

## **Impact of Climate Change and Mitigation Measures: The Case of Gully Erosion in South Eastern Nigeria**

P.C. Ike

Department of Agricultural Economics and Extension, Delta State University, Asaba Campus,  
Delta State, Nigeria

**Author's E-Mail:** ikepeecee@yahoo.com

### **Abstract**

The issue of gully erosion is of major concern in the South-eastern part of Nigeria. The vegetation in the area is steadily being degraded thereby exposing the soil to erosion, especially the gully type. This feature is not only increasing in occurrence but also in magnitude. Large areas of agricultural lands are lost or have become unsuitable for cultivation due to gully erosion. There have been numerous attempts to curb gully erosion in the region; especially through large-scale engineering projects, however, little has been discussed about ways to prevent their onset or the use of community-based low-technology approaches to mitigate their development. The possibility of climate change playing a role in this has not been given the deserved attention. This paper therefore examined the extent the climate of South-eastern Nigeria is changing and its implication in soil erosion occurrence and magnitude. The method adopted was observation of some gully erosion sites in the area, interview with key stakeholders and review of relevant literature. Findings showed that there has been an upward trend in annual mean temperature and rainfall in the area. It also revealed that many eroding gullies in the region are human-induced and therefore can be prevented. The gullies can be traced to poor land management practices and to a lack of innovation and awareness measures. It was concluded that community-based, low-technology land management practices and public awareness programs through workshops as well as concerted efforts by governments at all levels could halt the development of many gullies in the South Eastern region of Nigeria.

**Key Words:** erosion, land degradation, climate change impacts, climate change mitigation

### **1. Introduction**

In 1979, through the instrumentality of the United Nations, a worldwide conference on environmental sustainability of which Nigeria, participated was held in Rio de Janeiro, Brazil. The conference among other things came out with a set of guiding principles on strategies for pursuit of environmentally sound and sustainable development. In spite of these global efforts and declarations, there have been reports of extensive environmental deterioration suspected to have resulted from agricultural activities in Nigeria. This is also

prevalent in the southeastern States (Okoye, 2005). Majority of Nigerian's poor are concentrated in rural areas, depending directly or indirectly on agriculture and related activities while owning or controlling few physical productive assets.

Since poor households must ensure their survival, they frequently have no choice (particularly when faced with limited production base, meager capital and poor knowledge) other than to exploit and degrade their environment, especially their land resources



(Batie, 1992). Poor households subsist at various levels of deprivation: faced with acute land shortage, they respond by intensifying and over-using available land space; and even when land is marginal they continue to cultivate and so progressively degrade it since they must fight hunger.

Agricultural production in Southeastern Nigeria like other regions of the country is dependent on the vagaries of climatic variables. As climate is caused to change, other components of the earth-atmosphere system (soil and vegetation for example) might respond to influences exerted on them by the change. The current climate change is an issue that has captured not only the interests of researchers but also those of people, nations and governments the world over. Presently it is one of the most actively investigated scientific issues because of its potentially far-reaching consequences (IPCC, 1996; Danielson et al., 1998). Among these consequences are massive flooding, heavy storms and runoff, frequent and prolonged droughts, and increased sea temperature. The implications of these for man are enormous (Ike and Emaziye, 2012; Nwagbara et al, 2015).

Climate change which has been defined as a progressive change in climatic variables has been linked with change in the concentration of atmospheric gases particularly the ones termed "greenhouse gases" amongst which are carbondioxide, chlorofluorocarbons (CFCs), methane, tropospheric ozone and nitrous oxide. These gases trap terrestrial radiation (which is in long wave length and contains mainly infrared rays) that would normally be radiated onto the upper atmosphere but instead is re-radiated earthward, thereby promoting atmospheric warming (IPCC, 2007).

