors, especially rainfall and temperature on crop productivity, and sustainable supply of food, in Nigeria.

5.0 SUMMARY

Climatic factors play a significant role in determining the onset of the cropping season, cropping pattern and systems and the number of crops cultivatable by farmers in various ecozones of Nigeria.

6.0 TUTOR-MARKED ASSIGNMENT

1) Outline four ways in which rainfall affects agricultural crop production.
2) Differentiate (a) the cropping systems of Nigeria based on rainfall; and (b) excessive and inadequate rainfall.
3) What is the significance of inadequate rainfall?

7.0 REFERENCES/FURTHER READING

Agboola, S.A. (1979). *An Agricultural Atlas of Nigeria*. Oxford University Press Ltd.: U.K.