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Diseases of Cocoa Induced by the Climatic Elements of Rainfall and Temperature in Ekpoma, Edo State, Nigeria

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Abstract
This paper examined diseases of cocoa induced by the climatic elements of rainfall and temperature in Ekpoma, Edo State, Nigeria. The paper identified the varieties of cocoa cultivated in the study area, the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area, the level of awareness of cocoa farmers on the impact of the climatic elements (rainfall and temperature) on cocoa production in the study area and the problems induced by the climatic elements of rainfall and temperature on cocoa production in the study area. To achieve these objectives, the researcher used both primary and secondary research methods to collect the data used for the study. Four thousand and eleven cocoa farmers were found in the study area. Ten percent (10%) of the cocoa farmers' population (400 respondents) was used as the sample size. Therefore, four hundred questionnaires were administered to both cocoa farmers, marketers and the staff of Cocoa Research Institute of Nigeria (CRIN) Uhonmora,Edo State, Nigeria which were used for the investigation of the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area.. The secondary data used were obtained from National Population Commission (NPC), Agricultural Development Programme (ADP) and the Ministry of Agriculture and Natural Resources (MANR).The data obtained were analysed using tables, graphs, percentages and degrees. The results reveal that Amelonado, F3 Amazon and Trinidad(o) are the varieties of cocoa cultivated in Ekpoma. The study also reveals the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area as well as the problems posed by rainfall and temperature on cocoa production such as excessive rainfall prolong dry season and inadequate rainfall. These reduce cocoa production and consequently, the yield in the study area. Arising from the above findings The following recommendations are made which include: the employment of extension workers to train cocoa farmers, revitalization of the dilapidating weather stations and the establishment of new ones, reduction in the prices of cocoa production inputs such as herbicides and insecticides and granting soft loans to cocoa farmers. This paper is therefore concluded by advising the governments at all levels to effect the recommendations made by the researcher.

Keywords: Climatic, elements, rainfall, temperature, diseases and production.
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1. INTRODUCTION

Weather succinctly refers to the state of the atmosphere at a given point on the earth surface or over an area at a specified time while climate on the other hand simply refers to the summation or the totality of the characteristics of the atmosphere deduced from repeated observations over a long time, usually between 30-35years (Ayoade, 2004 and Lockwood, 2012). Most often, climate is defined as the average weather condition of a place for at least 5 years. The elements of climate include rainfall, temperature, humidity, sunshine, pressure; wind and cloud cover (Okhakhu, 2014). To a very large extent, the climatic condition of an area largely determines the prevalent diseases of plants, including cocoa in that area.

Disease is an illness affecting humans, animals or plants, often caused by infection (Oxford Advance Learners English Dictionary, 2024). Therefore, diseases of cocoa are the illnesses caused by infection that prevent cocoa trees from yielding optimally. Cocoa is a semi-deciduous humid tropical commercial tree crop. So, cocoa disease can be described as a particular abnormal condition that adversely affects the structure or function of all or parts of a cocoa tree crop and is not immediately as a result of any external injury.Cocoa diseases are also known to be medical conditions that are associated with specific signs and symptons. Cocoa has been a major commercial crop since its discovery in the Amazon Basin in Brazil in the 18th century (Opeke, 1978 and Ilenre, 2012). Since the discovery of cocoa in the 18thcentury, the cultivation has outspread to other parts of the world having similar environmental conditions which include South and Central America as well as West Africa which took the lead in its production since the 1960s(Adegeye, 1969 and Ayorinde, 1996).

