

On major environmental problem of desertification in Northern Nigeria with sustainable efforts to managing it

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Abstract

Purpose – The purpose of this paper is to show the extent of desertification and land degradation as threat to sustainable environmental, agricultural and land development in the Sahel of Nigeria with its consequences; with also some efforts to control desertification.

Design/methodology/approach – Several desertification attenuation projects in Nigeria are employing different methods for maximum benefits obtainable from the objectives) of the particular project. Specific methods will be cited for particular projects mentioned as appropriate. It is noted however that environmental impact assessment, community reconnaissance or needs assessments were initial part of pre-project activities.

Findings – Desertification has reached an alarming state in Nigeria. The frontline desert threatened States of Nigeria constitute 40 per cent of the land mass of the country. With increased pressure of desertification, exacerbated by a period of prolonged drought of about 20 years, climate change and human activities, it is becoming increasingly difficult to obtain sustainability in the management of the fragile lands and the region's ecosystem. Strategic interventions in combating the problem of desertification in Nigeria have attenuated some of the detrimental social, economic and environmental impacts on the affected communities of the Sahel of the country. Programmes and projects are designed to strengthen the resilience of the people in the affected region with sound ecosystems' management; support the efforts of the communities resulting in increased agricultural yields. Programmes and projects have strengthened the resilience of the people, participating in sand dune stabilization, the Great Green Wall Sahara Sahel Initiative and other shelterbelt development. Government has sustained inputs in environmentally friendly agriculture and also encouraged synergetic collaborative activities with national agencies, international agencies and local institutions.

Originality/value – These results/activities give evidence of the increased public awareness of environmental degradation due to desertification in Nigeria; the realization in environmental stabilization needs with ready participation of the communities for improved livelihoods in arid agriculture; resulting in internalization of these problems for Nigeria.

Keywords Sustainable development, Technology adoption, Climate change, Sustainable environment, Development policies, Renewable energy

Paper type Research paper



Introduction

Desertification, according to the United Nations Convention to Combat Desertification refers to land degradation in arid, semi-arid and sub-humid areas resulting from factors such as human pressure on fragile eco-systems, deforestation and climate change. The terms desertification and land degradation are mostly used interchangeably and closely linked to drought.

Desertification is caused by a combination of factors that change over time and vary by location. These include indirect factors such as population pressure, socioeconomic and policy factors, and international trade as well as direct factors such as land use patterns and practices and climate-related processes. The causes of desertification may be summarized as unsustainable management of resources and inputs such as over grazing of rangelands; improper farming and irrigation practices and systems; excessive application of fertilizers and chemicals; deforestation, forest fires and fire wood collection; urbanization; mining and change in land use patterns. Socio-economic factors include land tenure, fragmentation and common title; also weak participation of private sector; poverty and food insecurity. Institutional and legal factors include weak enforcement of legislation; weak institutional capacities and capabilities of the public, NGOs, CSOs or private sector and weak coordination mechanisms among them; Weak participation of different stakeholders in the decision-taking decision-making processes; lack of information and appropriate data; lack of proper awareness and appreciation among the people, media, legislators and decision makers; Low interest and budget allocation to combating desertification; lack of proper implementation of national policies, strategies and commitments to combating desertification and applying the proper incentives, policy tools and instruments; weak regional cooperation; ambiguity and overlap over responsibilities. Natural factors including climate change and weather factors; population growth and pressure are all apparent.

The purpose of this paper is to show the extent of desertification and land degradation as threat to sustainable environmental, agricultural and land development in the Sahel of Nigeria with its consequences.

Literature review on desertification in the frontline states of Nigeria: extent and severity

The frontline desert threatened states of Nigeria occupy some 40 per cent of the land mass of the country in the far north region and lies within the Sudano-Sahelian West Africa which stretches from Senegambia to Somalia in the East – a land mass located within Latitudes 10° to 14° N and Longitudes 3° and 14° East. They are collectively regarded as “frontline states” because they mostly share common boundary with the Sahelian Niger Republic. Indeed the northern borders are all Sahelian environment (Figure 1, Table I). This zone generally known as Sahelian zone of Nigeria is defined as an area that receives between 200 and 800 mm of rainfall per year. These States have a population of about 35 million people.

