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Land degradation in Nigeria and its impacts on biodiversity, ecosystem and provisioning services: A Review

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Abstract

Human society the world over is heavily dependent on land and its resources. Humankind's utilization of land has led to the modification of almost all parts of the earth. When the impact is negative and continuous over a long period of time, it results in land degradation that is the long-term loss of land ecosystem functions and services. Land degradation have become a major global issue especially since the second half of the 20th century. This paper reviews the occurrence, negative effects and strategies for addressing land degradation. Land degradation is extensive, covering approximately 23% of the globe's terrestrial area, increasing at an annual rate of 5-10 million hectares and occurring in most terrestrial biomes and agro-ecologies, in both low income and highly industrialized countries. Overall, land degradation affects about 1.5 billion people globally. Its processes have been attributed to rapid human population growth and concomitant intensification of land use. Land devastation is largely through overgrazing of rangeland, deforestation, over-cultivation of cropland, large scale expansion of irrigated agriculture, waterlogging and salinization of irrigated land, acidification and nutrient imbalance, overexploitation for fuel wood, climate variation/change, drought, bush burning, pollution, urbanization and industrialization. The negative effects of land degradation includes soil erosion, desertification, loss of agricultural land, low agricultural production and loss of biodiversity among others. It also contributes to poverty, decrease ecosystem resilience and provision of environmental services. Restoration of degraded land can be achieved through vegetal regeneration, agroforestry, mixed farming, strip cropping, and control of overgrazing and burning of forests/bushes. Also, soil conservation measures should be adopted. In addition, there is the need for increased investments in sustainable land management and formulation of good land use policies.

Keywords: Biodiversity, climate, degradation, ecosystem, environment, land, restoration.

Introduction

Although humans have transformed their environments for thousands of years, the pace of change has accelerated sharply in the last century and particularly since the 1960, as the world population more than doubled since then. United Nations Convention to Combat Desertification (UNCCD) (1996) defines land as a terrestrial ecosystem consisting of flora, fauna, hydrological processes and other ecological services beneficial to human beings. "Land" is also defined as a terrestrial ecosystem that includes not only soil resources, but also vegetation, water, other biota, landscape setting, climate attributes, and ecological processes that operate within the system, ensuring its functions and services (Millennium Ecosystem Assessment, MEA 2005). Human society the world over is heavily dependent on land and its resources. Without land, there would be no human existence (Joseph, 2014). Land provides soil for crops to grow, for provision of open space and wild places for recreation and to allow natural terrestrial ecosystem to thrive and secure genetic resources for the future (Ezeaku *et al*., 2008). Fertile soils are an essential building block for human existence on Earth. Food, fiber and other terrestrial ecosystem goods for the global population are drawn from land (Nachtergaele *et al*., 2010). Soils provide not only food, fiber, and many types of biomass we use, but

also a wide range of other essential ecosystem services, such as carbon sequestration, water purification, cultural, and aesthetic values (Nkonya *et al*., 2016).

Man's relationship with his environment has always changed with time depending on his understanding and knowledge of his physical environment. The environment is regarded by man as a depot housing his needs and therefore always seeks ways of extracting the resources within it to the sad neglect of the environmental sustenance and consequently the emergence of a number of environmental stresses (Ezeaku *et al*., 2008). Humankind's utilization of land has led to all areas of the earth being modified. Land use and land cover change has been recognized as an important driver of environmental change on all spatial and temporal scale as well as emerging as a key environmental issue on a regional scale (Tansey *et al*., 2006). Man's socio-economic activities are known to impact, often negatively, on the condition of the soil, vegetation and water resources. When the impact is negative and continuous over a long period of time, it results in land degradation in different forms (Adewuyi *et al.*, 2017). Increasingly sophisticated methods of land exploitation are being used as resources become depleted and inevitably lead to degradation of land as a resource (O'Riordan, 1995).

