The Menace of Widespread Gully Erosion in Southeastern Nigeria: Litho-Anthropogenic History and Management and Policy Issues

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Abstract

Gully erosion is widespread in the southeastern part of Nigeria due mainly to the prevailing environmental conditions and apparent lack of enforceable policies against unsustainable 'anti-environment' land-use practices. Its management involves huge financial demands and hence must be done with adequate understanding of these conditions as well as the economic implications. Researchers do not clearly agree on the dominant factor(s) responsible for the persistent occurrence of gullies in the region. Here we review the environment and the causes of formation and advancement of gullies in southeastern Nigeria as well as the management and policy options against this environmental menace. The study area is characterized by the dominance of low-activity-clay soils with inherently low liquid limit and hence low capacity to absorb water without shearing. Land-use changes which are on the rise in the region leaves the soils bare to flood associated with heavy rains which often aggravate the situation. Other factors include unfavourable topography and the lucrative anthropogenic activity of sand mining. Also, there is the problem of poor surface drainage systems in both housing and road infrastructures. To successfully manage gullies in southeastern Nigeria, information on the location and extent of the gully, the volume of water passing through it, as well as the present and possible land uses is critical. Then comes the issue of relevant policies of which there is a clear need to first create the enabling environment for hitch-free implementation before enactment and enforcement, without which any initial successes may not be sustained.

Keywords: soil erosion, southeastern Nigeria, vegetation cover, environmental management, policy

Introduction

Soil erosion is a hydro-meteorological event that induces movement of gross amount of soil material from a higher area to a lower deposition location due to raindrop impact, overland flow or wind. Soil erosion may be normal if its rate does not exceed the rate of soil formation. According to Kibblewhite *et al.* (2014), soil erosion becomes inimical when it harms the soil system (hydrological properties, nutrient processing, carbon transformations and physical structure) mostly due to prevailing natural hazards (climate change, soil, slope and aspect) and anthropogenic activities (land use and land management). Lal (1985) observed that accelerated erosion is a symbol of ecological imbalance.

How to APA-Cite: Okenmuo, F. C., Ibeh, K. G., & Obalum, S. E. (2023). The menace of widespread gully erosion in southeastern Nigeria: litho-anthropogenic history and management and policy issues. In: E. C. Igwe, I. Uko & A. O. Onunwa (Eds.), *Valedictorian Festschrift in Honour of Professor Peter Chinedum Nnabude* (pp. 61-79). Cadventures Press, Umunya, Anambra State, Nigeria

The environment in southeastern Nigeria is characterized by dispersible soil and geology, deforestation, heavy rainfall, climate and landscape changes, land misuse and increased built-up areas (Ofomata, 1981; Igwe, 2012; Udokporo *et al*, 2015; Nnabude *et al*., 2021). The combination of the hazards and vulnerable conditions results to ecological disasters as illustrated in Figure 1. The resultant soil erosion is caused by a lowered soil surface ability to withstand the increased pressure from erosive forces acting on land surface. The phenomenon is classified as interrill (sheet), rill or gully based on its degree and form (Plate 1).

Interrill erosion is relatively uniform erosion from the entire topsoil. Rills can be initiated when water concentrates in channels as it flows overland. It quickly degenerates into more visible gullies when not attended to immediately (Igwe and Obalum, 2013). In southeastern Nigeria, gully erosion is the most rampant type of erosion of serious concern. While other forms of erosion may exist, gullies are more visible and often exceed the available ability and resources for its management. The most common causes of soil erosion include climate erosivity, soil erodibility, terrain, and loss of ground cover (Nasir Ahmad *et al.,* 2020). Researchers have diverse views as which of the factor(s) is mostly responsible for gullies in different parts of southeastern Nigeria. With the increasing industrialization and urban development with a concomitant deforestation under a changing climate, gully erosion is projected to take more disastrous proportions in southeastern Nigeria.

In southeastern Nigeria, just like other parts of the world, gullies have taken a toll on land; agricultural, industrial and ancestral homes, roads, bridges, livestock and crops. Due to the obvious disastrous impact of this form of soil erosion in the region (Obalum *et al*., 2012), there have been concerns about how best to manage the menace. Earlier efforts involved enumeration of gullies through natural resources surveys. The approach was however reported to be too cumbersome and often a poor representative of the actual situation on ground (Igwe, 2012). To aid the assessment, models, remotely sensed data and geographic information system have been employed (Ofomata, 1985; Igwe, 1994; Igbokwe *et al.*, 2008). Despite the efforts, the gully erosion problem yet persists in more daring proportions.