Sahel is considered one of the most sensitive and delicately balanced ecological systems in the world. With the increased pressure of desertification, exacerbated by a period of prolonged drought of about 20 years (1970-1990) and human activities, it has become increasingly difficult to maintain sustainable development in the fragile lands of the region particularly in the States of Bauchi, Gombe, Borno, Yobe, Kano, Jigawa, Katsina, Sokoto, Zamfara, Kebbi and Adamawa (Figure 1).

The middle-belt States of Nigeria located between latitudes 6°N and 11°N that share boundary with the above frontline states serve as the buffer zone, because they absorb the pressure of migrating human and animal population. These states include Benue, the Federal Capital Territory, Kaduna, Kwara, Kogi, Nassarawa, Niger, Plateau and Taraba (Figure 1). Desertification maps by FAO, WMO and UNESCO in 1977, show significant southward migration of Sahara desert. For it is known that the Sahara is moving southward at the rate of 0.6 km yearly; amounting to a loss of about 351,000

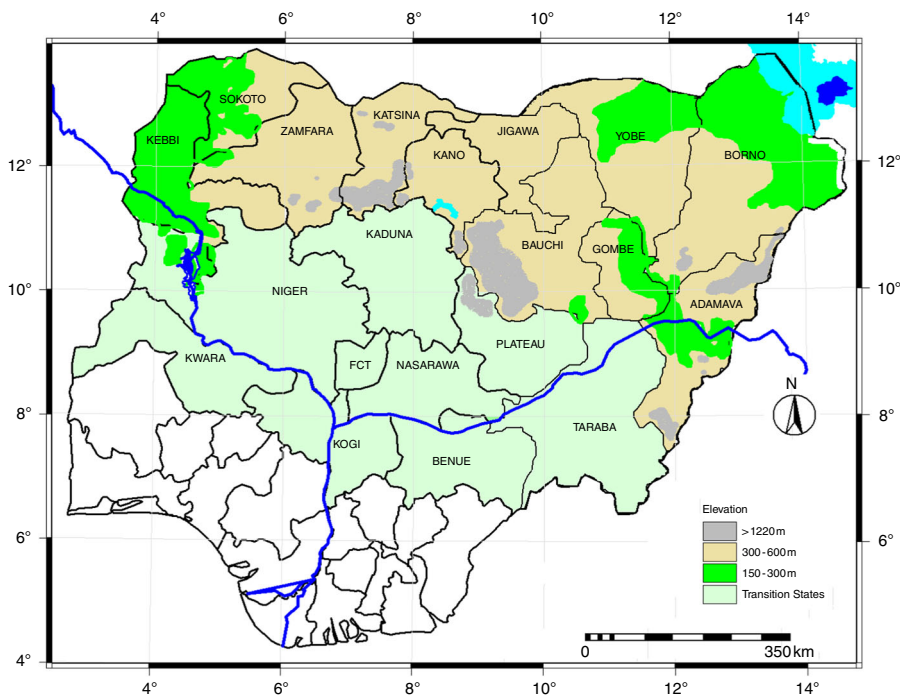


Figure 1.
Desertification
frontline States and
the Buffer Zone

Source: Gadzama and Ayuba (2014)

Table I.
Frontline states of
Nigeria affected
by desertification

Land area States	Km ²	% of Nigeria	Population Number	Density/km ²
Bauchi/Gombe	64,605	6.99	4,294,413	66
Borno	70,890	7.67	2,596,598	37
Yobe	45,502	4.93	1,411,481	31
Kano	20,131	2.18	5,632,040	280
Jigawa	23,154	2.51	2,829,929	122
Katsina	24,192	2.62	3,878,344	160
Sokoto/Zamfara	65,735	7.12	4,392,391	67
Kebbi	36,800	3.98	2,062,226	56
Adamawa	42,159	4.56	2,124,049	51
Total/average	393,168	42.56	29,221,471	97

hectares of both crop and rangeland to desertification each year (Gadzama, 1995; Tiffen and Mortimore, 2002; FGN, 2004). This is evident in the sand dunes that have covered large expanse of agricultural farmlands, livestock grazing land with trees dying within the region and drying up of local oases (Building Nigeria’s Response to Climate Change (BNRCC), 2012).