Land degradation

Land degradation is defined as the reduction of biological productivity and the decrease in the complexity of terrestrial ecosystems (Lal *et al*., 2012). The Millennium Ecosystem Assessment (MEA 2005) also defines land degradation as long-term loss of on-site and off-site terrestrial ecosystem goods and services, which humans derive from them. It is also defined as the persistent reduction of land's biological and/or economic production capacity, or as the long-term loss of land ecosystem functions and services (Vogt *et al*. 2011). Similarly, Adeel *et al.* (2005) refers to land degradation as "a persistent net loss of capacity to yield provisioning, regulating, and supporting ecosystem services". Millennium Ecosystem Assessment (MEA) considers the ability of land to support primary production as a key ecosystem service (MEA, 2005). Thus, a reduction in net primary productivity (NPP) at a site is often viewed as land degradation (Reynolds *et al*., 2007). Consequently, MEA's definition of land degradation stresses the leading role of primary production among other services as it generates products of biological origin on which other ecosystem services depend. The primary production regulates energy, water and nutrient flows in land ecosystems, sequestrates carbon dioxide, and it is the basis of food production and generally provides habitats for species (Adewuyi *et al*., 2019). Lal (2010) reported that land degradation can take the forms of loss of biodiversity, decrease in vegetation density, tree cover, deforestation, soil erosion (sheet, rill and gully) and reduction in Soil Organic Carbon (SOC).

Rasmussen (1999) outlined that there are differences in the use of land degradation terminologies between scientists and practitioners in different disciplines. From a botanist's point of view, the term degradation may be used to describe a change in vegetation composition of a region, involving, for instance the disappearance of characteristic tree species. In range management, range degradation may denote that the appearance of the range differs from an ideal picture of how a well-managed rangeland looks. In geomorphology and soil science, an area will be described as undergoing 'degradation' if there is an increase relative to some 'natural' level of the loss of topsoil by erosion. In hydrology, 'degradation' may be associated with a decrease in infiltration and increased surface run-off caused by surface crust formation. In forestry, reduction of the woody cover, of woody productivity and/or qualitative changes in species composition will be seen as 'degradation'. In economy, loss of economic productivity of the land will be the criterion for 'degradation'. In addition, Rasmussen (1999) reported that land degradation may encompass a variety of processes such as 1) impoverishment of the vegetation (including loss of biological diversity) 2) soil erosion by wind and water 3) depletion of soil nutrients 4) changes in the physical structure of the soil, including surface crusting 5) salinization of irrigated areas, as well as others.

Although land degradation has been critical problem throughout history (Diamond, 2005), it has attained its current global scales, becoming a major global issue especially since the second half of the 20th century (Nkonya *et al.*, 2011). Land degradation resulting from human activities has been a major global challenge since the 20th century and will remain high

on the international agenda in the 21st century (Matano *et al*., 2015). It is extensive, covering approximately 23% of the globe's terrestrial area, increasing at an annual rate of 5-10 million hectares and occurring in most terrestrial biomes and agro-ecologies, in both low income and highly industrialized countries. Land degradation is increasing in severity and extent in many parts of the world, with more than 20% of all cultivated areas, 30% of forests and 10% of grasslands undergoing degradation (Matano *et al*., 2015). Overall, land degradation affects about 1.5 billion people globally (Stavi and Lal, 2014). Land degradation wreaks its highest toll on the livelihoods and well-being of the poorest households in the rural areas of developing countries (Nachtergaele *et al*.2010). The global store of arable land and grazing land continuous to decline through urbanization, unsustainable agriculture practices and deforestation, while, significant portion of the remaining arable land and grazing land is under considerable pressure from compaction by livestock and farm implements, over use of fertilizers and pesticides, salinization, alkalization or acidification depletion of nutrients, water and wind erosion (Abebaw, 2019). It has been reported by Nkonya *et al*. (2016) that the annual global cost of land degradation due to land use/cover change (LUCC) and using land degrading management practices on static cropland and grazing land is about 300 billion USD. Sub-Saharan Africa (SSA) accounts for the largest share (22 %) of the total global cost of land degradation. Only about 46 % of the cost of land degradation due to LUCC—which accounts for 78 % of the US$300 billion loss— is borne by land users and the remaining share (54 %) is borne by consumers of ecosystem services off the farm. The physical, chemical, and biological properties of soil are adversely affected. Consequently, the ability of the soil to support the growth of vegetation reduces (Gisladottir and Stocking, 2005).

