Effects of Desertification on Rural Resources in Machina Local Government Area, Yobe State

Duchi, Fidelis Christopher and Habila, Sunday Kazahshii
Department of Urban and Regional Planning, Faculty of Environmental Design,
Ahmadu Bello University, Zaria-Nigeria.
[1]fidelisduchi@yahoo.com,

Abstract
This study examines the effects of desertification on the rural resources (livestock, crops and vegetation) of Machina Local Government Area of Yobe state. Data were collected from the Nigerian Meteorological Agency (NiMet)Makia Yobe state, on rainfall, temperature and relative humidity and outcomes of desertification effects from the Ministry of agriculture and Natural Yobe state. Data on the vegetal cover for a period of three (3) years was retrieved from the U.S Geological Survey (2012-2014) to show the vegetal degradation in the study are. The data were analyzed using descriptive statistics in understanding the causes and effects of desertification on the rural resources of the study area. The research revealed that there is a drastic drop in rainfall distribution from 750.6mm in year 2000 to 365.5mm in year 2009, increasing temperatures of 34.2ºC to 36.0ºC in (2000 and 2009) and decreasing average relative humidity of 40% to 37.7%. The foresaid climatic variability necessitates the depleting outcomes on local resources of Machina LGA in livestock production with a shortfall of 5,620 cattle, 9,380 goats and 2,072 sheep between years 2007 to 2010 were recorded. Decreasing natural vegetation was observed and on the verge of extinction within the period of year 2006-2014. Recommendations were made to control and reverse the process of desertification in other to increase productivity, maintain the functional base of the environment, reduce crop failure, death of livestock, loss of settlement and decrease in poverty level of the populace.

Keywords: Degradation, Desertification, Environment, Environmental effects, Resources.

Introduction
Desertification is a significant global ecological and environmental problem that results to permanent decrease in biological productivity of dryland areas (Geist, 2006). It is a type of land degradation in which a relatively dry area of land becomes increasingly arid typically losing its bodies of water as well as vegetation and wildlife (Geist, 2017). World Ecology Report (2009), revealed that drylands comprise 41% of the earth's land area and are home to roughly 2 billion people, or 34% of the earth's population. currently, over 250 million people in more than 100 countries are directly affected by desertification and more are at risk and the situation is most severe in Africa, where 66% of the total land area is arid or semi-arid. Desertification is closely related to drought. Drought is also associated with desert condition. It is an aspect of the widespread deterioration of eco-systems and has diminished the biological potential of the land, such as plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development (UNEP, 2003).

United Nations Convention to Combat Desertification (2016), defined desertification as "land degradation in arid, semi-arid, and dry sub-humid regions resulting from various factors, including climatic variations and human activities". On this basis, Adams and Mortimore (1997) also defined desertification as a

process that causes land degradation due to some prevailing climatic conditions and human activities such that it resulted into the inability of the environment to sustain the demands being made upon it by socio-economic systems at existing levels of technology and economic development. Desertification has played a significant role in human history, contributing to the collapse of several large empires, such as Carthage, Greece and the Roman Empire, as well as causing displacement of local Populations (Geist, 2006; Geist, 2013). Desertification is a major serious challenge and threat facing sustainable development in northern Nigeria and other African countries. Dry lands occur on all continents except Antarctica (United Nations, 2006). The problem has an adverse effect on human health, food security, economic activity, physical infrastructure, natural resources, and the environment, both national and global security is also affected by desertification (United Nations Economic and Social Council (UNECSC), 2007). As depicted in the report of United Nations Conference on Desertification (UNEP, 2003) which states that "desertification is the diminution or destruction of the biological potential of the land, and can lead ultimately to desert-like conditions. It is an aspect of the widespread deterioration of eco-systems and has diminished the biological potential of the land, i.e. plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development".

The United Nations Convention to Combat Desertification revealed the following figures in relation to livelihoods on degraded dry lands, that more than 1.5 billion people in the world depend on degrading land, and 74% of them are poor. Poor people spend between 50% and 80% of their income on food. Meanwhile, Agricultural yields could fall by up to 50% in some African countries if production practices are not changed, while 52% of the land under agriculture is moderately or severely degraded and 12 million hectares of productive land become barren every year due to desertification and drought alone, which is a lost opportunity to produce 20 million tons of grain (UNCCD, 2014).