Cocoa production in West Africaand particularly Nigeria was the base of the country's economic development before the discovery of crude oil (black gold) in large commercial quantities in 1956. The discovery and exploitation of crude oil in Nigeria drasticallydiverted and reducedthe attention of the governments of Nigeria (federal, state and local). Before the discovery of crude oil,cocoawas the highest foreign exchange earner in Nigeria. It was the commercial nature of cocoa that made the Western Region famous and more advanced in socio-economic and infrastructural development than any other region in Nigeria. The establishment of Nigeria's two great federal universities out of the then only six federal universities in the country was informed by the level of commercial value of cocoa. The construction of many rail lines and station in Ibadan was also informed by cocoa economy. Later on, cocoa production outspread from the Western Region to the then Mid-Western State viaIfonin Ondo State to Owan Local Government Areas in Edo State. In Edo State today, Owan Local Government Areas are among the highest producers of cocoa. In a similar vein, cocoa production outspread from Owan Local Government Areas to Esan land where Ekpoma is conspicuously located.

For the purpose of this study, rainfall encompasses itself, mist fog and dew. Rainfall is used synonymously with precipitation. Ayoade (2004), Emielu (2011) Lockwood (2012) and Getirana (2015) opined that rainfall is any aqueous deposit in liquid form derived from the lower atmosphere (troposphere). Ayoade (2004) and Lockwood (2012) argued that in the tropics, the term rainfall is interchangeable with precipitation since snow is generally absent except on some high mountains like the Kilimajaro in Tanzania, East Africa. For the purpose of this study, rainfall and precipitation were used interchangeably because the study area falls within the humid tropics. Rainfall is measured with the aid of rain-guage and expressed in millimeters (mm) or centimetres (cm).

Temperature in this study is defined in terms of the movement of molecules such that the more rapid the movement of the air is, the higher the temperature. Usually, temperature is defined in relative terms, that is, on the basis of the degree of heat a body has (Ayoade, 2004Ayoade (2004), Emielu (2011) and Getirana (2015)). Temperature is measured with the aid of thermometers. It is expressed in degree Fahrenheit {ºF} or degree Celsius (ºC).

Rainfall, andtemperature have the capability of inducing cocoa diseases in Ekpoma.

2. STATEMENT OF THE PROBLEM

Cocoa is a semi-deciduous commercialtropical tree crop that yields best in the humid tropics of the world. It is an important commercial tree crop hence it has attracted the attention of severalfarmers, researchers and scholars since its discovery in the 18th century at the Amazon Basin in Brazil (Okpeke, 1987 and Adegeye, 1996). For instance, Adegeye (1996) investigated the problems and solutions of marketingcocoa in Nigeria. In his research, he identified the problems of marketing cocoa in Nigeria. He also suggested feasible and actionable solutions. In a similar vein, Abdoellah (2007) examined CO2 absorption-emission balance in cocoa plantation. The findings revealed that cocoa is highly susceptible to drought and that the pattern of cropping is related to the distribution of rainfall. In addition, cocoa seedling mortality is encouraged by drought, that a short dry season affects pod filling which in turn affects bean size (Obatolu, Fashinaand Olaiya(2003), Anim-kwapong and Fripong (2005), Oyekale, Bolaji and Olowa, (2009), Ajewole and Iyanda (2011), Ofori-Boateng and Baba (2014) and Raufu, Kibirige and Singh (2016) examined the effects of climate change on cocoa production and yield. They observed that the higher the temperature (maximum of 32oC), the higher the yield whereas, the lower the relative humidity, the better the yield. They also observed that cocoa is known to yield with a minimal but sustained availability of water (rainfall) all year round.

Oyekale, *et al* (2009) noted in their study of the effects of climate change on cocoa production and vulnerability assessment in Nigeria, that the high rates in climatic changes in Nigeria have greater influence on the three phases of cocoa production ranging from seedling, establishment and processing. They posited that solar radiation produces energy for warming soil, rainfall and its characteristics in terms of amounts, intensity, reliability and distribution, temperature in the form of heat influence cocoa production and yield. They concluded that cocoa is highly sensitive to changes in climate.

Furthermore, Ajewole and Iyanda (2010) examined the effects climatic change would have on cocoa yield. From their work, they opined that cocoa being a picky (selective) crop reacts badly to any incidence of extreme weather. According to them, yearly variation in cocoa yield is affected more by rainfall than any other climatic factor.

