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Full Length Research Paper

Resolving the gully erosion problem in Southeastern Nigeria: Innovation through public awareness and community-based approaches

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The formation of gullies is one of the greatest environmental disasters in Southeastern Nigeria. 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. We reviewed pertinent literature, interviewed key stakeholders, observed gully erosion sites and had informal discussions with key experts in the field on the causes of gully erosion and community-based approaches in tackling the problem. Based on these discussions, interviews and observations, we showed that many eroding gullies in the region are human-induced and therefore can be prevented. The results also reveal that many of the causes of gully erosion can be traced to poor land management practices and to a lack of innovation and awareness measures. We conclude that community-based, low-technology land management practices and public awareness programs through workshops could halt the development of many gullies in the Southeastern region of Nigeria.

Key words: Erosion, gully, environmental management, soil, Southeastern Nigeria, workshop, public awareness**.**

INTRODUCTION

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). This region is fast becoming hazardous for human habitation. Hundreds of people are directly affected every year and have to be re-located. 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. Erosivity is a function of rainfall, a natural phenomenon which is outside human control and manipulation. Rainfall intensities can be high in Southeast Nigeria. Obi and Salako (1995) reported that rainfalls with intensities between the range of 100 to 125 mm h^{-1} are likely to occur more than five times a year. Storms with 25 mm/h intensity have been reported by Hudson (1981) to be erosive. Erodibility, on the other hand, is dependent on soil properties, topography, and land management.

Appropriate land management is very important in an area like Southeast Nigeria where the geotectonic, geologic, and geohydrologic characteristics of the region make many areas within it susceptible to gully erosion. 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; Okagbue and Uma, 1987).

The loss of soil degrades arable land and eventually renders it unproductive. As a result, there are significant

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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 (Pimentel et al., 1995). Large portions of land have been destroyed in recent years in towns such as Ekwulobia and Nanka[1]. In addition, highways are damaged, leading to numerous vehicle accidents and large displacement of residential houses.

A number of studies have been conducted on the causes of gully erosion in Southeastern Nigeria and ways to control them. These studies primarily revolve around geological properties of the region and proffer solutions that require large-scale engineering efforts with minimal regard to indigenous knowledge. They also deal more with combating gully erosion rather than their prevention and pay little attention to ways to control gully erosion from the perspective of members of the community that are affected by the erosion.

To bridge this gap, we conducted this short study intended to explore the causes of gully erosion and methods of preventing and controlling gully erosion in the region. This study was informed by the perspectives of those affected by gully erosion and further explored the human dimensions of the problem and potential solutions, with particular attention to low-cost, community-based approaches. To our knowledge, this study represents the first in which community based research has been used to study soil erosion problem in the region, and solutions proposed through a community-based framework.

Based on the results of this study, we posit that community-based land management practices and public awareness on the causes and solutions could prevent the onset of gully erosion within the Southeastern region of Nigeria.

METHODS

This study started at the Yale School of Forestry and Environmental Studies when a team of students developed a tentative proposal on sustainable and practical approaches to tackle gully erosion in Oko and Nanka, two towns in Anambra State in Southeastern Nigeria. A number of specialists in Nigeria were contacted and the team reviewed literature on the topic. The preparation of this study relied on multiple sources of evidence including direct observations, short informal interviews with stakeholders and documentation. However, the bulk of this study arose from direct observations and informal discussions among the team and experts.

A literature review of academic articles, news articles and publicly available documents were used in the study. We also interviewed six individuals, who represented public sector views within South-eastern region of Nigeria. The roles played by these interviewees included scientist, policymaker, farmer, surveyor, village head and nurse. The interview was designed as a loosely semi-structured format, and lasted approximately 20 min in length. It included ques-tions on understanding the gully erosion problem as well as specific questions investigating best practices for preventing and controlling erosion.

The study also included visits to gully erosion sites in the towns of Oko, Nanka and Ekwulobia and interaction with stakeholders affected by the erosion. In addition, informal discussions with key experts were held on the issue.

RESULTS

Many eroding gullies in Southeastern Nigeria are human-induced

The literature review 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. (Gobin et al., 1999; Olife et al., 2007; Osadebe and Akpokodje, 2007; Egboka et al., 1990; Igwe,1999). Although the interviewees 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. Observations made in Nanka and Oko and other studies also identified the prime contribution of poor land management practices towards the development of gullies as shown in Table 1 (Akpan et al., 2009; Egboka et al., 1990; Okagbue and Uma, 1987; Idike, 1992).

Some gully erosions can start very small. For example, in 2000, small sheet erosion on the side of a major road in the town of Ekwulobia in Anambra State developed into a deep gully within three years. This displaced many residents in the neighborhood, making the major road impassable. There are other incipient sites, which are preventable and can be tackled before they get too severe. According to a land surveyor who was interviewed, there has been an increase in houses without proper drainage systems, causing increased surface runoff and floods during heavy rainfall. For example, from observations made in this study, the ground surface was paved in many residential properties, with rainwater flowing into the surrounding areas. In addition, vegetation, which can retain fluid and retard water flow were absent in these residences due to the paved surfaces. This inability or unwillingness of many households to employ proper drainage systems is a major cause of gully erosion.

Gully erosion can be mitigated through low-cost approaches

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 – when sheet or rill erosion is still the erosion form

[1] These towns are located within the Awka-Orlu Cuesta and are prone to fractures and landslides (Egboka et al.,1990).

Table 1. Primary causes of gully erosion in Southeastern Nigeria.

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

– and erosion is still amenable to low technology intervention. Unlike soil properties and topography, which can 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.

Community-based land management practices coupled with public awareness is key

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. 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 1).

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.