Key drivers and causes of land degradation

Land degradation is the result of complex interaction among physical, chemical, biological, socio-economic and political issues of local, national or global nature (Abebaw, 2019). The conceptual framework categorizes the causes of land degradation into proximate and underlying, which interact with each other to result in different levels of land degradation. Proximate causes of land degradation are those that have a direct effect on the terrestrial ecosystem. The proximate causes are further divided into biophysical proximate causes (natural) and unsustainable land management practices (anthropogenic). The underlying causes of land degradation are those that indirectly affect the proximate causes of land degradation, such as institutional, socio-economic and policy factors. For example, poverty could lead to the failure of land users to invest in sustainable land management practices leading to land degradation (Way, 2006). The anthropogenic drivers of land degradation such as population growth and poverty combine with natural drivers such as background soil erosion and climate change. Population pressure, poverty, and market and institutional failures are commonly identified as the main drivers of land degradation (Kirui and Mirzabaev, 2014).

Accelerated land degradation processes have been attributed to rapid human population growth and concomitant intensification of land use. Land devastation is largely through overgrazing of rangeland, deforestation/expansion of agriculture on the forests and marginal lands, over-cultivation of cropland, large scale expansion of irrigated agriculture, waterlogging and salinization of irrigated land, acidification and nutrient imbalance, overexploitation for fuel wood (fuelwood harvesting), climate variation/change, drought, bush burning, pollution, urban and industrial use. Other causes of land degradation include; poverty, land owner ships problems and political instability (Vitousek *et al*., 1986; Abebaw, 2009). In addition, the area of land altered by mining industries and contamination due to industrial activities is considerable (Salvati *et al*., 2012; Fairbank *et al.,* 2000). Agropastoralism is considered one of the most important land degradation driving forces as it acts both directly (e.g., overgrazing) and indirectly generating land cover changes to create new pastures and promoting mechanical tillage to improve forage production (Salvati *et al*., 2012). The conversion of forests into grazing lands was the major driver of deforestation in the Amazon region. In Central Asia, conversion of grassland to barren lands and shrublands was the major type of land degradation. There are still substantial deforestation and other forms of LUCC that need particular attention in the tropics and temperate regions (CBD, 2014).

Land degradation in Nigeria

Nigeria is consistently topmost on the global degradation danger list (Hansen *et al*., 2013). Degraded land in Nigeria surpasses the landmass of Ghana (Yirdawe *et al*., 2017). In all parts of Nigeria, there is noticeable evidence of land degradation. The occurrence of land degradation varies from place to place in terms of the types, duration, severity and socio-economic impact (Senjobi, 2007). Land uses such as tree felling for fuel-wood and timber production, crop and pastoral land expansion and agricultural intensification have been suggested to be part of the causes of land degradation in Nigeria (Nosike, 2004). The intensification of the use of fragile and marginal ecosystems has led to progressive degradation and continued degradation of marginal agricultural lands. The damage by drought and population pressure may have resulted in the genetic loss of a vast array of valuable plant species. Pressure on the dwindling resources in the arid prone areas has caused a number of devastating socio-political and sectarian conflicts in the country with concomitant death, injury and heavy economic losses (Joseph, 2014). The mining of some minerals in the country has caused land degradation in those areas where mining activities are being carried out. These activities range from prospecting and exploration to exploitation. For example, the geo-physical method (seismic) used in oil exploration sets up landslides in areas of unstable rocks. Mineral exploitation always affects the geology of the land. The resultant hazards include landslides, erosion, flooding, minor tremor and faulting (Nosike, 2004). In the mining of minerals such as limestone and iron ore, open cast method of mining is used. This destroys the top layer of the soil and the soil profile. This method also generates material debris called overburden which is filled on the land that reduces the quality of the land. The tin mining activities of the Jos Plateau have produced landscape features such as badlands, mine dumps, pits and ponds. These render the land uncultivable, leaving the land derelict (Nosike, 2004). Mining damages the soil and the underlying structure of the land. Chemicals used or mined pollute soil and water courses (Web, 2005a). The expansion of mining activities have contributed to the loss of agricultural land to mining because the areas of rich alluvial deposits also tends to coincide with some of the better agricultural lands. Consequently, conflicts often arise between companies and the local people (Alexander, 1985). During the 90 years of tin mining on the Jos Plateau, large amount of land have been rendered derelict through mining activities. It is estimated that about 316km^2 of the total 8600km^2 of the Jos Plateau land had been damaged by mining activities (Alexander, 1985).