Despite these studies, no one known to the researcher has focused on the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area. It is this identified research gap that this paper is out to fill. Consequent upon the above, this paper intends to examine the diseases of cocoa induced by the climatic of elements of rainfall,and temperaturein Ekpoma, Edo State, Nigeria.

3 AIM AND OBJECTIVES

The specific objectives are to:

(i) examine the varieties of coca cultivated in Ekpoma, Edo State, Nigeria.

(ii) examine the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area:

(iii)examinethe level of awareness of cocoa farmers on the impact of the climatic elements (rainfall and temperature) on cocoa production in the study area; and

(iv) examine the problems induced by the climatic elements of rainfall and temperature on cocoa production in the study area.

4. THE STUDY AREA

The study area is Ekpoma. It is one of the seven clans that constitute Esan West Local Government Area of Edo State (Eseigbe, 2011 and Ehisuoria, 2012). Ekpoma lies approximately within latitude 06^0 04^1 and 06^0 45^1 North of the Equator and longitude 06^0 05^1 and 06^0 10^1 East of the Greenwich Meridian (Eseigbe, 2011). The study area comprises of twelve (12) communities which are Eguare, Emaudo, Ujoelen, Ukpenu, Uhiele, Illeh, Emuhi, Iruekpen, Uke, Ihumudumu,Idumebo and Ujemen. Figure 1 expansiates further on the study area.

Ekpoma is located in the humid tropics. It has the humid tropical climate characterized by wet and dry seasons. The climate is controlled by the position of the Inter Tropical Convergence Zone (ITCZ). The Northerly and the Southerly movements of the ITCZ throughout the year is marked by outset of the wet and dry seasons (Eseigbe, 2011). The hottest period of the year in the study area is recorded between January and March (34^0C) while the lowest temperature is recorded between June and July (24^0C).

The soils in Ekpoma are ferri soils on loose sandy sediments. These soils are less leached and consequently retain water and encourage agricultural practices.

The economic activities of the people of Ekpoma encompass agricultural and non –agricultural sectors. The agricultural sector includes crops cultivation, and animal grazing. The crops cultivated include yams, maize, cocoyam, pepper, plantain, banana, pineapple, pawpaw and mango. Others are oil palm, cocoa, cashew, pear, orange and ducanut. The animals domesticated are goats, dogs and sheep. Poultry farming is also a famous agricultural activity carried out by the people of Ekpoma. The non –agricultural sector is industrialization. The industrial sector of Ekpoma is comprised of both agro and non –agro based industries. The agro-based include cassava grating and processing, rice milling and processing, vegetable oil processing and palm oil milling. The non agro-based industries in the study area encompasses block moulding, black smiting, welding, vulcanizing, hair dressing and banking –industries(Ehisuoria, 2012).

The population of Ekpoma is relatively high. The 1991 population census estimated the population of Ekpoma at 45,488 persons. The population of the study area in 2006 population census rose astronomically (though the figures for the locality are not made available bythe National Population Commission (NPC). However, the population census conducted in 2006 estimated the population of the entire Local Government Area at 127,718. Ekpoma has over 70% of the total population of Esan West Local Government Area because of the pull factor of Ambrose Alli University which is located in the study Area. The population of Ekpoma is made up of indigenes as well as non indigenes (Okojie, 1994). The non indigenes are the immigrants who are either staff or students of Ambrose Alli University Ekpoma, Staff of Irrua Specialist teaching Hospital, Staff of Esan West Local Government Ministries and parastatals. The other non indigenes are the workers employed by trading activities and industries located to service the university such as the banks, private schools, and hotels (Ehisuoria, 2012).

