
INVESTIGATING THE MENACE OF SOIL EROSION IN LAFIA MUNICIPALITY, NASARAWA STATE, NIGERIA

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ABSTRACT

This work used primary informations from field measurements, surveyed ingrained view of the inhabitants, self-experience& observations of the research team, as well as reviewed literature. It appraised the nature, perceived causes, impacts, control attempts of the incidence of soil erosion in Lafia City, Nasarawa State, Nigeria, and mapped out promising solutions to it. The study found that, soil erosion has been the major environmental disaster bedeviling the township, as it doesn't spare an inch of interred surface within the city vicinity, in fact, many neighborhoods was completely under its siege. And the menace has been incessantly claiming and threatening lives, properties, day-to-day activities, and the general wellbeing of the physical environment. Even with, the situation was tends to be overlooked, thus witnessing an astronomical worsening daily. The article finally recommends five doable ways forward for all the stakeholders' perusal, namely; biological control of drought & trample resistant weed replantation of bare grounds, intensive anticipatory public enlightenment campaign, constituting community-based anti-erosion laws and taskforces, eroded surfaces embankment, and infiltration and damming of excess discharge which might be used as an add-on benefit for irrigation farming.

Keywords: *Soil Erosion, Natural Causes, Anthropogenic Causes, Impacts, Lafia City*

INTRODUCTION

Man's perpetual quest for livelihood (food, clothing, shelter etc) was evident altering the default wellbeing of the environment (as to land in this study case), which when coupled with some auto-natural phenomena often adversely affect its quality, this is termed as 'Land degradation'. Meanwhile, the most affected land constituent is soil; for about three-

quarter of man's developmental projects are on it [16]. Wherefore, soil degradation (erosion particularly) globally has been one of the most devastating and widespread disaster and became a world issue [1, 2, 7, 8, 9, 12, 16, &18]. Soil erosion world through has led to tremendous loss of land estimated at 6 million hectares annually [10]. China alone, as the world worst hit has erosion surface of 3.6 million square kilometers, equivalent to 37% of its territorial extent [3]. Within Nigeria's context, soil erosion has been the biggest environmental hazard of the country [1, 2, 4, 12, 13,& 16], for it prevails in all regions of the nation at an exponential trend. But it was reported more pronounced and calamitous in the south-eastern region where a gully of up to 2km exists [12]. Anambra State alone for instance, has about 700 gully sites, and over 70% of its landmass is under erosion threat [10]. Research has shown that, soil erosion is detrimental to physical and socio-economic environment. [1, 2, 5, 8, 9& 12] reports soil erosion have globally undermines agriculture (world's largest means of livelihood) through depriving the soil of its essential nutrients, and also leading to loss of lives and properties. Nigeria in particular, records an annual loss of \$3billion through destroyed structures, animals and citizens deaths, and residents' displacement caused by soil erosion [18]. In the south-eastern region, almost everybody was said to had once been victimized by it anyways [10], and over 70% of the dwellers was said to be either losing kinsman or a property worth \$70,000 every year [16].

There is no formal conflict on the cause of soil erosion, that it's been move by both natural and anthropogenic forces, the discord base is on which had been the pilot between the aforementioned two. Some authors such as [2, 3, 5, 12, & 14] are on the view that, natural conditions like; faulty geological formations, and extreme climate inform of high surface run-off & storms were the actual perpetrators of erosion, that they always initiates the process and then aids by developmental actions, thus the natural factors were master actors. In the other camp, the likes of [1, 6, 7, 8, 10, 11, 13, 16, 18, & 19] imposingly opined that, the roles of natural drivers always relied/build upon anthropogenic actions, for the process usually begins with loosening and removal of top soils via human disturbances, and unlike natural phenomena which has been mostly seasonal, man-induced causes such as devegetation and indiscriminate land uses are all time practices, thus have been more offensive and master movers of soil erosion. Notwithstanding, soil erosion heedless of the cause had been noisome to socio-economic development everywhere.

Therefore, regular inquest of soil status is indispensable, and underestimating such necessity amounts to putting lives, food security, shelter, businesses, and even future of a given place at stake. Nasarawa State as reported by [10] has about 76.84% of its total area either been ravaged by soil erosion or shown its signs, and the case is more horrible and incessant in Lafia City. Hence, there is compelling need of a soil erosion study in the township, with a view to finding an urgent and feasible ways to address it for betterment of the current residents, and preserving the land use right of the generations to come, this is the objective of this paper.