Tin mining in Jos Plateau has led to negative impacts on biophysical and hydrological environments. Agricultural productivity is affected as a result of declining soil fertility. Also considerable erosion damages to land have arose from active gully. The tin mining landscapes is also characterized by mined ponds, pilot ponds, reservoirs, mine dumps and mounds (Jiya and Musa, 2012). Around Bukuru mine tailings, neglected mining excavations and unfilled sample pits have an indelible disfiguration of a once rich beautiful region (Adepetu, 1986). In addition, tin mining have led to destruction of arable land and forests. Though, some of the mining ponds are intensively used for water supply, fish farming and irrigation, in spite of these advantages, mining activities on the Jos Plateau have left a terrible land destruction. Little or no attention have been paid to reclamation of the derelict mining ponds (Jiya and Musa, 2012).

About 80% of the inhabitants of the Northern region are involved in crop production, pastoral farming and nomadic pastoralism (Macaulay, 2014). These agricultural activities require the use of land, which if not managed properly may lead to the over-exploitation of the natural resource and consequently, degradation. Changes in human activities have resulted in the continuing loss of vegetation cover. Land use change has been suggested to impact the northern ecosystems of the country over the years leading to a perceived creeping of the savannah into the tropical rain forest zone (Badejo, 1998). The perceived encroachment of Nigeria's Savannah into its rainforest zone indicated possible land degradation. Some authors attributed this degradation to anthropogenic sources whilst others reported climatic variability (which is nature-driven) as the singular culprit. Human-related activities such as agricultural/pastoral expansion, agricultural intensification and fuel-wood extraction as well as

climatic/physical factors such as rainfall variability and land-atmosphere feedback mechanisms were suggested by various authors as agents of land degradation in Northern Nigeria (Nwonkonwo, 2003). The regular burning of rangelands by pastoralists to generate pasture for their livestock is a common practice in northern Nigeria. The fires as well as farming and hunting related bush burning also result in loss of vegetation. The result is increased soil erosion and decline in soil fertility (Nwonkonwo, 2003). This has contributed to land degradation in the north. Thus, with bush burning, serious erosion can occur if heavy downpour occurs and if the ashes are blown away, loss of nutrients results. Changes in crop and livestock production methods and increasing demand for forest products (such as fuelwood and timber) will accelerate the rate of land degradation if not checked (Macaulay, 2014).

A large portion of Nigeria consists of the Guinea Savannah, often categorized as a heavily-degraded dryland ecosystem (Yirdaw *et al*., 2017). The Nigerian Guinea Savannah (NGS) is the largest and currently most threatened agro-ecological zone, owing to its closeness to the extensively degraded Nigerian Sudano-Sahelian region, Hence its exposure to desertification effects is compounded by pressure from the encroaching Sahara desert (Macaulay, 2014; CILSS, 2016). It has been predicted that climate change due to deforestation may cause tropical savannahs to creep into tropical rainforests stretching 500 to 1000 km into the zone whilst the savannah will in turn be encroached by the Sahara. Many authors termed this 'southward creep' as desertification. Desertification has been identified to be one of the processes that degrades land (Macaulay, 2014). However, there has been an unending debate about the use of the concept to describe the environmental changes occurring in the African terrain. One of the definitions of desertification is 'the expansion of desert-like conditions and landscapes to areas where they should not occur climatically' (Graetz, 1991). The UN (1992) later modified their definition to 'land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climate variations and human activities' (Warren, 1996). Or, desertification is the reduction of biological productivity of dry land ecosystems, including rangeland pastures and rainfed and irrigated croplands, as a result of an acceleration of certain natural processes (Williams and Balling, 1995)

Degradation of land in Northern Nigeria and its resulting impact on other agricultural resources may have exacerbated the economic and social conditions of the region. Land use change has been suggested to impact the northern ecosystems of the country over the years (Badejo, 1998). The remediation strategies to reduce the impacts of anthropogenic factors include the practice of agroforestry, rainwater harvesting, local irrigation techniques, utilization of wetter sites, contour ridging and terracing to conserve nutrient and water run-off, cautionary expansion of cultivated sites, and the maintenance of a viable seed stock well-suited to variable climatic conditions (Macaulay, 2014)**.**

In the southern parts of Nigeria, forest areas and bushes are set on fire for the prime reason of clearing plots of land for shifting cultivation. Areas of the country's forests are being destroyed by fires and on steep slopes serious erosion may follow such fires. This has caused land degradation in those areas (Ladan, 2004). In the Niger Delta region of Nigeria, the negative impact of oil exploration is obvious. Large scale devastation of land either in terms of destruction of the scenic appearance or polluting the soil have been a common phenomenon. Oil extraction and production has led to adverse environmental impact on the soil, forest and water. Harmful and toxic organic compounds introduced into the natural environment during oil extraction causes pollution, consequently changing the geo-chemical composition of the soil, water and other components of the environment (Uyigwe and Agho, 2007). This in turn affects agriculture and leads to a drastic decline in output in fishing and farming activities. Ultimately, agricultural activities is affected, causing problems of environmental refugees.