Mayell (2001), revealed in his study of the Global desertification map, that the Lake Chad located in the North-eastern part of Nigeria has been shrunk by 94% between 1960's and 2001, and this is the same climatic region with Machina Local Government Area, Yobe State. Medugu (2009), observed that a good number of policies and programmes have been implemented by Nigerian government to combat desertification, yet the problem is rather aggravating due to numerous issues including but not limited to handling the problem as a sectoral issue instead of an integrated approach that will bridge the gap between the formation of policy and strategies of combating drought and desertification. In the light of the foresaid, the study intends to examine the effects of desertification on the rural resources of Machina Local Government Area of Yobe State with the view to suggesting ways in improving / ameliorating the adverse outcomes of the phenomena. This will be achieved through these objectives:

i. Reviewing the causes of desertification and environmental management approaches in controlling desertification.

ii. Examining the effects of desertification on rural resources in the study area and recommending ways of controlling desertification in Machina Local Government area.

Study Area

Machina Local Government Area is geographically situated in the north-west of Yobe state (Figure 1). Its headquarter is in the town of Machina at 13°08´ 11´´ N and 10°02´ 57´´ E. It has an area of 1,213km^2, with a total Population of 61,606 persons according to the NPC census, 2006. It is 307km away from Damaturu and it is bordered to the north by Niger Republic, to the south and west by Jigawa state and to

the east by Nguru Local Government area of Yobe state (Fig. 1).

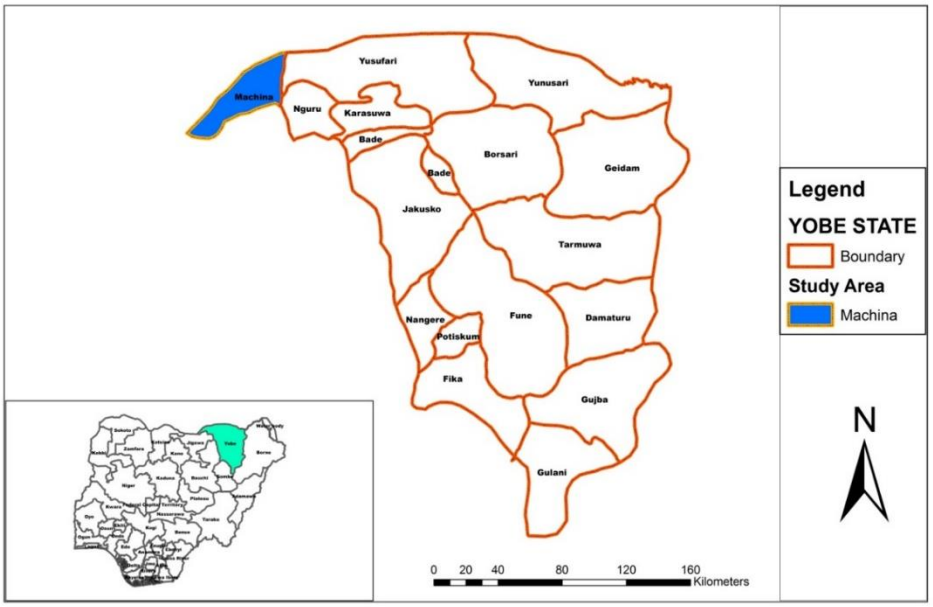


Figure 1: *Map of Yobe state showing Machina Local Government Area*
Source: Wikipedia Encyclopedia, and modified by Author, 2017.

Causes of Desertification

Desertification is caused by concomitant of natural (climatic) and Human factors discussed below:

Natural (Climatic) Factors

The natural factor is basically on the Shift in the Inter Tropical Discontinuity (ITD). A supposedly climate trend may in fact be part of a climatic cycle (Ayoade, 2004). It is noted that when the Inter Tropical Discontinuity shifts, for Instance, toward the equator, the incursion of rain bringing south-west trade wind is restricted to the coastal areas, this means a southern shift of climatic belt, resulting in lack of rain in areas north of the ITD (Ayoade, 2004). Increase in Atmospheric Carbon Dioxide Content; Carbon dioxide prevents the escape of earth reaching sun heat from escaping back into the atmosphere. The increase in CO_2 far above the natural volume means that its heat preservation will be higher; creating what is called greenhouse effect, thus this result in increase in temperature and global warming (retrieved from https://history.aip.org/climate/co2.htm).
Increase in albedo; Albedo is the rate of emission of ground reaching heat from the sun. Bare land surface emits more heat than soft and vegetation covered surface. Increase in albedo means the warming of the lower layer of the atmosphere. Increase in Atmospheric dust; A part of CO_2, other gases and dust are said to be on the increase. This is said to create warm inversion layers and to suppress convection rising of humid surface air (Ayoade, 2004).