STUDY AREA

Lafia City, the capital of Lafia Local Government Area and Nasarawa State, North central Nigeria, lies between longitudes $8^{\circ}26'0''E$ – $8^{\circ}30'0''E$ and latitudes $8^{\circ}30'0''N$ – $8^{\circ}34'0''N$. The municipality has a perimeter of $6.13km^2$ [17], comprising of four Local government councillorship wards namely; Chiroma, Gayam, Makama, and Zanwa. The township falls under tropical wet and dry (Aw) climatic type on Koeppen's model. It records an annual precipitation of 1100-1500mm, spanning in seven months (May-November), and annual mean temperature of $23.5^{\circ}C$. The city is drained dendritically via Guma, and Ma river systems [21]. It is within the southern guinea savanna vegetation zone, characterized with dense trees and grasses of about 15m and 5m tall respectively. The dominant geological setting is cretaceous sandstones of pre-Cambrian origin which formed an undulating plain of about 300m above sea level. The soils type is an old sedimentary derivative of interplay of the area's climate, hydrogeology and vegetation, which is well structured fertile alluvial of oxisol and ferrisol gene.

However, the city's being the administrative hub of the state, became a destination to a large mass of migrants from within and outside the State, thus experiencing rapid urbanization. As of 2006 census, the municipality housed 330,712 residents of multiplex genealogy, co-habiting harmoniously. The native ethnicities includes; Kambari (Bare-bari), Koro (Migili), Alago, Mada, Gwandara, and Nungu, while the dominant immigrants are Hausa, Fulani, and the tribes of middle belt. These dwellers mostly engaged in small and medium enterprises (SMEs), craftsmanship, and civil service

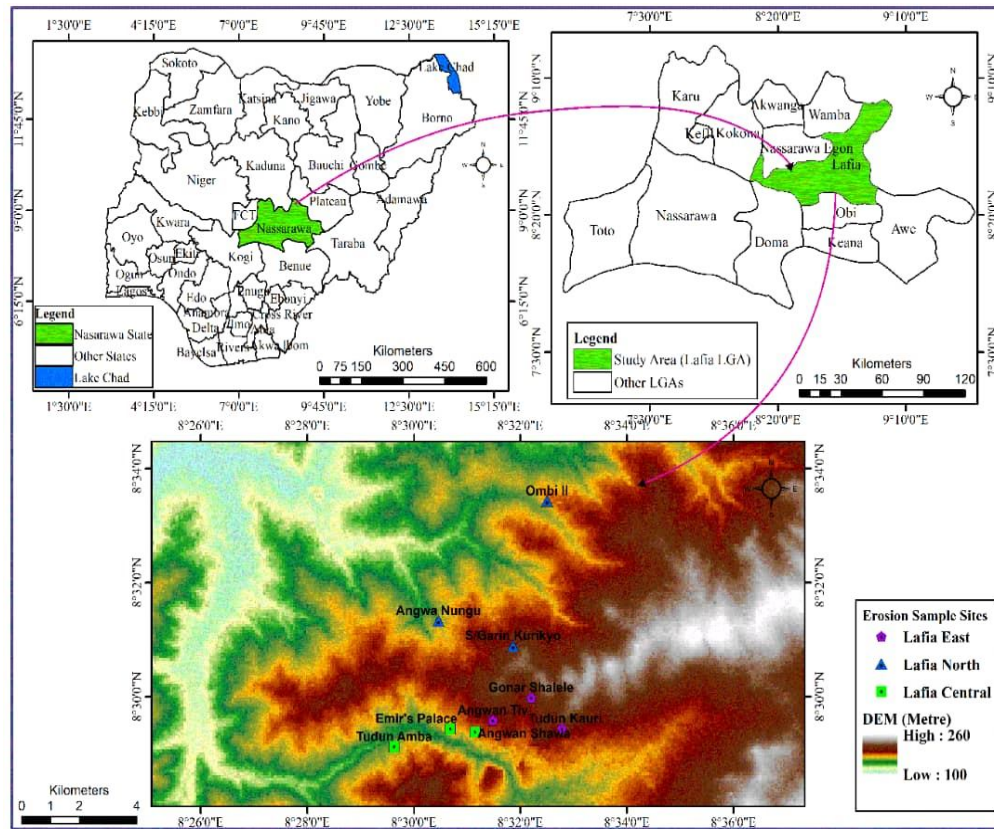


Figure 1: Location of Lafia City showing the sampled erosion sites

MATERIALS AND METHODS

Sources of data

All informations used in this article were harvested principally from field works (field measurements, structured interview surveys, and self-observations) conducted by the research team, documentary informations from relevant bodies namely; Nasarawa State Ministry of Environment, Nasarawa Urban Development Board (NUDB), and Nasarawa Geographic Information system (NAGIS) and a review of the literature which served as conceptual framework.