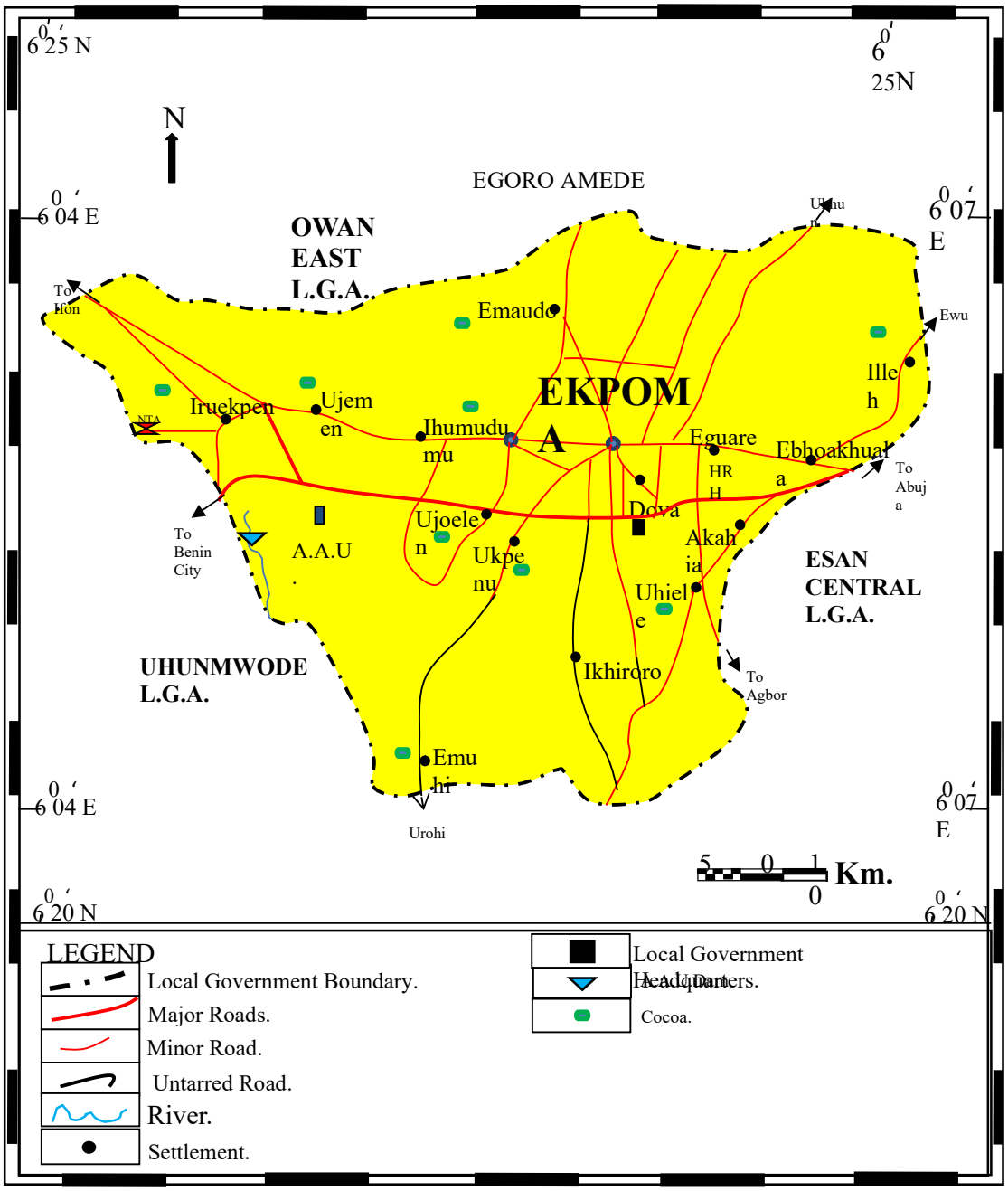

FIGURE 1: COCOA PRODUCING AREAS IN EKPOMA.
Source: Cartography Studio, A.A.U.Ekpoma, 2017.

