Perceived Effects of Drought on Urban and Peri-urban Crop Production in Nigeria: Farmers' Adaptation Measures

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Abstract

This paper examines the perceived effects of drought on crop production in Ilorin and its fringes by making use of climatic elements (temperature and rainfall) and crop yield for a period of 10years. One hundred and twenty crop farmers were sampled randomly with copies of questionnaire. Climatic and crop yield data from 2011-2020 were collected. Findings revealed that sampled farmers (85%) perceived drought to be cessation of rainfall for a long period during rainy season. Causes of droughts include insufficient rainfall, high temperatures and deforestation among others. Decline in crop was perceived as the greatest effect of drought on crop production by 92% of the sampled farmers. The correlation analysis revealed rainfall is highly correlated with maize (0.723), but weakly correlated with sorghum (0.190) and cassava (0.037). Maximum temperature correlates weakly with cassava (0.003). Minimum temperature also correlates weakly with cassava (0.019) maize (0.274) and sorghum (0.152). The regression analysis revealed that 43%, 67% and 82% of the variance in sorghum, maize and cassava production respectively could be explained by the climatic elements under study. Amongst the adaptation measures suggested include irrigation and changing planting dates. It can therefore be concluded that fluctuations in rainfall and temperature resulted into drought, which affect crop production in the study area.

Keywords: Climate, Crop Production, Drought, Precipitation, Urban Agriculture

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Received on March 7th, 2023/Accepted on December 27th, 2023

Ghana Journal of Geography Vol. 16 (1), 2024 pages 162-192

Doi: https://dx.doi.org/10.4314/gjg.v16i1.6

Introduction

Drought is a climatic term that means a period of time when there is less rainfall or water availability. It is not the same thing as aridity and water scarcity, aridity is a climatic feature of a region (low rainfall area) while water scarcity is when there is no adequate water to meet the demand. A state of stress caused by a lack of water is what is being referred to as drought. Drought can be regarded as water availability that is less than normal (Van Loon & Laah, 2014). Drought, according to Yaduvanshi et al. (2015) is defined as long-term shortages of surface and subsurface water that disrupt natural ecosystems. The World Meteorological Organisation (2012) defined drought as a globally recognized devastating disaster that affects agriculture, forestry, vegetation and human activities. The three categories of drought as identified by Dai, (2011) include, metrological, agricultural, and hydrological, with precipitation as the key variable. Agricultural drought is a major concern in this research and it is synonymous to dry soils that results from below average precipitation, which is the dearth of sufficient rainfall required for growing crops affecting plant growth and viable crop yield (Dai, 2011). However, the promising level of agro-business is a reflection of the amount of rainfall it enjoyed.

In Nigeria, droughts have occurred and continue to. For instance, it occurred in 1883, 1903/1905, 1913/1915, 1923/1924, 1942/1944, 1954/1956, 1972/1973, 1982/1983 and 1991/1995. Furthermore, a reporter (Sardauna, 2023) from *This Day* newspaper reported that not less than 60% farmers across the 34 local governments of Katsina State, Nigeria lost over 1.7 million metric tonnes of grains to drought caused by climate change in the year 2021. The most affected included maize and rice in the central and northern part of the state while sorghum, millet, cowpeas, rice, soybean and maize were worst affected in the southern zone of the state. Similarly, Murtala, (2021) a Vanguard Newspaper reporter, reported that farmers lost two-thirds of their products to insufficient rainfall and could not harvest the remaining one-third of what they planted.

In the same vein, Mojeed (2023) of Premium Times observed from a survey conducted in seven states (Nasarawa, Osun, Benue, Oyo, Katsina, Ogun and Lagos) of Nigeria that about 79 per cent of Nigerian farmers were estimated to have been affected by the ravaging effects of drought and flooding in 2020. Sunday (2021) of The Guardian Newspaper also reported that drought had led to dwindling reserves thereby making herders migrate with their cattle to where they get greener pasture and this has led to several clashes between them and farmers in these new areas.

Despite the establishment that drought has been dangerous to the existence of man in terms of food security, little research has been conducted on it in Kwara State especially in relation to urban crop production. This paper, therefore, intends to examine the perceived effects of drought on crop production in Ilorin and its fringes in the last ten years. Specifically, the paper assesses farmers' knowledge of drought; causes of drought; the effects of drought on agricultural production; the impacts of climatic variables (temperature and rainfall) on crop yield for a period of 10 years (2011 -2020); and highlight the measures to mitigate the effects of drought on crop production. The rationale for this study is because of the current increase in food prices and findings from some studies carried out in the study area where drought has been seen as a serious threat to crop yield. For instance, Ezekiel et al., (2012) examined the effects of irrigation and drought on agricultural productivity in Kwara State, Nigeria and discovered that drought reduces the yield of crops, increases food shortage and decreases the cultivated land area available for agricultural production. Similarly, Ayinde, et al., (2018) studied the vulnerability analysis of maize farmers to climatic risk in Kwara State, Nigeria and concluded that farmers do not have the necessary capacity to mitigate against the effect of climate change especially drought. Hence, the need to carry out a study of this nature.

Urban ad Peri-urban Agriculture

Urban agriculture is defined as production of food grains, fruits, vegetables, fish raising, herb gardening, livestock, all forms of poultry rearing, honey harvesting, flower and shrub growing within (intra-urban) or periphery (peri-urban) areas for home consumption and or/ for the urban market and related small-scale processing and marketing activities (Tunde, 2016). Mougeot (2000: 10) indicates that “urban agriculture is an industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows and raises, processes and distributes a diversity of food and non-food products (re-) using largely human and material resources, products and services found in and around that urban, and in turn supplying human material resources, products and services found in and around that urban area, and in turn supplying human material resources, products and services largely to that urban area”.

