Rainfall pattern in enugu state, nigeria

CHAPTER ONE

1. 0INTRODUCTION

Enugu State is located in the southeastern part of Nigeria created in 1991 from the old Anambra state and the principal cities in the state are Enugu, Agani, Awgu, Udi, Oji-River and Nsukka. The state shares borders with Abia and Imo State to the south, Ebonyi State to the East, Benue state to the Northeast, Kogi state to the Northwest and Anambra state to the West.

Enugu, the capital city of Enugu state, is approximately 21/2 driving hours away from Port Harcourt where coal shipments exited Nigeria. The word " Enugu" (from Enu Ugwu) means " the top of the hill". The first European settlers arrived in the area in 1909, led by a British mining engineer, named Albert Kitson. In his quest for silver, he discovered coal in the Udi Ridge, colonial Governor of Nigeria Frederick Lugard took keen interest in the discovery, and by 1914 the first shipment of coal was made to Britain. As mining activities increased in the area, a permanent cosmopolitan settlement emerged, supported by a railway system. Enugu acquired township status in 1917 and became strategic to Britain interests.

Foreign businesses began to move into Enugu, the most notable of which were John Holt, Kingsway Stores, British Bank of West Africa and United Africa Company. From Enugu the British administration was able to spread its influence over the southern province of Nigeria. The colonial past of Enugu is today evidenced by the Georgian building types and meandering narrow roads within the residential area originally reserved for the whites, an area which is today called the Government Reserved Area (GRA).

The state Government and the Local government are the levels of government in Enugu state and have 17 Local Government areas. Economically, the state is predominantly rural and agrarian, with a substantial proportion of its working population engaged in farming, although trading (18. 8%) and services (12. 9%) are also important. In the urban areas trading is the dominant occupation, followed by services. A small proportion of the population is also engaged in manufacturing activities, with the most pronounced among them located in Enugu, Oji, Ohebedim and Nsukka. The state boasts of a number of markets especially at each of the divisional headquarters, prominent of which is the Ogbete Main market in the State capital, Electricity supply is relatively stable in Enugu and its Environs. The Oji River power station (which used to supply electricity to all of Eastern Nigeria) is located in Enugu state. The state had a population of 3, 267, 837 people at the census held in 2006 (estimated at over 3. 8 million in 2012), it is home of the Igbo of southeastern Nigeria.

The average temperature in this city is cooler to mild (60 degrees Fahrenheit) in its cooler months and gets warmer to hot in its warmer months (upper 80 degrees Fahrenheit) and very good for outdoor activities with family and friends or just for personal leisure. Enugu has good soil-land and climatic conditions all year round, sitting at about 223 meters (732 ft) above sea level, and the soil is well drained during its rainy seasons.

The main temperature in Enugu state in the hottest month of February is about 87. 16 ^{0} F (30. 64 ^{0} C), while the lowest temperatures occur in the month of November, reaching 60. 54 ^{0} F (15. 86 ^{0} C). The lowest rainfall of

about 0. 16 cubic centimeters (0. 0098 cu in) is normal in February, while the highest is about 35. 7 cubic centimeters (2. 18 cu in) in July.

The differences in altitude and relief create a large variation in climate in various regions of the country. In places that are characterized as semi-arid zones, climate shows wide fluctuation from year to year and even within seasons in the year. Semi arid regions receive very small, irregular, and unreliable rainfall (Workneh, 1987).

The annual cycle of the climatology of the rainfall over tropical Africa and in particular over Nigeria, is strongly determined by the position of the Inter Tropic Convergence Zone (ITCZ) (Griffiths, 1971). Variations in rainfall pattern throughout the country are the result of differences in elevation and seasonal changes in the atmospheric pressure systems that control the prevailing winds. The climate of Nigeria is characterized by high rainfall variation (Yilma et al., 1994). In Nigeria, several regions receive rainfall throughout the year, but in some regions rainfall is seasonal and low making irrigation necessary (Alemeraw and Eshetu, 2009). Rainfall is the most critical and key variable both in atmospheric and hydrological cycle. Rainfall patterns usually have spatial and temporal variability. This variability affects agricultural production, water supply, transportation, environment and urban planning, thus, the entire economy of a country, and the existence of its people. Rainfall variability is assumed to be the main cause for the frequently occurring climate extreme events such as drought and flood. These natural phenomena affect badly the agricultural production and hence the economy of the nation. In regions where the year-to-year variability is high, people often suffer great calamities due to floods or droughts. Even

though damage due to extremes of rainfall cannot be avoided completely, a forewarning could certainly be useful (Nicholls, 1980). Nigeria is one of the countries whose economy is highly dependent on rain-fed agriculture and also facing recurring cycles of flood and drought. Current climate variability is already imposing a significant challenge to Nigeria in general and Enugu in particular, by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters. Recurrent floods in the past caused substantial human life and property loss in many parts of the country.