Adequate management of soil erosion is preceded by information on the erosive event, its impact, frequency and prevailing conditions. For instance, Ofomata (1985), Lal (1998) and Obiadi *et al.* (2011) viewed the failure of gully control efforts in certain sites as a misunderstanding of the interaction of hydrological, biophysical, social and ecological processes of the environment. The near absence of community participation in erosion

management and the belief that erosion control was a costly endeavour beyond reach of land owners are other factors behind failure in erosion control. Vital to sustainable management is a social engineering tool called laws and policies which order the behaviour of people and thereby promote soil conservation and adequate resource prioritization. Egboka and Okoyeh (2016) recommended that its enactment and strict enforcement will reverse the state of environmental destruction in the region. This paper, therefore, aims at understanding lithology, the management and policies involved in soil erosion control in southeastern Nigeria.

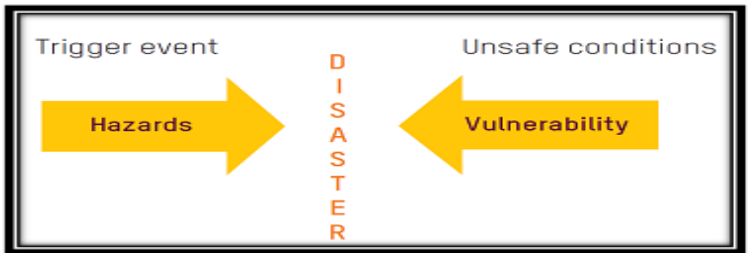

Figure 1:
Relationship between disaster, hazard and vulnerability (Hai and Smyth, 2012)

(a)

(b)

(c)

Plate 1:

Pictures related to
(a) interrill (sheet) erosion
(b) rill erosion and
(c) gully erosion in the study area (Photo taken by Okenmuo, F.C.)

Origin of Gullies in Southeastern Nigeria

Akamigbo (1988) observed that prior to the arrival of the British Colonial Government; some areas in southeastern Nigeria had been long bedevilled by gully and sheet erosion. They reported that soil erosion (gullies) at Udi in Enugu State and Nanka, Alor, Oraukwu and Agulu all in Anambra State were older than 150 years, predating any human being in the areas concerned. Egboka and Okpoko (1984) traced gullies in some areas of southeastern Nigeria to around the year 1850 when they appeared as mere narrow channels of rills which later metamorphosed into disastrous gullies. The challenge of gullies in southeastern Nigeria was a subject of interest to the British colonial Government as far back as 1920s. Then came the Nigeria civil war during 1967-1970 which not only took a death toll but also led to the loss of plantations, forest reserves and farmlands that hitherto protected the land from soil erosion. During the war, there was massive establishment of refugee camps and cultivation of fragile land. Presently, most of the former camps house major gullies in Anambra and Enugu States. Soil erosion has been attributed to development linked with the oil boom of Nigeria in the 1970s (Abegunde *et al.,* 2006). When lithologically poor soil materials were mined for construction, the landscape was often left denuded and susceptible erosive forces of rainfall.

Efforts in combating the menace began in the 1920s and 1930s by the Colonial Government and by the Eastern Nigeria Government policy on planting cashew nuts (*Anacardium occidentale*) plantations in the 1950s at the affected areas. The post-independence regional government's efforts in biological preventive measures were truncated by the civil war. Many forests and farmlands were left unprotected for serious sheet erosion which is a precursor to many gullies and trenches were left unfilled; developing into gullies. Some communities attribute the sheet erosion to the activities of deities because they were accompanied with yield declines and subsequent loss of land. In 1974, the Federal Military Government contracted the Italian Firm of Consultants, Technical S.P.A., Rome and Niger Techno Ltd, Lagos, to undertake a pre-feasibility study of the entire area suffering from soil erosion (Akamigbo, 1988). Landmass lost to erosion was estimated at 9,902 hectares from preliminary aerial photography. Agulu/Nanka complex was identified as one of the problem areas requiring priority attention. It comprised of five major active gullies located in Agulu, Nanka, Ekwulobia, Oraukwu and Alor towns in Anambra State and application of civil engineering in tackling the challenge began in the 1980s. Today, the gully complexes continue to gulp enormous resources with little successes.

Location, Extent and Factors Responsible for Gullies in Southeastern Nigeria

According to the Nigeria Ministry of Environment (2016), there is an estimated 3,000 gullies in southeastern Nigeria. The report further highlighted the phenomenal increases in incidences of gullies over the years as associated with population density. Over 1,970 gully erosion sites are found in Abia and Imo States alone (Asiabaka and Boers, 1988). Egboka (2004) and Igbokwe *et al*. (2008) from their assessments of gullies in southeastern Nigeria reported that gullied sites were highest in Anambra State (700) and lowest in Ebonyi State (250). The sizes of the states, severity of erosion classification and soil losses are summarized in Table 1.