Peri-urban farming however, implies farming production units close to towns which operate semi-intensive or full commercial crop production such as vegetables and livestock (Komirenko & Hoermann, 2008). The Food and Agricultural Organisation (FAO) prioritizes peri-urban agriculture as one of the leading programmes to deal with the impending food scarcity that might arise due to the loss of peri-urban agrarian landscapes (Luck et al., 2015). Peri-urban farming is influenced by unavoidable changes that take place in such places as expansion of cities, increase in rate of land use for other economic purposes, changes in land cover, agricultural loss which are associated with opportunities created for commercial or market oriented cultivation of high value crops (Simon, 2008).

FAO (2001), in an attempt to differentiate urban and peri-urban agriculture refers to urban agriculture as small areas within the city where crops are grown and small livestock are raised for consumption or sale and peri-urban agriculture as farm units close to town, which operate intensive or commercial farms.

Benefits of urban and peri-urban agriculture to towns and cities include source of income, reduction of hunger, poverty alleviation, (Binns & Fereday, 1996; Lee et al., 2010), food security, environment enhancement and sustainable management (Egzibber et al., 1994; Kutiwa et al., 2010). Urban crop production is however; characterized by low capital profile, land tenure system, efforts inculcated by individuals and subsistence farming. An in-depth examination reveals that crop production has taken a new dimension, taking place along roadsides, in containers placed on balconies, on vacant readily available plots and in backyards (Tefera, 2010; Lawal & Aliu, 2010).

Urban encroachment and changing climatic variations are a threat to urban crop production and it is pertinent that these threats are addressed. This is because any threat to urban crop production could culminate into poverty amongst farmers, as well as food insecurity and famine (Wahab & Popoola, 2019). In Nigeria, farmlands, crops and livestock have been damaged because of an increase in the frequency of weather storms, hence, making it difficult to access farms and to market products (Nwajuiba, 2012).

It is important for urban communities to develop wide and workable adaptive capacities to poverty, food security and climate change (Tacoli *et al*., 2013). An adaptive capacity is the propensity and the will to cope with the consequent impacts of differentials in climate change as well as the ability to adjust to these changes (Smit & Pilifosova, 2001).

Adaptive capacity varies from individuals, communities, socio-economic phalanx and regions. Generally, the group with the least adaptive capacity suffers the negative impact of climate variability and change more (Satterthwaite, 2008). This assertion is specifically true for small-scale farmers who depend both on resources and seasonal variations of weather for their livelihoods. The Nigeria's agricultural sector is vulnerable because it is occupied mainly by small scale farmers who are reliant on variation in rainfall and other climatic factors that are susceptible to change, hence, the need for adaptive capacity to poverty and climate change is imperative for achieving food security and poverty alleviation (Lawanson et al., 2015).

Occurrence of Drought in Kwara State and Nigeria

According to the 2017 and 2018 seasonal rainfall prediction by the Nigerian Meteorological Agency, most of the North Central States which Kwara State is an integral part were predicted to have late onset and early cessation of rainfall (NIMET, 2011, 2017 and 2018). However, in 2017, the weather prediction was in deficit. While 1545 mm and 1240mm of rainfall were predicted for Ilorin and Minna, the actual amount of rainfall recorded was 1324mm and 1050mm respectively. On the same note, the agency warned of an abnormal temperature prediction, which has been reported in retrospect (Anufurom, 2009). An analyzed rainfall data reported from 1911- 2000 under thirty (30) years interval of 1911-1940, 1941-1970 and 1971 -2000 respectively revealed that parts of the central states including Kwara State, recorded late onset of rainfall, early cessation and shortened length of the rainy season and a reduction in the amount of rainfall (Idaki & Well, 2019). Generally, droughts occur across Nigeria, but they occur frequently and are more severe in the Sudano Sahelian states such as Kebbi, Sokoto, Kano, Gombe, Borno, Jigawa, Yobe, Katsina, and Zamfara States. There is therefore the need for monitoring of droughts in these regions in order to identify onset, intensity, cessation, duration and spatial extent and frequency of occurrence (NIMET, 2009).

Possible Adaptive Measures to Drought

The Food and Agriculture Organization (2008) defined adaptation as all possible human adjustments in response to climate change, which help farmers to adjust their livelihood in the changing climate situation. Adaptation helps to modify the causal effects of climate change or exploits the benefits which may accrue from it. Adaptation measures may include food security measures, introduction of saline crops and drought resistant crops, development of local food barns, improving farming and non- farming options such as economic diversification (FAO, 2008).

The degree of the risks wrought by drought relates to the interaction of the drought and the vulnerability of both human and natural systems as well as their ability to adapt (Field et al., 2014). In order to actualize a viable and lasting solution to the menace of drought, people who are vulnerable to drought are first communicated for possible adaptation. This requires treating the most vulnerable not as just a target audience, but as stakeholders in interactive learning through the means that promotes their contributions (Roncoli et al., 2001).

Measures for coping and adapting to droughts need to be propagated among farmers of all categories especially those who are more vulnerable and this requires that both farmers and agricultural extension workers operates an approach that encourage knowledge sharing (Dakolo et al., 2019). Periods of droughts is attributed to seasons when farmers lose their livelihood and investments in agricultural practices. Farmers are unable to manage or cope without external assistance during droughts in terms of relieve palliatives from both government and private organizations (South African Drought Management Plan, 2005). The relics of droughts are numerous, ranging from shortage of food, social unrest, and it can impede the redistribution of land. Additionally, the lack of adequate knowledge and paucity of resources available to farmers during droughts and other climate hazardous situations impede the coping and adaptive choices of farmers.

Relationship between Crop Production, Rainfall and Temperature

In most developing countries including Nigeria, there is a strong relationship between crop production, rainfall and temperature. According to Ayoade (2004), water is very important for the growth of all crops. Agriculture in Nigeria is generally rain-fed. This means rainfall is an important factor in crop production although it varies from place to place and from time to time. Considering its role in crop production, rainfall is usually determined by such factors as total amount of fall, number of rainy days, time of fall and the type of soil. Rainfall is usually a determinant when considering the type of agricultural system to practice and type of crop to grow in different parts of the country. For instance, maize requires an annual rainfall of 600 mm to 1000 mm while cassava requires 1000 mm or more with 6 months number of rainy days.

