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ASSESSMENT OF THE IMPACT OF SAND DUNES ACCUMULATION ON LIVELIHOOD IN GIDAN JADO DISTRICT OF GADA LOCAL GOVERNMENT AREA, SOKOTO STATE, NIGERIA

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Abstract

Sand dunes as a major product of desertification is well known to affect soil resources, water resources and vegetation especially in arid and semi-arid region, this scenario disrupt the livelihood security of people in the affected areas. This research assessed the episode of sand dunes accumulation on house hold livelihood security of people in Gidan Jado district of Gada Sokoto dstate Nigeria. The researcher collected soil sample and subjected it to laboratory test and also 200 questionnaires was administered to the sample respondents us. The major findings shows that 80% of the respondents agreed that sand dunes affect water availability, soil fertility, transportation and fishing activities and as such posed negative consequences to lively hood security. Also 62% of the respondent suggested that they plant trees in their farm land s and homes in order to reduce the negative effect of sand dunes. However, on the soil parameters tested, it indicated low Organic carbon, Nitrogen, Potassium, Calcium and Phosphorus but higher values was recorded in Sodium and Cation exchange capacity which served as an evidence of high or strong aridity nature of the soil in the area. This consequently affected crop yield. Based on the findings the researcher recommended planting of tress as well as the use of organic manure for higher crop yield and as such improved lively hood of people in the area.

Keywords: *Livelihood, Sand Dunes, Accumulation, Desertification and Security*.

Introduction

Sokoto states like its counterpart in Sudan Sahelian region of Africa is highly susceptible to Geomorphological and hydrological changes which many a times are associated with catastrophes such as desertification, flooding, drought, land degradation, accumulation of sand dunes among others (Mohammad 2000). The above mention geomorphological and hydrological changes are disastrous to man as it affect agriculture, forestry, water resources, vegetation resources as well as human habitat (settlement) and as such impose negative consequences to man ranging from low agricultural yield, low income, and shortage of water for domestic and agricultural uses, thereby affecting livelihood security negatively.

Sand dunes otherwise called sand storm is a hill of lose sand built by Aeolian processes or the flow of water and occurring in different shape and size and are more likely to occurs in desert environment (Tarig2021). Sand storm/dunes poses a threat to livelihood security and sustainability as it affect the basis that supply humans with basic or primary needs i.e., it affect soil, vegetation and water resources and as such causes reduction or total disruption of such vital resources to human and consequently subjecting livelihood security and sustainability to poor status (Tarig 2021).

However, in Nigeria, the Northern most part is the most highly affected region by geomorphological and hydrolog2ical changes. This might be as a result of the fact that the area is closer to desert margin (Sahara desert), this in conjunction with the dominant human activities in the areas, for example; farming, grazing, cutting down of forest trees for fire wood among others, made the area to experienced drought, acid rain, land degradation, formation and spread of sand dunes, drying out of lakes and rivers, reduction in crop yield and loss of biodiversity. All these above mention are continuously affecting socio-economic base of people (livelihood security) in the area, inducing poverty, scarcity of water, food insecurity, and rise in crime as well as competition on the available resources and consequently jeopardizing peace and stability in the region (Odjugo and Ikhuria 2003). It is on this basis this research work is intended to examine the negative impact of sand dunes on soils and water resources as the major means of livelihood in Gada local government area of Sokoto state. Lastly, possible suggestions would be provided to curtail the negative effect of sand dunes accumulation in the study area, for greater livelihood security and improved socio-economic growth and development in the area.

Impact of Desertification on Households Livelihood Security

Desertification was considered as a monster capable of rendering million malnourished, poor and unable to feed themselves and their families around the World. It has further stressed that desertification can result in forced migration, social instability and human in ability to feed themselves, with this desertification can lead to human right abuse, especially the right to food considered ideal for the enjoyment for the right to life (Kaspa, 2022). Kaspa, (2022), in his studies further pinpointed that on a global scale land degradation and desertification (LDD) through human activities are negatively impacting the well-being of at least 3.2 8billion people, pushing the planet toward a sixth mass species extinction and coasting more than 10% of the annual global gross domestic product in loss of biodiversity and ecosystem services. The study also indicated that overgrazing by some 3 billion cattle, sheep and goat strips the soil of its vegetation and leave it exposed to the wind and rain that erode it and that the more the vegetation becomes degraded due to human endeavors to satisfy food needs, the more they tend to over use the natural resources, upon which they depended for their income and food and the more, many were rendered hungry.