Between the period of 1976/1978 and 1993/1995, sand dunes increased by approximately 17 per cent from 820 to 4,830 km² (Federal Ministry of Environment (FMEEnv), 2008). Some villages and major access roads have been buried under sand

dunes in the extreme northern parts of Katsina, Sokoto, Jigawa, Borno and Yobe states. An example is the receding Lake Chad. Gully erosion, that hitherto was not a major threat, increased, threatening about 18,400 km² (compared to only 122 km² in 1976/1978) (FMEnv, 2008; Musa *et al.*, 2008).

It has been estimated that between 50 and 75 per cent of the 11 frontline states of Nigeria are under severe threat. The pressure of migrating human and livestock populations from these states are being absorbed by buffer states resulting in an intensive use and degradation of the fragile and marginal ecosystems of these areas, even during years of normal rainfall. The buffer states are reported to have about 10 to 15 per cent of their land areas threatened by desertification (Gadzama, 1995; Tiffen and Mortimore, 2002; FGN, 2004).

This timely land use and vegetation cover studies by Forest Management, Evaluation and Coordinating Unit (FORMECU) of Federal Department of Forestry, for the periods 1976/1978 and 1993/1995 showed that the changes in vegetation during the interval period of 15 years (1978-1995), was staggering with 32 per cent of the riparian vegetable cover removed by year 1995. Forest cover became less than 20 per cent that of 1978, and that the present estimated forest cover for Nigeria is less than 10 per cent, with increased distribution of alluvial and rock out crops, signifying degradation. With increased population, it is not surprising that there would be intensive agricultural land use.

Desertification and climate change

Diverse views exist on the complex relationship between climate change and desertification. It is presently estimated that Nigeria is losing some 351,000 km² to the desert, representing 40 per cent of its total land mass due to desertification effect (Tables I). In Nigeria alone, it is estimated that more than 38 million people, representing more than 32 per cent of the total population of the country live under hardship of desertification (UNSO, 1989). It is also subjectively estimated that the rate of desertification in the country is about 0.6 to 35 kilometres per year (Thambyahpillay, 1991; Gadzama, 1995). This spread in value is not however surprising in view of the fact that desert movement is erratic and depends on variable factors and locations measured.

In general impact of desertification is that more land brought under agricultural production expanded from 503,000 to 585,000 km²; an increase of 82,040 km² (16 per cent). Gully erosion, which hitherto was not a major threat, has increased and is threatening 18,400 km² (compared to only 122 km² in 1976/1978). Sand dunes have equally increased by approximately 17 per cent from 820 km² to 4,830 km² over the period. It is now observed that the Sudan savanna ecology is transiting to Sahel (*sahelinization* of the Sudan savanna), while the Guinea savanna ecology is transiting to Sudan (*sudanization* of the Guinea savanna), an indication that desertification intensity is increasing in Northern Nigeria.

Decreasing rainfall and desertification

In Northeastern Nigeria, annual rainfall values have varied considerably over the last century. Hess *et al.* calculated an average decline in annual rainfall of 8 mm yr⁻¹ from 1961 to 1990 during the Sahel drought for the region Hess *et al.* also reported that over the 30-year period, there has been an unpredictable, yet significant decline of 8 mm per year in the mean annual rainfall in the zone. This however, is not generally

associated with a change in the length of the season, but with the reduction in the number of rain days per season and the consequent reduction in the mid-season (August) rainfall totals. However, since the mid-1990s the decreasing trend in annual rainfall seems to have been reversed with the 2005 and 2007 annual rainfalls of up to 800 mm have been recorded in the Maiduguri station. Rainwater is the major source of recharge in the region and therefore decrease in rainfall due to climate change will lead to corresponding decrease in recharge which will greatly affect the quantity and quality of potable water from the boreholes.