Global warming has not been a uniform phenomenon across the globe. So also are its manifestations. Vegetation and soil are some

of the components of the earth-atmosphere system that might be affected by the variations in climatic factors as an increased rainfall implies more luxuriant growth for vegetation while a reduction in it especially in combination with raised temperature brings about withering of vegetation. On the other hand, an increase in rainfall portends an increase in soil erosion, where exposed, and a decrease in it could result in the drying up of the soil, thus making it (i.e the soil) more erodible as the particles become more detached. This has been the situation which has made the Southeastern part of Nigeria to be highly vulnerable to devastating gully erosion.

The formation of gullies has become one of the greatest environmental disasters facing many towns and villages in Southeastern Nigeria (Adekalu et al., 2007; Okpala, 1990). The region is fast becoming hazardous for human habitation. Large areas of agricultural lands are becoming unsuitable for cultivation as erosion destroys farmlands and lowers agricultural productivity (Egboka et al., 1990). Erosivity and erodibility are the factors that contribute to erosion and gully formation (Ezezika and Adetona, 2011). Erosivity is a function of rainfall, a natural phenomenon which is outside human control and manipulation. Rainfall intensities can be high in Southeast Nigeria. Nwagbara et al (2015) reported that rainfall in the region has had a progressive increase of 5.25mm to 5.84mm per annum. Erodibility, on the other hand, is dependent on soil properties, topography, and land management. Appropriate land management is very important in an area like Southeastern Nigeria where the geotectonic, geologic, and geohydrologic characteristics of the region make many areas within it susceptible to gully erosion (Ezezika and Adetona, 2011). For example, cuestas, fractures and joints are common features in the gully-erosion-prone areas of Southeastern Nigeria and have been identified as significant factors in the formation of gully erosion (Gobin

et al., 1999). The loss of soil degrades arable land and eventually renders it unproductive. As a result, there are significant per capita shortages of arable land. The effects of this erosive action are made more severe by recent and rapid population growth in the Southeastern region of Nigeria. Loss of agricultural output is one of the greatest economic costs of gully erosion.

Over the years some studies have been carried out both at small and large scale levels on the causes of control of gully erosion in Southeastern Nigeria. Most of these studies have primarily revolved around geological properties of the region and solutions proffered have always been large-scale engineering efforts at resolving the menace. This paper examines the extent the climate of Southeastern Nigeria is changing and its implication in gully erosion occurrence and magnitude. It also explores human dimensions of the problem and potential solutions, with particular attention to low-cost, community-based approaches at preventing rather than combating gully erosion.

### **Research Methods**

**Study area** : Southeastern Nigeria is one of the six geopolitical zones in Nigeria and it is occupied by the Igbos, the third largest ethnic groups in Nigeria. Southeast Nigeria comprises five states: Abia, Anambra, Ebonyi, Enugu and Imo state. The zone has a population of 16.32 million composed of 8.31million (50.92%) males and 8.01million (49.08%) females (NPC, 2006). The very location of South-Eastern Nigeria between latitudes 4010' and 7008'N and longitudes 5030' and 9027'E makes it a region of relatively high temperatures all year round (Nwagbara et al, 2015). This is for both maximum and minimum temperatures, thus making the range between them to be very small if compared with that of northern Nigeria. The mean daily maximum temperature is usually above 27°C all through the year. It is

highest from February to April but rarely goes above 35°C. The mean daily maximum temperature increase from its South towards the north is attributable to the moderating effect of the Atlantic Ocean in the South.

The annual rainfall total ranges between 1500mm, at the northern part of the region, to 4000mm at the extreme South. Vegetation of South-Eastern Nigeria closely follows that rainfall pattern of the region. The dominant vegetation type is the tropical rainforest. The Guinea Savanna exists in the northern fringes of the region. Climate equally has a hand in the soils of the region as the colour of the soils is as a result of climatic conditions. Generally, the soils are heavily leached, reddish brown and sandy.

