

Critical Review of the Causes and Effects of Dry Spell in 2021 Rainy Season in Danko Wasagu Local Government, Kebbi State, Nigeria

Sanchi, I. D¹, Alhassan, Y. J^{2*}, Sabo, Y. A¹, Hamid, B. J³

¹Department of Agricultural Economics and Extension, Federal University of Agriculture Zuru, Kebbi State, Nigeria

²Department of General Studies Federal University Wukari, Taraba State, Nigeria

³Kebbi State University of Science and Technology Aliero, Nigeria

*Corresponding author: Alhassan YJ

| Received: 04.11.2021 | Accepted: 10.12.2021 | Published: 30.12.2021 |

Abstract: The paper reviewed the concepts of dry spells based on United States Geological Survey (USGS) perspective and other perspectives such as those adopted in different fields like meteorology, hydrology, and economy of water resources. It showcases the forms of dry spells to include meteorological dry spells, Agricultural dry spells, socioeconomic dry spells and hydrological dry spells. The paper succinctly elucidated the various causes of dry spells such as natural causes, altered weather patterns, excess water demands etc. the paper also unveils the disastrous effects of dry spells on farm families to include famine and hunger, social conflicts and wars, migration and relocation etc. the paper then suggested ways and/or coping strategies of dry spell issues for improved food security such as planting more trees and combating deforestation, irrigation, use of dry spell tolerant and early maturing crop varieties by farmers.

Keywords: Causes, Effects, Dry Spell, 2021 Rainy Season, Danko Wasagu Local Government.

INTRODUCTION

One of the impacts of climate change on rain-fed agriculture in the arid and semi-arid regions of northern Nigeria is the increasing frequency and magnitude of occurrence of dry spells. A dry spell is a period of 3 or more days of lack of rainfall during the wet season. A pentad dry spell is a dry spell of five days duration. Dry spells, apart from limiting soil moisture for plant use, pose serious threat to uptake of nutrients thereby affecting crop yield. Occurrence of dry spells during the growing season which cause deficiency of soil moisture therefore, poses the greatest threat to food security in this region. Dry spell occurrence has not only reduced the yield of crops in this region but have in many case lead to complete loss during extended period of occurrence, leading to drought. The 1972/73 and 1984 droughts in Nigeria were a consequence of cumulative effect of dry spells of long duration that led to the droughts in the extreme northern states of Nigeria.

Dry spells are sequences of days without precipitation. They can affect societies in many ways, including negative effects on water security and food production. The intensity and duration of droughts are

directly proportional to the number of days without precipitation. Extreme dry spells refer to meteorological droughts. Long dry spells can increase, for example, the risk of agricultural losses or wildfires. Wet spells, on the other hand, are sequences of days with precipitation above a certain (minimum) threshold. Extremely long wet spells can lead to saturated soils and thus influence the flood hazard and, depending on the climatic conditions, can have direct impacts on agriculture and the prevalence of water related vector-borne diseases. Additionally, dry and wet spells can affect water quality. For example, dry spells can lead to lower river flows, reduced velocities and thus higher water residence.

Dry spells increase the risk of drought occurrence and make the affected regions more vulnerable to food insecurity. Studies indicate that large parts of the world rely on rain fed agriculture for their food security (Fischer, 2012). Over the last decades as a consequence of climate change, dry spells have been increasing in spatial and temporal scales leading to rainfall variability that has become a concern in the rain fed agricultural regions of the world (Mugalavai and Kipkorir 2015). In many African regions, dry spells

Quick Response Code



Journal homepage:

<http://crosscurrentpublisher.com>

Copyright © 2021 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

Citation: Sanchi, I. D *et al* (2021). Critical Review of the Causes and Effects of Dry Spell in 2021 Rainy Season in Danko Wasagu Local Government, Kebbi State, Nigeria. *Cross Current Int J Agri Vet Sci*, 3(8), 66-75.

have continuously impacted on small scale agriculture that includes livestock production which forms approximately 90% dependency for food production and 80% of the population reliance as a source of livelihood (Rockstrom *et al.*, 2003). Kenya where Homa Bay County is situated is one of the East African Countries that drought is prone due to its peculiar eco climatic conditions. It has a long history of extreme climatic conditions of dry spells and drought (Mateche, 2011). Spatial and temporal distribution of short and long rains in many parts of Kenya is defined by the general prevalence of monsoons and the corresponding agricultural practices (Stewart, 1988). Both short and long rainy periods experience some degree of dry spells that substantially influence agriculture and specifically livestock production especially in the rangeland and sub humid lands.

Water has long been considered to be the main limiting resource for crop growth in semi-arid sub-sahara Africa. Although water is limiting, it is often the distribution of water rather than lack of total seasonal amounts that is affecting crop growth and final yields (Monteith, 1991). The uneven seasonal distribution of rainfall may expose the crop to a range of mild to severe intra-seasonal dry spells, which may subsequently affect the yield adversely. While dry spells may affect crop growth without significant reductions in seasonal rainfall totals as compared to average totals, meteorological droughts occur when. Drought is the major disaster that affects the Sudan region of Nigeria, it has occurred quite frequently in the past years over this region, and it is primarily due to insufficient rainfall caused by prolonged dry spells. Consequently, insufficient rainfall has devastating impacts on Nigeria's economy as poor agricultural practices, low agricultural yield and poverty have been directly linked to it. The effects of drought and dry spells to livestock are also extreme, and it results in long distance migration of herders in search of water and green pasture for their livestock.