Processes of plant growth is usually affected by temperature of the air and soil. At every stage of its growth, plant possesses minimum, optimum and maximum temperature limits. For example, maize grows well at temperature between 21^{o}C and 27^{o}C during the day and about 14^{o}C at night. The optimum temperature requirement for maize is between 28^{o}C and 30^{o}C. Similarly, cassava requires a mean temperature of 25-29°C, and a soil temperature of about 30°C. It also needs adequate soil moisture from planting to sprouting. Sorghum needs about 15^{o}C of soil temperature.

Materials and Methods

The study area is Ilorin and its fringes. Ilorin is the capital city of Kwara State, Nigeria. It is located at the transition zone between the Southern Forest Vegetation and the Northern Savanna Woodland between latitude $8^0 30^{"}$ N of the equator and longitude $4^0 35$" E of the Greenwich Meridian in the plain of the South Western Nigeria. It occupies a land mass of about $765km^2$ (Tunde & Abdulquadri, 2021) and a population of 777,664 (NPC, 2006). Ilorin shares boundaries with Moro Local Government Area to the north and to the East by Ifelodun Local Government Area, to the West by Asa Local Government Area and to the South by Oyun Local Government Area. It comprises of twenty (20) wards (see figure 1) namely; Sabon-Gari I, Sabon-Gari II, Oke-Ogun, Balogun Fulani, Zango, Balogun Gambari, Magaji Are, Magaji Gari, Magaji Okaka, Magaji Badari, Magaji Ibagun, MagajiOjuekun, Balogun Ajikobi, Balogun Alanamu, Baboko, Adewale, Ubandawaki, Magaji Oloje, Magaji Ogidi and Magaji Zarumi (Tunde, 2013). The city has humid tropical climate and experiences two types of seasons, the dry and wet seasons. Wet season begins in March when Tropical maritime air mass is prevalent and ends in October often abruptly. Dry season begins with the onset of tropical continental air mass which is predominant between the months of November and February (Tunde & Abdulquadri, 2021). The mean annual rainfall is 1,200mm (Olaniran, 2002). Rainfall concentration is usually between the months of March and October, exhibiting double maxima rainfall pattern with peak periods in the months of June and September and a period of dry spell in July. While maximum average temperature of the study area ranges between 30^0 and 35^0C respectively. The soil type of the study area is ferruginous soil of the basement complex origin which is composed of reddish-brown soil and has high concentration of iron-oxide (Olaniyan, 2002:12). The city is drained mainly by River Asa and its tributaries. The land in the study area is also been used by its inhabitants for different purposes among which are residential, agricultural, commercial, educational, religious, agricultural, recreational, and industrial. Most residents of the city are engaging in farming which is favored by the arable land and rich fertile soil **(**Olaniyan, 2002:12). The major food crops that is cultivated in this region include maize, guinea corn, groundnut, soybeans, yam, cassava, potatoes and vegetables. Most of the farming activities are rain fed in nature, especially the arable one.

Primary data were obtained randomly from one hundred and twenty urban farmers with the use of questionnaire. This is because there is no official record of the total number of urban famers in the study area. Secondary data were gotten from journals, textbooks and internet among others. Similarly, to augment the data obtained from the questionnaire, climatic (rainfall, number of rainy days, maximum and minimum temperature) (see Table 1) and crop yield (maize, cassava and sorghum) (Table 2) data of Ilorin were obtained from the Kwara State Agricultural Development Project, for a period of 10years (2011-2020).