During the course of the 20th century, the average temperature has risen between 0.3°C and 0.6°C. This is probably due to the effects of industrialization that has increased greenhouse gas emissions. The general rise in temperature has increased the rate of evapotranspiration leading to a drop in soil humidity and an increase in the condition of top soil, particularly in the dry lands, is a consequence of temperature variation, rainfall and soil humidity that exacerbate the process of desertification. Onyeanusi and Otegbeye (2012), showed that Nigeria is not excluded from the impacts of climatic variability and global warming with prominent localized effects in the highly industrialized cities and

Northern Nigeria which has resulted into the observed environmental degradations. Increased temperature of the average 1.1°C and decreased rainfall of average 81mm.

Human Factor

Overgrazing removes the vegetation cover that protects soil from erosion (UNCCD, 2011) and degrades natural vegetation that leads to desertification and decrease in the quality of rangelands. Livestock population in Nigeria has been estimated to consist of 16 million cattle, about 13.5 million sheep, some 26 million goats, approximately 2.2 and 150 million pigs and poultry respectively (Gadzama, 1995). The dry lands of Nigeria are said to support much of the country's livestock economy, hosting about 90 % of the cattle population. In the Sudan and Sahel zones, which carry most of the livestock population, nomadic herdsmen graze their livestock throughout the area and are constantly in search of suitable pastures. Additional pressure is also put on pasture resources by livestock from neighboring countries, notably Cameroon, Chad and Niger respectively (www.greenfacts.org). Nneji (2013) also, attributed rapid economic growth and urbanization as causal factors of desertification. The problem is more severe and complicated in developing world. Clearing of lands to accommodate the increasing population and accommodate the necessary infrastructure in northern is commonly done without adequate environmental consideration; this has led to the removal of vegetation cover in the area and as such, making the area desertified. There is a negative impact of the energy sector on forest and other vegetation cover and land productivity globally. This is why Biomass constitutes 30% of the energy used in Africa and over 80% used in many sub-Saharan countries such as Burundi (91%), Rwanda and Central Africa Republic (90%), Mozambique (89%), Burkina Faso (87%), Benin (86%), with Madagascar and Niger (85%) (Africa Regional Review, 2005). Urbanization in Kano City for instance has been estimated to be increasing rapidly at the rate of between 5 to 10% per annum (Federal Ministry of Environment of Nigeria, 1994). At least, 20,000 ha of land are cleared annually for construction. Cultivation of marginal lands: In periods of higher than normal rainfall, people tend to extend farming activities into the marginal areas. When the years of plenty are followed by dry years, exposed land with very little vegetal cover is at the mercy of the winds. The fine clays and silts are carried away as dust, and the sand drifts into dunes. The effect of this could be irreversible except through carefully planned rehabilitation programme.

Effects of Desertification

According to the United Nations Economic Commission for Africa report (2008), the impacts of drought and desertification are among the costliest events and processes in Africa. The widespread poverty, the fact that a large share of Africa's economies depends 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 continent especially vulnerable to impacts of drought and desertification. The effects of desertification are far-reaching and diverse. All aspects of human lives are either directly or indirectly impacted wherever the phenomenon exists. It ranges from food insecurity, water scarcity, and socioeconomic hardship to political unrest.

Food insecurity: Crop failure and death of animals means shortage of food supply for people which eventually results to famine.

Water Scarcity: Shortage of water makes life become unbearable and people are forced to leave their settlement. The scarcity of water leads to dryness of surface water and absence of natural recharge for ground water. This intensifies aridity condition and contributes to human sufferings.

Control of Desertification

Nwokocha (2015) identified the following Environmental management practices evolved over time to combat desertification. Various ancient and modem environmental management practices have been developed under a great diversity of socio-economic and ecological conditions. These practices can be categorized as:

1. Water management
2. Plant management
3. Soil management

Water Management: This can be achieved through, water conservation, improved irrigation methods, dependable water supplies, salinity control, run off management and flood control. Each has various technological methods that could improve productivity, halt desertification, reverse the process and reclaim extremely degraded areas.

Plant Management: This can be achieved through plant conservation, plant establishment and plant production (Agricultural, Rangeland and forestry). The most promising and effective technologies to halt desertification or to reclaim deteriorated areas are. Re-vegetation, Rotational grazing, deferred grazing, rotational pasture, crop rotation, fuel wood control, wind breaks shelterbelts and fencing.

Soil Management: The main aim of soil management is to halt desertification. Soil conservation, Soil moisture conservation, salinity control, drainage and measures of improving soil fertility are applied to solve problems of soil degradation. Various technologies are applied in each of the above.