Rainy season in Nigeria is highly variable in both spatial and temporal scales. Water is a major limiting factor for crop growth in smallholder farming systems in semiarid and dry sub-humid Africa. The climatic conditions with high atmospheric evaporative demand and highly variable rainfall in spatial and temporal scales make farming a risky business. As a result of variable rainfall, low fertilizer use and poor overall crop management, small-holder farmers' cereal yields are low at 1 t ha⁻¹ or less (e.g. Rosengrant *et al.*, 2002). Potential yields obtained by on-station or commercial farmers for similar conditions are 3-5 times higher. In a longer term perspective on a regional scale the effect is less ability to feed the population as yield growth stagnate or decrease over time. Future scenarios with high population growth (UN/Population Division, 2002) albeit not necessarily in agricultural production (Tiffen, 2003), marginally reduced poverty (FAO,

2003) and increasing demand of water and land for other societal and ecosystems uses (Falkenmark, 1997), put additional pressure on small-holder farmers to produce more with less resources. Better on-farm water management through rain water harvesting can prove to be an opportunity to upgrade current farming practices in these climate regions. Less risk of crop failure due to crop water deficits may improve farmers' willingness and ability to further invest with fertilizers and other crop management strategies.

One of the consequences of global warming is resulting in droughts. Droughts have been in existence for Millenia but with the trends of global warming and climate change, more droughts will be witnessed and more calamity will only follow.

Concepts of Dry Spells

The United States Geological Survey (USGS) defines dry spell as a period of drier-than-normal conditions that results in water-related problems. Dry spell is characterized by a lack of precipitation, such as rain, snow, or sleet, for a particular period, resulting in a water shortage.

The precipitation is low even if the amount of precipitation at a particular location varies from year to year. When little to no rain falls, soils dry out and plants die. When the level of rainfall is less than normal for weeks to years, streamflow declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. When such dry weather persists and water supply problems develop, the dry period becomes a drought.

Dry spell affect more people globally than any other natural disaster. Also, in contrast to other natural disasters, they all announce their arrival, are large and generate destruction in impact and even after they are gone, but droughts are different. They do not make a big entrance and the start of a drought might even be mistaken for a bit of a dry spell. Their impacts build over time and leave a trail of destruction as dangerous and deadly as any other extreme weather event. What is also serious about droughts is that they do not leave immediately and in fact, they have affected more people over the past four decades than any other type of natural disaster. Also, unlike other natural disasters, droughts can be occasioned by human activity. Well, they can occur naturally, but human activity, such as water use and management, can exacerbate dry conditions.

Dry spells are categorized according to how they develop and what types of impact they have. Meteorological droughts occur when a region's rainfall falls far short of expectation. This results in a large swath of parched and cracked earth. Agricultural dry spell are occasioned by agricultural tendencies when available water supplies are unable to meet the needs of crops or livestock at a particular time. This type of

drought can stem from meteorological droughts, reduced access to water supplies, or simply poor timing. For example, when snowmelt occurs before runoff is most needed to hydrate crops. Finally, you have hydrological droughts, which occur when a lack of rainfall persists long enough to deplete surface water like rivers, reservoirs, or streams, as well as groundwater supplies.

Dry Spells Views Adopted in Different Fields

Many dry spells definitions are adopted in different fields (meteorology, hydrology, economy of water resources), with reference to various hydrometeorologic variables.

Meteorological dry spell

Meteorological definitions of dry spell are the most prevalent. They often define dry spell solely on the basis of the degree of dryness and the duration of the dry period. Thus, meteorological dry spell has been defined as a period of more than a particular number of days with precipitation less than some specified small amount (Wilhite and Glantz, 1985).

Hydrologic Dry spell

Definitions of hydrologic dry spell are concerned with the effects of dry spells on surface or subsurface hydrology, rather than with the meteorological explanation of the event. The frequency and severity of hydrologic dry spell is often defined on the basis of its influence on river basins. Hydrologic dry spells are often out of phase with both meteorological and agricultural dry spell.

Agricultural Dry spell

Agricultural dry spell occurs when soil moisture is depleted to the extent that crop and pasture yields are significantly affected. Agricultural drought definitions link various characteristics of meteorological dry spell to agricultural impacts, focusing, for example, on precipitation shortages, departures from normal, or numerous meteorological factors such as evapotranspiration.