5. CONCEPTUALTRAMEWORK AND LITERATURE REVIEW

5.1 Ergoclimate Concept

Ergoclimate Concept by Duckham (1963)is a concept of crop-weather relations. Climate affects both crop growth and the condition under which they take place. This, no doubt prompted Duckham (1963) to develop the ergoclimate concept (that is work climate). This concept is concerned with those conditions which influence the ease or difficulty of crop production and hence the speed of work and which may, as a result curtail the length of the climate-growing season by delaying one or more of the cultivation stages. Rain affects directly the physiological condition of crops so as to make their handling difficult in terms of both the time and energy spent on the farm. The effect of climate is however the most important with respect to the timeliness of farm operations, since there are limits to the season or period within which certain operations can be performed. Climate exerts or exercises a direct impact on the range and yield of crops. Climate also operates indirectly through its influence on the geographical range, the seasonal development and the activities of crops pests and pathogens to attack crops. In addition, temperature amongst others is regarded as the most important climatic factor affecting and influencing the spread of pests and diseases. Obviously, temperature often controls regional distribution of pests and diseases particularly in terms of latitude, altitude and seasonal incidence. Optimum temperature for infection or infestation and the subsequent development vary with the host species and the varieties of pests and pathogens, the length of the life cycle of such organism decreases and the rate of the development increases with increasing temperature.

As a result of the reliance on climatic elements of rainfall (precipitation) and temperature, most types of crop production practices and stages are unavoidably subject to unpredictable long and short-terms fluctuation characteristics of atmospheric conditions. Climate introduces an element of risk in crop production which makes it a particularly risky or hazardous human activity. A climatic hazard could be said to be a type of extreme atmospheric (that is, actual weather) condition and that can damage or destroy or harm crops and cause a particularly unusual decrease in production. Drought, rainstorm, flooding, fire, desiccating winds etc are some of the major types of climatic hazards to crops in general and ncocoa in particular. The extent to which climate creates serious hazards depends on several variables. These include the time of occurrence, the intensity or magnitude, and the duration of the particular event on one hand and the age, state of development and inherent tolerance or resistance of the pest or diseases on crop plants on the other hand. Crop plants are normally more sensitive to extreme weather conditions during the growing season and more particularly, in their early stages of growth. The above review could prompt one to agree with Waggoner (1969) who posited that meteorological data are required by farmers in order that they can suggest and decide those approaches best suited to cope with current weather as well as to enable them to plan long-term strategies in relation to variation in climate.

5.2 Literature Review

More than two thirds of global cocoa production takes place in that part ofWest Africa, where monthly rainfall is becoming more erratic alongside increasing temperature (Ruf, 2011). According to Abdulai et al., (2020), annual optimal rainfall for optimum cocoa yield ranges between 1500 and 3000mm, whileWood, (1985) reported that annual maximum and minimum temperature ranges are at 30–32° C and 18–21^0 C, respectively. Furthermore, Mahob et al., (2015),Medina &Laliberte, (2017) and Abdulai et al.,(2020) noted that these two climatic indices influence tree performances and the incidences of pests and diseases which contribute to lowercicoa yields.

High rainfall correlates with high on-farm humidity which promotes fungal black pod disease caused by *Phytophthora palmivora* and *Phytophthora megakarya* (Akrofi et al., 2015). The disease is highly destructive with attacks on both developing and ripening cocoa pods, causing up to 60–100% production losses if the disease is not controlled or checked (Adeniyi, 2019; Akrofi et al., 2015);). The disease peaks in May–June, which coincides with high rainfall volumes and humidity (Akrofi et al., 2015)). Management of black pod disease has been through fungicide applications, and phytosanitary practices including the removal of infected pods and pruning of both cocoa and shade trees to enhance aeration.