The receding Lake Chad

The Lake Chad Basin serves as a source of freshwater to the over 20 million people who depend on it for their livelihood. The Lake with its rich biodiversity also provides a source of fishery, pastoral and agricultural activities for the inhabitants in the Basin. However, the lake has continued to shrink with desertification. It is estimated (Musa *et al.*, 2008) that between 1963 and 2007, the surface area of the lake has shrunk from 25,000 km² to less than 3,000 km² with little or no water in the Lake in the Niger and Nigerian portions.

From the above review, the major agents of desertification in Nigeria are climate change (especially changes in rainfall patterns), and increased variability of droughts are major factors. Others are inappropriate use of technologies in agriculture and land management and land demand by the large population of the country. The Sudano-Sahelian region is the main livestock production area and the seasonal migration of large herds result in land degradation. Nomadic Arabs from Niger (Renaud *et al.*, 2007) are also recorded as still crossing into the northern most parts of Nigeria in Gashigar, Duji, Asaga, Damasak and all border settlements of Borno State. These migrants and present insurgency, pose very special security and socio-economic problems.

Methodology

Many national and international Agencies have participated in several desertification attenuation projects in Nigeria employing different methods for maximum benefits obtainable from the objective of the particular project. Specific methods will be cited for particular projects mentioned as appropriate. It is however noted that environmental impact assessment or community reconnaissance and needs assessments were initial part of all pre-project activities.

Review of previous interventions against desertification

Early control efforts in the 1960s, 1970s and 1980s

Efforts at desertification control in Nigeria started during the colonial era. The colonialist focused attention on forest reservation (Forest reserve Ordinance of 1916). At that time, each of the three existing regions of Nigeria (East, West and North) enjoyed territorial power over its forest resources and was equally responsible for monitoring and supervising the activities of the native authorities that undertook assigned forestry activities. The Federal Government, however, retained the aspects of forestry research and education since 1954. Thus, many forest reserves were gazetted before and after Nigeria's independence in the 1960s by the various state governments. By the late 1970s and early 1980s, the focus shifted to establishment of large-scale monoculture plantations of exotic species (afforestation projects), as tree-planting campaigns, shelterbelts development (to roll-back the desert),

etc. Recently, (with the Forestry Policy of 2006) there is a paradigm shift from the mono-culture plantation to community-based forestry programmes. This is in realization that local population must be brought on board in the planning and implementation of forestry projects as part of sustainable environmental awareness campaign programmes.

Frontline states' realization of the threat of desertification in 1980s

The collaborative efforts of the 11 Northern States in the 1980s have been most appropriate and impressive. In realization of the serious situation of drought and desertification in the northern parts of Nigeria, the Military Governors of the 11 Northern States, set up a Consultative Committee on Desert Encroachment to assess the extent of desert encroachment in the North, review the efforts made on anti-desertification and make recommendations on the situation both on regional and national bases. The Committee had toured all the affected States and submitted their preliminary but discouraging report.

In their core report, the Committee made general observations that the affected areas could be categorized into Critical areas (zone 1); Less critical areas (zone 2); Partially deforested areas (zone 3) and Special decertified areas (zone 4). The States in zone 1 (Borno, Kano, Jigawa, Katsina, Sokoto and Bauchi) were adversely affected, particularly areas north of latitude 12°N where over 75 per cent of the land was desertified. The general conclusion was that the Northern states were in great danger, with average desertification of about 48 per cent. There was also much anxiety over the state of deforestation in the north with its average forest coverage of less than 25 per cent which is considered to be far below the international standard (it is presently estimated to be below 10 per cent in 2009). In 1989 Sokoto, Katsina and Kano states, in collaboration with the Federal Government, had reported commendable achievements on the massive shelterbelt developments. These shelterbelts, as shown in Plate 1, are now satellite beacons in the zone which are immensely appreciated by the rural communities, especially the farmers that testify shelterbelts' contribution to enhanced crop yields and multiple harvests in a year.



Source: Gadzama and Ayuba (2014)

Plate 1.
Shelterbelt at
Danbatta, Kano
State. This row of
Neem (*Arachzirdah
indica*) in
combination with
gum arabic trees,
provided good wind
breaks

Work of forestry management, evaluation and coordinating unit in Northern Nigeria (monitoring natural resources degradation)

FORMECU played a critical role in conducting an inventory of natural forest and plantation resources in 28 states of the country, culminating in the production of forest management plans for each of the states involved and the development of forest information system to assist in the sustainable management of forests. It also coordinated the National Forestry Action Programme for Nigeria in the 1990s. More importantly, the work of FORMECU provided critical evidence of the serious vegetation changes and biodiversity loss particularly in northern part of the country, forewarning on problems of desertification.