Thus, the more these resources become degraded the more food security becomes jeopardized. This is the reasons why the call for farmers all over the World to feed the growing world population, to must matched with farmer's capabilities to better manage and rehabilitate the lands, for as Kabermatten acknowledge (former executive secretary of the UNCCD) "food security is fundamentally about soil fertility, water availability and food production all of which are severely jeopardized by desertification. According, study conducted by Gashu (2018) with a title Re-think the interlink between land degradation and livelihood in rural communities in Chilga District, North Western Ethiopia indicated that land degradation and desertification has the highest effect on the lively hood and well-being of the poorest household in rural areas. The study attributed land degradation and desertification in the area to high population pressure which depended solely on natural resources, particularly on soil for crop and animal production. This in collaboration with poor management, poor land tenure system continued to worsen the situation as the land is degraded to a highest possible degree, the study asserted that 85% of Ethiopian land are degraded and as such place the nation on the basket of poor food security bedeviling almost every person in the region (Bizuayehu *et al.*, 2022).

Similarly, study conducted by Jamala *et al.* (2018) on socio economic impact of desertification on rural livelihood in Ganye South East Adamawa State Nigeria shows that among the major effect of desertification were reduction in the amount of rainfall received each year, increases in temperature

and drying of water bodies, all of which resulted to low agricultural yield, poor and low pasture to livestock and as such inducing poverty to people of the area, other findings of the study includes; sharp declined of soil fertility. The study in line with its findings recommended a forestation and maintenance of shelter belt as the best strategy for combating desertification. According to Bishir, *et al* (2018) in a study conducted on impact of desertification on livelihood in Katsina state Nigeria using random sampling techniques to takes 385 respondents from farming families across the three agro-ecological zones of the state. The study established that pastoralism and rain fed crop production to be the mostly affected as the area experienced reduction in crop yield and degradation of grazing land. However, the study also found out that desertification induce migration to urban centers and also the forest reserve of the area has diminished through deforestation and conversion to farm lands by the farming families.

Impact of Sand Dunes on Households Livelihood Security

A dune is a hill of loose sand built by Aeolian processes or the flow of water and occurs in different shapes and size and that they are more likely to occur in dessert environment e.g. the Sahara Desert (Tarig, 2021). A study carried out by Tarig, (2021), on sand dunes, mechanism, and impact and control measures in semi dry region of Sudan, revealed that sand dunes lead to loss of 27.0 and 18.2 million hectares of soil with wind erosion as the most dominant and that mobile dunes covered about 20% of the area. Similarly, the study revealed that the amount of sand reaching the Nile in the Northern State is estimated at about $45m^3$/km/day causing sand bars, dust storm, which not only reduce visibility but also cause health problems. Moreover, the study indicated that in the Gezira scheme which used to be the back bone of Sudan economy is affected by moving sand invading crop fields and irrigation canals, thousand hectares of land are thrown out of production.

Similarly, a study conducted by Maha (2022) on sand Storms and desertification instability in the South of Iraq asserted that the impact of Sand Dune on people livelihood, health and stability has exacerbated. This study further asserted that, the Iraq ministry of environment has warned that by 2050 more than 300 sand storms may occur annually and that finding long and short term solution is therefore crucial for stability. The study continued to revealed that dust and sand storms were posing a serious challenge to the economy public health and stability, with an estimated loss of about seven million US Dollar, across different sectors but mostly in agriculture, the study also highlighted shrinkage of agricultural land because of drought. Dust and sand storm added to the challenges by reducing crop yield and quality and as such affecting income and livelihood of people in the region. Another study by Ganiy *et al* (2020) on assessment and local perception of sand deposits induce desertification in Sokoto State, Nigeria, the study connected or related desertification with sand dunes and asserted that the accumulation of sand dunes impacted negatively on socio economic life of rural household as it lead to reduction in crop yield and animal production causing scarcity of water as ground water is highly affected. Also, transportation is affected as rural roads are blocks by sand and as such leading to difficulties and high cost of transportation which in turn affect families' incomes and rise in price of food stuff. The study strongly recommended plantings of tree and shelter belt in order to reduce the menace of sand dunes and desertification in the area.