Mahob et al., 2015 on the other hand, observed that temperature is known to play an important role in the incidence and severity of insect pests in cocoa. For example, the incidence of mirids (*Sahlbergellasingularis* Hagl. and *Distantiellatheobroma* Distant, Heteroptera: Miridae), and shield bugs (*Bathycoeliathalassina*, H.S, Hemiptera: Pentatomidae) are exacerbated under high temperatures. Large populations of mirids often occur between August and January . Mirids affect cocoa production by piercing young and soft tissues of stems, branches, pods, and killing host cells while producing unsightly necrotic lesions that cause up to 40% yield losses (Anikwe&Otuonye, 2015). In a similar vein, Adu-Acheamong et al., 2015, noted that Mirids feed on shoots which usually leads to the death of terminal buds and leaves, with the consequent cocoa dieback in most severe instances. They are usually found in open areas of cocoa canopies where many fresh shoots (chupons) and pods are produced. The cocoa shield bugs mostly attack cocoa pods

leading to early ripening of young pods, and subsequently yield reduction. So far, the two insects have been managed principally through the application of insecticides.

6. RESEARCH METHODS

The data required for this study were collected from both primary and secondary sources. The primary source formed the major source of data needed for this paper. The primary data were collected by the use of structured questionnaire administration and personal observation in the field. Four thousand and eleven cocoa farmers were found in the study area. So, 400 cocoa farmers which representten percent (10%) of the cocoa farmers' population in the study area were considered. Consequent upon the above, four hundred questionnaires were administered in five selected communities in the study area. Thefour hundred questionnaires were retrieved and used for the study. The communities where questionnaires were administered are Iruekpen, Ujemen, Idumebo, Emaudo and Ukpenu. The stratified sampling method was used to select the communities while the random sampling technique was used to select the respondents for interview. Questions were asked on the varieties of cocoa cultivated, the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area, the level of awareness of cocoa farmers on the impact of the climatic elements of rainfall, and temperatureon thediseases of cocoa. problems posed by rainfall, and temperatureoncocoa production in the study area.

The secondary data used in this paper include but not limited to the population data as generated by the National Population Commission (NPC), Esan West Local Government Council, Agricultural Development Programme (ADP) in Irrua, Esan Central Local Government Area/Benin City, Ministry of Agriculture and Natural Resources (MANR), Ekpoma–Esan West Local Government Area/Benin City, and Cocoa Research Institute of Nigeria (CRIN), Uhumora,Owan West Local Government Area, Edo State. The data collected were collated and analysed using tables, percentages/degrees and multiple regression statistical technique. Furthermore, each of the variables of rainfall andtemperature was regressed against the diseases of cocoa to determine their level of impact.

7. RESULTS AND DISCUSSION

The diseases of cocoa in any area are highly dependent on a number of factors and these factors vary from one locality to another. This variation is explained by several natural and man–made factors. The natural factors include but not limited to climatic factors (rainfall, temperature, humidity, sunshine, wind, pressure and cloud cover) and soil types. The man-made factors are labour, capital, transportation, management/entrepreneur, high yielding varieties (HYV), high diseases resistant varieties (HDRV) and chemical application for fungicide, insects and herbs control.

7.1 Varieties of Cocoa Cultivated in Ekpoma and Their Yields in Kilogrammes (kg)/Hectare (h) in Five Consecutive Years (2018 – 2022).

Table 1 shows the varieties of cocoa cultivated in the study area. From table 1, it is crystal clear that three varieties of cocoa are cultivated in Ekpoma at present. These varieties are Amelonado, F_3 Amazon and Trinidad(o). Table 1 also reveals clearly that out of the three varieties cultivated in the study area, F_3Amazon with 4,370kg representing 35.65% of the total number of kilograms produced within five years (2018–2022) ranked highest, Trinidad(o) with 4,070kg representing 33.1% of the total number of kilogrammes produced within the five years ranked second while Amelonad(o) with 3850kg representing 31.3% of the total number of kilogrammes produced within the five years period ranked third (last) among the three varieties of cocoa cultivated in the study area.

Table 1: Varieties of Cocoa Cultivated in Ekpoma and Their Yields in Kilogrammes (kg)/Hectare (h) in Five Consecutive Years (2018 – 2022).