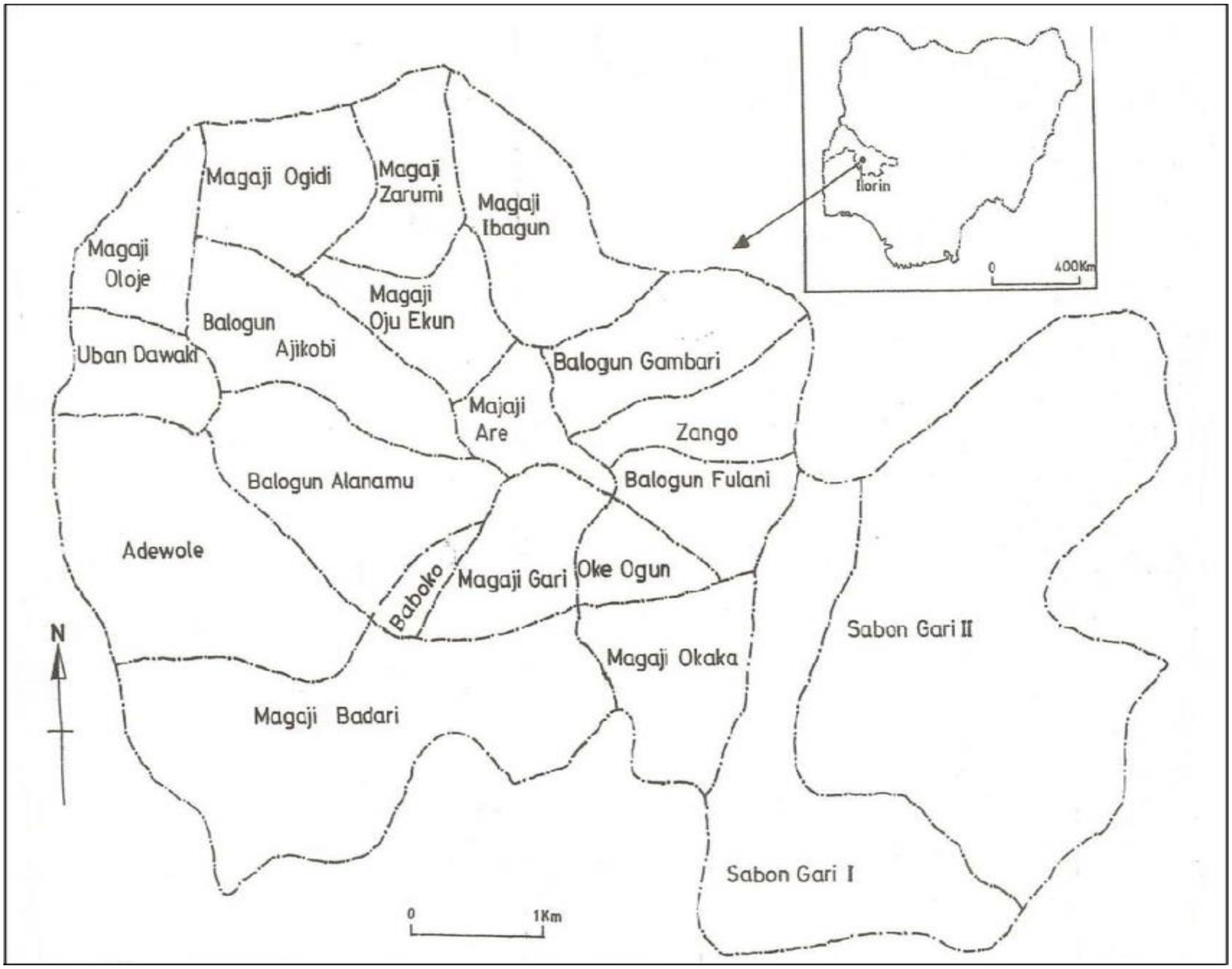

Figure 1: Map of Ilorin showing the wards

To support the findings from the respondents, crop yield and climatic parameters were subjected to trend, correlation and multiple regression analyses.

Table 1: Mean Annual Climatic Data for Kwara State (2011-2020)

Year	Rainfall (mm)	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)	Number of rainy days
2011	1252.8	36	23	59
2012	1617.8	32.4	23.7	60
2013	900	35.5	22.8	54
2014	1016	37.7	21.4	55
2015	806	37.3	22.5	47
2016	1747.2	35.8	21.03	83
2017	1504.86	39.8	21.8	55
2018	1283.7	34.4	21.2	88
2019	1065.3	34.8	22.3	73
2020	959.4	33.6	20.5	98

Source: Kwara State Agricultural Development Project, Ilorin, 2021

Table 2: Crop yield (2011-2020)

Year	**Maize**	**Cassava**	**Sorghum**
2011	1.79	16.8	1.52
2012	1.58	16.98	1.55
2013	1.59	17.48	3.87
2014	1.63	17.76	3.19
2015	1.55	16.89	2.34
2016	1.57	17.18	2.49
2017	1.65	14.81	2.61
2018	1.73	19.22	2.74
2019	1.78	19.8	2.82
2020	1.76	19.5	2.78

Source: Kwara State Agricultural Development Project, Ilorin, 2021

Results and Discussion

Table 3 presents the socioeconomic characteristics of the respondents. According to the sex structure of the respondents, out of 120 respondents, 60 percent are males and 40 percent are females. From the research, more males were involved in crop production than female because it requires physical strength to prepare the land for farming. This is similar to Abaje et al. (2014) who observed that males dominated activities related to agriculture, especially farming.

Furthermore, the highest (40%) age group were those between the ages of 15 and 30 years old, while the lowest (3.3%) was those over 60 years old. It can also be noted that the bulk (53.3%) of the respondents are married.

In addition, the educational status of the respondents was investigated, the results revealed 45% had secondary education and 40% obtained tertiary education. This suggests that the vast majority of the respondents are well-educated. In addition, about 6.6% sampled respondents had no formal education. The majority of the respondents (50%), are Christians, followed by Islamic faith 46.7% and 3.3% traditional religion.

The household size of the respondents was investigated, and the following results were discovered; 53.3% of respondents have between 4 and 6 household size, 31.7% have between 7 and 9 household sizes, 11.7% have between 1 and 3 household size, and 3.3% have over 10 household sizes. This is against the finding of Tarfa et al., (2019) where average household size of farmers was 10. The respondents' annual agricultural revenue was also examined and majority (50%) of farmers make between ₦150,000 and ₦300,000 per year from their agricultural produce, while only 6.7% earn more than ₦600,000.

Table 3: Socio-Economic Characteristics of Respondents

Socio-economic characteristics	Frequency	Percentage
Sex		
Male	72	60
Female	48	40
Total	120	100
Age Group		
15 - 30 years	48	40
31 -45 years	25	20.9
46 - 60 years	43	35.8
Above 60 years	4	3.3
Total	120	100
Marital Status		
Single	46	38.3
Married	64	53.3
Divorced	1	0.8
Widowed	9	7.6
Total	120	100
Educational Status		
No formal education	8	6.6
Primary	10	8.4
Secondary	54	45
Tertiary	48	40
Total	120	100
Religion		
Christianity	60	50
Muslim	56	46.7
Traditional	4	3.3
Total	120	100
Household Size		
1 to 3	14	11.7
4 to 6	64	53.3
7 to 9	38	31.7
above 10	4	3.3
Total	120	100
Annual Farm Income		
below ₦150,000	20	16.7
₦150,000 - ₦300,000	60	50
₦310,000 - ₦450,000	18	15
₦460,000 - ₦600,000	14	11.6
above ₦600,000	8	6.7
Total	120	100

Source: Field Survey, 2022

Knowledge and Causes of Drought

Farmers were asked about their understanding of drought. According to the sampled farmers, the majority (85%) of the farmers perceived drought as cessation of rainfall for a long period during rainy season. This is in conformity with findings of Atedhor, (2014). Others perceived it as the lack of rainfall during rainy season. The responses revealed that sampled farmers have adequate knowledge of the meaning of drought.

Insufficient rainfall, high temperatures, deforestation, drying up of water bodies, prolonged daylight, and other factors are among the significant causes of drought in Ilorin. From Figure 3 on the causes of drought, 36% of the farmers are of the opinion that insufficient rainfall causes drought. This corroborates Oruonye (2014)'s findings that farmers in Taraba State opined that there was always a delay in the onset of the rainy season which causes droughts. Furthermore, 22% perceived it to be prolonged daylight, 19% believe that high temperature is a cause of drought, 11% believed its drying up of water bodies while 8% and 4% associated it with deforestation and some other factors (intensive farming resulting in the land's ability to absorb and retain water) respectively.