Sampling Frame

A stratified random sampling method was used in generating the desired data. The three already established geographical entities of the city (Lafia Central, Lafia North, and Lafia East) were taken as stratas for a fair representation of the whole, in which three (3) erosion sites were randomly selected from each of them, making a total of nine (9) sampled

sites and then five (5) structured-interview respondents was randomly drawn at each selected site, forty five (45) interviews combined

Field Measurement

The coordinates of each sampled location was usually taken first using GPS, followed by systematic measurement of basic erosion variables (such as length, width, and depth of the eroded channel/surface). The measurements team constituted of two (2) pole men (one at each edge of the measuring tape), one (1) recorder and another as observer. Other features of interest that was subsequently observed, assessed and duly recorded are; land use, land cover, geologic formation, menace intensity, channel shape and activity status of the erosion heads. Finally questionnaire interviews were administered afterwards to assess the perceptions and views of residents around each sampled location.

Data Analysis and Presentation

The descriptive statistical technique was used in analyzing the data, and the result were presented in forms of tables, charts, and figures for interpretation

RESULTS AND DISCUSSION

Nature and Intensity of the erosion

Table 1: Basic erosion variables across sampled sites of the study area

S/N	Site name	Length	Width	Depth	Type	Ditch shape	Activity status	Land use/cover	Geological formation
1	Tudun Amba	1.5km	16m	34m	Gully	Linear	Active	Commercial/moderate	Sandy loam
2	Kofar fada (Emir's palace)	38m	7.6m	0.4m	Sheet	Irregular	Active	Residential/Bare	Loamy
3	Angwan Sha'awo	350m	7.6m	3.4m	Gully	Irregular	Active	Residential/Bare	Sandy
4	Angwan Nungu	2km	100m	80m	Gully	Linear	Active	Commercial/moderate	Sandy loam
5	Ombi II (College)	180m	7m	0.6m	Rills	Irregular	Active	Commercial/moderate	Sandy
6	Sabon garin Kurkyo	150m	12.7m	1.3m	Gully	Linear	Active	Residential/Bare	Loamy
7	Angwan Tiv	44m	9.1m	12.4m	Gully	Irregular	Active	Residential/Bare	Loamy
8	Gonar Shalele	3.1km	6.5m	3.3m	Gully	Ravenous	Active	Residential/Bare	Sandy loam
9	Tudun Kauri	200m	100m	3.4m	Gully	Irregular	Active	Residential/Bare	Sandy

Table 2: Perceived rate of advancement (N = 45)

Rate	F	%
Slow	05	11
Fast	18	40
Very fast	22	49

Where F is the frequency of responses in respect to total number of the respondents N

From tables 1&2, it is distinctly clear that soil erosion is dreadfully rocking Lafia city for a quite long period of time. Table 1 elucidates that the menace rampages every part of the township in an alarming rate, but more terrifying in places characterized with sandy soils and bare vegetative cover, such as Angwan Nungu and Gonar Shalele, where gullies of up to 1.5 kilometers are very common. The situation has been more nauseating to Lafia East geographical entity, where a gigantic gully trench was observed existing, stretched out from Nasarawa State government house in the eastern end, westward to Almakura Street graveyard, and virtually all adjacent mobility networks(streets & footpaths) along this trench have also have been abraded, invaded by soil erosion and metamorphosed into ravenous gully heads, in which like in a river or mountain systems, these ditches joined one another at a points and subsequently the larger perpendicular channel/ditch, forming a super-duper gully network, herein named **Giant Gully Chain of Lafia City (GGCLC)**. This monstrous gully chain could cumulatively be up to 10 kilometers long, and averagely 9.5m and 7.9m wide and deep respectively. Table 1 also further reveals that most of the eroded surfaces all over the town except for Ombi II and Kofar fada (as represented in the sampling) are gullies of irregular shapes, and as of the time of this study all are active, none have been found treated, thus witnessing fleet and unceasing expansion daily (table 2)



Plate 1: Gully head about to join GGCLC at Gonar Shalele, Lafia East,



Plate 2: A cross section of one of the GGCLC confluence points/intersection at Layin Mada, Lafia East

Driving Factors

Table 3: Perceived causes of soil erosion in the study area (N = 45)