The menace of soil erosion especially gully no doubt represents a major ecological challenge facing most states in Nigeria especially Anambra, Imo, Ebonyi, Abia and other states in the humid tropical regions of southern Nigeria (Ume *et al*., 2014). Soil erosion is particularly pronounced in the ecologically vulnerable areas of southeastern Nigeria where population densities and least land per capita ranks among the highest in rural Africa (Okorafor *et al*., 2017). Soils of

the southeastern Nigeria have high soil erodibility and are classed as structurally unstable (Idowu and Oluwatosin, 2008), therefore erosion forms a major type of soil degradation in the area. The development of gullies and other forms of erosion have become the greatest environmental hazard and disaster rampant in the region. In southeastern Nigeria the soils are naturally prone to erosion due to their fragile nature and ease of leaching being mainly ultisols and alfisols (Oguike and Mbagwu, 2009). Both physical, socioeconomic and anthropogenic factors as well as deficient agricultural production practices are believed to have aggravated and exacerbated the high erodibility of the soils in the region. Major causes of soil erosion in southeastern Nigeria are narrowed down to human interference, climatic factors (rainfall), poor geology, undulating topography and soil nature. Gully erosion is caused mainly by flood as a result of high precipitation, which is a fall out of climate change. The development of gullies causes the loss of a great amount of soil and can be considered as one of the principal causes of geo-environmental degradation in the Southeastern Nigeria (Chiemelu *et al*., 2013).

Nwachukwu and Onwuka (2011) reported that erosion predominates in areas which have been subjected to bush burning, continuous cultivation and mining on hill side slopes, all of which are common and long-term traditional practices in southeastern Nigeria. Asiabaka and Boers (1988) had estimated over 1970 gully sites in Imo and Abia states. A conservative assessment shows the distribution of known gully sites in different stages of development as follows; Abia (300), Anambra (700), Ebonyi (250), Enugu (600) and Imo (400), (Egboka, 2004). The massive soil loss in the Southeastern Nigeria results in severe ecological damages, soil fertility depletion, loss of soil structure, reduction of soil biodiversity, soil compaction, decline in agricultural productivity, low farm income, poverty, food insecurity and social disorder (Junge *et.al*., 2008). Okorafor *et al.* (2017) have reported that agricultural productivity, sustainability and management for food security/sustenance in the southeastern region has been undermined and greatly limited by the menace posed by soil erosion while the availability of farmlands for agricultural production and construction activities have been reduced. Pimentel (2006) also reported the diminishing of soil quality and reduction in the productivity of natural, agricultural and forest ecosystem (Pimentel, 2006).

Land degradation and impacts on agricultural productivity

Land degradation has many negative impacts on agricultural productivity by reducing the fertility of agricultural land. More than 20% of all cultivated areas is undergoing degradation. Millions of hectares of land per year are being degraded in all climatic regions (Abebaw, 2019). Worldwide, the crop land available for agriculture is shrinking. The agricultural impacts of land degradation are, loss of soil nutrient, soil erosion effects, reduction of crop yield, silting up of reservoir, contributes to persistent poverty, decreasing ecosystem resilience and provision of environmental services. In addition, environmental decline due to land degradation adversely affects the health, well-being and livelihood opportunities of the individuals (Abebaw, 2019). In 1970, there was a global average of 0.38 hectares per person. By 2003, this had declined to 0.21 hectare per person (Food And Agriculture Organization, 2005). A survey in 1990 by the United Nations suggested that a quarter of the world's total crop land is affected by degradation severely enough to restrict its productivity. 15.6% of this compromised agricultural land is strongly degraded land whose original biotic functions including nutrient cycling are largely destroyed. FAO (1984) have reported that in the last 50 years, 20% of the world's agricultural land has been irreversibly damaged. Crop land is most threatened in Africa with about 65% degraded (O'Riordan *et al*., 2000). The degradation of soils and land poses significant challenges for the well-being and food security of all the people around the world. The degradation of natural ecosystems, including land and soils, has rapidly increased, posing daunting challenges to achieving sustainable development and poverty reduction. The annual global cost of land degradation due to land use/cover change (LUCC) and using land degrading management practices on static cropland and grazing land is about 300 billion USD. Sub-Saharan Africa (SSA) accounts for the largest share (22 %) of the total global cost of land degradation (Foley *et al*., 2005).