	Varieties of cocoa and their yields in Kg/h in Ekpoma in 5years		
Year	**Amelonado**	**F_3 Amazon**	**Trinidad (o)**
2018	763	862	803
2019	770	868	810
2020	767	880	816
2021	770	885	817
2022	780	875	824
Total	**3850(31.3%)**	**4370(35.6%)**	**4070(33.1%)**

Source: Field Survey, 2023

7.2. The Diseases of Cocoa Induced by Climatic Elements of Rainfall and Temperature in Ekpoma

Table 2 clearly depicts the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area. From the table, it is clear that the diseases of cocoa induced by the climatic elements of rainfall and temperature identified in the study area are nine (9). These diseases are conveniently categorized into in the field and nursery diseases. Among these diseases, black pod disease with 144 respondents representing 36.00% of the sample population ranked highest among the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area.Swollen shoot virus/disease is next to black pod disease in their order of impact/attack on cocoa in the study area. It had 123 respondents representing 30.75% of the sample population. Young pod wilt (*Cherelle*) is another cococa disease in the study area with 32 respondents representing 8.00% of the sample population. Table 2 also revealed that Black mirid *(distentielatheobroma*) is also in the field disease that affects cocoa in the study area and it had 26 respondents representing 6.50% of the sample population. Brown mirid *(sahbergellasingularis*) is another in the field disease that affects cocoa in the study area and it had 18 respondents representing 4.00% of the sample population. Black pods, swollen shoot virus young pod wilt (*Cherelle*), black and brown miriddiseases are described as in the field diseases because they attack cocoa in the field in the study area and other areas having the same or similar agro-climatic conditions.The other diseases of cocoa induced by the climatic elements of rainfall and temperature identified in the study area are technically described as in the nursery diseases. Amongst them, Witches broom and cocoa grasshopper *(zonoerus variegated*) ranked highest. Each had 30 respondents representing 7.50% of the sample population. Cocoa mosquito *(helopethisbegrotis*) had 2 respondents which represents 0.50% of the sample population. Cocoa ants (such as *oocophilalonginoda, crematogastagabonenesis)* were identified as the least exerting out of all the diseases of cocoa induced by the climatic elements of rainfall and temperature in the study area. It had only 1 respondent representing 0.25% of the sample population.

Table 2: The Diseases of Cocoa Induced by the Climatic Elements of Rainfall and Temperature in Ekpoma

Rainfall and temperature induced diseases	**Number of Respondents**	**Percentage Respondents**
Black pod disease	144	36.00
Swollen shoot virus/disease	123	30.75
Witches broom	30	7.50
Young pod wilt (*Cherelle*)	32	8.00
Black mirid *(distentielatheobroma*)	26	6.50
Brown mirid *(sahbergellasingularis*)	16	4.00
Cocoa mosquito *(helopethisbegrotis*)	02	0.50
Cocoa grasshopper *(zonoerus variegated*)	30	7.50
Ants such as *oocophilalonginoda, crematogastagabonenesis*	01	0.25
TOTAL:	**400**	**99.025%**

Source: Field Survey, 2023

7.3 The Level of Awareness of Cocoa Farmers on the impact of the climatic Elements of Rainfall and Temperature on Cocoa Yield

Table 3 shows the level of awareness of cocoa farmers on the impact of the climatic elements (rainfall and temperature) and cocoa production in the study area. From the table, it is obvious that 358 respondents representing 89.50% of the sample population was found to possess high awareness level of the impact of the climatic elements (rainfall and temperature) on cocoa production in the study area, 41 respondents representing 10.25% of the sample population was found to be of average level of awareness on the impact of the climatic elements (rainfall and temperature) on cocoa production while only 1 respondent which represent 0.25% of the sample population was found to possess low level of awareness of the impact of the climatic elements (rainfall and temperature) on cocoa production in the study area. From the available results, it is clear that almost all the cocoa farmers in the study area are aware of the impact of the climatic elements (rainfall and temperature) on cocoa production. So, it can be inferred from the results obtained that the level of awareness of cocoa farmers on the on the impact of the climatic elements (rainfall and temperature) on cocoa production is very high in the study area.

