

An Empirical Investigation into the Causes, Nature, Impact and Remedy of Soil Erosion in Dakingari Town, Kebbi State, Nigeria

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Abstract:- This research work was carried out to examine the nature of soil erosion menace in Dakingari town with a view to providing a remedy. Objectively, it is to determine the causes and the impact of this menace on socio-economic activities and residential structures. Five research questions were formulated to guide the study in line with the stated objectives of this study. Two null hypotheses were tested at 0.5 level of significance. The research used primary and secondary sources of data including structured questionnaire, interview and library research. Random sampling method was employed to determine the study population. It was established that part of the town has been affected by soil erosion mainly caused by rainfall and wind. The activities of human being were also found to have caused soil erosion including building construction, road constructions, cutting down of trees as well as bush clearing for farming. The erosion had made serious damages on houses and other structures like schools and electricity poles. The types of control measures adopted were stone wall, stone line, stone bonds and sand bags. Local Government Authority also plays vital role in assisting the victims in reducing the menace. It has supplied gravels and sand to the victims together with monetary assistance. It has also constructed culverts and drainages for the easily draining of surface flow during rainfall. It was however recommended that government should construct good drainages system and culverts for proper flowing of water during and after rainfall, Areas where the erosion has just started, gravels should be used to control such erosion to prevent the place from developing into large channels and Government should intensify public enlightenments campaign to educate the people on the danger of soil erosion and its possible control measures among others.

Keywords:- Investigation, Erosion, Soil Erosion, Surface Flow, Remedy, Rainfall, Damages, Wind.

I. INTRODUCTION

Soil can be defined as the process by which soil materials are detached and transported away by such agents of erosion as water, wind and ice, [1]. Soil is permanent resource when it is correctly used, whether to produce crops or to supply other needs to man, but the use of the soil robs it of its fertility and unless this fertility is somehow conserved or replaced [2]. The soil will become useless and the land rendered barren and unable to support crops or plants growth. In other words, there

is a very close link between soil and plant resources. On the one hand, plants depend very largely for their growth on the underlying soil which supports them; while on the other hand, plants protect the soil from erosion [3][4]. This relationship between soil and plant resources is best expressed as soil conservation or to struggle by man to keep soil in continuous use and production it is done by reducing to a minimum the accelerated loss of soil that attends its use for agricultural production and by attempting to reclaim waste or badly ended land [5][7].

Soil erosion is as old as mechanized farming. This is evidenced among other things, by numerous records of conservation work in different countries, particularly in the developed countries and these attempts at conservation are aimed mainly at preventing accelerated soil loss by surface run-off and, to some extent, by wind [8]. The inadequacy of these efforts lies in the fact that the destructive forces themselves were not clearly understood, while little or no attempt was made to improve the farming methods which were the main causes of soil erosion [9].

➤ *Statement of the Problem*

Soil erosion in Dakingari town has become more complex in recent times. This is due to the negligence by the Local Government Authority and the inhabitants of the town. As soil erosion is unchecked, so also the volume of it increases. Soil erosion has not only resulted in the loss of soil organic matter and plant nutrients, but also degraded and damaged the beauty of our environment. For these reasons therefore, it is important to examine both soil erosion and soil conservation in Dakingari town. In Dakingari town, soil erosion is a serious problem today, in which it has affected the agricultural lands and residential buildings. Therefore, proper care is needed to be taken. The cost of reclamation is higher than the value of the land due to the fact that, the reclamation is always difficult and expensive. Areas that are yet to be affected by erosion have to be prevented from erosion, because prevention is better than cure. It is surprising that in spite of the elitist nature of the town, there appears to be no seriousness in the effort to check and conserve the menace of soil erosion.

➤ *Objectives of the Study*

The aim of this research is to examine the nature of soil erosion menace in Dakingari town with a view to providing a remedy. The specific objectives for the study are:

- To examine the factors responsible for soil erosion in Dakingari town

- To identify the nature and extent of soil erosion on residential structures in Dakingari town
- To assess the proper conservation of soil erosion and financial problems in Dakingari town
- To determine the consequences of soil erosion to the people of Dakingari town?
- To offer recommendations in the light of the findings

➤ *Research Question*

The following questions are however formulated for this research in order to provide guidance in the conduct of the research:

- What are the factors leading to soil erosion in Dakingari town?
- What is the nature and extent of soil erosion menace in Dakingari town?
- What is the financial implications of soil erosion in Dakingari town?
- What are the consequences of soil erosion to the people of Dakingari town?
- What are the stabilization measures of solving or reducing the menace of soil erosion in Dakingari town?