The north east arid zone development programme, funded by the federal government of Nigeria and European Union assistance

This commenced in February 1990 with the main objective of motivating and assisting the rural development, targeting at improving the standard of living of the rural population through proper resource use and management. The programme covers an area of about 25,000 km² in the extreme northern part of Borno State (now Borno and Yobe States). The major components of this programme include water resources development and management (including irrigated agriculture), provision of micro-credit for off season economic activities, cottage industries, livestock fattening, rural banking and popularization of animal traction for land preparation for agric. activities in environmentally friendly system. The programme was very beneficial to many communities in Yobe State that has presently continued to sustain its activities.

UNEP/University of Maiduguri community sub-regional model village project

This was a sub-regional project carried out under the name, Mega-Chad Project in developing appropriate rural technology options in harmony with environmental protection. In this regard, the University of Maiduguri (Centre for Arid Zone Studies), in partnership with Federal Ministry of Environment of Nigeria, adopted a small town called Sabon Gari Nangere in Yobe State of the country in 1995 for environmental study trials in community acceptance and adoption of fabricated energy saving cooking stoves. The objective was to create partnership with the local communities in the Sahel, and through appropriate education and input of material, financial, intellectual resources and guidance, the communities would become self-sustaining in terms of undertaking good practices for improved livelihoods. This would indeed contribute to environmental conservation. Because of its community acceptance, the Project was successfully replicated in four sub-regional Sahelian communities of Turba Gida (Niger Republic), Ngala (Nigeria), Zafaya (Tchad) and Makilingai (Cameroon) with good degree of acceptance/adoption of the rural technologies – (fabricated clay stove, saw dust stove and solar cooker). The Mega Tchad Project was financially supported by the Belgium Government through UNEP.

The Great Green Wall Sahara Sahel Initiative (GGWSSI) in Africa

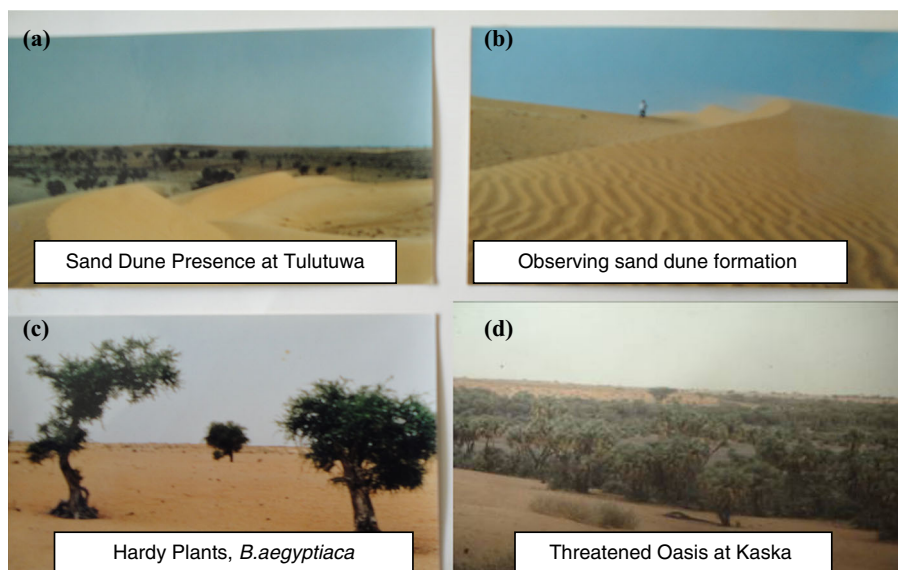
In 2007, African Heads of State and Governments endorsed the Great Green Wall for the Sahara and the Sahel Initiative (GGWSSI) with the objectives of tackling the detrimental social, economic and environmental impacts of land degradation and desertification in the region. The initiative aims to support the efforts of local

communities in the sustainable management and use of forests, rangelands and other natural resources in drylands. It also seeks to contribute to climate change mitigation and adaptation, as well as improve the food security and livelihoods of the people in the Sahel. The vision for the Great Green Wall (GGW) has evolved into that of a mosaic of interventions of tree planting and addressing the challenges facing the people in the Sahel.