### *Data Collection and Analysis*

The study relied on interviews collected from stakeholders including scientists, policymakers, farmers, surveyors, village heads etc in some communities with extensive gullies as well as observation and documentation of such gullies. It also relied extensively on literature. Literature reviewed covered academic articles, news articles and publicly available documents. The interview was open ended and included questions on understanding the gully erosion problem as well as specific questions investigating best practices for preventing and controlling erosion.

The major erosion sites in the study area that are notorious for their dimension and destruction are located in the Derived Savanna where vegetation has been cut and burnt as a result of increasing population density and demand for farmland and other developments. These sites are found mainly in the following towns of Southeastern Nigeria: Agulu, Nanka, Alor, Nnewi, Ideani Oraukwu, Oko Nkpor, Ekwulobia/Oko, Uke, Ojokoto/Oba, Udi, Enugu, Ukehe, Ezimo, Obollo-Afor, Amucha, Njaba, Isiukwuato,

Ohafia, Abiriba, Arochukwu, Igbere, Ozuitem, etc (Ofomata, 1985 and 1988; Ijeoma, 1988, Egboka, 2004; Abegunde et al., 2006; Nwagbaa et al, 2015 and Igwe, 2012).

Typical of these gullies are as presented in Figures 1 and 2.



Figure 1: Erosion site at Nanka, Anambra State



Figure 2: Erosion site at Ezimo, Enugu State



do not have proper drainage systems to

## Results and Discussion

Major findings and discussions of the research are grouped into causes, consequences and mitigation as well as preventive measures of gully erosion.

### *(i) Causes of Gully Erosion in the Southeast*

Available literature suggests that although some gullies are initiated by natural cracks in the earth, much of the gully erosion in the Southeast region of Nigeria can be linked to human activities, which can be managed and controlled through proper land use, forest vegetation, etc (Osadebe and Akpokodje, 2007; Egboka et al., 1990; Igwe, 1999). Although the respondents acknowledged that the nature of the soil is a strong contributing factor to the rapid development of gully erosion in the region, they noted that most of the causes of erosion are linked to poor land management practices. Egboka (2016) gave an extensive discussion on the major causes of gully erosion in the Southeast region of Nigeria. He observed that rainfall occurs as thunderous showers with fast runoff and severe outwash. The floods start as sheets, rills, develop as channel flows and eventually into gullies and landslides along the flow path, wreaking mayhem along. The underlying soils are erodible sands, loose and permeable Geologic Nanka Sands/Ameki Formation. The former enveloping rainforest canopy of trees has been deforested and do not cover/protect lands anymore; rain waters wash off soils quite easily. Demographic/urbanization impacts complicate the environmental malaise: population density is immense with consequent heavy human activities. There has been intense deforestation to build heavy infrastructure of houses, landscaping, roads, poor drainages, commercial/industrial centres etc. There have been poorly-planned civil works that are erosion causative being practiced all over the Southeast; these projects

evacuate the heavy floods that habitually-occur annually. People build across flood channels and along wetlands thereby exacerbating incidences of flooding and erosion. Above all, there is high level ignorance or nonchalant attitude towards proper understanding of the causes and implications of the problems of floods and erosion by most people of the Southeast, whether educated or not; as a result they assist in worsening the problems through their misplaced acts or inaction. Egboka (2016) further reports that these are some of the weighty reasons why gullies are endemic and have uncontrollably-spread all over the Southeast and shall continue to spread in geometrical progression unless checked.