Socio-economic Dry spell

Definitions which express features of the socioeconomic effects of dry spell can also incorporate features of meteorological, agricultural, and hydrological dry spell. They are usually associated with the supply and demand of some economic good. Yevjevich (1967) has suggested that the time and space processes of supply and demand are the two basic processes that should be considered for an objective definition of dry spell

Various Causes of Dry Spells

Large numbers of inhabitants of the dry spell prone areas are small arable farmers, who depend mostly on the highly variable rainfall for crop cultivation and maintenance of their herds. The causes

of dry spell can be the nature of the changing weather patterns which often seen via uncontrolled buildup of heat on the earth's surface, meteorological changes which result in a reduction of rainfall, and reduced cloud cover, all of which results in greater evaporation rates. Another cause is the over active participation of human activities which affects the climatic condition of the land and forest. These human activities are bush burning, deforestation, overgrazing and poor cropping methods, reduction of water retention in the soil, and improper soil conservation techniques, which lead to soil degradation.

The underlying causes of most dry spell issues can be related to changing weather patterns manifested through the excessive buildup of heat on the earth's surface, meteorological changes which result in a reduction of rainfall, and reduced cloud cover, all of which results in greater evaporation rates. The resultant effects of drought are exacerbated by human activities such as deforestation, bush burning, overgrazing and poor cropping methods, which reduce water retention of the soil, and improper soil conservation techniques, which lead to soil degradation. Between 1950 and 2006, the Nigerian livestock population grew from 6 million to 66 million, an 11-fold increase. The forage needs of livestock exceed the carrying capacity of its grasslands. It is reported that overgrazing and over-cultivating are converting 351,000 hectares of land into desert each year. The rates of land degradation are particularly acute when such farming practices are extended into agriculture on marginal lands such as arid and semi rid lands, hilly and mountainous areas and wetlands (Lester, 2006). Lester (2006) highlighted other causes of Dry spell as follows:

Natural Causes

Some dry spells have occurred naturally, plaguing humankind throughout much of our history. Until recently naturally occurring dry spells were often natural phenomena triggered by cyclical weather patterns, such as the amount of moisture and heat in the air, land, and sea.

Altered weather patterns

The distribution of rainfall around the world can also be impacted by how air circulates through the atmosphere. When there is an anomaly in surface temperatures, particularly over the sea, air circulation patterns are altered.

This changes how and where precipitation falls around the world and the new weather patterns will most likely throw water supply and demand out of sync, as is the case when earlier-than-usual snowmelt reduces the amount of water available for crops in the summer.

Excess water demands

Dry spells can also result because of an imbalance in the supply and demand of water. As the

global human population continues to balloon, and intensive agricultural practices continue to be employed, more water is required to sustain the human race as well as the agricultural practices. This continues to tip the scales, making droughts a reality with each passing day.

A study estimated that between 1960 and 2010 the human consumption of water increased the frequency of drought in North America by 25%. The situation is worsened by dwindling rainfalls, forcing people to pump more water from rivers, aquifers and reservoirs. Doing this depletes valuable water resources that could take years to replenish and could permanently impact future water availability. At the same time, demand for water supplied by upstream lakes and rivers, particularly in the form of irrigation and hydroelectric dams, leads to the diminishing or drying out of downstream water sources, further contributing to droughts in other regions

Deforestation and soil degradation

Trees and plants are important as they release moisture to the atmosphere, resulting in clouds forming and rainfall falling, returning the moisture to the ground. Unfortunately, the human race is the best at destroying these natural resources. When forests and vegetation disappear, less water is available to feed the water cycle, making entire regions more vulnerable to drought. Meanwhile, deforestation and other poor land-use practices, like intensive farming, continue to diminish soil quality and reduce the land's ability to absorb and retain water. As a result, soil dries out faster, inducing agricultural dry spell, and less groundwater is replenished, contributing to hydrological dry spell.

Global warming

As the name suggests, the planet is being warmed at alarming rates and could result in droughts. Global warming is mostly associated with human activity such as releasing greenhouse gases which cause a trapping effect, causing global temperatures to rise. With increased temperatures, water from rivers, streams, lakes and other bodies of water will continue to evaporate and other practices will result in less of it coming back down as rain. This will therefore result in less rainfall and of course dry spell.

Climate change

Rising temperatures have the effect of making wet regions wetter and dry regions drier. For wetter regions, warm air will absorb more water, leading to larger rain events while in more arid regions, warmer temperatures mean water evaporates more quickly.

Climate change also alters large-scale atmospheric circulation patterns, causing a shift in storm tracks off their typical paths. This, in turn, magnifies weather extremes, which is one reason why climate models predict the already parched U.S.

Southwest and the Mediterranean will continue to get drier.

Disastrous Effects of Dry Spells on Farm Families Hunger and famine

Dry spells result in too little water to support food crops through either natural precipitation or irrigation using reserve water supplies. When drought undermines or destroys food sources, people go hungry and when the drought is severe and continues over a long period, famine occurs.

The best example is the 1984 famine in Ethiopia which was the result of a deadly combination of a severe drought and a dangerously ineffective government and led to hundreds of thousands dying.

Not enough drinking water

Dry spells will also result in there being not enough water to drink or use. All living things must have water to survive and when desperate for water to drink, people will turn to untreated sources that can make them sick.