Methods of prediction of rainfall extreme events have often been based on studies of physical effects of rainfall or on statistical studies of rainfall time series. Rainfall forecast is relevance to the agriculture sector, since it contributes significantly to the economy of countries like Nigeria. In order to model and predict hydrologic events, one can use stochastic methods like time series methods. Numerous attempts have been made to predict behavioral pattern of rainfall using various techniques (Yevjevich, 1972; Dulluer and Kavas, 1978; Tsakiris, 1998). Awareness about the characteristics of the rainfall over an area such as the source, quantity, variability, distribution and the frequency of rainfall is essential for the implication in utilization and associated problems. Assessing rainfall variability is practically useful in making decision, risk management and optimum usage of water resources of countries. Thus, it is important to obtain accurate rainfall forecast at various geographic levels of Nigeria and work towards identifying periodicities in order to help policy makers improve

their decisions by taking into consideration the available and future water resources . In this study, univariate Box-Jenkins methodology to build ARIMA model are used for assessing the rainfall pattern in Enugu State based on data from Nigerian Meteorological Agency.

1. 1Weather and Climate

Weather and climate over the earth are not constant with time: they change on different time series ranging from the geological to the diurnal through annual, the difference between weather and climate is a measure of time. Weather is what condition of the atmosphere over a short period of time and climate is how the atmosphere behaves over relatively long period of time. Seasonal and intra-seasonal time scales. Such variability is an inherent characteristic of the climate. The study of climatic fluctuations involves description and investigation of causes and effects of these fluctuations in the past and their statistical interpretation. Much of the work done is about variability of the two important meteorological parameters: rainfall and temperature. Rainfall is a term used to refer to water falling in drops after condensation of the atmospheric vapor. Also rainfall is the resultant product of a series of complex interactions taking place within the earth-atmosphere system. Rainfall is only water that falls from the sky, whereas precipitation is any wet things that fall from the sky, which include snow, frozen rain…. etc. Water in all its forms and in all its various activities plays a crucial role in sustaining both the climate and life. It is also a major factor for planning and management of water resource project and agricultural production. Even though Nigeria enjoys a fairly good amount of rainfall, wide variability in its

distribution with respect to space and time are responsible for the two extremes events (floods and droughts) (Yilma et. al, 1994).

1. 2Rainfall Characteristics

Rainfall varies with latitude, elevation, topography, seasons, distance from the sea, and coastal Sea-surface temperature. Nigeria enjoys the humid tropical climate type. Because of its location just north of the equator, also, Nigeria enjoys a truly tropical climate characterized by the hot and wet conditions associated with the movement of the inter-Tropical convergence Zone (ITCZ) north and south of the equator.

While there is a general decrease in rainfall in Nigeria, the coastal area is experiencing slight increase. Apart from the general southward shift in rainfall patterns, the duration has also reduced from 50-360 (1993-2003) to 30-280 (2003-2013) rainy days per year. This has created ecological destabilization and altered the pattern of the vegetation belt especially in the northern part of the country. The rainfall pattern has also enhanced wind erosion and desertification, soil erosion and coastal flooding in the north, east and coastal areas of Nigeria respectively.

The country experiences consistently high temperatures all year round. Since temperature varies only slightly, rainfall distribution, over space and time, becomes the single most important factor in differentiating the seasons and climatic distribution are however dependent on the two air masses that prevail over the country. Their influences are directly linked to the movement of the ITCZ, north and south of the equator. The two air masses are the Tropical maritime(Tm) and the Tropical continental (Tc). The former

is associated with the moisture-laden south-west winds (south westerlies) which blow from the Atlantic Ocean, while the latter is associated with the dry and dusty north-east winds (easterlies) which blow from the Sahara Desert.

Conversely, with the movement of the ITCZ into the Northern Hemisphere, the rain-bearing south westerlies prevail as far inland as possible to bring rain fall during the wet season. The implication is that there is a prolonged rainy season in the far south, while the far north undergoes long dry periods annually. Nigeria, therefore, has two major seasons, the lengths of which vary from north to south. The mean annual rainfall along the coast in the south-east is 4000mm while it is 500mm in the north-east.