These findings of Primary causes of gully erosion in South Eastern Nigeria are summarized as follows:

1. Roads without proper drainage or catchments pits.
2. Unguided cultivations that cause flooding
3. Indiscriminate channeling of flood water on sloped terrain, especially in loose soil structure area
4. Intense rainfall on metal roofs without drains, which congregate to form large, unguided water channels
5. Large cracks in hills that form flood channels especially on loose soil ecological terrain
6. Grading of roads, thereby reducing road levels and creating waterways
7. Poor drainage systems

### *ii) Consequences of Gully Erosion in the Southeast Nigeria*

The observed consequences gully erosion in the Southeast as well as those revealed in literature are enormous. The environmental

disasters have singly- and jointly-caused massive deaths of men, women, children, animals, plants etc.; caused losses of lands and vegetation; destroyed surface waters and groundwater resources in places; caused massive destructions of infrastructure such as buildings, ancestral homes, cemeteries, churches, schools, playgrounds, roads, drainages, bridges, electricity, telecommunication lines, springs, streams, lakes, rivers, aquatic flora and fauna, irrigation schemes, agricultural farms, industries, commercial centres etc. (Egboka, 2016).

These disasters have wrought inestimable socioeconomic damages to the States/nation's overall human and economic resources on local and regional scales over the years. These havocs have continued to spread in depth, width and breadth dimensions. They shall continue to do so unabated in geometrical progression unless immediate remedial actions are taken by the Federal and State governments of Nigeria, aid agencies, groups and individuals to control them.

Floods, soil and gully erosion occur during rainy season; landslides also occur in some sensitive areas during dry season. Many communities in Southeast are ravaged by these disasters annually. The menace has been more in Anambra and Abia States than the other States in the region. For instance as reported by Egboka (2016), in Anambra State, many towns and institutions have been cut away from one another and means of communications severed/dislocated. Towns, villages, families, schools, churches, markets, playgrounds etc. are separated from one another at Agulu, Nanka, Alor, Nnewi, Ihiala, Obosi, Oraukwu, Ekwulobia, Umuchu etc. People find it near-impossible to go to markets, churches, schools, town halls etc. for social outings and commercial functions; students are equally-hazarded while going to schools as road networks are mostly unsafe; ancestral shrines, family/public cemeteries are uprooted/destroyed; local water supply

sources such as springs, streams, lakes and artificial reservoirs are regularly-polluted, and -silted up; wetlands and agricultural watersheds are also silted up and rendered infertile; aquatic animals and plants are destroyed in polluted waters; lakes become highly-eutrophic; valued lands are lost to siltation, gullies and landslides etc.

In some rural communities of Agulu, Nanka, Ekwulobia, Obosi etc., many people particularly the aged ones and children are sometimes trapped in their homes already cut-off or encircled by advancing gullies. Many a time, because of emotional attachment to their property and ancestral living, they refuse to leave their homes or run away; they eventually-lose their lives and property to the gulping gullies. In many urban centres of Nnewi, Obosi, Onitsha, Awka etc. huge commercial concerns/property are lost annually to floods and gully erosion. Many people's homes, lands and property perch precipitously/perilously at edges of chasmic gullies. The people of the threatened areas live in terrible psychological fear and total helplessness all the year round, fearing when their homes might be carried away by gullies or landslides.

In Abia State as reported by Nwilo et al (2011), most of the affected communities include Amakama, Uturu, Ekenaobizi, Ohiya, Amaokwe, Amayi, Amuzukwu and Umuajata. Others are Okwudor, Abiriba, Ohafia etc. Landslides and gullies have caused untold hardship on the people of these communities which have consequently resulted in loss of financial and material resources. This has made the bid of the people to attain self-sufficiency in local production of food and agro based industrial raw material almost impossible. Chukwuedozie and Arinze (2011) documented that gully erosion menace has over the years been responsible for increasing losses of houses and land of the people, thereby displacing affected inhabitants. Also, it

has led to the loss of life of people and livestock, as well as the destruction of farms on which the majority of the population depend for survival.

*(iii) Mitigation of Gully erosion*

Although some gullies have become too severe to remedy, and will require huge engineering efforts, others can be prevented and incipient ones tackled through a variety of best land management practices and low-cost approaches. Control measures to stem gully erosion that are incipient are most effective when erosion is still at an early stage of sheet or rill erosion which is amenable to low technology intervention.