Materials And Methodology

The data required for the study includes rainfall, temperature, relative humidity for the period of ten (10) years (2000-2009) and were obtained from the Nigerian Meteorological Agency (NiMet) Yobe state. The data helped to show climatic variability that explains the desertification conditions of the study area. Available data on livestock and agricultural production were collected from the Ministry of Agriculture which revealed the impact of desertification on local resources such as farm produce for a period of four years (2007-2010) and data on the vegetal cover over for a period of three (3) years was retrieved from the U.S Geological Survey (2012-2014) to show the vegetal degradation in Machina Local Government Area, Yobe State. The information derived from the data aforementioned were useful in drawing inferences on the subject matter.

Results and Discussion

Rainfall

Figure 2.0 shows that Rainfall in Machina LGA has been decreasing since 2000 to 2006 and then there was a rise in 2007 which was recorded to be 483.1mm. Between 2007- 2009 rainfall has been inconsistent with a fall in 2008 (320.3mm) and a slight rise in 2009 (366.5mm). The amount of annual rainfall over the years reveals the location of study area as Sahel region of Nigeria. The fluctuation in amount of rainfall between years 2007, 2008 and 2009 clearly indicates uncertainty of rainfall distribution in the area. The uncertainty of rainfall distribution, in addition to the fact that rainy season in the Sahelian region of Nigeria only last for three to four months (Geography of Nigeria retrieved from www.wikipedia.org on the 5th December, 2017) will in turn has adverse consequences on farming activities, livestock production and general livelihood of the people. By extension, Rainfall is highly irregular which makes farming activities difficult since small differences in the amount and timing of rain received at the area may determine the success or failure of critical stages in vegetal growth and development.

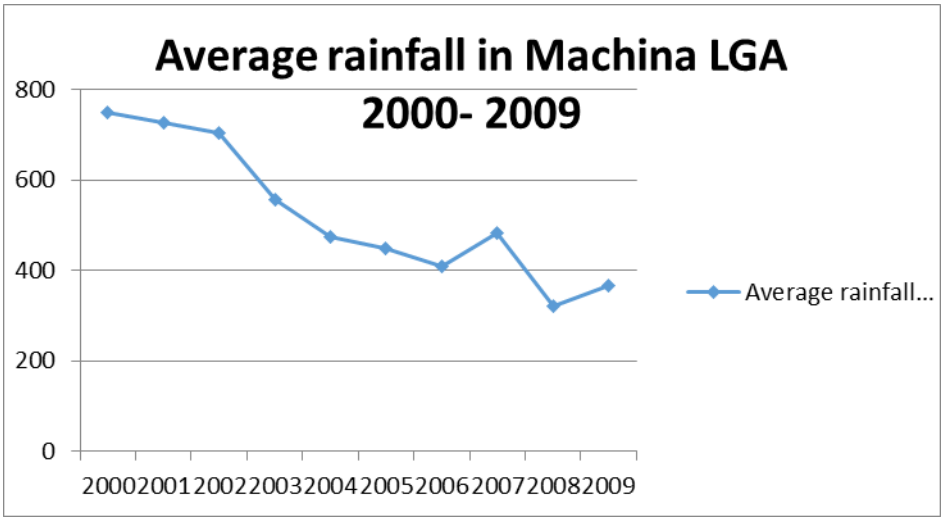


Figure 2: *Average rainfall in Machina Local Government Area*
Source: *Nigerian Meteorological Agency, Yobe State (2012).*

Temperature

By the records of the NiMet (2012) Makia Yobe, the mean temperature is about 37°C, the highest is about 42°C normally experienced in April and the minimum is about 30°C normally experienced in December. Fig. 3 shows that the highest temperature was recorded in 2009 with a mean minimum and maximum temperature of 21.7°C and 36.0°C respectively. Over the years temperature has been on the increase with a slight fall in 2002 and 2003 which was 33.7°C and 32.8°C, this indicates increase in the heating condition which is an indicator of the advancement of desert like condition. It can be inferred that there has been intense heating of the ground surface and also the temperature exceeding the limit to which plants can survive.

Relative Humidity

Records from NiMet (2012), shows that relative humidity is high during the rainy season and low during the dry season. Figure 4, revealed that over the years high relative humidity is associated with the morning hours because of the high moisture content and relatively low during the afternoon hours, because air moisture content has reduced this is in consonance with the relative humidity of the Sahelian region as seen in Literature. In 2004 there was a sudden rise in relative humidity of 42.4. % and then a sudden decline in 2009 with 37.7% relative humidity. This fluctuation depicts the climatic variability posed by climate change factor and the decline in moisture content of air means low moisture content that could encourage more rains in the region. It can be inferred that low relative humidity in Machina explains the decrease in the amount of rainfall due to light burdened (dry air) predominant in the region. This in turn has adverse effect on the general livelihood of Machina and environs

.