Research gap

Many researches related to geomorphological and hydrological changes have been conductedsuch as Tiwani, (2000) on the impact of hydrological hazard in Himalayas, which shows that drought, river rine flood, flash flood erosion and rain induce land slide are continuously affecting agricultural productivity and as such livelihood security of the region. Similarly, empirical study by Akhtar and Bahdun (2019) on localize flood, poverty and food security in rural Pakistan, shows rural livelihood

is the most vulnerable to the menace of geomorphological and hydrological changes. This might be attributed to dependency on agriculture and other primary sources of livelihood. Also, study conducted by Tarig (2021) revealed that sand dunes lead to loss of 17.0 to 18.2 million hectares of soil in Sudan, with wind erosion as the most dominant. Similarly, it has been asserted that the impact of sand dunes on people livelihood, health and stability has exervated in South-Iraq (Maha 2022).

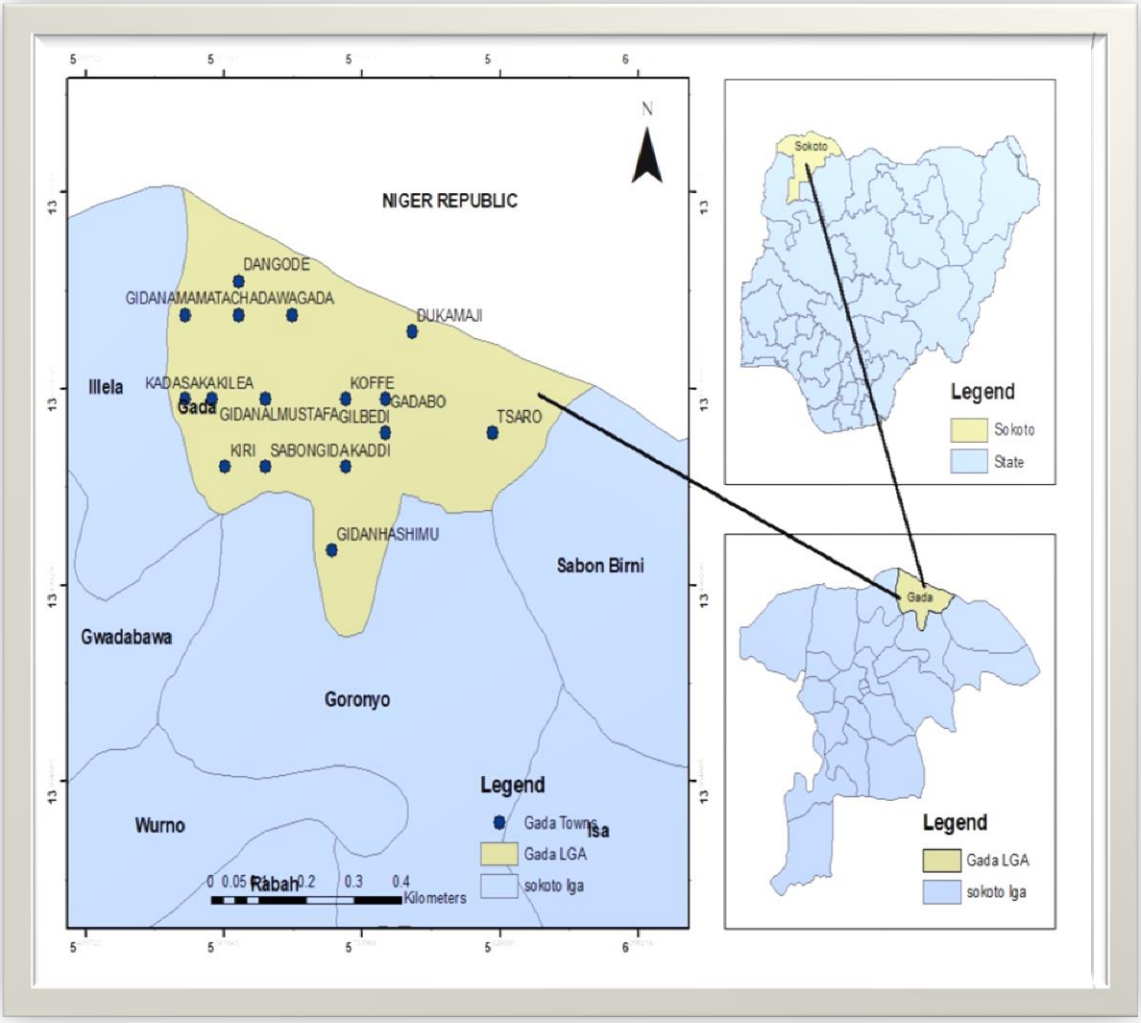
So also, in Nigeria Ganiy*et al* (2020) asserted that the accumulation of sand dunes impacted negatively on socio-economic life of rural households as it lead to reduction in crop yield and animal production. Causing scarcity of water, as it affect ground water, so also it affect transportation as roads are block by sand leading to difficulties and high cost of transportation, which in turn affect families income and rise in price of food stuff. All the afore mention researches and many others not stated here vary with this research work in term of scope, dimension and approach for example in this research soil sampling was involves to ascertain the effect of sand dunes on soil productivity. The objective of the research was as follows to:

- **i.** examine the physical and chemical characteristic of soil in both sand dunes affected and non-sand dunes affected areas
- **ii.** find the impact of sand dunes accumulation on socio economic activities of people in the area
- **iii.** investigate the adoptive and coping mechanisms adopted by people to combat the impact of sand dunes accumulation in their area.

The Study Area

The Gada Local Government Area (LGA) is one of the twenty three (23) local government areas of Sokoto state and it is situated at Latitude 13° 46’ 13’’N and Longitude 5°39’ 31’E. It is headquarters are in town of Gada and it comprises eleven wards which are: Kyadawa-Holai, Ilah-Dukamaje, Gubadi, KaffeTsitse, Kadadi, Kadasssaka, Kaddi, Kiri and Kwarma respectively. By its location, it shares boundaries with the Niger Republic to the north, Illela LGA to the west, Goronyo LGA to the south and SabonBirni LGA to the east. The LGA covers a total land area of about 1,315km^2(Free Encyclopedia, 2023).

In terms of climate of Gada Local Government Area is classified as a semi-arid climate (Free Encyclopedia, 2023). It is characterized by hot, dry conditions for much of the year, with a short rainy season. The region experiences high temperatures throughout the year, with average daily temperatures ranging from 30°C to 40°C.The rainy season typically occurs from June to September, with the peak rainfall in August. During this period, the area receives an average annual precipitation of about 600-800mm. The rainfall is usually short-lived, characterized by intense thunderstorms and heavy down pours. These rains are vital for agriculture and support the growth of vegetation and crops. The dry season in Gada typically lasts from October to May, when rainfall is scarce or completely absent. The temperatures during this period can be extreme, with daily maximums reaching up to 45°C. The harmattan, a dry and dusty wind that blows from the Sahara Desert, is also experienced during the dry season, leading to reduced visibility and dry atmospheric conditions (Abubakar & Adesola 2012). Due to the aridity of the climate of the area and its surrounding areas face challenges related to water scarcity, desertification, and drought. The scarcity of water resources during the dry season affects agriculture, livestock rearing, and human settlements, requiring proper water management and conservation practices (Abubakar & Adesola 2012).



Geologically, the area and its surrounding areas are part of the Sokoto Basin, which is a sedimentary basin extending across northwestern Nigeria and parts of Niger Republic. The underlying rock formations consist mostly of sedimentary rocks such as sandstone, shale, and limestone. These rocks were deposited during different geological epochs and have undergone various tectonic processes over millions of years. The landscape in Gada is characterized by flat plains, with occasional hills and ridges formed by erosion and weathering of the sedimentary rocks. The area is relatively dry and dominated by savanna vegetation (Abubakar & Adesola 2012; Musa, *et al* 2014). In addition, during the period of rainy session; there is runoff and surface water accumulation in rivers, streams, and temporary water bodies. The major rivers in the area include Rima River, Gagere River, and Wurno River, which are tributaries of the Sokoto River. These rivers play a vital role in the hydrological system of Gada and are important for irrigation, domestic water supply, and socio-economic activities in the local government area. The groundwater system in the area is also significant, with the presence of aquifers in the underlying sedimentary rocks. Wells and boreholes are common sources of water supply, especially during the dry season when surface water availability is limited (Musa, *et al* 2014; Maju-oyovmikowhe & Okudibie 2023).