The lack of clean water will also result in poor public sanitation and personal hygiene and of course a wide range of life-threatening diseases. Every year, millions are sickened or die due to a lack of clean water access and sanitation, and droughts will only make the problem worse.

Wildfires and an effect on wildlife

The low moisture and precipitation that often characterize dry spells can quickly create hazardous conditions in forests and across rangelands, setting the stage for wildfires that may cause injuries or deaths as well as extensive property damage and already shrinking food supplies.

With wild animals and plants suffering from dry spells, even if they have adapted to dry conditions, they will die or invade human populations in search of water. Dry spells will then result in increased mortality and reduced reproduction, which is especially problematic for populations of at-risk species whose numbers are already very low.

Social conflicts and wars

When a precious commodity like water is in short supply due to drought, and the lack of water creates a corresponding lack of food, people will compete, and eventually fight and kill, to secure enough water to survive. The ongoing Syrian Civil War is believed to have started after millions of rural Syrians fled the dry spell-stricken rural areas for the cities, triggering unrest.

Migration and relocation

Faced with the impacts of recurring dry spells, many people and of course animals will flee a dry spell-

stricken area in search of a new home with a better supply of water, enough food, and without the disease and conflict that were present in the place they are leaving.

Blackouts

The majority of people in the world continue to rely on hydroelectric projects for their electricity. Dry spell will reduce the amount of water stored in reservoirs behind dams, reducing the amount of power produced. This problem can be very challenging for the numerous small communities relying on small-scale hydro, where a small electric turbine is installed on a local creek.

Other Effects of Dry Spells

The impacts of dry spells in general include mass starvation, famine and cessation of economic activity especially in areas where rain fed agriculture is the main stay of the rural economy. It is common knowledge that drought is the major cause of forced human migration and environmental refugees, deadly conflicts over the use of dwindling natural resources, food insecurity and starvation, destruction of critical habitats and loss of biological diversity, socio-economic instability, poverty and climatic variability through reduced carbon sequestration potential. The impacts of drought and desertification are among the most costly events and processes in Africa. The widespread poverty, the fact that Nigeria's economy depend on climate-sensitive sectors mainly rain fed agriculture, poor infrastructure, heavy disease burdens, high dependence on and unsustainable exploitation of natural resources, and conflicts render the country especially vulnerable to impacts of drought. The impacts of droughts are well known and have been analyzed and elucidated by several authors.

Jibrin (2010) highlighted the effects of Dry spells as follows: low or no crop yields resulting in low food security index; mass famine; death of livestock; low groundwater levels resulting in dry wells (which needed to be dug deeper and deeper to obtain water for drinking); drying of lakes and dams; loss of biodiversity and impoverishment of ecosystem; acute shortage of water for domestic use and for livestock; decline in GDP; migration into urban areas; separation of families; and increased indebtedness.

The Effect of Dry Spells in Danko Wasagu Local Government

Generally speaking, dry spells has a vast effect on mass starvation, famine and cessation of economic activity especially in areas where rain fell agriculture is the main stay of the rural economy. Forced human migration and environmental refugees, deadly conflicts over the use of dwindling natural resources, food insecurity and starvation, destruction of critical habitats and loss of biological diversity, socioeconomic instability, poverty and climatic variability through

reduced carbon sequestration potential are common knowledge of the causes of drought.

Several research have been conducted on the effect of drought and they have come to terms that drought especially in Africa and with particular reference to Nigeria assert that several challenges such as the widespread poverty, the fact that Nigeria's economy depend on climate-sensitive sectors mainly rain fed agriculture, poor infrastructure, heavy disease burdens, high dependence on and unsustainable exploitation of natural resources, and conflicts are major reasons why drought often harm the Northern region of Nigeria [20, 22].

Other forms of effect of dry spell was identified in the work of Jibrin (2016) such as low or no crop yields resulting in low food security index; mass famine; death of livestock; low groundwater levels resulting in dry wells (which needed to be dug deeper and deeper to obtain water for drinking); drying of lakes and dams; loss of biodiversity and impoverishment of ecosystem; acute shortage of water for domestic use and for livestock; decline in GDP; migration into urban areas; separation of families; and increased indebtedness. Other identified categories of drought effect includes; on agriculture and food security, on water availability, on biodiversity, and energy availability

Effect of dry spell on agriculture and food security

The majority of the populations in the dry spell prone states live on marginal lands in rural areas practicing rain-fed agriculture. Dry spell threatens agricultural production on these marginal lands, exacerbating poverty and undermining economic development. The impact of drought and climatic variability in both economic and mortality terms is generally larger for relatively simple and predominantly agricultural economies. The drought of 1971-72 for example reduced Agricultural contribution to GDP in Nigeria from 18.4% in 1971-72 to 7.3% in 1972-1973. The poor crop yields or total crop failure due to drought result in mass poverty and starvation as agriculture is the mainstay of Nigeria's rural economy. Although agriculture will remain for many years as major contributor to the economies of most developing countries, in some countries, however, its share of GDP will progressively decline as drought and desertification take their toll with food shortages increasing at the same time. The poor households that are affected by drought and desertification do not have adequate resources to deal with food shortages leading to food insecurity and hunger that affects millions of people. Agriculture is one of the main economic activities in Nigeria (which account for around 40 percent of the country's GDP and employs about 60 percent of the active labour force), thus drought would lead to a catastrophe with unprecedented repercussions. The most severe consequence of drought is famine.