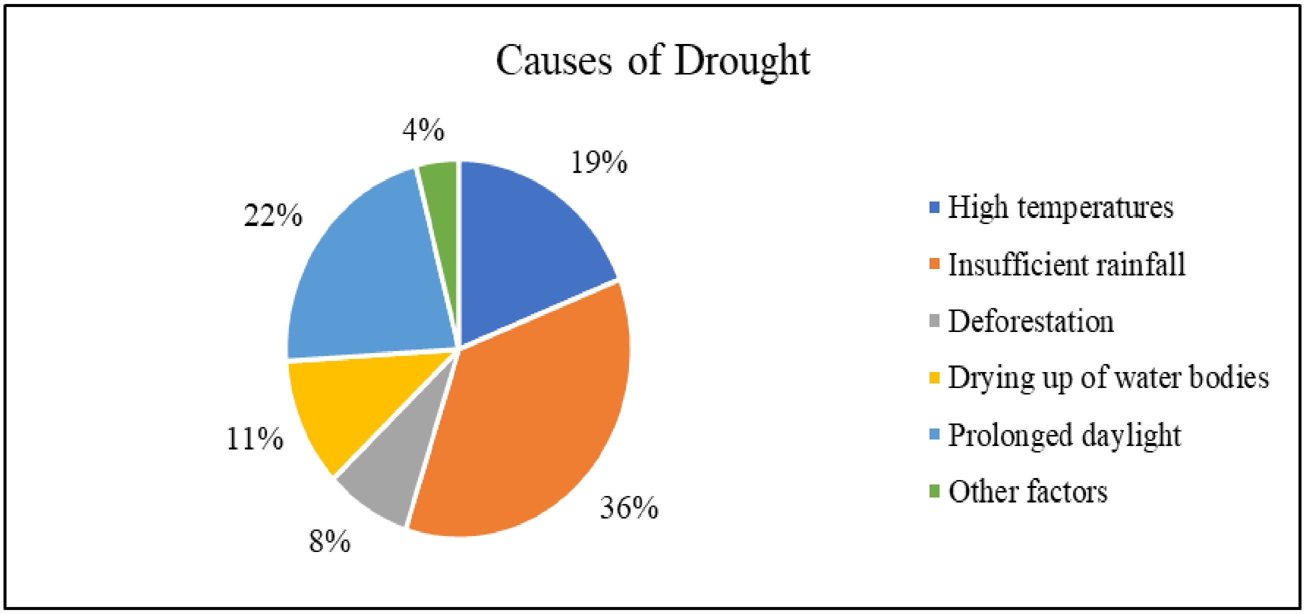

Figure 2: Causes of Drought

Source: Field Survey, 2022

Effects of Drought on Crop Production

Regarding the effects of drought on crop production, Table 4 revealed that there are variations in the effects of drought as put forward by the sampled farmers.

Table 4: Effects of Drought on Crop Production

Impacts	Frequency	Percentage
Decline in crop yield	110	92
Stunted crop growth	100	83
Food Shortage	80	67
Poor quality of crops	55	46
Less cultivated area	46	38
Discouragement	50	42
Others	30	25

Note: Total not 120 because of Multiple Responses

Source: Field Survey, 2022

From table 4, there are multiple responses and 92% perceived the effect of drought on crop production to be a decline in crop yield. This is in tandem with the finding of Orimoloye et al., (2022). Stunted growth of crop was seen as another effect of drought on crop production by 83% of the sampled farmers. About 67% of the sampled farmers opined that the effect of drought on crop production is that it leads to food shortage. Poor quality of crops was considered as an effect by 46% of the sampled farmers. Discouragement and cultivation of less area of land were seen as the effects of drought on crop production by 42% and 38% of the sampled farmers respectively. Only 25% of the sampled farmers claimed the effect of drought on crop production to be other factors such as increase in price of food in the market and scarcity. This implies that drought affect crop production largely in the study area. This finding is in harmony with that of Eze (2018) who reported that agriculture in the study area is currently being constrained by the frequent occurrence of droughts.

Trend of annual rainfall

To support the findings from sampled farmers, rainfall trend was examined. From figure 2, rainfall fluctuates as the mean annual rainfall was highest in the year 2016 with a mean value of 1747.2mm, followed by years 2012 and 2017 with mean annual values of 1617.8mm and 1504.9mm respectively. The lowest rainfall (figure 2) was experienced in 2015 with a mean value of 806mm. Hence, there is an evidence of rainfall variability which can cause drought particularly between years 2011 and 2015; also, years 2016 and 2020.