With desperate efforts of the ever-increasing population to achieve development and meet food demands, land use planning is increasingly compromised for immediate economic gains. Often, infrastructural and farming activities without planning cause blockage/change in the natural waterways and also increase the concentration of excess runoff. The newly formed gully often becomes refuse disposal sites (Plate 2a). Municipal solid wastes find their way into gullies and drainage channels; blocking the drain and acting as a 'sponge' rubbing against gully walls when associated with floodwater and causing more devastating erosion. With continuous waste-to-gully disposal, efforts to manage gullies often become more far reaching. Another important factor is urbanization without consideration of accumulated water impact on often bare or partly bare land.

As forests and sand deposits become a source of community revenue, they are often exploited without consideration of the negative impact (Plate 2b). Nnabude *et al*. (2021) noted that most of the excavations during sand mining were never filled up but left to become hollows and gullies. Also, when road infrastructures are constructed without drainages or inadequate drainages for the volume of water passing through it, soil erosion channels begin to appear. The gullies (active) expand with each rainfall, extending for kilometres with depths in tens and hundreds of metres as observed in Abagana, Awka, Enugwu-Ukwu and Nanka areas, as observed during fieldwork by the authors in 2019.

Table 1: Southeastern states, size, extent of gullies and soil loss

State	Size (km^2)	Gully classification			Soil loss (t/ha/yr)	
		Mildly gullied areas (km^2)	Moderately gullied areas (km^2)	Severely gullied area (km^2)	Min (in low areas)	Max (in high areas)
Abia	6320	3322.61 (79.4%)	864.45 (20.6%)	-	9.2	10.16
Anambra	4844	1661.38 (35.1%)	1316.58 (27.8%)	1758 (37.1%)	9.11	10.03
Ebonyi	5533	2447 (47.4%)	2712.06 (52.66%)	-	8.71	9.6
Enugu	7161	6252.08 (80.8%)	1481.41 (19.2%)	-	9.46	10.54
Imo	5530	4694.67 (88.1)	634.50 (11.9%)	-	9.23	9.93

Modified from Igbokwe *et al.* (2008)

The high rainfall in the South East is a major factor behind the high soil erosion in the area. As large amounts of water flows, it detaches soil particles, transports and deposits them at the lower areas. In a study of Anambra sub-basin, Egboka and Okoyeh (2016) observed that the dip slopes were more vulnerable to gullies compared to the scarp slope. Examples of towns with gullies along the scarp slopes are Agulu, Nanka, Adazi Ani, Oko, Ekwulobia, Umuchu, Uga, while Alor, Oraukwu, Abatete, Nnobi and Ideani gullies occur on the dip slope. When hydrological interactions occur on unfavourable slopes, gullies are often associated with complex landforms. Reports of gullies defying conservation measure put in place to check them (Plate 3a and 3b) have been observed (Obiadi *et al*. 2011). Adebayo (2014) observed that lack of adequate attention to urban planning could make erosion control unrealistic.

Data on gully erosion has been accessed through natural resource surveys (Egboka and Okpoko, 1984; Obiadi *et al.*, 2011; Okoyeh, 2014; Egboka and Okoyeh, 2016). This method is often cumbersome and time-consuming. To solve the problem of natural resource surveys, emphasis has recently been placed on the application of geospatial technologies as a more advantageous in terms of accuracy and ability to record the time during which an event occurs. The extent of gullies can be estimated by aerial photo interpretation of some areas of interest (Igwe, 1994, 2012), scanned, digitized and analysed in a geographical information system (GIS). Disaster Monitoring Constellation (DMC) space crafts have been applied in monitoring and managing gully erosion and other environmental management problems such as logging, drought, land submergence and denudation of the ecosystems (Akinyede *et al.*, 2015). Igbokwe *et al*., (2008) utilized remote sensing technologies to study the spatial distribution of gullies in southeastern Nigeria. Geostatistics was implemented in a GIS to study the spatial distribution gullies and factors behind their occurrence in Abia State (Nwilo *et al.*, 2011). The use of geospatial technologies in mapping gully and erosion sites is very promising but only few studies have utilized it in the area of concern. This may be attributed to poor access to remotely sensed data and manpower shortages in southeastern Nigeria.