The predominant soil types in Gada include sandy soils and sandy loams. These soils are generally well-drained but have a low water-holding capacity. They are often subject to erosion and nutrient leaching due to the sporadic and intense rainfall during the rainy season. The alluvial soils deposited by flooding along rivers and temporary water bodies are more fertile and suitable for agriculture (Maju-oyovmikowhe & Okudibie 2023). However, the vegetation in the area is characterized by savanna woodlands and grasslands. The prominent vegetation types include scattered trees such as acacias, baobabs, and Shea trees, along with grass species adapted to arid conditions. These grasses serve as valuable forage for livestock during the dry season. During the rainy season, the vegetation becomes lusher, with an increase in herbaceous plants and shrubs. The presence of rivers and temporary water bodies provides habitats for various aquatic plants and wildlife (Maju-oyovmikowhe & Okudibie 2023).

Furthermore, based on the 2006 National Population Census Gada LGA has a population of 248,267 and it has a total projected population for 2022 of 407,158which is made up of 194,622 males, accounting for approximately 47.8%, and 212,536 females, accounting for the remaining 52.2% of the total population with an average annual growth rate of 3%. The projection was done using the Newman's (2001) formula: {Pn= Po + (1+R/100 X Po)N} as cited by Barau, Sahabi & Sani (2023) and Attahiru, Saidu & Barau (2024), where Pn = population in the recent year, Po = population in the base year (248, 267), R = annual growth rate (3%) and N = number of intermediary years (2022-2006 = 16).Nevertheless, farming activities in Gada LGA mainly focus on rain-fed agriculture. Crops such as maize, millet, sorghum, and cowpeas are commonly cultivated during the rainy season, while some farmers practice irrigation using groundwater sources for vegetable production during the dry season. Overall, the soil in the area is generally sandy and less fertile, presenting challenges for agriculture. However, the presence of alluvial soils along rivers and the adaptability of crops and vegetation to the semi-arid conditions sustain agricultural and pastoral activities in the region (Maju-oyovmikowhe & Okudibie 2023).

Materials and Methods

The types of data for this research work were source from both primary and secondary source. The primary data for this research was obtained by taking soil sample from 20 point at an interval of 5metres from areas in Gada affected by sand dunes and also other areas south of Gada local government (Gigane settlement) not affected by sand dunes accumulation/desertification (this is for comparison and to ascertain the effect of sand dunes accumulation on soil parameters). The soil sample was taken using soil Auger following randomization method. A soil composite was form in each separate area. Then the sample was air dried, and taken to laboratory for test and the following parameters were tested; soil texture, soil pH, other chemical parameters tested were soil organic carbon content, soil nitrogen, soil phosphorus content, potassium and sodium.

Questionnaire formulated based on the objectives of the research was administered to the respondents who were randomly selected from the study area. The data were presented and analyzed using simple descriptive statistics i.e. table and chart. Also, the result of the soil from laboratory was compared with critical limit of soil parameters by Chude *et al*. (2005) to ascertain the level of these soil parameters tested.

Results and Discussions

Demographic and Socio-Economic Characteristics of the Respondents

From the data analyzed only 5% of the total respondents are female, while 95% of the respondents are male. This might be attributed to religion and cultural aspect of the people in the area, which pave almost all responsibility of household on male counterpart with the exception of certain circumstance i.e. death or separation of marriage.

In term of occupation, most of the respondents about 75% engage in Agriculture (raising of crops and rearing of animals). Also in term of education majority of the respondent are having Islamic education with few literacy and numeracy with regard to western education. From the investigation on the negative effect of sand dunes, 99% (almost all the respondents) agreed that, sand dunes tend to affect water availability, health facilities, transportation and fishing activities and as such posed serious consequences to livelihood in the area.

With regards to mitigation measures developed and adopted by people in the area to cope with the negative effect of sand dunes accumulation, about 60% of the respondents suggested that, they plant trees in their farm lands and homes in order to reduce the negative effect of sand dunes in their environment, 20% suggested that they make use of animal dungs in order to enhance the fertility nature of their farm lands. While 10% of the respondents suggested that, they engaged in dry season farming to supplement their income and as such are little hit by consequences of sand accumulation.

However, the respondents opined that they receive little to moderate government intervention in form of chemical fertilizer and other farm inputs on subsidy. Also each on every year government comes up with mass tree planting campaign with the zeal to combat desertification and its menace in the area. Other incentives include creation of shelterbelt, provision of extension workers by local government authority as well as loan to farmer's cooperation groups. Lastly about 95% of the respondents agreed that desert encroachment, climate change, negative human activities, soil erosion are the major causes of sand dunes accumulation.