The overall goal of the GGW as mentioned above, is a strategic initiative to strengthen the resilience of the region's people and natural systems with sound ecosystems' management, sustainable development of land resources, the protection of rural heritage and the improvement of the living conditions of the local population. The African Union considers GGW as a special Programme, thereby recently upgrading it to the status of a PAN AFRICAN AGENCY with its Headquarters located in Nouakchott, Mauritania and administered by a Director General.

For Nigeria, the GGWSSI is community driven in outlook, as all the eleven frontline states, involving 46 local governments, running from Kebbi to Borno State, covering a distance of 1,500 Km long by 15 Km wide would be developed. As a rural-based programme, the communities will be supervised to raise 60 million drought-resistant tree seedlings, to be planted for the establishment of contiguous shelterbelt across the states. More than 100,000 people in the rural areas will be employed, beside the 1,000 forest guards and 450 extension workers that will be required.

It is with great anticipation that the above will successfully be implemented to match the great shelterbelts in Jigawa and Kano states developed in the 1960s which are now satellite beacons in the Sahel of Nigeria. Nigeria's GGWSSI was recently launched by His Excellency, the President, Dr Goodluck Ebele Jonathan in Kebbi State in November, 2014 (Plate 2).



Source: Gadzama and Folorunso (2011)

Plate 2.
(a-d): Desertification
in Process at
Tuluwa and
Kaska, in Yobe State
of Northern Nigeria

Strategic desertification control: taming sand dunes of Nigeria*Sand-dune fixation/stabilization*

Many communities in the northern-most parts of Yobe and Borno States have been forced to migrate as a result of the encroachment of sand dunes. For instance in Tosha village (Yobe State), upland farm yields have gradually decreased over the years as sand dune formation became prominent about 40 years ago. The dunes have now encroached on farmlands near Sansan and also threaten the main access road to Damasak in Borno State (BNRCC, 2012). These are to be stabilized.

Several techniques have been used to fix the dunes in Nigeria: from the mechanical, to mulch, aerodynamic, to biological fixation. The more successful methods in the flat land of Borno and Yobe States where sand dunes occur more frequently are the mechanical, mulch and biological fixation methods. After dunes have been mechanically stabilized, they can be permanently fixed by planting trees and perennial vegetation. The top 20-30 cm of the dune act as a protective cover, thus reducing the loss of the moisture in lower levels that is essential for the establishment and growth of the species planted. In Tosha (Yobe State) and Sansan (Borno State), the biological approach was adopted with the planting of 15,000 seedlings of the early colonizing and fast growing tree – *Prosopis juliflora* on the leeward side of the dunes that are threatening the two communities (BNRCC, 2012). The development of large scale Jatropha biodiesel producing farms in the Sahel of Nigeria is now land stabilizing prospect.

Discussion and conclusion

The outstanding environmental threat in the Sahel of Nigeria is the southward spread of desertification. The sustainable containment of this problem should take into priority the components observed and discussed below in order to encourage sustainable livelihoods in the Sahel and to fight desertification.

As a major limitation, it is the variation in rainfall that creates serious problem in the development of arid lands, where there is the constant danger of over-exploitation of groundwater leading to the threat of emptying the reservoir, low water level and deterioration in water quality. In Nigeria, the River Basin Development schemes have profoundly altered water flows, drainage patterns and ecology of many areas in Borno, Kano and Sokoto States, leading to social, economic and political problems. There should be environmental impact assessment, a thorough multi-disciplinary investigation on possible consequential problems such as the loss of arable lands, displacement of the local population, destruction of forest and wildlife resources, possible increase in water-borne diseases (Carter *et al.*, 1990) and effects on down-stream economic activities. Carter *et al.* (1980) therefore endorsed the small-scale development approach now being adapted by the ADPs, and the large-scale mechanized and irrigated food production enterprises for the River Basin Development Authorities that should now provide the farmers with resources, infrastructures and technical inputs.