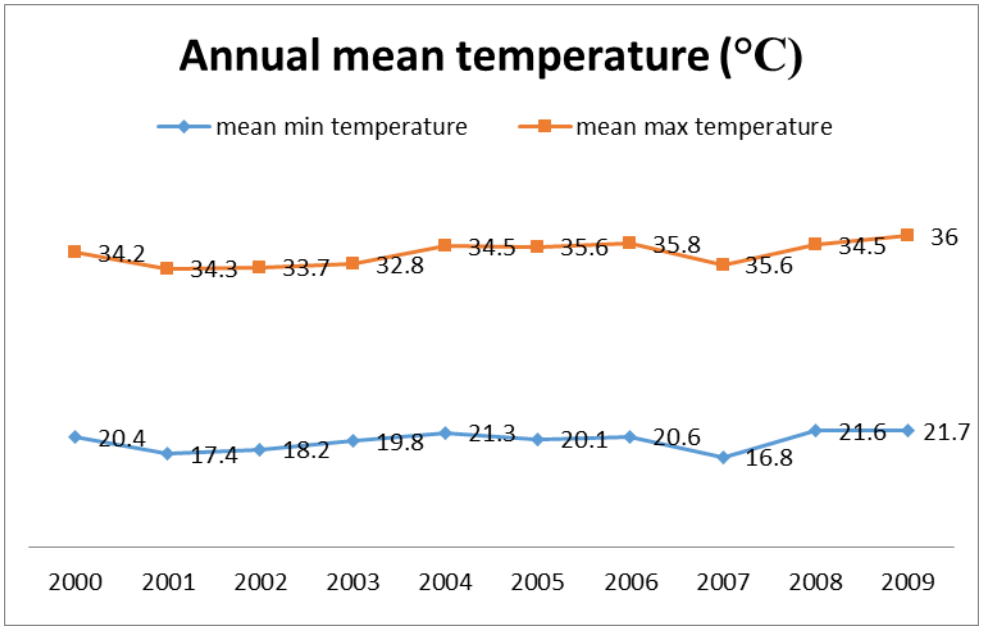


Figure 3 *Showing mean annual temperature in °C*
Source: *Nigerian Meteorological Agency (2012)*

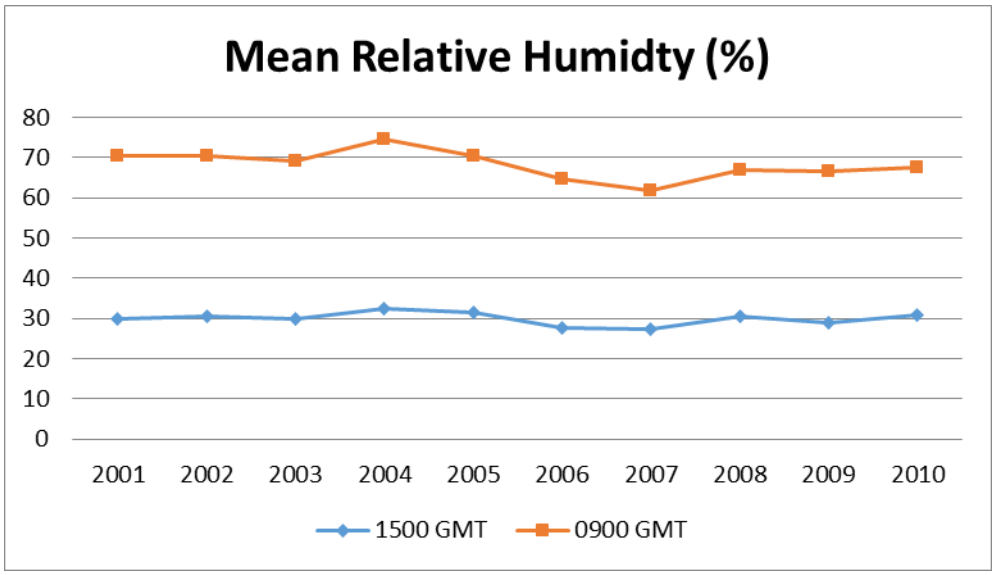


Figure 4: mean relative humidity (%).
Source: *Nigerian Meteorological Agency (2012)*

Effects of Desertification on Principal Rural Resources in Machina Local Government Area

LIVESTOCK: Livestock farming is one of the major activities that take place in most of the rural settlements in Machina LGA. The major livestock that are being reared include goats, cattle, and sheep and a few rear camels which are mostly used for transportation. Other livestock that are being reared on a smaller scale include poultry, ducks etc which are mainly meant for domestic consumption. There has been a decrease in the number of livestock over the years (Table 5), due to insufficient feed as a result of low and unpredictable rainfall

distribution, high temperature and Low relative humidity which encourages desertification. Machina known as an agricultural Local Government area with this revelation means an economic down turn and loss of livelihood to many residents, because so many households raises livestock for the sake of sustenance of their families, with the foresaid so many families are said to be experiencing economic hardship. To a large extent it affects the Gross Domestic Product (GDP) of the area and even the state at large.