(a)

(b)

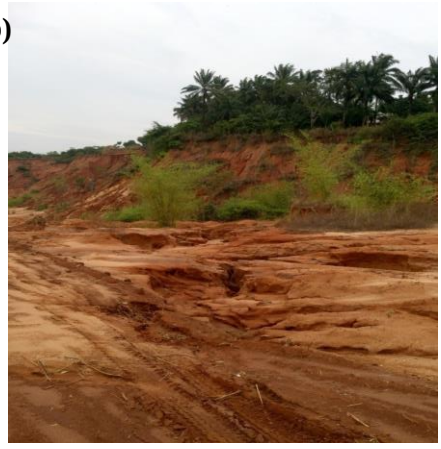

Plate 2:
a. Refuse disposal at a gully site
b. Gully erosion on an abandoned sand mining site

(a)  **(b)** 

Plate 3: Examples of failed conservation measures in Anambra State
a. Bio-structural measure failure at Enugwu-Ukwu **b.** Failed horizontal drainage channel at Awka

Lithological Background

The role of lithology in the menace of gully formation in southeastern Nigeria has been noted (Ofomata, 1985; Igwe, 2012). Lithology pertains to the behaviour of the originating rock in terms of physical and chemical characteristics. Grove (1951) observed that lithology which largely determines susceptibility to erosion was the best basis of regional differentiation of southeastern Nigeria. Among the lithologies reported are lignite series, weak sandstones and siltstones, clays, clay shales, coal measures, weak sandstones, shales. False-bedded sandstone, coastal plain sands, Nanka sands, Ajali sandstone and the Bende-Ameki parent materials form very serious gullies (Nwilo *et al.*, 2011; Igwe, 2012; Egboka *et al.*, 2019). Lithologically, these formations are dominated by weak unconsolidated sand-textured soils with high detachability and rapid water movement into and within the soil. Their richness in loam, silt and sand with less clay causes the gully depth to widen as drainage water moves through. Iheme *et al*. (2016) studied gullies in Orlu and its environment of Imo State. They observed that among three geologic formations in the area namely Ameki, Ogwashi Asaba and Benin Formations, no gully was observed in the Ogwashi Asaba Formation.

In contrast, Igwe and Egbueri (2018) observed similar erodibility characteristics between the Benin, Ogwashi-Asaba and Nanka formations in Anambra State. The results indicated that all soils were loose and collapsible with low contents of fine particles, non to low plastic and highly to moderately permeable. Sand dominated lithologies are more erodible as compared to clay-dominated (Hudec *et al.* 2006; John *et al.*, 2015). Interestingly, Nwankwoala and Igbokwe (2020) generated a gully characteristics map and reported the variation of gullies in

relation to their lithology in parts of southeastern Nigeria. Obiadi *et al.* (2011) and Egboka *et al.* (2019) observed that the alternation between wetting and drying often leaves cracks arising from volume changes in interbedded shales and clay. Such cracks experience erosion along their exposed cracks especially where landform is favourable. Areas without plastic soil materials were highly affected by gullies since low plasticity indicated low cohesive forces between the grains (Onwuemesi *et al.*, 1991; Iheme *et al.*, 2016; Nwankwoala and Igbokwe, 2020). With very low plasticity index of 4.90% to 7.10%, Onwuemesi *et al.* (1991) reported that during the rainy season at the Agulu-Nanka area, the rise in water table and associated properties increases which in turn increases the ground water velocities, hence drastic erosion take place in the loose materials as a result of ground water flux. Many streams, lakes and springs appeared as a result of this process of concentrated flow. Overtime, mineral particles such as sand are moved by erosive conditions while clays with reduced permeability lose their shear strength during expansion, hence problems associated with massive soil losses are common features (Egboka and Okpoko, 1984). Erosion caused by underlying lithology may be associated with little or no control by man but appropriate behavioural orientation and laws can help stem the trend of gully expansion (Abdulfatai *et al.*, 2014).

Management of Gully Erosion

Since the 19th century when gullies began to appear in some areas in southeastern Nigeria, several efforts have been made by the government in tackling the menace, ranging from attempted evacuation of the inhabitant (Emenike, 1988) to the planting of trees along steep landscape positions between 1930s and beyond (Skyes, 1940; Igwe, 2012). Since many of such interventions failed, the World Bank and Nigeria Government are financing the implementation of the Nigeria Erosion and Watershed Program (NEWMAP) to tackle the ecological problem. NEWMAP tackles erosion by the integration of a hard (concrete) and a soft component (green) (Plate 4). According to NEWMAP (2015) in order to choose a particular gully out of many for allocation of scarce resources, the following criteria are used:

(i) State of the gully erosion (inactive, moderately active, very active or severely active),
(ii) Population affected,
(iii) Human life risks,
(iv) Built assets risks,
(v) Natural assets risks,
(vi) Local-level participation and commitment, and
(vii) Simplicity of intervention measures.