Unlike soil properties and topography, which cannot be only be manipulated by human action, land management is often very much under human control. Proper land use and watershed management can be used to reduce surface water runoff and control infiltration in order to dampen erosive forces and reduce the erodibility of soils. The importance of proper land use management for erosion control had also been noted in at least one study conducted in the area (Igwe, 1999). Some of the immediate control measures that were either alluded to by interviewees or corroborated by previous studies included: reduction of surface runoff from impervious surface; provision of collection system for roof rain water runoff and its subsequent reuse;

drainage of surface runoff, including the establishment of interception, division and primary (trunk) drains and the construction of interception ponds; planting of grasses on available favorable surfaces to reduce the amount of bare soils exposed to the erosive force of the rains, and to control infiltration; forestation in the areas more susceptible to gully formation and the planting of local cover crops such as indigenous leguminous plants.

However, lack of awareness about the cause of the problem was very evident within the community. Many households in the community either do not know the cumulative effect of the lack of proper drainage systems or do not care because there are no direct and immediate repercussions for their poor land management. There is a lack of legislative frameworks to ensure that households refrain from practices that cause gully erosion, and enable these communities enact enforcement mechanisms. In addition, information on the causes of gully erosion and how it can be prevented are scarce. Many of these communities are not aware of the major causes of gully erosion and how it can be prevented, or how their actions are contributing to the problem.

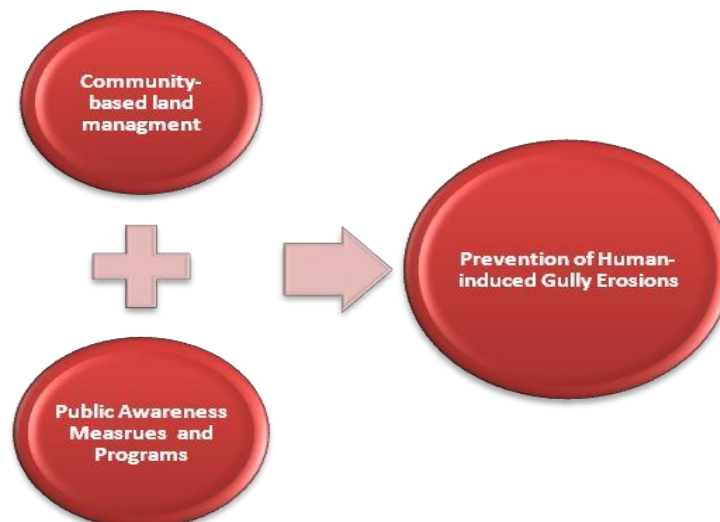


Figure 3: Effective Land Management Framework

(iv) *Preventive Measures of Gully Erosion*

Community-based land management practices coupled with public awareness has been identified as the key in gully erosion prevention. Gully erosion can be prevented when communities engage in more public awareness initiatives and put in place structures that can govern and implement best land practices (Ezezika and Adetona, 2011). Effective land management practices coupled with pragmatic public awareness measures within the community is crucial to mitigate further onset of gully erosion in the region (Figure 3). Interviewees recommended that communities take part in initiatives that adopt and engage in small-scale, low technology input and best land management practices. By ensuring that the public is more aware of the gully erosion problem and the best mitigating practices, as well as by putting in place proper legislative and administrative measures for land management practices, the initiation and reoccurrence of gully erosion may be prevented (Okagbue and Uma, 1987).

For example, residents who pave their lands may not be aware that their actions could exacerbate gully erosion in the community because rainwater flowing out of their land to the surrounding regions causes surface run-offs and could initiate erosion. However, a strong public awareness program could help resolve the ignorance surrounding this issue. On the other hand, if a neighbor, knowing the consequences, still decides to forego a drainage system, the existence of a community regulatory framework to ensure that each landlord is responsible for all rainwater that falls within his property can help mitigate against poor land management practices. The framework may include provisions wherein an individual can be fined or face disciplinary actions from the community for his or her poor land management practices.