Impacts of land degradation on provisioning, socio-economic and ecosystem services

The degradation of soils and land poses significant challenges for the wellbeing and food security of all the people around the world. Degradation of ecosystems is posing environmental challenges and is leading to the loss of land productivity (Nkonya *et al*., 2016). Land degradation no matter the form and extent is inimical to the socio-economic development of any area because it reduces the productivity of the land which subsequently reduces the income and standard of living of those who depend on the land. Also, as the productivity of the land reduces, biodiversity would be threatened. Such detrimental processes call for urgent and comprehensive action to halt land degradation (Stavi and Lal, 2014). Some of the challenges faced by residents of degraded areas are reduction in crop yield, reduction in size of land available for agriculture (crop farming and animal husbandry), limited land use options, increase in cost of conservation, forceful migration, hostility and of course poverty (Adewuyi *et al*., 2019). The degradation of natural ecosystems, including land pose daunting challenges to achieving sustainable development and poverty reduction (Nkonya *et al*., 2016). The losses from land degradation include environmental degradation cost measured directly on-site (e.g., soil loss and nutrient depletion) and also the cost of indirect and off-site environmental impacts (e.g., siltation of water bodies, water pollution, and biodiversity declines) (Foley *et al*. 2005).

Restoration of degraded land

Land restoration is the process of ecological restoration of a site to a natural landscape and habitat, safe for humans, wildlife and plant communities (Wikipedia, 2020). The restoration of degraded land is intended to enhance land resources and their ability to support life on land (Cowie *et al*., 2018). For this reason, global development actors have stressed the need to prevent land degradation and restore ecosystem performance (Scholes *et al*., 2018). The concept of Zero Net Land Degradation (ZNLD), or land degradation neutrality encompasses two complementary mechanisms: appropriate management of currently non-degraded lands in ways that do not cause degradation, thus halting further loss, and at the same time, restoring already-degraded lands (Gnacadia, 2012b). If the continuing loss of fertile lands is offset by the restoration of already-degraded lands, and the annual rate of reclamation equals that of degradation, then a ZNLD is attained, and the area of global fertile land remains stable. According to this concept, the restoration efforts would ideally be in the same landscape, the same type of ecosystem, and would serve the same community where land degradation has occurred (Lal and Stavi, 2014). There is the need to ensure that the global degraded lands decrease or at least, remain stable. To achieve this, the rate of global land degradation should not exceed that of land restoration.

Restoration efforts should include not only croplands, rangelands, and woodlands, but also natural and seminatural lands that do not generate direct economic revenues. Adewuyi and Mustapha (2017) stressed the need to question the sustainability of the current trend of land utilization in the short, medium and long-term effects and to devise means of restoring the land to cater for both the current and future generations. Vegetation plays a very important role in ecosystem balancing. Therefore, the first step towards restoration is to stop the removal of vegetation and the top soil in order for them to provide the essential requirements for vegetal regeneration and subsequent sustainability of the ecosystem (Easdale, 2016). The restoration of the degraded sites would best be based on vegetal and soil restoration which can best be achieved through the adoption of agroforestry system of agriculture at the degraded sites (Amundson *et al.*, 2015).

To reduce the rate of land degradation, soil conservation measures such as soil erosion control should be adopted. Also, mechanical measures which are restricted to arable land such as terrace, ridges contour ploughing and also, biological measures such as mixed farming, strip cropping, cultivation methods and early planting etc. In addition, overgrazing should be controlled by only allowing livestock grazing based on the carrying capacity of the land to reduce degradation (Adewuyi, 2019). Similarly, grazing reserves and cattle routes should be clearly demarcated and general grazing practices improved. Equally, the burning of forest areas and bushes need to be checked in view of its negative effects on the land. This will reduce greatly the loss of vegetation that provides cover and protection against degradation. There is a need for developing land use policies and planning

that will ensure that forests and other high value biomes are protected and continue to provide ecosystem services both to local communities and to the global community (Nkonya *et al*., 2016). The global efforts towards increasing protected areas have been successful, especially in the temperate areas, though deforestation rates in the tropical areas continue posing a big challenge (CBD, 2014).