➤ *Research Hypotheses*

The hypothesis put forward for testing are:

- H₀₁ That wind is not a major factor causing soil erosion in Dakingari town.
- H₀₂ That the main control measure is not the use of stone line.

➤ *Significance of the Study*

This research becomes necessary because soil erosion is a serious problem in every part of the world. Unfortunately, the rate at which soil erosion is damaging the soil in Dakingari has not received the desired attention. The rate at which soil erosion is being spread suggests that, many people don't know the effect and consequences of erosion. This study will try to explain the menace of soil erosion in Dakingari town. Many people have put forward their ideas to this problem but still there is a need to examine not only the problem but also peoples' perception. It is also imperative to conduct this study not only for its academic quest but to being out useful facts so as to get solution to such problems. Finally, it's hope that this research will add to the existing knowledge of the subject matter and provide room for further research in the area.

II. METHODOLOGY

A. *Historical Background of the Study Area*

Dakingari town was initially a settlement founded by Hodi Jankosai and his followers of both Kabawa and Kyangawa. The name Dakingari is a derivation from Hodi's two rooms; one containing his foodstuff and the other was his sleeping room. Whenever he had guests Hodi used to send them to the former rooms for reception and he called it Dakingari. Another source maintains that Hodi was a hunter who moved out of Birnin Kebbi to avoid Sokoto Jihadists. According to this source, Hodi was very generous and entertained not only his guests at his settlement but all travelers passing through the area. From then people made use

of the word Dakingari to refer to the settlement. Hodi continued to attract people to the area especially after a well was drilled by a Fulani man called Ja'oje and the well is still near Dakingari old market.

The settlement developed into a very big of Kabawa, Gobirawa, Kyangawa and many anti-Caliphates' elements who fled and settled in the area. To avoid attack by the jihadists at the settlement, Hodi went to Zagga and asked for a teacher who would teach his people Islam and Islamic education. The Magajin Zagga granted Hodi's request by sending a *Malam* called Bosu to go to Dakingari and propagate Islam. Bosu taught Islamic religion and education and also served as *Imam* in the area. After the death of Bosu, Boyi Bosu was given the position of *Imam* even though Hodi's eldest son wanted to be one. Boyi served as *Imam* and also became the first Village Head of Dakingari. After Boyi, Mamman Sambo became the *Imam* and the second Village Head of Dakingari village group. This means that, the Kabawa and Kyangawa of the old Kebbi Kingdom were the original inhabitants and founders of Dakingari District. The Fulani of Zagga became the royal families of Dakingari only by an opportunity of being Islamic scholars.

Dakingari is administered by a District Head called Sarkin Kudu, before October 2011, when the District Headship was returned to the indigenous rulers of the area, with the title of Lamido; the title that remains as a nomenclature for the District Head since 2011. The Lamido of Dakingari has authority over the town of Dakingari as well as all the villages and their Village Heads including that of Dakingari itself. He exercised his power through assistances and advices of various officials like Ajuja, Galadima, Magajin Gari, Dangaladima, Marafa and Hakimin Dakingari. He is directly responsible to the Emir of Gwandu who with his approval the Chief could be appointed and deposed.

B. *Geographical Location of the Area.*

Dakingari town lies in the central part of Kebbi State. It is located approximately on latitude 11° 38' 53" North of the equator and longitude of 4° 3' 42" East of the Greenwich Meridian. The town shares boundary with Goron Dutse to the north, Zagga to the south, Aljannare to the west, and Giro to the east. Other major towns that are close to Dakingari are Bunza, Suru, Bagudo, Illo and Kamba.

C. *Climate*

The climate of Dakingari town like all other West Africa towns is largely the result of the interplay of two different air masses: The moist, tropical, maritime air mass from the Atlantic and the dry, continental air mass from the Sahara. The zone where these two air masses converge is known as the Inter-Tropical Discontinuity (ITD). The tropical maritime air mass from the Atlantic signifies the rainy season, while the tropical continental air mass from Sahara signifies the dry season. The length of rainy season in Dakingari is 4 to 5 months. Several months of the year are practically rainless. The mean annual rainfall of Birnin Kebbi is 793mm (31.7inch) according to Abdul et al (1982) which is almost similar to that of Dakingari. The rain begins in the late April and lasts till early October, reaching its peak in August. In the rainy season,

the daily maximum temperatures fall below 90oF (36oC) but at the same time cloudiness and humidity prevent back radiation at night. In the dry season daily maximum temperatures fall below 59oF (17oC). The relative humidity of Dakingari is about 27% and the climate is nearly the same with other Sudan Savannah Zone, it is tropical wet-dry-climate.