Other preventive measure could be by finding a channel of gully erosion control through workshops: One of the most effective avenues for combining a public awareness program and effective land management policy is through workshops in various towns and villages that accesses local knowledge. As a strategy, these workshops should include the following elements:

- *Awareness* - sensitize the community on issues concerning erosion;
- *Education* – relate to the community the causes of erosion, suggest control measures that can be undertaken on the individual and communal levels, and initiate best management practices for the control of surface water and infiltration;
- *Recruitment* – recruit students and youths in the area to disseminate necessary information, and equip them to communicate erosion control measures and best land management practices. They will also help in the evaluation and monitoring process;
- *Learning* – gather local knowledge that could be useful and/or impact on the overall objectives of the project as they relate to the community. In addition, find out what the local attitudes to gully erosion are, and how land management practices have changed over time;
- *Demonstration* – show to the community the practice of some of the control measures during the workshop;
- *Evaluation and monitoring* – put a system in place to monitor and evaluate the effectiveness of the project, and develop indices that tie improvements in erosion control to the project;
- *Working example* – put a system in place that will show case project as a working example of a community based



erosion control effort; use it as an educational tool, where possible, for other communities that may be interested in starting community based erosion control projects; future small and

- *Large scale interventions* – use the proposed project as a reference for future attempts to assist communities in South Eastern Nigeria to control erosion.

These workshops should include mitigation measures such as identification of the causes of gully erosion by all stakeholders and review of the different measures of mitigation, targeted to each stakeholder group. It should also involve steps to implementing new policy and policy suggestions, leadership training and ways to secure funds and investments. Thus the following proposals put forward by Ezezika and Adetona (2011) and Egboka 2016 are reiterated as Mitigating strategies for erosion control in South-eastern Nigeria:

1. Local government officials and legislative representatives should be more aware of the problem of gully erosion, along with concrete suggestions to combat and prevent erosion in the local context.
2. The Federal Ministry of Environment together with local communities should design public awareness programs on the causes and mitigation measures of gully erosion.
3. Community leaders should ensure that households account for surface runoff from impervious surfaces within their residential property and other best land management practices.
4. Organizations and churches should be more involved in public awareness measures and capacity building programs such as planting of grasses on available favorable surfaces, afforestation projects in the areas more susceptible to gully formation, and planting of local cover crops.

5. The State and local government should organize workshops for community leaders, households and youths on measures of gully erosion mitigation.

## Conclusion

This study focused on developing erosion mitigation measures for South Eastern Nigeria where soil erosion is continuing to be a huge environmental problem, and local communities are currently ill equipped to combat the problem. Through the use of direct observations, short informal interviews, and informal discussions among the study team and soil erosion experts, it was discovered that there was a general lack of awareness of the human factors that contribute to the development of gullies in the communities where the study took place. It was determined that there is great opportunity to adapt small scale, low technology land management practices in order to prevent erosion and the development of gullies through community based approaches and public awareness programs. Finally, it is recommended that equipping and shifting responsibility towards the community would enhance erosion control efforts.

## References

- Abegunle, A.A., Adeyinka, S.A., Olawuni, P.O. and Oluodo, O.A. (2006), An assessment of the socio-economic impacts of soil erosion in Southern Nigeria. *Shaping the Change*, XXIII: 1- 15. FIG Congress, Munich, Germany.
- Adekalu K.O., Olorunfemi I. A., Osunbitan J. A. (2007). Grass mulching effect on infiltration, surface runoff and soil loss of three agricultural soils in Nigeria. *Bioresour. Technol.*, 98(4): 912-91