Nigeria can, thus be broadly divided into the following climatic regions:

1. the humid sub-equatorial, in the southern lowlands
2. the hot tropical continental, in the far north
3. the moderated sub-temperate in the high plateaus and mountains
4. the hot, wet tropical, in the hinterland (the middle-belt)

1. 3The main effects of Rainfall

Trends in rainfall extremes have enormous implications. Extreme rainfall events cause significant damage to agriculture, ecology, and infrastructure. They also cause disruption to human activities, injury, and loss of life. Socioeconomic activities including agriculture, power generating, water supply, human health, etc. are also very sensitive to climate variations. As a result, Nigeria economy is heavily dependent on rainfall for generating employment, income, and foreign currency. Thus, rainfall is considered as

the most important climatic element that influences Nigeria agriculture. The severity and frequency of occurrence of rainfall extremes events (meteorological, hydrological, and agricultural) vary for different parts of the country.

Drought: Drought is an insidious hazard of nature. It is often referred to as a “ creeping phenomenon” and its impacts vary from region to region. Drought can therefore be difficult for people to understand; it is equally difficult to define, because what may be considered a drought in, say, Bali (six days without rain) would certainly not be considered a drought in Libya (annual rainfall less than 180 mm). Some drought years have coincided with EN events, while others have followed it. According to DDAEPA (2011) the trend of decreasing annual rainfall and increased rainfall variability is contributing to drought conditions in Nigeria Administration. The average annual rainfall patterns of Abuja for the periods 1999 to 2008 and 1984 to 1991 show two important trends. First, annual average rainfall has declined from the mean value by about 8. 5% and 10% respectively. Secondly, the variability of rainfall shows an overall increasing trend, suggesting greater rainfall unreliability. These rainfall patterns have led to serious drought/flood episodes throughout the Administration.

Flood: Floods are known as the most frequent and devastating natural disasters in both developed and developing countries (Osti et al., 2008). Between 2000 and 2008 East Africa has experienced many episodes of flooding. Almost all of these flood episodes have significantly affected large parts of Ethiopia. Ethiopia’s topography characteristics has made the country pretty vulnerable to floods and resulting destruction and damage to life,

economic, livelihoods, infrastructure, services and health system (FDPPA, 2007). Flooding is common in Ethiopia during the rainy season between June and September and the major type of flooding which the country is experiencing are flash flood and river floods (FDPPA, 2007).

Like other regions of Nigeria, the issue of flood continues to be of growing concern in Enugu especially to peoples residing in lowlands, along or near the flood courses as well as village located at the foot of hills and mountains. Flood disasters are occurring more frequently, and having an ever more dramatic impact on Enugu in terms of the costs on lives, livelihoods and environmental resources. The topography of Enugu Administration mainly consists of mountains and hills with steep slope, valleys, and river basins. The catchment characteristics accompanied with its large area coverage coupled with torrential rain fall during the short and long rainy season had been the main factors that contribute to the pervious flood events.

Soil Erosion: when soil moves from one location to another, it is referred to as soil erosion. The impact of rainfall striking the surface can cause soil erosion; erosion is a concern for farmers as their valuable, nutrient rich top soil can be washed away from rainfall. It can also weaken structures such as bridges or wash out roads. Vegetation can decrease the amount of soil that is eroded during a rain. Erosion has been going on and has produced river valleys and shaped hills and mountains. Such erosion is generally slow but can cause a rapid increase in the rate at which soil is eroded (i. e. a rate faster than natural weathering of bedrock can produce new soil). This has resulted in a loss of productive soil from crop and grazing land, as well as

layers of infertile soil being deposited on formerly fertile crop lands: the formation of gullies: silting of lakes and streams, and land slips.

1. 4Aim and Objectives of the study

The main aim of this study is to analyze rainfall pattern in Enugu State using appropriate time series methods based on 15 years (January, 1999-Decimeber, 2013) data recorded at Nigerian Meteorological Agency (Enugu State).

Specific Objectives

1. To fit appropriate time series model to the monthly rainfall data.

2. To forecast the rainfall pattern in the study area.

1. 5Data source

The monthly rainfall data in millimeters for the period January, 1999 to December, 2013, collected from the Nigerian Meteorological Agency (Enugu State) were used in the study. The site was chosen due to availability of relatively long series of meteorological data, the data is a secondary data.

1. 6Significance of the Study

Knowledge of what happens to the water that reaches the earth surface will assist the study of many surface and subsurface water problems, for efficient control and management of water resources. For a country like Nigeria, whose welfare depends very much on rain-fed agriculture, a quantitative knowledge of water requirements of the region, availability of water for plant

growth and supplemental irrigation, etc. on a monthly or seasonal basis is an essential requirement for agricultural development. In this regard, increased capacity to manage future climate change and weather extremes can also reduce the magnitude of economic, social and human damage and eventually, lead to better resistance. Assessing seasonal rainfall characteristics based on past records is essential to evaluate rainfall extreme risk and to contribute to development of mitigation strategies. Therefore, a reliable rainfall forecasting and assessing behavior at station, regional and national levels is very important.