Cause	$\frac{F}{N}$	% of N
High surface run-off	38	84
Geology & topographical setting	24	53
Inadequate land cover	11	24
Poor and total lack of drainage	36	80
Indiscriminate waste disposal	17	38
Poor land uses& management practices	28	62

The ingrained view of the respondents as recounts by the table 3, had predicated high surface run-off which conjoined with poor state or total absence of drainage system as the major driving forces of soil erosion in the city. Then loosed topography and hydrogeological setting of the township (being gentle sloping undulating plain of unfossiliferous, non-salt bearing sandstones) which coupled with very poor land use practices and dissatisfactory managements policies are also evident plays a vital role in escalating the problem. In support of the later assertion, many residents of Gonar Shalele, (the most badly hitted location in the township) have reported that, the blighting soil erosion mess in the area was resulted from an unfortunate streets and paths clearance made for unexercised roads construction by the past administration, which made the streets became very loose and more liable to erosion. Among the causes of soil erosion in the municipality as enshrined in the same table 3 are inadequate land cover and indiscriminate waste disposal habit of the residents, which was also seen expediting the rapid advancements of the menace

Impacts

Figure 2: Respondents' self-victimization by erosion

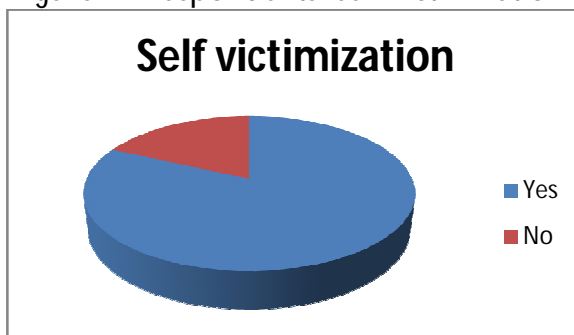


Table 4: Adverse Effects Suffered by Respondents (N = 45)

Effects	F/N	% of N
Loss of kinsman's life	14	31
Loss of properties	29	64
Sustained injuries	11	24
Displaced out of house and business place	19	42
Threatens own house & business place	42	93
Difficulty in mobility	45	100
Living in perpetual fear & anxiety	38	84

The gathered empirical evidences had depicted/shown how outrageous the soil erosion has been to physical environment and socio-economic wellbeing of Lafia people. Figure 2 expounded that eighty two percent(82%) of the (interviewed) inhabitants had been directly traumatized by it. Table 4 conveys that, 31% and 64% of all the residents had once lost a family member and/or properties to soil erosion respectively, while 24% others sustained various degrees of injuries. As well, large proportion as ninety three percent (93%) of all the residents' houses and businesses were under enormous threat of soil erosion, and another 43% had once been completely dislodged by it. Same token, 84% of the city dwellers had complained of being living in persistent fear and anxiety of uncertainties bedeviling their homes and businesses lots from soil erosion impendence. In sum, virtually all and sundry in the city (100%)was its victim one way or the other, for everybody must at least be facing/experiencing difficulty in mobility within the municipality corridors. Apart from the **Giant Gully chain** occupied area, there are many places in the township such as in Tudun Gwandara, Angwan Ishawo, Sabon garin Kurkyo etc, that are difficult to pass, while some remained inaccessible, for even the youthful and energetic pedestrians let alone the disabled and motorists used to crawl through a series of deep erosion gorges to access their respective journey ends.



Plate 3: A wheel barrow pusher being aided by local to cross gully trench at Angwan Ishawo, Lafia Central



Plate 3: Soil erosion usurping houses along Makurdi road, Lafia Central



Plate 5: Soil erosion trespassing Garri processing plant near Angwan Nungu, Lafia North

Responses

Table 5: Respondents' own control/mitigation effort (N = 45)

Effort type	F	%
Sand & stones embankment	13	29
Refuse dump blockade	10	22
None	22	49

Where F is the frequency of responses in respect to total number of the respondents N

Table 6: Government's control/mitigation effort (N = 45)

Effort degree	F	%
Well done	01	2
Little	06	13
None	38	85

Where F is the frequency of responses in respect to total number of the respondents N