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

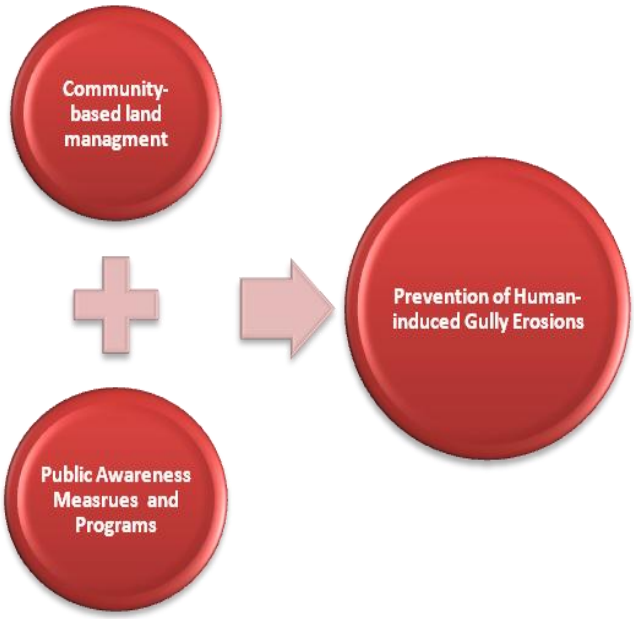

Figure 1. Improved gully erosion control through a community-based approach and public awareness program.

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 Southeastern 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.

DISCUSSION

A number of studies have shown that the Southeastern region of Nigeria is susceptible to gully erosion due to the nature of the soil, topography and geology (George et al., 2008; Okagbue and Uma, 1987; Onu, 2005; Osadebe and Akpokodje, 2007; Stamp, 1938; Teme and Youdeowei, 2004). For example, Nanka and Oko, the towns for this study, are located within the Awka-Orlu Cuesta, which is an area susceptible to ground surface cracks and landslides during the rainy season. In 1988, there was a landslide initiated by fractures in which many properties, including sixty homes, were reported to have been lost (Egboka et al., 1990). The two cuestas in the area – the Udi-Nsukka and the Awka-Orlu Cuestas – are thought to have been formed due to compression and consequent uplift of the landscape. These cuestas make the region susceptible to gully erosion. Cuestas are ridges that have gentle and steep slopes on their opposite faces. The red lateric soils of the area overlay white sands referred to as the Nanka Sands (Egboka et al., 1990; Okagbue and Uma, 1987). The soils have low silt/clay content which decreases with depth. The white sands are cohesionless, very permeable and have high infiltration rates, making control of gullies difficult after they have cut through the red soils at the surface. In addition, the rise in the water table due to heavy rain falls in the rainy season contributes to an increase in hydraulic head, high subterranean flow rate, and the enhancement of gully formation (Egboka et al., 1990).

However, this study has also shown that despite the susceptibility of the region to gully erosion, it can be prevented through enhanced public awareness programs and better land management practices. Although these practices are insufficient to resolve the huge gully erosion sites, these practices can prevent the occurrence of future

Table 2. Mitigating strategies for erosion control in Southeastern Nigeria.

Strategy for erosion control
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.

future ones. It is important for community leaders to organize awareness programs that provide reliable information to the community on gully erosion mitigation strategies. These programs can be an incipient process for providing the community with methods of tackling erosion, sharing of local knowledge on these issues, and raising awareness. These workshops could serve to introduce strong policies to bring about better management and monitoring of effective land and farming practices and to mitigate the formation of gully erosion in Southeastern Nigeria.

Farming is still an important occupation in the area and much of this is done on a subsistence level. It has been opined that “the farmer [in the region] can only be convinced through measures and approaches that are economically feasible, non complex and can accommodate his values and ethics” (Okagbue and Uma, 1987). It is thus important to access local knowledge to ensure the success of any erosion mitigation and soil project in the Southeastern region of Nigeria, while stressing the need to concentrate on low technology, low capital control measures. It is also important to note that control measures to stem incipient gully erosion are most effective when erosion is still at an early stage and amenable to low technology intervention.

The constitutional framework for the management of the environment in Nigeria remains very centralized. This results in a system where government at the state and federal levels holds the primary responsibility for developing and applying the legislative framework, including supervisory and regulatory roles, for environmental management (ARD, 2002). This framework can be improved by increasing the capacity of local governments to integrate environmental planning and management into their activities.

Gully erosion occurs locally, usually starts small and is best mitigated at the community and local levels. Therefore, a system where the local communities most affected by erosion drive the mitigation strategy is both empowering and most effective. We propose the action plans in Table 2 which are geared towards engagement at the level of the local community.

The workshops will allow for rich interaction among community residents, community leaders and village chiefs, the academic community, legislative and policy representatives in order to get a full representation of those affected by and influencing erosion control in South eastern Nigeria. They will also provide the opportunity to determine the major causes of soil erosion in the region through the consultation of all of the stakeholder groups, creating a comprehensive body of information for use by the local organizations, and residents.

Additionally, by interfacing with the community leaders and chiefs of the various villages, the present institutional and legal frameworks available for addressing gully erosion can be assessed. This would facilitate possible legal and regulatory changes that will enable these communities, towns, and villages at the local level to enhance their inherent capacity to protect against gully erosion. This creates a hub for developing innovative ideas and erosion control programs. It also moves the responsibility to the affected community and creates structures through these workshops or other discussion fora that emphasize the exchange of ideas and the demonstration and application of techniques and skills to manage erosion in the region.

Conclusion

This study focused on developing erosion mitigation measures for Southeastern 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 believed that equipping and shifting responsibility towards the community would enhance erosion control efforts.

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