Generally, in gully management, on arrival at a particular gully location, the manager assesses the affected area. The peripheral boundary that separates the area affected from unaffected land is revealed in order to show the affected area (Crozier, 2005). The approach of examining the affected area is similar to other forms of disaster management all over the world. The next factor the manager should be concerned about is the amount of floodwater and how to control it. Flood water control may involve practices such as massive afforestation, excavation of trenches, channels and dams and all efforts aimed at minimizing the potential of water to cause soil loss. Huge costs are required in order to curb soil erosion once it has developed into gullies and most local government authorities are often not delegated with power or mercenaries that can be deployed to control gullies even at incipient stages. When gullies further develop to pose a lot of danger at a disastrous scale, assistance is sought from outside the impacted area and is often delayed by bureaucratic processes involved in decision making. The delay causes various types of on-site effects such as destruction of roads, houses, farmland and soil loss at uplands, offsite effects are the deposition of sediments in low-lying areas especially after flood event.

Gully control method depends on the prevailing land-use, frequency gully occurrence, size of affected area and the impact. The three major gully control methods administered by the NEWMAP and other erosion control bodies are briefly discussed below:

i. Hard component

Hard components are civil engineering structures that can reduce velocity of water flow or channel runoff and overland flows to favourable slopes. Examples are soil drains, cut-off drains, with combinations of toe buttress works involving the use of gabions and piles. A great deal of expertise is required in the construction/installation of such structures because when done haphazardly, they often end up exacerbating rather than solving the problem.

ii. Bioengineering

Reforestations have been one of the earliest forms of gully prevention and remediation. Earlier, bioengineering was aimed at achieving land conservation as well as the production of economic services such as food and wood. Presently, there seems to be little interest in the latter as little areas managed for their erosion risks are mainly the so-called government restricted areas. Obiadi *et al.* (2011) reported the efficiency of effective afforestation in gully erosion control. Such programmes must be done with adequate knowledge of soils, forestry, engineering and agriculture. For example, Ofomata (1985) reported that the forestation of gullies in Agulu-Nanka areas of Anambra State using cashew exacerbated gullying rather than control it. Its roots were unable to bind the soil together and secreted chemical substances which inhibited other forms of vegetation.

iii. Combination of hard and soft components

This, which is a combination of bioengineering and civil engineering structures, has been noted to be a very effective approach in soil and water conservation (Obalum *et al*., 2011). An example of this gully control measure is illustrated in Plate 4.

Plant covers and soil erosion

Plants can be classified based on their life pattern and growth characteristics as grass, crippling plants, climbers, herbs, shrubs and trees. These are collectively termed vegetation. Of all the factors prompting water erosion in this region (climate, topography, vegetation and soil), vegetation is of utmost importance as it is renewable and man has absolute control over it compared to others. Trees are known to be great soil binders which improves the structure of the soil, enhance water infiltration and generally reduces the rate of runoff.

The soils in the South East are unstable, sloppy and characterized by red earth alongside sandstones with loose surface (Asadu *et al.*, 1997). According to Igue (2002), this forms red sand-clay-loam soil that may or may not contain ferric properties; and are mostly Ultisols and Alfisols (Oguike and Mbagwu, 2009). Based on the nature of the soils of southeastern Nigeria, disturbances mostly through anthropogenic activities such as bush burning, overgrazing, continuous cultivation, construction of roads that lead to excavation/mining, and excessive timber harvesting/deforestation have caused almost all the erosion in the region.

Since the degree of water erosion taking place depends mostly on rainfall and the runoff generated during the rainfall as they disconnect and transports the eroded soil (FAO, 2019). Vegetation, therefore, plays immeasurable protective roles to the soil and in erosion control. Naylor *et al.* (2002) grouped these influences of vegetation on soil into two main classes which are bioprotection and bioconstruction. The bioprotective roles of plant cover are guarding soil against erosion by slowing down the rate of water runoff (Durán *et al.*, 2008), by improving infiltration of water into the soil (Wainwright *et al.,* 2002) and binding soils with their roots (De Baets *et al.,* 2007). Tree canopies intercept the rainfall and reduce the effect of rain splashes. The litterfalls improve soil organic matter and water infiltration thus (Oguike *et al.,* 2023), reducing volume and speed of runoff.