NATURAL VEGETATION: The vegetation of the study area is located within the Sahel (dry) Savannah belt which means that trees and shrubs are sparsely distributed (Plate 1). Figures 5, 6 and 7 reveals an appalling information on the depleting trend and loss of vegetal cover from years 2006-2008, 2009-2011, and 2012-2014 respectively. This is in agreement with the increasing temperatures as discussed in figure 3. that is harsh for plant survival, decreasing amount of rainfall and its uncertainty alongside short period of fall explains this depleting circumstance of the vegetal cover. In addition, the rural dwellers in Machina LGA depend on the scares and depleting vegetation resource for their source of fuel wood (Plate 2) and feeding of livestock which has resulted in the decrease of the scanty vegetation cover that cannot be replenished with the very little amount of rainfall. Over the years' tree felling for either domestic or commercial purposes, clearing of land for farming purposes has become very intense.

Table 5: Showing mean number of livestock produced

Livestock	2007	2008	2009	2010
Cattle	45,400	43,380	40,400	39,780
Goat	23,587	17,117	16620	14,207
Sheep	20,722	19.724	19,151	18,650

Source: *Ministry of Agriculture, Yobe state (2016)*

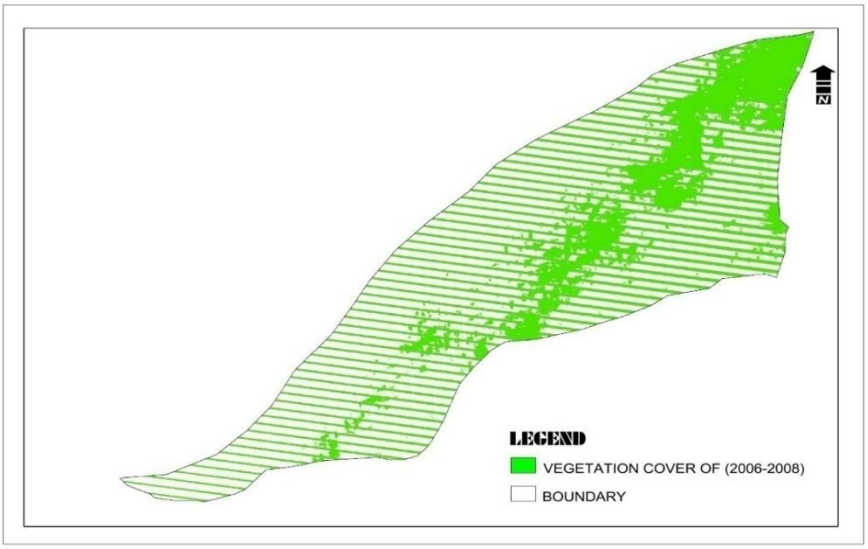


Figure 5: Vegetal cover of Machina LGA (2006-2008)
Source: United States Geological Survey (2016)