Despite the gruesome threats that the soil erosion is invigorating to the natural and socio-economic environmental horizons of Lafia Municipal and the satellite towns within its impact area, the situation isn't getting its

deserved attention from all the concerned quarters. Table 5 reveals that almost half of the residents whom the menace is directly traumatizing are doing nothing to contain it, due to the vulture mentality of most of the people that all public projects and issues was government's exclusive duty/affair, thus they are waiting for it to come and fix it for them. While the other half's efforts were indigenous such as; sand embankment (laying sacks filled with sand at the abrasion heads), stones embankment, and thrash embankment (depositing large mass of refuse and junks along the erosion heads to fold its expansion). These local strategies are too feeble and impotent as per as the severity of the problem is concerned. In the same note, the government that supposed to be *prima-de-factor* to champion the fight against the disaster is grievously worst pertaining to action in the right direction. The gathered data shows that only one person translating to 2% of the respondents had attested that the government is making required effort toward compounding the erosion menace in the city, this is as good as none. And those who certified a little concern by the government were just 13%, while regrettably 85% affirmed that the government has been impassive to their pleas. Some residents even complained of getting tired with regular visitation of governments' officials (including former governors themselves), researchers, and non-governmental organizations to the sites, on ground of assessing the situation for a better approach, but nothing is yet to be done.



Plate 6: A typical sand sack embankment to block further erosion expansion in Kurkyo, Lafia North

CONCLUSION

Soil erosion was found to be a universal disaster in Lafia city, wreaking havoc in an expeditious pace. Its menace is so worrisome to the extent that gullies had taken over many streets and footpaths in the township, so the commuters have to follow through very deep gully ditches to arrive at their respective destinations, especially in Lafia east where it (erosion) had overrun all unadorned surfaces. The calamity was also evident adversely affecting the city inhabitants through incessant loss of properties, lives, and injuries to residents and threatens residences, businesses, and overall civilization, that in no distant future, many places in the city will no longer be habitable, as erosion may cut-off all accesses between homes, to workplaces, markets, and other destinations of daily mobility, and will subsequently swallow all the residential and commercial quarters if left unchecked. Both natural (high run-off, hydrogeology, and topography) and man-induced (poor land management practices) factors were observed to interchangeably play to its causes. And despite these agonizing situations, the stakeholders are making very little efforts to curtail/address it.

RECOMMENDATIONS

The recommendations were given under five thematic ways, viz;

- **Soil surface vegetative cover** to shield the bare surface from the fierce denudation effects, which will in turn lessen the ferocity of erosion mechanism. This method is the simplest, most economically friendly (cheapest) and researchers' most recommended strategy of checking soil erosion, as put forward by [5, 7, 8, 10, 12 & 20]. The weed called '**Hana kwari**' in Hausa—meaning 'Anti-abrasion/erosion' will perfectly do this magic. Its drought and abrasive resistant abilities as well as wide ground coverage nature are what have earned it such name. So, having this weed's wide plantation across all bare and most vulnerable surfaces in the metropolis would be very effective, for will of course reduce the erodibility and erosivity factors, will hence curb the intensity of the menace. This could maximally be achieved by engagement of all the stakeholders (the government, researchers, civil societies and residents) in an exhaustive planting exercise in order to have all neighborhoods covered.
- **Public sensitization programmes** is also elemental. The government, traditional rulers, civil societies and the scholars have

to engage the general public on a massive community enlightenment campaign to firstly make them aware of the real dangers looming up, clean up the popular misconception of always keeping eyebrows at the government to see to all societal problems and then enroot in them the spirit of putting hands on deck to as a matter urgency confront own problems beforehand.

- **Community-based anti-erosion policies** should also be formed. This is for the community to willingly convene and enact local by-laws binding them against all erosion leading activities and promote environmentally sustainable ways instead to safeguard their shelter from the onslaught of erosion. And also constitute a local taskforce among them to guard/ defend such laws. For instance, to sanction indiscriminate waste disposal around their neighborhood, or proscribe that, whoever from now-on wills to build a house, should also construct drainage in front domain his/her plot, by doing that, all the places will be jointly drained, and the whole of such area would be protected.
- **Gully heads disking and embankments of the eroded areas** could also work out to control the menace. That is to embank all large gullies that are too big to be filled up to halt its further expansion, so that turn the treated channel into excess rain storm collecting duct (to be explicate in next theme)
- **Surface run-off retention and infiltration strategy.** This is to consolidate and reap gains in the fourth method. The government should have all the city drainages connected to bigger treated channels as hinted above to serve as central collecting ducts, where all the discharges from the smaller drainages will be tapped in for onward flow into catchments ditches/pools to be sunk in two strategic locations outside the city (just assumed). So that all the excess flow stored (in the catchment pools) could be utilize to irrigate the surrounding land for dry season farming to booster the economy of the people.

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