Effect of dry spell on water availability

Drought influences water availability, which is projected to be one of the greatest constraints to economic growth in the future. Reduced annual average rainfall and its run-off would increase desertification in Nigeria. Most of the rivers and streams in the drought prone areas flow into Lake Chad. Drought, therefore exacerbate the shrinking of the lake. The rivers in addition to contributing in recharging Lake Chad are catchments to several dams built for irrigation and domestic water supply. This means that the regions will not have sufficient water resources to maintain their current level of per capita food production from irrigated agriculture - even at high levels of irrigation efficiency - and also to meet reasonable water needs for domestic, industrial, and environmental purposes.

Effect of dry spell on biodiversity

One of the most important effects of dry spell is the depletion of biodiversity. Existing fauna and flora that are not resistant to drought are likely to go extinct. Several animal and plant species are disappearing in the dry spell prone region of Nigeria. The combined effects of drought and bush burning (during dry season) have made the flora to go extinct and the animals to migrate to safer havens. Drought, land degradation and desertification have had serious impact on the richness and diversity of plants and animals in the region. Plant biodiversity will change over time, unpalatable species will dominate, and total biomass production will be reduced.

Effect of dry spell on energy availability

The impacts of dry spell and desertification on the energy sector are felt primarily through losses in hydropower potential for electricity generation and the effects of increased runoff (and consequent siltation) on hydropower generation. In Nigeria, electricity is largely generated through hydropower thus drought is likely to reduce the volume of water in the dams and rivers and consequently lead to reduction in hydroelectricity generation and hence load shedding of electricity in the country. Load shedding as result of low water volume in Kainji and Jebba electricity projects has become more pronounced during the dry season thus compounding the energy crisis in Nigeria. Energy impacts can also be experienced through reduction in the growth rates of trees due to drought. Majority of peasant people in Nigeria rely on fuel wood as source of energy.

Strategies for Mitigating Dry Spells Issues Irrigation

Irrigation is one of the most effective ways of coping with and reducing the risk of dry spell. As

aftermath of the 1972-73 drought, the Federal Government of Nigeria established River Basin and Rural Development Authorities charged with the responsibility of developing irrigation infrastructure all over Nigeria. The surface water in Nigeria is provided by 22 major rivers and their tributaries. The annual flow of these rivers is estimated to be between 193-315 billion cubic meters. This network of rivers constitutes the basis of major irrigation development in Nigeria. At the end of 1990s, Nigerian Government had invested about \$3.0 billion (Mahmood, 1994) in irrigation and drainage on over 300 dams and reservoirs. Government has impounded 12 billion cubic meters of water in dams and reservoirs that are intended to command net irrigation area of 245,650 hectares (Rabiu, 2009). Apart from the Federal Government dams and irrigation schemes, some states such as Kano and Katsina have made significant efforts at developing irrigation schemes. Table 3 showed the total potential land of over 3, 739,041 ha for the Fadama areas. This potential can be exploited through exploitation of ground water by sinking boreholes and tube wells and use of solar pumps to lift the water. However, the overall performance of the major public irrigation schemes in Northern Nigeria was reported to be generally poor due to improper maintenance, unreliable water delivery as well as technical deficiency in the infrastructure (Abubakar, 2008; Othman *et al.*, 2010).

Use of Dry Spell Tolerant and Early Maturing Crop Varieties by Farmers

The predominant crops grown in the dry spell-prone region of Nigeria include cowpea, sorghum, millet, groundnut and maize in various mixtures. In drought areas which are characterized by erratic and unreliable rainfall in the beginning and towards the end of the season, the importance of drought tolerant crop varieties as well as early maturing varieties that could escape terminal drought cannot be overstated. These crops are used in various forms to provide energy, protein, oil and fat to drought prone communities. The International Institute for Tropical Agriculture (IITA) and the International Centre for Crop Research in Semi-arid Tropics (ICRISAT) in collaboration with the national research institutes such as the Institute for Agricultural Research (IAR), Zaria and Lake Chad Research Institute (LCRI), Maiduguri have released varieties of cowpea, maize, sorghum, groundnut and millet that are drought tolerant and some of the varieties have earliness attributes which enable the varieties to escape drought. Table 4 shows the list of varieties released by the national research institutes and their characteristics.