Plant roots improve the ability of soil to resist flow and reduce the extent of soil detachment. Due to their numerous functions, plant roots are considered very important in erosion control process. As density of vegetation increases from cropland to grassland to forest, there is a resultant increase in soil resistance to erosion and a proportional reduction in runoff during and after rainfall (Torri and Poesen, 2014). As erosion proceeds from sheet erosion at the upslope to gullies at the bottom slope (Figure 2), the density and type of vegetations needed for water erosion control may increase from grasses to shrubs and trees or their combinations.

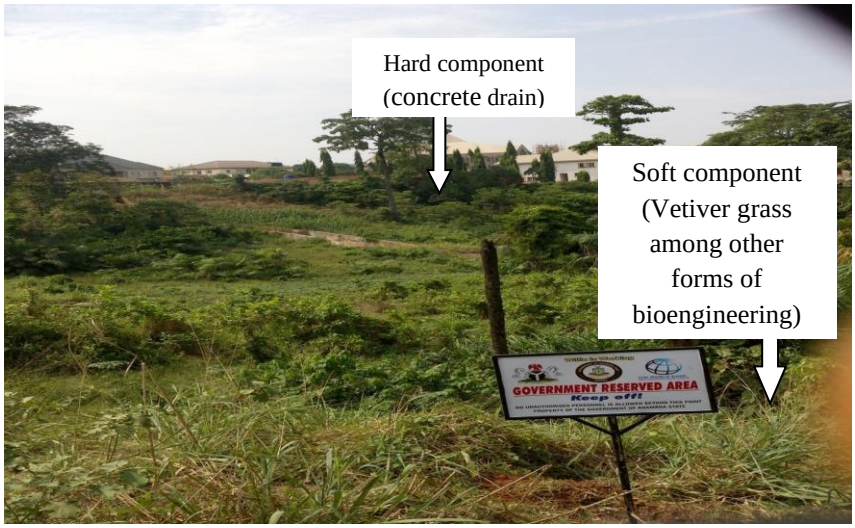

Plate 4:
A successful combination of bioengineering and civil works in erosion control

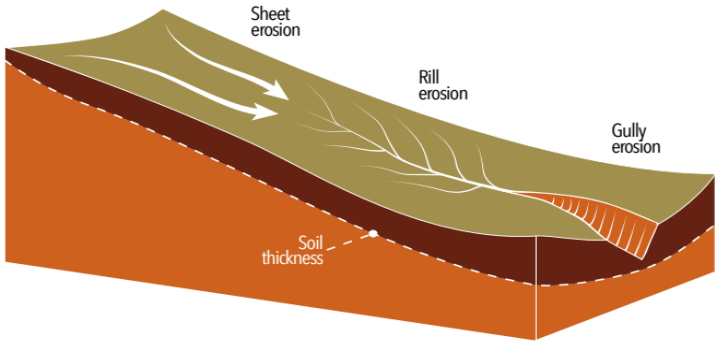

Figure 2:
Diagrammatic representation of the positions of interrill (sheet), rill and gully erosion in a hillslope system (FAO, 2019)

Increased rate of deforestation and tree cover loss thus, means an invariable increase in environmental issues of which gully erosion is the key in the region. The high level of tree cover loss as compared to the gains in Table 2, indicates an increasing future menace if adequate measures such as roadside planting, increase afforestation and reforestation, as well as decreased deforestation, are not put into place. Worthy of note is that reforestation may take a long time to rehabilitate gullies (Valentin *et al*. 2005) or may never if done without considering the stage of the gully, technicality among other factors.

Policy and Legislation

Despite the existence of the conservation measures stated above, there are no clearly implemented laws/policies that guide farmers and communities towards their adoption. A relevant policy can be enacted to ensure that issues relating to development of newer gullies are addressed with urgency at the incipient stages. Where erosion risks are high, policies should target promotion of lowland farming (Obalum *et al*., 2012) as well as adoption of appropriate land uses in the uplands (Uzoh *et al*., 2020), which may involve the relocation of inhabitants and reforestation of the affected areas (Ouyang *et al*., 2019). These measures can help to reduce pressure on upland soils and to place restrictions on steep slope cultivation.