Adewuyi *et al*. (2019) noted that restoration of degraded land requires baseline data on the types and spatial extent of areas affected. This will help to determine the types of restoration techniques that should be adopted, define the scope of operation, simplify the estimation of cost and establish the necessary re-orientation of the land users to forestall future occurrence. Also, well-informed planning and policy decisions, which are related to the sustainable land management (SLM) and to "zero net land degradation" target, require, credible and spatially explicit information on degraded lands (Stavi and Lal, 2015). The availability of spatial data on land degradation is also a precondition for the implementation of land rehabilitation measures (Dubovyk, 2017). The United Nations Convention to Combat Desertification (UNCCD) envisages achieving this target by 2030. This could be achieved if degraded lands are restored to a considerable extent and, at the same time, land-degrading management practices are replaced with ones that conserve soils (Stavi and Lal, 2014). One of the 17 United Nations Sustainable Development Goals (SDGs) aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UNDP, 2015).

Adewuyi *et al*. (2019) noted that there are no systemic approaches to the amelioration of land degradation over a large area, and as such, the treatment given to each site is site specific. In order to have a comprehensive and cost-effective approach to the restoration of any piece of land degraded; the first step is to identify and characterize the type of land degradation. A database can thus be established for the subsequent land restoration operations. To ensure sustainability of available land resources, it becomes mandatory to gather information on the nature and pattern of land degraded at sampled sites. Answers need to be provided to such questions as: where are the degraded sites? What are their sizes? What is the pattern of their distribution? And what type of degradation is ongoing therein? How best can it be stopped in order to restore the status of the land?

In addition, Ladan (2004) noted that through environmental education, people would have a better awareness of their environment and acquire the knowledge, values; skills and experiences that will help them solve their present land degradation problems and prevent future occurrences. Poverty alleviation programmes of the government should target the rural poor to reduce the level of poverty. This will go a long way in reducing dependence on firewood as energy source.

Sustainable land management

Action against land degradation involves preventing the degradation of currently used or usable lands or rehabilitating degraded lands. Action against land degradation referred to as sustainable land management, according to TerrAfrica (2006), is generally understood as the "adoption of land systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land, while maintaining or enhancing the ecological support functions of the land resources". Nkonya *et al*., (2016) stressed the need to design strategies for achieving sustainable development goals and other efforts to address land degradation and halt biodiversity loss. Given that LUCC accounts for the largest share of cost of land degradation, there is a need for developing land use planning that will ensure that forests and other high value biomes are effectively protected. The involvement of local communities in managing forests and other high value biomes and creating mechanisms for them to directly benefit from their conservation efforts lead to more effective protection than is the case with centralized protection (Nkonya *et al*.,2016). One of the 17 Sustainable Development Goals (SDGs) of the United Nations aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UNDP, 2015). Despite the severe impact of land degradation on the poor and the crucial role that land plays in human welfare and development, investments in sustainable land

management (SLM) are low, especially in developing countries. In particular, investments and incentives for sustainable land use and for prevention of land and soil degradation are presently inadequate and would need to be substantially increased in order to eradicate poverty and enhance food security in the world (FAO, 2012).

Conclusion

Land degradation is a major global issue. It involves complex processes that leads to loss of agricultural and forestry productivity from both the ecological sustainability and economic perspective. Its processes have been attributed to rapid human population growth and intensification of excessive land use. The Nigerian Land is degraded largely through overgrazing, bush burning, deforestation, mining, drought, climate change and erosion. The effects include loss of biodiversity, decline in agricultural productivity, poverty, food insecurity, social disorder and severe ecological damages. Therefore there is need to restore the degraded lands through reforestation, agroforestry, control of overgrazing and bush burning. Also, soil conservation measures should be adopted. In addition, mining ponds can be utilized for development of water resources, fish farming, irrigation agriculture and tourism/recreation.

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