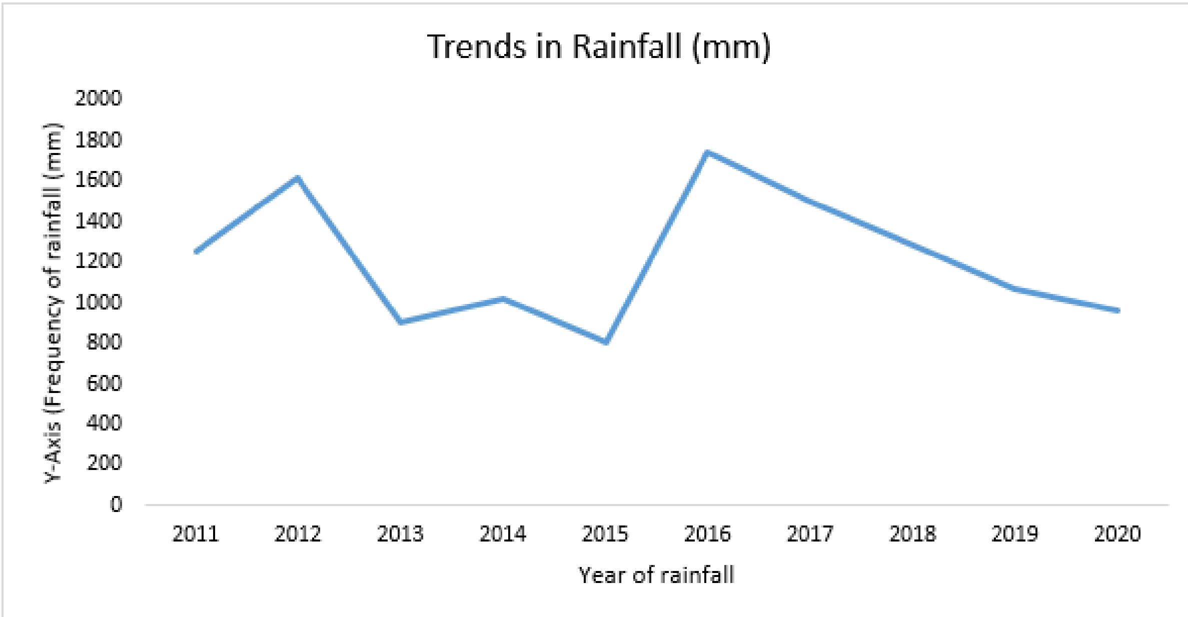

Figure 2: Rainfall (mm) trend from 2011-2020

Source: Computer output, 2022.

Similarly, the trend of annual number of rainy days (Figure 3) showed fluctuations as it was 98days in the year 2020 while in the year 2015 it only rained for 47 days. The implication of this is that crop yield will be low because rainfall has been declining since year 2016, considering the fact that agriculture in the study area is rain-fed.

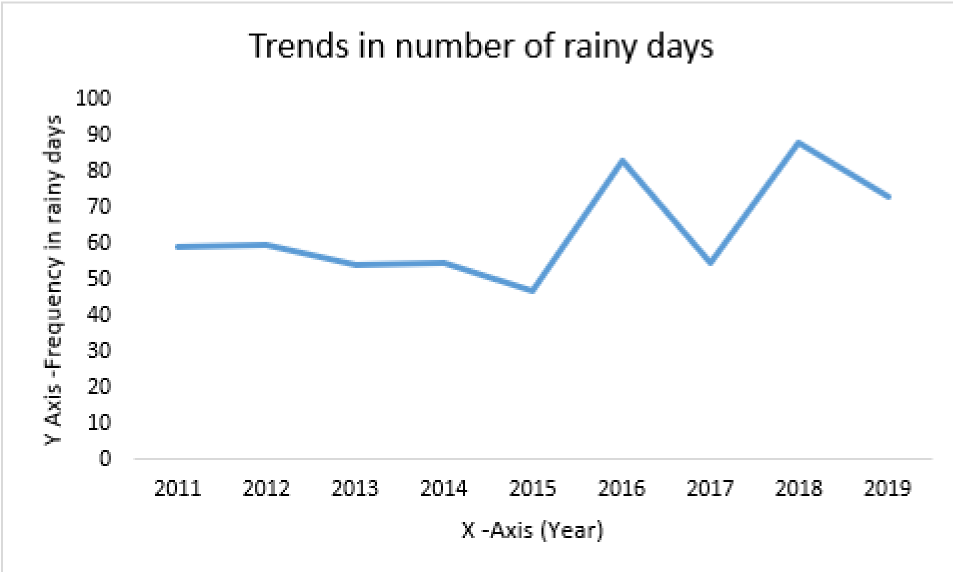

Figure 3: Trends in number of rainy days from 2011-2020

Source: Computer output, 2022

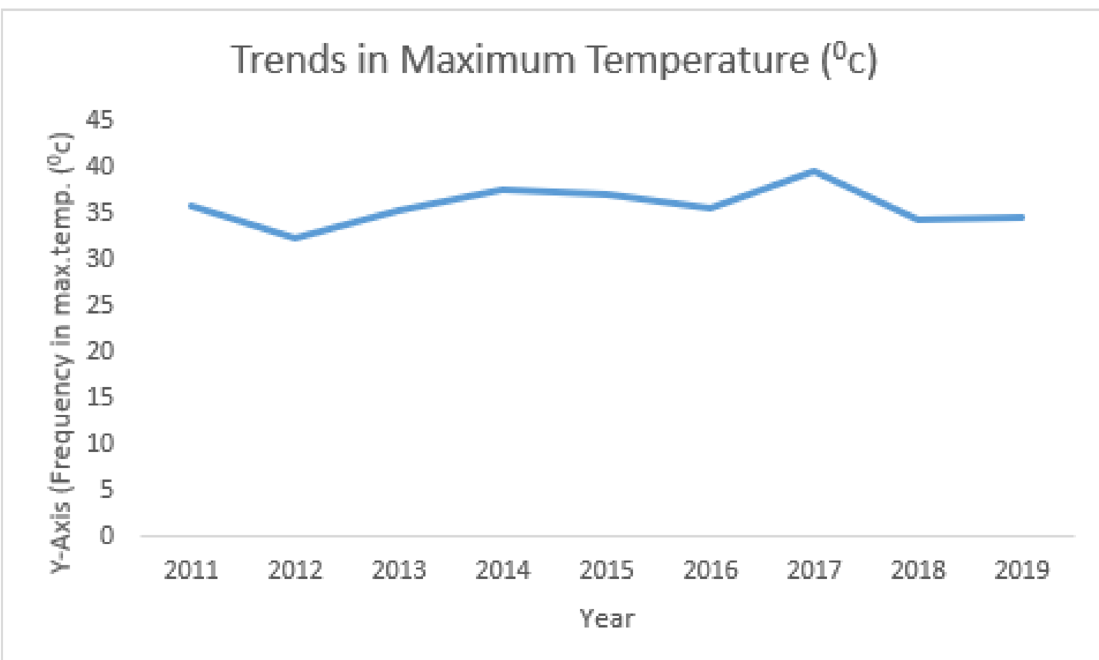

Figure 4: Trends in maximum temperature (0c) from 2011-2020

Source: Computer output, 2022

Maximum temperature (figure 4) on the other hand also varies but not too much. For instance, temperature was highest in the year 2017 with a mean value of 39.8oC while the lowest was in the year 2012. Minimum temperature was the highest in the year 2012 with a mean value of 23.7oC while the lowest was in the year 2020 with a mean value of 20.5oC.