Table 2: Forest cover from 2001-2014 in southeastern Nigeria

State	Land Area (ha)	Forest Cover in 2000 (ha)	% Forest Cover in 2000	Tree Cover Loss (2001-2014)	Tree Cover Gain (2001-2014)
Abia	472,226	113,000	24	8,602	1,064
Anambra	453,138	34,000	7	675	53
Ebonyi	618,646	15,000	2	1,004	130
Enugu	770,092	63,000	8	1,153	19
Imo	530,389	101,000	19	10,697	941
Total	*2,844,491*	*326,000*	*60*	*22,131*	*2,207*

(Excerpt from Agbeja, 2016)

Fagbohun (2010) gave a historical account of the emergence of environmental laws in Nigeria. The environmental era came of age with the adoption of the Stockholm Declaration in 1972 at the First International Conference on the Environment. The declaration from this conference promoted awareness that the environment as a global entity required protection. In response, Nigeria created the Federal Environmental Protection Agency (FEPA) in 1988 (Ogunba, 2016). Environmental issues associated with development (deforestation, floods, soil erosion, desertification, oil pollution, urban decay, industrial pollution, coastal erosion, biodiversity loss and dumping of toxic/hazardous substances) formed the core responsibility of the ministry. The use of laws in encouraging ethical behaviour towards the environment was recognized at the Rio conference (Adebayo, 2014). The conference declares as follows:

"States shall develop national law regarding liability and compensation for the victims of pollution and environmental damage. States shall also co-operate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction".

The main type of law and policy material aimed at the global control of soil and land degradation was noted to be the "soil conservation law" (Grossman and Brusaard, 1992). Laws and policies governing soil erosion-induced environmental degradation in Nigeria along with their shortcomings are summarized in Table 3.

Other issues and way forward

The Federal and State Ministry of Environment needs to step up in playing the roles related to awareness creation, populace education and championing the establishment of SWC and activities that encourage sustainable land use. Ezezika and Adetona (2011) recommended the use of technologies that are adaptable to local users as well as sensitizations to stem the tide of

Table 3: Laws related to soil erosion management and control in Nigeria with their associated shortcomings

	Law/Policy	Instrument	Major shortcoming
1	The constitution of the Federal Republic of Nigeria 1999	Section 20 imposes a duty on the Nigeria States to ensure environmental protection in Nigeria.	The law does not state which tier of Government will be responsible for forestry management.
2	Land Use Act of 2004	The Governor of the state holds all land by law in trust for the common good of the people based on Section 1 of the Act. A statutory right or customary right is vested on holders or occupiers of urban or rural land for a maximum of 99 years. The Government can therefore control the use of the resource by refusing to grant right of occupancy to potential occupiers of areas with high erosion risks.	The pitfall of this act is that community tends to withhold indigenous knowledge with the perception that the Government will always have its way. Also, successive governments tend to relegate forest management in its developmental efforts.
3	Environmental Impact Assessment Act of 2004	Nigerian Federal EIA procedure is set by Decree No 86 of 1992. It is the first policy that offered centralized procedure in ensuring resource conservation. The responsibilities are split between the project developer, the general public and the approving ministry. Where the project will have significant impact on the environment, people or society in an immitigable way, the project will be rejected. On the receipt of the mandatory study report, the agency puts out a notice to the public for requisite comments on the conclusions and recommendation. The comments are considered in the final decision of the agency. EIA can be used in preventing activities that make the environment vulnerable to soil erosion such as indiscriminate forest clearing, topsoil removal, inadequate drainage system, bush burning among others.	EIA in Nigeria, if carried out, however makes no provision for judiciary review by the public after decision has been made by the agency.
4	National Environmental Standards and Regulations Enforcement Agency NESREA Act 2007	Section 36 of the NESREA Act repealed the FEPA Act, empowering NESREA to protect and develop the environment in Nigeria. NESREA ensures compliance with relevant international law instruments.	The major pitfall of the Act is that it does not empower NESREA to prosecute offenders.

5	National Policy on the Environment 1989	This is the first articulated policy goal for the nation's environment.	Whereas the National Environmental Policy recognizes the import of the public participation in public policy, Government and companies continually downplay it.
6	National Policy Guidelines on Solid Waste Management	This policy entails the efficiency in waste management processes with environmental sustainability considerations.	
7	National Policy on Erosion and Flood Control, 2005	The policy aimed to correct past failed, un-coordinated, poorly funded and discontinuous attempts to curb soil erosion so as to achieve sustainable development. The National Policy aimed at a proactive and participatory approach in erosion and flood management by raising public awareness and enlightenment. The policy is aimed at preventing and managing ecological hazards (floods and erosion) as well as promotes activities meant for achieving sound soil and water conservation.	The policy flaws are evident in attitudes such as indiscriminate dumping of refuse, sand mining, construction on waterways, deforestation, overgrazing on the environment. The impact of the 2012 flooding and persistent gullies are sad realities.
8	Agricultural Policy 2001	The new Nigerian Agricultural Policy document 2001 was an off-shoot of previous agricultural policy document formalized in 1988. The policy aimed at achieving food security, food production, exportation and sustainable land management.	Sustainable environmental management is often suppressed in efforts to ensure food sufficiency.
9	National Environmental (Mining and Processing of Coal, Ores and Industrial Minerals) Regulation No. 31 2009	The regulation seeks to foster the use of efficient and cleaner technology to minimize pollution.	In efforts to achieve development, industrialization is often done without environmental considerations.