Table 4: Some improved varieties of maize, cowpea, sorghum and millet released by the IAR, Zaria and LCRI, Maiduguri

Crop	Varieties	Attributes	Yield Potential (tons/ha)
Maize	Sammaz 19	90 days to maturity and dry spell tolerant	5.0
	Sammaz 20	Early maturing and dry spell tolerant	3-4
	Sammaz 22	Late maturing, dry spell tolerant and also tolerant to low nitrogen	4
	Sammaz 23	Late maturing, tolerant to dry spell, streak and low nitrogen	6
	Sammaz 24	Late maturing, tolerant to dry spell, streak and low nitrogen	6
	Sammaz 25	Late maturing, tolerant to dry spell, streak and low nitrogen	7
	Sammaz 26	Medium maturing, tolerant to dry spell, streak and low nitrogen	4
	Sammaz 28	Early maturing, tolerant to dry spell, streak and low nitrogen	4
	Sammaz 29	Extra early maturing with dry spell escape ability	3
Sorghum	Samsorg 5	Early maturing and dry spell tolerant	2
	Samsorg 6	Early maturing and dry spell tolerant	2
	Samsorg 7	Early maturing and dry spell tolerant	2.5
	Samsorg 8	Early maturing and dry spell tolerant	2
	Samsorg 40	Early maturing and dry spell tolerant	2.5
	Samsorg 41	Early maturing and dry spell tolerant	2.5
Groundnut	Samnut 17	Medium maturing and dry spell tolerant	2.8
	Samnut 18	Medium maturing and dry spell tolerant	2.8
	Samnut 14	Medium maturing and dry spell tolerant	2.8
Cowpea	Sampea 4	Early maturing and dry spell tolerant	2
	Sampea 5	Early maturing and dry spell tolerant	2
	Sampea 7	Medium maturing and dry spell tolerant	2
Millet	Sammil 3	Early maturing and dry spell tolerant	2
	Sammil 6	Early maturing and dry spell tolerant	2
	Sammil 7	Early maturing and dry spell tolerant	2
LCRI Millet	SOSAT	Early maturing, High yielding and dry spell tolerant	3
	LCIC9702	Early maturing, High yielding and dry spell tolerant	2

Reduction in Post-harvest Crop Losses

Agricultural production in Nigeria is characterized by high post-harvest waste. These losses occur during harvest due to lack of mechanization and untimely harvest or during storage (caused by insect, pests, rodents, diseases and physical and physiological deterioration due to improper drying) and during processing (lack of processing tools and equipment). Post-harvest crop losses could be as much as 50%. Jeon and Halos-Kim (1998) reported that in cassava post-production losses can be as high as 45%, with about 14% occurring during harvesting and 22% during processing. Qualitative and quantitative post-production losses in cereals and grain legumes have been estimated at 30-50%. The progress made in increasing crop yields could be negated by post-harvest losses. Nigeria is familiar with the annual losses of tomato and fruits due to inadequate facility to process and store them. The grains consumed and destroyed by pests and ruined by microorganisms, and fresh fruits and vegetables damaged and deteriorated as they move slowly through a long chain of middle men, mostly in poor vehicles along bad roads in tropical climates means more deprivation for the poor and less food for the underfed (Sen, 1975). The developing countries including Nigeria mostly consist of subsistence farmers who must store the bulk of the grain after harvest in their own households. Losses are reported to reach 7-10% in the

first three months of storage and may climb as high as 50% if the grain is stored beyond 4-6 months. Inefficient milling is another major source of post-harvest loss. Post-harvest must be deduced drastically in order to harness the surplus grains and other food produce to be used to reduce the risk of drought.

Increase in Livestock and Fisheries Production

Incidentally, the dry spell prone areas are the major livestock production zone of Nigeria. In recent years, there has been development of commercial livestock industries with modern breeds of cattle, sheep, goats, poultry and rabbits. The use of modern techniques such as artificial insemination to improve the productivity of the local breeds in beef and milk production is being utilized. Few countries in the world are endowed with the potentiality of developing a highly productive fisheries industry like Nigeria. Nigeria is blessed with abundant fresh and marine waters, good stocks of fish and a large number of fishermen who have developed the skills through years of practice on the job. Apart from Rivers Niger and Benue, and their various tributaries, Lake Chad and the Atlantic Ocean offer the country rich sources of fish. The Country is further blessed with inland lakes, ponds and irrigation reservoirs. The country is currently enjoying a boom in private fish farming and cultures. The farmers should be encouraged to ensure quality

food for all Nigeria. The artisanal fishermen should be encouraged to exploit our rivers, lakes and reservoirs. The catch from the fishing industry will provide readily source of protein for the drought areas in case of drought emergency.

National Strategic Grain Reserve

The Federal Government of Nigeria has established the strategic grain reserve in order to reduce the risk of dry spell and as coping measures for effects of dry spell. Currently, the scheme has twelve silos with a total storage capacity of 350,000 metric tonnes. In addition to the silos capacity, there are various warehouses for storage of grains. Contract has been awarded for construction of 20 additional silos with storage capacity of over one million metric tonnes and the project will soon be completed. Figure 2 shows the locations of all silos in Nigeria (completed and ongoing). When completed the total silos capacity will be one million, three hundred and fifty thousand (1,350,000) metric tonnes. The silos storage will boost the national capacity to reduce risks of dry spell.

National Emergency Management Agency

The National Emergency Management Agency was established by the Federal Government to provide emergency relief to victims of disaster including drought, floods and other natural disasters. The service of this agency is complimented by numerous Non-governmental organizations (NGOs) involved in providing immediate reliefs to victims of natural disasters.