Table 3: The Level of Awareness of Cocoa Farmers on the impactof the Climatic Elements of Rainfall and Temperature on Cocoa Yield

Awareness	Number of Respondents	Percentage Respondents
High	358	89.50
Average	41	10.25
Low	1	0.25
Total	400	100.00

Source: Field Survey, 2023

7.4 Problems induced by the Climatic Elements of Rainfall and Temperature on Cocoa Yield in the Study Area

Table 4 shows the problems induced by the climatic elements of rainfall and temperature on cocoa production in the study area. Massive attack of pests on cocoa pods with 116 respondents representing 29.00% of the sample population ranked first among the problems posed by rainfall and temperature on cocoa production in the study area. Massive attack of pests on cocoa pods is the most serious of all the problems posed by rainfall and temperature on cocoa production in the study area. The table also reveals that contaminated cocoa beans with 88 respondents representing 22.00% of the total sample population is the second among all the problems posed by rainfall and temperature on cocoa production in the study area. Another serious problem posed by rainfall and temperature on cocoa production in the study area is weight loss which had 72 respondents representing 18.00% of the total sample population. Late or delayed ripening was also identified as one of the problems posed by rainfall and temperature on cocoa production in the study area and it recorded 45 respondents representing 11.25% of the sample population in the study area. Also identified is excessive rainfall on cocoa production in the study area with 18 respondents representing 4.50% of the sample population attested to this. Very close to excessive rainfall is prolonged dry season with 17 respondents representing 4.25% of the total sample population. Also, 16 respondents representing 4.0% revealed that soil erosion/impoverishment is a problem posed by rainfall and temperature on cocoa production in the study area. Low temperature was also identified as one the problems and it recorded 15 respondents representing 3.75% of the sample population. Finally, high temperature with 13 respondents representing 3.35% was the least of all the identified problems posed by the climatic elements of rainfall and temperature on cocoa production in the study area.

Table 4: Problems induced by the Climatic Elements of Rainfalland Temperature on Cocoa Yield in the Study Area

Problems	**Number of Respondents**	**Percentage Respondents**
Weight loss	72	18.00
Contaminated cocoa beans	88	22.00
Late or delayed ripening	45	11.25
Massive attack of pests on cocoa pods	116	29.00
Excessive rainfall	18	4.50
Soil erosion/impoverishment	16	4.00
Prolonged dry season	17	4.25
High temperature	13	3.25
Low temperature	15	3.75
Total	400	100

Source: Field Survey, 2023

8. RECOMMENDATIONS AND CONCLUSION

Arising from the findings of this research, the following recommendations are made.

The government at all levels, corporate bodies and individuals should work out measures, modalities, strategies, approaches, technologies and techniques to modify the climatic conditions (rainfall and temperature) to reduce the adverse effects of the diseases of cocoa induced by rainfall and temperature thereby encouraginghigh cocoa yield in the study area.

Extension workers should be made available to teach, train, retrain and encourage cocoa farmers on the cultivation of the cocoavarietiesthat can tolerate, resist and withstand the different climatic conditions such as drought, excessive rainfall, extreme temperature and strong winds.

Revitalization of the dilapidated weather stations and the establishment of new ones where agro–climatic data can be generated, collected, analyzed and used to boost cocoa production and consequently, the

yield in the study area should be encouraged, emphasized and sustained.The government at all tiers should come up with legislation on the granting of soft loans to cocoa farmers yearly cum subsidizing the prices of chemicals and other cocoa production input to encourage and stimulate high production and consequently, the yield.

9. CONCLUSION

The overall aim of this paper was to examine the diseases of cocoainduced by the climatic elements (rainfall and temperature) in Ekpoma, Edo State, Nigeria. The investigation ofthe diseases of cocoa induced by the climatic elements of rainfall and temperature in Ekpoma, Edo State, Nigeria should adopt a functional agro-climatologic principles which when genuinely, conscientiously, painstakingly and thoroughly applied would bring about long–term sustainable benefits to both the cocoa farmers and the nation at large

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