Modified from: Ogunba (2016), Abuza (2017), Osumgborogwu and Chibo (2017)

massive soil degradation in South eastern region of Nigeria. This could aid in correcting the trend of crisis-management usually observed in the approach by both community and state in combatting soil erosion (Gobin *et al.*, 1999; Adebayo, 2014). Since most gullies often begin in form of sheet and rills, incentives backed by policies could be provided to land users to encourage them adopt conservation practices. Further assistance could be provided through education, technical and financial assistance, research and development, land retirement, and regulation and taxes (Onwuemesi *et al.*, 1991; Abdulfatai et al., 2014; Merem *et al.*, 2019).

Another critical point is to ensure that land-use policies are within the capability of the land. A study carried out by Igwe (1999) demarcated the southeastern region into four management zones based on slopes for appropriate policy formulation and management. There is need for funded researches especially in locations of unstable cuestas and escarpments.

Policies that prohibit dumping of refuse in gullies and waterways, proper channelization of floodwater and maintenance of conservation structures are also crucial (Uri, 2000). Such policies will engineer an attitudinal change towards the environment; a critical aspect in the success of any conservation approach. Communication gap between land users and the Government, exploitative tendencies of users and insufficient understanding of soil and water conservation are reasons for failed past efforts (Ofomata, 1985). Therefore, if success must be the outcome, communities who have direct relationship with the environment should be considered in conservation strategies and policy decisions. Conservation should be undertaken from the local level upwards (Government). In a study by Abuza (2017), the bottom-up approach was reported to be better than the top-down approach in curbing the threat of desertification in Nigeria.

Affected communities should be involved in policy formulation, implementation and monitoring to ensure their effectiveness in 'policing' the environment. For example, the communities should be sensitized of the socio-economic benefits of involving trees for which they have comparative advantage over other regions. A typical example is oil palm known to be endemic in southeastern Nigeria and which has numerous functions (Okolo *et al.*, 2019). Also, such communities could be given incentives for employing bioengineers for the conservation projects rather than waiting for the Government. It is only by so doing that community authorities can be held accountable for the failure of conservation projects and incidence of accelerated erosion in their communities.

Lastly, fighting erosion requires adequate funding of anti-erosion agencies. Key institutions financing soil erosion control in Nigeria include the World Bank, the European Union (EU), and the African Development Bank (ADB) among others. There is a need to ensure transparency in the use of the funds to guarantee the goals are met. In the process of meeting set objectives, the wide disparity and disconnect between relevant policies and implementation bodies need to be addressed. Furthermore, research should be carried out to examine options that could enhance government policy implementation as well as improve willingness of land owners to adopt.

Conclusion

Soil erosion has assumed a disastrous dimension over the years despite various attempts to curb the menace. The lithology is dominated by sedimentary deposits with mainly sand and sometimes underlying clay layers both which are prone to erosion. Chief among the attempts in curtailing the menace include the use of bioengineering, civil engineering structures or their combinations. With the development of environmental laws and policies, the major issues that include; downplay of soil erosion by various governments, ineffectiveness of relevant policies, poor implementation and monitoring of policies, undue political interference, lack of clarity, reluctance of government to collect relevant data for informed decisions, inconsistency of policy, decentralization of policies, lack of enforcement, poverty, insufficient environmental managers. Most important aspect of policies should be their potential as a tool for engineering attitudinal changes in communities that depend on the environment; evoking more involvement in environmental management processes. This will play a major role in ensuring conservation measures success and reduce the huge cost demands of advanced gullies, as the aphorism goes that “prevention is better than cure”. Such environmental laws must be created and implemented in ways prevents the deterioration of environmental resources, encourage rehabilitation and ensures enforcements; including penalizing defaulters and rewarding sustainable environmental behaviours. Policies aimed at encouraging “soft” solutions should be encouraged since it meets environmental concerns. To achieve success, the practice should be standardized and included in the curriculum of environmental managers in the zone.

Acknowledgements

This review developed as part of a project on assessment of soil erosion induced environmental degradation and its management in southeastern Nigeria funded by the African Union scholarship to the first author (FCO). We also appreciate the suggestion given by Prof. P.C. Nnabude of Nnamdi Azikiwe University Awka during the course of this work.

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