In arid agriculture which always impacts on environment, and in the effort to sustain appropriate livelihoods, the following factors must be taken into consideration in order to set the right goals and priorities in maintaining a proper balance between food production and environmental quality. These factors include availability of water, climatic change and its impact, soil parameters, land use and socio-cultural trends (Plate 3).

Although the livestock population in Nigeria is estimated at 26 million goats, 14 million cattle and 10 million sheep, little is known of its changing distribution in

the country and the effects on the environment. Mention had earlier been made on the implication of overgrazing to environmental quality. The issues that must be considered are the reduced potentials of grazing due largely to ecological degradation, irrigation works, settlement expansion and infrastructural development encroachments (Okaiyeto, 1987). Any attempt to settle the nomadic pastoralists and the delineation of grazing areas should be preceded by careful studies of the laws and policies of land tenure, rights to land and water. The urgent action now is the immediate census of livestock in the country in order to obtain some baseline data for policy decisions. It must be said that the bulk of livestock, especially cattle in Nigeria came from the Sahelian zone of the country; these animals greatly contribute to desertification if not well-managed.

In view of the recurring drought in the Sahel, deforestation, population pressure, fuel wood which is a major energy source of developing economy of the Sahel, is becoming very scarce. The high rate use of fossil energy and the under-development of solar energy and biogas as alternative sources have compounded the problem. It is essential the fuel wood sources are well managed, protected and replenished as effectively as possible. Energy mixes should be pursued to achieve sustainable energy consumption compatible with environmental requirements Application of fuel-efficient stoves and charcoal should be encouraged. As biogas can be an important source of energy the existing technology for the use of agricultural, animal and human wastes should be applied more widely by means of incentives guidance. Renewable energy sources should receive high priority and should be applied on a wider scale than in the past; giving full consideration to their environmental impacts: technologies to develop renewable resources of energy such as wind, geothermal and especially solar, should receive particular attention. International co-operation should facilitate this process (Plate 4).

Also, women in the North had become very keen to participate in anti- desertification efforts as the degradation of the environment penalizes them in the domestic tasks especially in fuelwood supplies, water supplies (both in quality and quantity) and the degradation or reduced availability of cultivable land . Women therefore

(a)



(b)



(c)



(d)



Plate 3.
(a) Harvesting Water
Melon in dry season;
(b) Harvesting
Pepper in dry
season; (c) Millet: as
main wet season
grown food crop
of the Sahel;
(d) Cowpea:
important protein
food and cash crop
of the Sahel in the
wet season

Sources: (a), (b) Gadzama and Folorunso (2011); (c), (d) Gadzama and Ayuba (2014)

Plate 4.

Bundles of fuel wood for sale on the road side between Damaturu (Capital of Yobe State) and Potaskum, an area highly degraded in the Sahel



Source: Gadzama and Ayuba (2014)

participated in desertification control schemes on a massive scale. The inputs in the tree planting programmes in Nigeria by the “Better Life for Rural Women” Association was a commendable example of contribution in National Projects.

Conclusion

Desertification and environmental insecurity are accelerating in the north, where an intersection of hotspots lead to increasingly tenuous livelihoods. Climate change is expected to compound the problems even further. The impacts of desertification on ecosystem and livelihoods of the people in the frontline States are enormous and poverty generating.

The Great Green Wall Sahara and Sahel Initiative (GGWSSI) in Nigeria is a programme that should be given special priority attention by the Federal Government, if the problem of desertification is to be addressed in a sustainable way. Its implementation should encompass all stakeholders including but not limited to Federal, States, Local governments, private sectors, villages, communities, women and the nomads.

Monitoring, Evaluation and Assessment must be enhanced. FORMECU should be made to carry out nature degradation survey in Nigeria for 2010 and 2012 since basic requisite facility and trained personnel exist in Federal Ministry of Environment.

In adapting indigenous knowledge and skills, it is in enhancing the economic and social well-being of dry land communities; and to enable them sustain adoptive capacity to manage environmental issues.

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