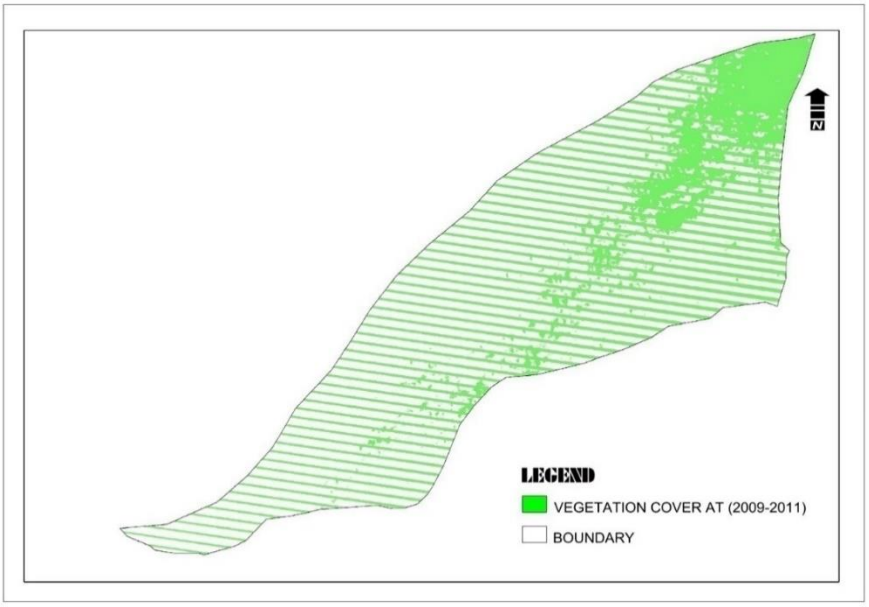
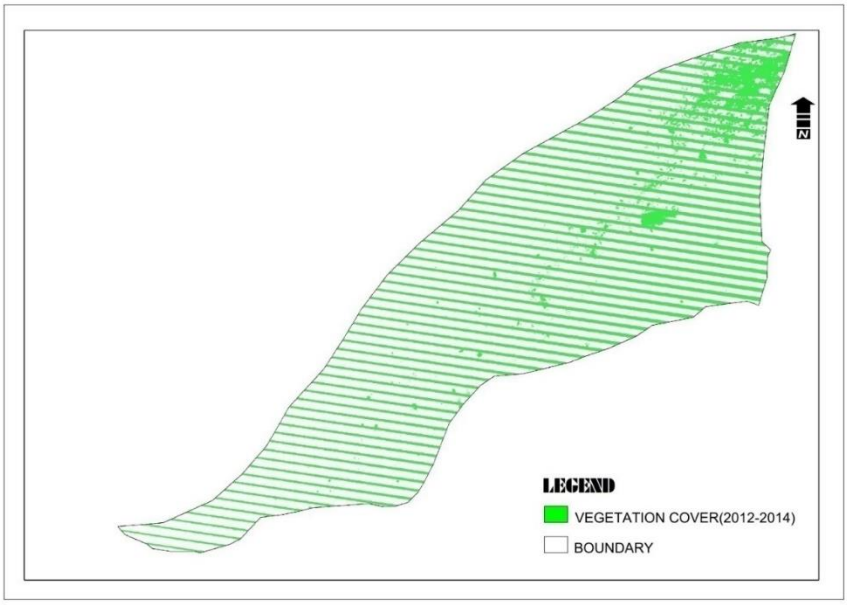


Figure 6: Vegetal cover of Machina LGA (2009- 2011)
Source: United States Geological Survey (2016)



Source: United States Geological Survey (2016)
Figure 7: Vegetal cover of Machina LGA (2012- 2014)

Plate. 1: Scattered trees plantings

Plate 2: Wood gathered by a hut

.

CROPS FARMING: Table 6. Shows that Crop farming is the predominant occupation of the rural dweller, either as source of income or source of food. The major crops that are being produced include beans, millet, guinea corn, maize. It revealed a declining crop yield per hectare for Beans the crop yield per hectare in 2007 was 1.25 but declined to 1.12 in 2010, maize 0.95 in 2007 to 0.75, and Millet 4.25 in 2007 to 3.91 in 2010. This again is bad revelation to the threat of livelihood of the Machina community because hunger/ food crises and economic hardship is already being experienced in the area. In addition, with the rapid rate of unemployment in Nigeria, many heads of household may depend on the sale of their produce so as to be able to meet up with some domestic needs of the household. As desertification increases, crop production reduces making it difficult for some of the rural dwellers to have food for themselves and also get income from sale of produce.

Conclusion

The study has established that the causes of desertification in the study area includes Inadequate and uncertain rainfall distribution / amount, increasing mean annual minimum and Maximum Temperatures by the years and decreasing relative humidity. This in turn reverts, negative influence on the output of average crop yield per hectare, depleting vegetation cover, and decreasing livestock production in Machina Local Government area.

Table 6: showing average crop yield per hectare

Crops	2007	2008	2009	2010
Beans	1.25	1.21	1.17	1.12
Maize	0.95	0.86	0.83	0.75
Millet	4.25	4.10	4.05	3.91

Source: Ministry of Agriculture, Yobe state (2016)

Recommendation

Based on the findings of this the following are recommendations on ameliorating the effects of desertification on the principal rural resources (vegetation, crop production and livestock) of Machina Local Government Area.

Vegetation

1. The use of pampers should be encouraged for planting of seedlings because of its high-water retention capacity due to presence of high temperatures that encourages evapo-transpiration.
2. The establishment of shelterbelts is good, but that alone cannot guarantee the success of natural vegetation cover restoration without the involvement of the communities located close to the project sites. Therefore, it is strongly recommended that efforts be geared towards enlightening the local communities on the need for conservation. Government and Non-

Governmental Organizations should as well encourage the foresaid.