Soils Parameters Sample from Gada Areas

Table 1: Results of Soil Sample Tested from Gada Area

Parameters Tested	Result
PH	6.92
Ca	0.7cmol/kg
Mg	0.22cmol/kg
CEC	4.4cmol/kg
N	0.042%
OC	0.12%
PO_4	0.54mg/kg
Sand	89.8%
Silt	7.8%
Clay	2.4%

Source: Soil Laboratory, Usmanu Danfodiyo University, Sokoto (UDUS) (2023)

From table 1 above, the soil pH is said to be more of neutral and all the parameters tested shows low with the exception of Mg and Sodium which indicate high and medium concentration. This is in comparison with critical limit for interpreting soil parameter (Chude et *al.*, 1995).

The low value of K, N, OC and PO_4 might be attributed to scanty vegetation in the area making the area poor in term of humus which is a major source of Nitrogen, Organic carbon and many more other essential elements in soil. Also as shown from the table, the soil in the area is having high to medium sodium concentration this is a clear indication that the area experience excessive evaporation and vapor transpiration and as such lead the soil to have higher salt concentration. In term of texture, the soil is having high sand and silt concentration with clay having very little value. This signifies the effect of wind and sand storm which continue to break the soil particles, leading to more salt and dust concentration in the area. The finding of the study tallies with the finding of Jones and Wild (1995) who opined that, the Savanna soil is having little Nitrogen content due to poor or little vegetation in the area. Similarly, Ahmed (1995) conducted a study on a similar soil and found low organic matter content and attributed it to effect of burning and removal of crop residues.

Soils Parameters Sample from Gigane Areas

Table 2: Result of Soil Sample Tested from Gigane Areas

Parameters Tested	Result
PH	6.06
Ca	0.6cmol/kg
Mg	1.4cmol/kg
Na	0.13cmol/kg
K	0.3cmol/kg
CEC	3.8cmol/kg
N	0.035 %
O.C	0.30%
PO_4	0.49mg/kg
Sand	91.7%
Silt	2.0%
Clay	6.3%

Source: Soil Laboratory, Usmanu Danfodiyo University, Sokoto (UDUS) (2023)

From table 2 above, the soil pH is said to be slightly acidic, low in term of Calcium, Potassium, Nitrogen, organic carbon, Phosphorus, Cation exchange capacity (C.E.C); low in Sodium and high in term of magnesium . All these are in comparison with critical limit for interpreting soil by chudeet*all* (1995). Also from the table it shows higher values of sand concentration with lower values in silt and clay. This is a clear indication of greater effect of desertification in the area which induce wind action that continue to blow and break away sand particles, leading to greater concentration of silt and dust particles in the area.

Comparison between Soil Samples Tested form Gada and Gigane Areas Using Chude *et al.* (2005) Method of Analyzing Soil Parameters

From the result obtained, it shows that there is little variation in term of most of the parameters tested, except in Sodium which shows higher values in soil of Gada, this might be attributed to greater aridity in the area which accelerated higher evaporation and evapotranspiration and as such

high sodium accumulation in the soil of the area. However, in term of silt concentration, there is significance variation between the two area with Gada having higher figure, this is a clear indication that Gada area suffer more on the impact of desertification which pave way for greater wind actions which is responsible for blowing and breaking down of soil particles and as such greater concentration of silt in the area leading to accumulation of sand dunes.

Conclusion and Recommendations

Base on the finding of the research the researcher concluded that sand dunes accumulation posed a threat to livelihood security of the people of Gada and its environs, as it affect soils, water resources, vegetation and infrastructural facilities. Also, the research pointed evidence of desert encroachment in the area. Based on the findings of the research the following recommendations were offered as**:**

1. Government of Sokoto state should intensified on massive tree planting campaign as shelter belt in the area.
2. Government of Sokoto state should provide better and effective irrigation scheme in the area in order to enhance food security and livelihood.
3. The Farmers in the area should embark on the use of organic/farm yard manure in order to maintain and improve the fertility of soil in their farmlands.
4. Awareness programs on the need to conserved soils, vegetation and water resources should be provided by government and other stake holders.
5. People of the area should be encourage on planting of trees on their home stead and farm lands as a means of fighting desertification and sand dunes accumulation.

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