- Akpokodje, E.G., Tse, A.C. & Ekeocha, N. (2010). Gully erosion geo-hazards in South-eastern Nigeria and Management implications. *Scientia Africana*, 9 (1):20-36.
- Batie, S.S. (1992) Sustainable development: concepts and strategies. In G.H. Peters and B.F. Stanton (eds.) *Sustainable Agricultural Development: The Role of International Cooperation*. Proceedings of the 21<sup>st</sup> International Conference of Agricultural Economists held at Tokyo, Japan, 22-29 August, 1991. London: Dartmouth Press.
- Danielson, E.W., Levin, J. & Abram, E. (1998) *Meteorology*. Boston: WCB/McGraw-Hill.
- Egboka, B. (2004) Gully erosion in Alaigbo. *Osondu News Letter*, 4. Online Edition, (Available at <http://www.osondu.com/abec/erosionindex>)
- Egboka B. C. E, Nwakwor GI, Orajaka IP (1990). Implications of palæo- and neotectonics in gully erosion-prone areas of South-eastern Nigeria. *Natural Hazards*, 3: 219-220-231
- Egboka B. C. E (2016), Impact of Gully Erosion on Infrastructure in the Southeast (<http://www.osondu.com/abec/erosionindex>)
- Ezekika O. C. & O. Adetona (2011), Resolving the gully erosion problem in South-eastern Nigeria: Innovation through public awareness and community-based approaches; *Journal of Soil Science and Environmental Management* 2(10):286-291.
- Gobin A. M., Campling P., Deckers J. A., Feyen J, Poesen J. (1999). Soil erosion assessment at the Udi-Nsukka cuesta (South-eastern Nigeria). *Land Degrad. Dev.*, 10(2): 141-160.
- Hudson NW (1981). *Soil conservation*, New York: Cornell University Press.
- Igwe, C.A. (2012): "Gully Erosion in South-Eastern Nigeria: Role of Soil Properties and Environmental Factors" Intech-Open Access Company. DOI: 10.5772 51020, Chapter 8.
- Ijeoma, M.A. (1988): A conceptual ecosystem's model for effective gully erosion management: a case study of the Onu-igbere gully. Proceedings of the International Symposium on Erosion in South-Eastern Nigeria, :92-97.
- Intergovernmental Panel on Climate Change (IPCC) (1996): *Climate change 1995*. New York: Cambridge University Press.
- IPCC (2007) *Climate Change: 2007: The fourth Assessment Report*. New York: Cambridge, University Press.
- Ike P.C. & P.O. Emaziye (2012) An assessment of the trend and projected future values of climatic variables in Niger Delta Region, Nigeria; *Asian Journal of Agricultural Sciences* 4(2): 165-170.
- Nwagbara, M.O., G. N. Chima & N. Ndukwe-Okoye (2015). Climate change and gully erosion in the derived savannah of South-eastern Nigeria'; *International Journal of Environment, Ecology, Family and Urban Studies (IJEEFUS)* 5: 35-44
- Nwilo, P.C.; D. N. Olayinka, I., Uwadiogwu & A. E. Adzandeh (2011) An assessment and mapping of gully erosion hazards in Abia State: A GIS Approach; *Journal of Sustainable*



*Development*, Vol. 4 (5),: 196 – 211

Ofomata, G.E.K. (1985) Soil erosion in Nigeria: The views of a geomorphologist. An inaugural lecture of the University of Nigeria, Nsukka.

Ofomata, G.E.K. (1988). The management of soil erosion problems in South-Eastern Nigeria. Proceedings of the International Symposium on Erosion in South-Eastern Nigeria, 3-12.

Okoye, C.U. (2006), Estimating farm-level soil erosion control and damage costs in Enugu State, Nigeria. In S.O. Adepoju & P.B. Okuneye (eds.) *Technology and Agricultural Development in Nigeria*, Proceedings of the 20<sup>th</sup> Annual Conference of Farm Management Association of Nigeria, 521-529

Okpala, A. O. (1990). Nigerian population growth and its implications for economic development. *Scandinavian. J. Dev. Altern.*, 9(4): 63-77.