Weather and Climate Forecasting

The monitory of natural disasters and studying other environmental issues using space technology have become an interesting development in the contemporary scientific research. In Nigeria, the Nigeria Meteorological Agency (NIMET) is vested with the responsibility of forecasting weather and climate variability including drought. The agency forecasts the onset and end of the rainy season to enable farmers to plan farming operations and also to decide on the crops to grow. One major limitation of the forecast is its inability to highlight the distribution pattern of the rain.

Harvesting rainwater

This is an easy solution to droughts and can be employed with ease at home. With rainwater harvesting, homes can store the water they get from rain and then use it when they need it in dry conditions, rather than exhausting present water bodies like rivers. If a house has a primary water source, then rainwater harvesting provides them with an auxiliary option that they can use when water is not available.

Planting more trees and combating deforestation

This is something that needs to be employed by everyone in the world and can result in billions of trees planted daily. It is a piece of old-age advice but still applies today. Planting more trees will improve the

quality of the environment and increase the success of precipitation.

It can also reverse the drought and arid conditions of an area if the trees are maintained well until maturity. With planting more trees, the other solution is to avoid the existing ones, unless more are planted. For instance, the Amazon in South America is being destroyed at alarming rates, and scientists have warned that decades of human activity and a changing climate will bring the jungle near a “tipping point.” The deforestation coupled with forest fires and global temperature rises will soon result in the water cycle being irreversibly broken and locking in a trend of declining rainfall and longer dry seasons that began decades ago.

Switching to renewable energies

We have, for long, relied on non-renewable sources for our energy, like petroleum. The extraction and use of these energies results in more greenhouse gases being pumped into the atmosphere, resulting in global warming, and of course droughts. The alternative is to switch to renewable sources like wind and solar, which have little to no effect on the environment and will not result in droughts.

Stricter government policies

These can be used at the local, national, regional and international levels. Stringent laws need to be implemented on those who use practices that can result in droughts or other environmentally damaging results. Doing this will stop climate change and solve the ongoing droughts. They include limiting the amounts of greenhouse gases being pumped into the atmosphere and higher taxes for non-compliance.

Becoming environmentally conscious

This includes educating the younger generation on the need to protect, preserve and improve the environment, recycling, reusing and planting more trees. The education curriculum, the news media and companies also need to stress the need to care for the environment, so that it becomes an individual task to prevent droughts.

Man has always faced weather and climate vagaries and problems related to droughts. However, the recent problems of inadequate water quality, which effectively reduced the available resources, increased the severity of water deficits. Drought-related disasters have been more devastating than other natural hazards (earthquakes, volcanoes, etc), as far as deaths, suffering and economical damages are concerned. Apart from destructive direct effects, drought events have been followed by secondary, indirect calamities, such as famine, epidemics, fire, etc. Despite the progress in science and technology, man is still vulnerable to extreme drought events. The losses increase due to the continuing development of costly infrastructure, rise in

population density, and decrease of the buffering capacities (deforestation, urbanization, drainage wetlands, etc). Understanding droughts, their occurrences, mechanisms, characteristics and regularities is of great importance for the design and management of water resources systems.

The aim of this report is to provide a description of the background of the causes and effects of dry spell of 2021 in Danko Wasagu LGA. Emphasis is given to the spatial variability over the region, and the effects of dry spell on crop and animal production

Findings from Farmers in Danko Wasagu Local Government

Finding from the Interview with farmers shows the following

- Dry spell is one of the most important natural disasters that show its influences slowly by time and that had great influence on crop and animal production.
- Dry spell was caused by the changing weather patterns, uncontrolled buildup of heat on the earth's surface, meteorological changes which result in a reduction of rainfall, and reduced cloud cover, all of which results in greater evaporation rates and hence reduced crop production
- The people interviewed supported that major reasons why drought often harm Nigerian people is because of the widespread poverty, poor infrastructure, heavy disease burdens, high dependence on and unsustainable exploitation of natural resources, and conflicts.
- A Farmer named Hon Garba Mohammed with a farm located around Maga axis of Danko Wasagu LGA applied 151 bags of NPK Fertilizer on his maize farm but could not harvest anything because of the dry spell
- The village Head of Rafin Gora in Wasagu District lamented that this is the first prolonged dry spell they ever experienced for the past 15 years.
- Another maize farmer named Peter Wanda with a farm located in Waje area of Ribah applied Over 25 bags of both NPK and Urea fertilizer but could not obtain reasonable yield as a result of the impact of 2021 dry spell
- Many other rice farmers also complain bitterly of the severe effect of the dry spell on the yield of rice. Infact many of them could not harvest anything from their farms

CONCLUSION

Dry spell affects Nigerian farmers and Nigeria in many ways by affecting its economy, agriculture, environment and biodiversity, population dynamics, human nutrition and health, animal population and water resources and hydrology. The importance of measures to reduce the effects of dry spell cannot be overemphasized. Measures such as irrigation,

development of dry spell tolerant early maturing and high yielding crop varieties, reduction in post-harvest crop losses, efficient weather forecast, storage of excess production and development of fishery and livestock industries assist greatly in reducing the risk of dry spell.