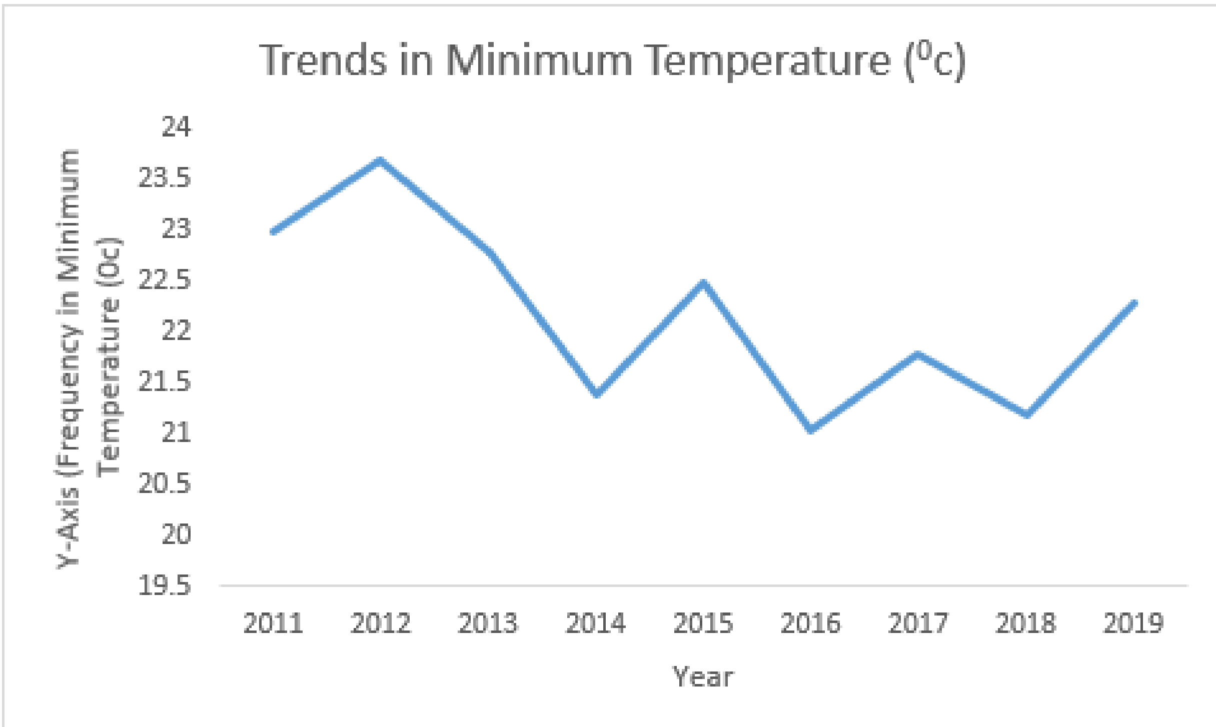

Figure 5: Trends in Minimum Temperature from 2011-2020

Source: Computer output, 2022.

Since there is variation in temperature in the study area, the implication is that when temperature is high, the soil will not be moist and this can lead to reduced crop yield.

Trend of Crop yield

The trend analysis as revealed in Figure 6 indicated little variation in maize yield as the highest yield was year 2011 with 1.79 yield/ha and lowest was year 2015 with 1.55yield/ha. This shows a downward trend. It started increasing again in year 2017 till year 2020.

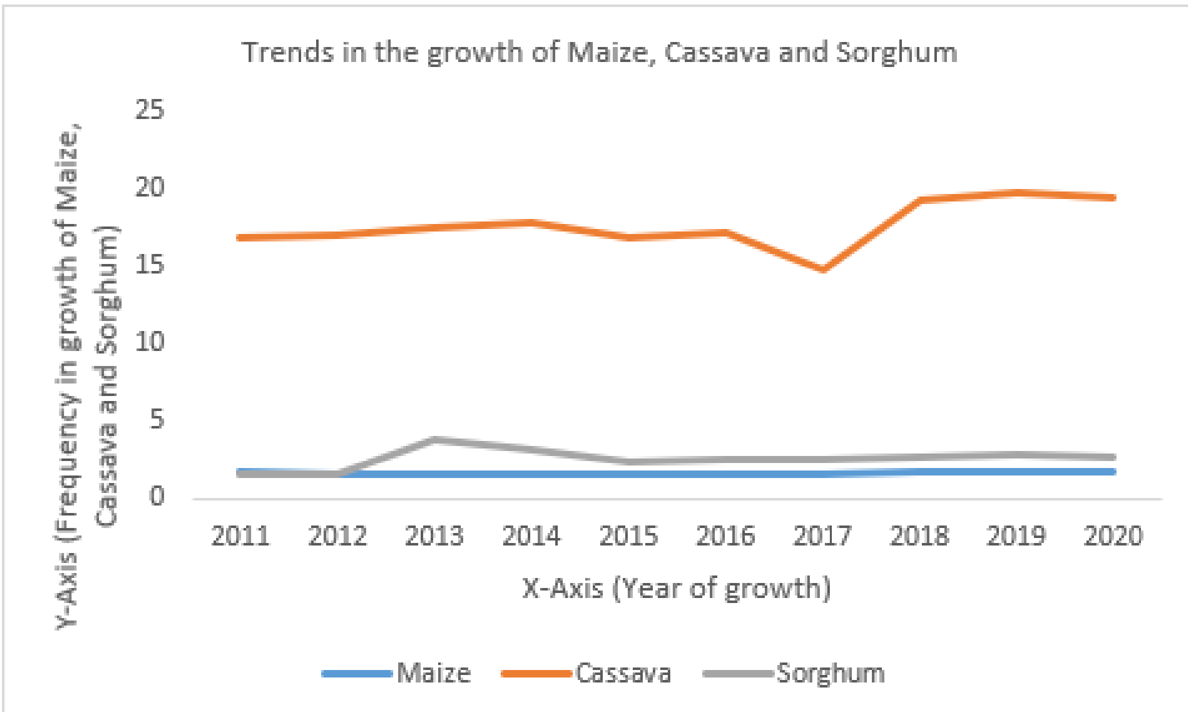

Figure 6: Trends in the growth of Maize, Cassava and Sorghum

Source: Computer output, 2022

There was an upward trend in sorghum from year 2011 to 2013. From year 2014, it started decreasing and also fluctuating till 2020. It is only cassava that did not show any significant variation from year 2011 to 2020, except in year 2014 where it dropped a bit.