3. Drought resistant grasses, shrubs and trees (such as gum Arabic seedlings) with high forage values should be used in rangelands and farmlands.
4. Discourage the indiscriminate felling of trees, by introducing the use of efficient wood burning stove which cooks faster and consumes little quantity of wood. and encourage the use of kerosene stoves to those that can afford.

Crop production

1. Promoting sustainable agricultural practices using drought-resistant crops such as drought tolerant, early maturing and high yielding crop varieties should be provided by the Ministry of Agriculture.
2. The use of Farm Yard manure and compost should be encouraged so as to add nutrient to the soil which aids in the early maturity of crops.
3. All water for irrigation purposes should be examined to establish the PH level that is conducive and devoid of low level of salt that may be have negative effects on crop production as well as ensuring a good drainage system.

Livestock

1. Strengthening of livestock extension services to deliver qualitative Veterinary services should be provided by the ministry of agriculture.
2. Rain water harvest and storage should be provided in all grazing/ rangelands so that rain water can be collected and used for animals feeding.

Reference

Adams W. M., & Mortimore, M. J., (1997). "Agricultural Intensification and Flexibility in the Nigerian Sahel". *The Geographical Journal of Environmental Transformations in Developing Countries*: 150-60.

Africa Regional Review (2005). Report on Energy for Sustainable Development.

Ayoade, J.O. (2004). *Introduction to Climatology for The Tropics.* Spectrum Books Limited (2nd ed.) Ibadan.

Federal Ministry of Environment (FMEnv) (1994). A report on National Action Programme to Combat Desertification in Nigeria.

Gadzama, N.M. (1995) Sustainable Development in the Arid zone of Nigeria. Monograph Series No. 1 32pp, Centre for Arid Zone Studies, University of Maiduguri, Nigeria

Geist, H. (2006). Dry land Ecohydrology. Springer Science and Business Media. Retrieved from tps//books.google.com.ng

Geist, H. (2017). The causes and Progression of Desertification. Ashgate studies in environmental policy and practices. Taylor and Francis publishers Limited, United Kingdom.

Geography of Nigeria (2017) retrieved from www.wikipedia.org on the 5th December, 2017.

Manuel, A.G. (1977): Technology and Desertification. United Nations Conference on desertification. Nairobi, 29 August- 9 September 1977 (Nairobi: UNEP).

Mayell, H. (2001) Shrinking African Lake offers Lesson on Finite Resources. Retrieved from

National Geographic News on the 21st June, 2011.

Medugu, I.N. (2007) A Comprehensive Approach to Addressing Drought and Desertification in Nigeria

Ministry of Agriculture and Natural Resources, Yobe state (2016). Unpublished records from the Ministry of Agriculture and Natural Resources.

Musa, M. A. (2016): Assessment of the Effects of Desertification on Rural Resources in Machina Local Government Area, Yobe State. An unpublished Bachelor of Urban and Regional Planning Dissertation, Department of urban and regional planning, Ahmadu Bello University Zaria, Nigeria.

Nneji, L.M. (2013). A Review of the Effects of Desertification on Food Security. Representative Opine. 5(10): 27-33

Nigerian Meteorological Agency, MAKIA, Yobe state (2012).

Nwokocha, C. (2015). Effects of desertification on Environmental Management in Northern Nigeria. Arabian Journal of Business Management Vol. 3. No.6 retrieved from www.arabianjbmr.com

Onyeanusi, A.E and Otegbeye, G.O (2012). *The impact of Deforestation on Soil Erosion and on the Socio-economic Life of Nigerians.* Sustainable Environmental Management in Nigeria, Book Builders publisher, Nigeria. pp. 315-331.

U.S Geological Survey (2016).https://www.usgs.gov/science-explorer results. Machina + vegetation

UNEP, (2003). Desertification. United Nations Environmental Programme, Nairobi, Kenya.

United Nations Convention to Combat Desertification (2016) retrieved from www.unccd.int on the 21st June 2016).

United Nations Convention to Combat Desertification (UNCCD) (2014): a carrying pillar in the global combat against land degradation and food insecurity. Background paper for the San Rossore meeting 'Climate change: a new global vision' Pisa, Italy.

United Nations Economic and Social Council (2007). Africa Review Report on drought and desertification, Fifth Meeting of the Africa Committee on Sustainable Development (ACSD-5), Regional Implementation Meeting (RIM) for CSD-16, Addis Ababa, 22-25.

United Nations, (2006). International Year of Deserts and Desertification, retrieved February

2006, http://www.iydd.org/

World Ecology Report (2009): Desertification: Its Effects on People and Land. spring 2009 vol.XX1 No.1Special Focus.