Information on dry spell alongside other rainfall-related variables such as rainfall onset and cessation dates, length of the growing season and seasonal rainfall amount is highly needed for agricultural planning and adaptation strategies

Drought can be referred to as dry spells at the beginning or at the end of each season. Drought is perceived as one of the expensive natural disaster of the world and affects more people than any other natural disaster in the world.

RECOMMENDATIONS

Based on the causes and effect of dry Danko Wasagu LGA Kebbi State, Nigeria, the researchers therefore recommends that;

- The government should support the rural farmers through the initiation of programs or policies that monitors reduction in postharvest crop losses, weather forecast, storage of excess production and livestock management.
- Forest management research centers should be established in the region where dry spell is experience
- Government should provide financial/food items support to the farmers affected with dry spell especially maize farmers, rice farmers and guinea corn farmers
- Government should provide dry spell resistant varieties of crops to farmers in the area.

REFERENCES

- Abaje, I. B. (2007). Introduction to soils and vegetation. Kafanchan: personal touch productions.
- Nyong, A., Adesina, F., & Elasha, B. O. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation strategies for global Change*, 12(5), 787-797.
- Loukas, A., & Vasiliades L. (2004). Probabilistic analysis of drought spatiotemporal characteristics in Thessaly region, Greece. *Natural Hazards and Earth System Sciences. European Geosciences Union*, 4, 719-731.
- National Drought Mitigation Center (NDMC). (2006). What is Drought? Understanding and Defining Drought.
- Okorie, F. C. (2003). Studies on Drought in the Sub-Saharan Region of Nigeria Using Satellite Remote Sensing and Precipitation Data.
- Ayoade, J. O. (2004). Introduction to climatology for the tropics. (2ndedn) Ibadan: Spectrum Books Limited.

-
- Barry, R. G., & Chorley, R. J. (2003). Atmosphere weather and climate (8thedn) London: Routledge Taylor and Francis Group, UK. p: 536.
 - Trenberth, K. E., Jones, P. D., Ambenje, P., Bojariu, R., Easterling, D., Klein Tank, A., ... & Zhai, P. (2007). Observations. Surface and atmospheric climate change. Chapter 3.
 - Nicholson, S. E., Some, B., & Kone, B. (2000). An analysis of recent rainfall conditions in West Africa, including the rainy seasons of the 1997 El Niño and the 1998 La Niña years. *Journal of climate*, 13(14), 2628-2640.
 - Chappell, A., & Agnew, C. T. (2004). Modelling climate change in West African Sahel rainfall (1931–90) as an artifact of changing station locations. *International Journal of Climatology: A Journal of the Royal Meteorological Society*, 24(5), 547-554.
 - Dai, A., Lamb, P. J., Trenberth, K. E., Hulme, M., Jones, P. D., & Xie, P. (2004). The recent Sahel drought is real. *International Journal of Climatology: A Journal of the Royal Meteorological Society*, 24(11), 1323-1331.
 - Ati, O. F., Iguisi, E. O., & Afolayan, J. O. (2007). Are we experiencing drier conditions in the Sudano-Sahelian zone of Nigeria? *J of Appl Sci Res*, 3, 1746-1751.
 - Alatise, M. O., & Ikumawoyi O. B. (2007). Evaluation of drought from rainfall data for lokoja. A confluence of two major rivers. Electronic Journal of Polish Agricultural Universities.
 - Abubakar, I. U. (2008). Issues on crop production in northern Nigeria: Poor Crop Yields and Irrigation.
 - Jibrin, M. J. (2010). Coping with Droughts in Nigeria's Sudano-Sahelian Zone.
 - Nnaji, A. O. (2001). Forecasting seasonal rainfall for agricultural decision making in northern Nigeria. *Agricultural and Forest Meteorology*, 107, 193-205.
 - ICRISAT. (1984). Agrometereology of sorghum and millet in the semi-arid tropics. Proceedings of an International Symposium. ICRISAT Center, Pantancheru, India. p: 322.
 - Adeoye, K. B. (1986). An Evaluation of drought incidence and hazard in northern Nigeria. Paper Presented at the 22nd Annual Conference of the Agricultural Society of Nigeria.
 - Glantz, M. H., & Katz, R. W. (1977). When is drought a Drought. *Nature*, 267, 192-193.
 - Van Apeldoorn, G. J. (1981). Perspectives on drought and famines in Nigeria. George allen and Unwin Ltd, London. p: 184.
 - Lester, R. B. (2006). The earth is shrinking: Advancing deserts and rising seas squeezing civilization. Earth Policy Institute.
 - Mortimore, M. (1989). Adapting to Drought. Farmers, Famines and Desertification in West Africa. Cambridge University Press, Cambridge p: 299.
 - Van Den Beldt, R. J., & Napompeth, B. (1998). Leucaena psyllid comes to Africa. *Agroforestry Today*, 4, 11-12.
 - Evans, J. (1992). Plantation forestry in the tropics (2ndedn) Oxford: Oxford University Press.