Correlation analysis for climatic elements and crops

Table 5 revealed the correlation between climatic variables and crop yields. From the table, rainfall is highly correlated with maize (0.723), but weakly correlated with sorghum (0.190) and cassava (0.037). The implication of this is that the higher the rainfall the higher the yield of maize, while cassava and sorghum require minimum rainfall. This corroborates the findings of Olanrewaju (2010) that the amount of rainfall received is as crucial as its spread over time for optimal yield of some crops. Maximum temperature correlates weakly with cassava (0.003). This is in support of Tunde, (2019) where maximum temperature correlates weakly with cassava. Minimum temperature correlates with cassava (0.019) which is very weak, maize (0.274) and sorghum (0.152). This implies that maize requires minimum temperature for their yield.

Table 5: Correlation analysis for climatic elements and crops

Crops	Rainfall	Max. temperature	Min. temperature	Number of Rainy Days
Maize	0.723	0.474	0.274	0.160
Cassava	0.037	0.003	0.019	0.033
Sorghum	0.190	0.768	0.152	0.888

Correlation is significant at the 0.01 level

Source: Computer Output, 2022

Impacts of climate variables on Crop production

To assess the impact of climatic variables (rainfall, maximum, minimum temperature and number of rainy days) on crop yield in the study area, a multiple regression analysis was employed. The result of the regression analysis on Table 6 reveals that 43%, 67% and 82% of the variance in sorghum, maize and cassava respectively be explained by the climatic elements under study. The implication is that 57%, 33% and 18% of the variance in the crops under study can be explained by some other factors such as edaphic factors, farm techniques and seed varieties. This is similar to the study by Ajadi et al., (2011) that variation in crop yield could not only be attributed to the impact of changes in climatic elements but also to some other non-climatic factors such as soil fertility and farm techniques.

Table 6: Regression Analysis for Crops

Crops	R	R^2	Standard Error	Regression Coefficient	F-ratio	P-Value
Sorghum	0.662	0.438	0.7038	21.873	0.794	0.496
Maize	0.819	0.671	0.7187	-5.129	-1.824	0.166
Cassava	0.909	0.827	0.8441	28.505	0.863	0.038

Source: Computer output, 2022

Adaptation Measures

The farmers respond to the measures adapted to mitigate the effects of drought on crop production. The result on Table 7 shows varied responses from farmers. To study the extent of association between farmers' measures taken, the data collected were subjected to 5-point Likert scale to include:

5 = strongly agree, 4 = Agree, 3 = Undecided, 2 = Strongly agree, and 1 = Disagree.

Table 7: Adaptation Measures

Adaptation measures	SA	A	UN	D	SD	Mean Ẍ	Rank
Enhancing irrigation schemes	95 (79.1)	20 (16.6)	10 (8.3)	0 (0)	0 (0)	4.9	1st
Restoring pastures and balancing water resources	40 (33.3)	20 (16.6)	60 (50)	0 (0)	0 (0)	3.8	8th
Water harvesting (such as micro dams, ponds and wells, use of reserved sources of groundwater	90 (75)	25 (20.8)	5 (4.2)	0 (0)	0 (0)	3.9	6th
Shifting to drought tolerant crops	100 (83.3)	20 (16.6)	0 (0)	0 (0)	0 (0)	4.8	2nd
Crop insurance	40 (33.3)	30 (25)	40 (33.3)	5 (4.2)	0 (0)	3.8	8th
Recovering the water holding capacity of soils through tree planting (including fruit trees)	80 (66.7)	35 (29.2)	5 (4.2)	0 (0)	0 (0)	4.6	4th
Mulching	95 (79.1)	25 (20.8)	0 (0)	0 (0)	0 (0)	4.8	2nd
Changing planting dates	30 (25)	20 (20.8)	10 (8.3)	40 (33.3)	20 (20.8)	3.0	11th
Scaling down production to reduce crop loss	50 (41.2)	30 (25)	0 (0)	30 (25)	10 (8.3)	4.0	5th
Migration	35 (29.2)	25 (20.8)	30 (25)	25 (20.8)	5 (4.2)	3.5	10th
Pray to God	40 (33.3)	30 (25)	50 (41.2)	0 (0)	0 (0)	3.9	6th

Source: Field Survey, 2022

The measures adapted upon to reduce the effect of drought were ranked, from the ranks, enhancing irrigation scheme was ranked as the most important measure with a mean value of 4.9. This contradicts the study by Abaje and Magaji (2022) where praying to God (4.46) was ranked as the most important strategy to adapt to drought. The second measures according to the ranking were shifting to drought tolerant crop and mulching with mean values of 4.8 and 4.8

respectively. The fourth measure practiced by farmers to limit the effects of drought was recovering the water holding capacity of the soil through tree planting with a mean value of 4.6.

Conclusion

Since crop production in Nigeria is rain-fed, the perceived effects of drought on crop production cannot be overemphasized. Findings from the study have shown that rainfall and temperature have great impact on the crop yield under study. This is because cessation of rainfall and increased temperature often lead to drought, which consequently lead to crop losses and low income from the crops. The increase in temperature in Ilorin and its fringes and cessation of rainfall when compared with rural areas contributed to decline in crop yields. It can therefore be concluded that farmers in the urban areas especially Ilorin should be encouraged to adopt irrigation services to maintain their crops as this will not only help in crop growth but also boost crop production generally in the study area. Training of extension agents in the area of climate change in order to pass sufficient knowledge on how to curb such hazards as drought should be encouraged the more. In essence, the findings will be a useful planning tool to avert problems associated with drought in the study area and in Nigeria as a whole.

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