D. Vegetation

Dakingari town is situated within the Sudan Savannah vegetation. It is characterized by sparse trees of up to 20ft or more in height. The plain has been subjected to considerable human interference through cultivation, grazing and burning, thereby most of the vegetation has been reduced to acacia scrub of less than 35% of the vegetation cover at Macro-level. Consequently, the grasses and trees are shorter than in the Guinea Savanna Zone. During the long dry season, the grass die off leaving the ground exposed. Trees tend to occur singly and not in groups or clusters. The most common trees found in Dakingari town are baobab trees, neem trees and acacia.

E. Geology and Soils

Dakingari town consist of mainly an ancient crystallize Basement Complex composed of very old volcanic and metamorphic rocks, which dates from pre-Cambrian era. It is under the Gwandu Formation which was deposited as a result of overlain of sedimentary rocks on Basement Complex rocks which took place from the Eocene to the Miocene period. The Gwandu Formation is covered by loose sand and laterite, (Abdul, *et al.*, 2012).

The soil in Dakingari is ferruginous tropical soil and the present materials are crystalline rock of basement complex rich in quartz. A common feature of the soil is its apparent down warp migration (leaching) of the clay within the profile resulting in sandy surface with low organic matter.

F. People and Population

The town was largely people by the Fulani of Jagwadawa and the Borgawa as well as other stock of Hausa. The massive emigration of the Kabawa and Kyangawa to the town was after the fall of Birnin Kebbi to the Sokoto jihadists in 1805. Among the minority groups were also some tribes from Yauri, Zabarmawa, Gimbanawa, Yorubawa and Igbo but Kabawa predominated all these minor groups in the area. Because of many affinities between Hausawa and Fulani, Hausa Fulfulde became the dominant languages in the area but the former, even though foreign, superseded the later. This is because Hausa had become the major means of communication among various ethnic groups in the area. The population of Dakingari town is about 12,558 people according to 2016 population report. The population is still growing and the town is also expanding due to increase in the number of people.

G. Economic Activities of the people in the Area.

The people of Dakingari are largely agriculturist. Agriculture is the mainstay of Dakingari economy and about 90% of the people in Dakingari are farmers. Corn and rice are the common and the dominant agricultural food crops produced in the town. Other important cereals and grains produced are maize, guinea corn, millet and sorghum.

Majority of Fulani in Dakingari are cattle Fulani including the settled Fulani. Both nomads and non-nomads engage in rearing cattle, sheep, goats and camels. Other economic activities of the people also include tailoring, pottery, transportation, hunting, carving and.

H. Types and Source of Data

The types of data comprise both primary and secondary types of which will be used in carrying out this research work. The primary data will be collected from the area of the study through the field work. Secondary data will be obtained through library search.

I. Techniques of Data Collection

These were methods used in collecting the data. The methods include:

- Reconnaissance survey: This served as an initiative for the preparation of the questionnaire and interview. This will necessarily be done with the aim that; efficient data can be gathered which is essential to the achievement of the objective of this research.
- Sampling methods: Random sampling method will be used and the survey will cover 10% of the town. Areas of the study will be selected randomly and the selection will take into account both the old and new sections of the area. 60 households will be selected randomly from the area. This sampling measure will take for fair presentation of the area.
- Questionnaires and interviews: Both questionnaires and interviews are important, for that will assist in getting information from the people in the area selected. Both questionnaires and interviews will be structurally designed, 60 questionnaires will be distributed to both local people and officials working in Dakingari Local Government Secretariat.

J. Techniques of Data Presentation

This will involve statistical presentation and analysis of data that will be collected from the questionnaires and interviews, in order to know what it will make up. The analysis also will involve tabular presentation with frequencies and percentages. To show and reveal analyzed data, bar graphs will be used in presentation of the result.

In testing the hypothesis also, chi-square will be used with the use of chi-square formula:

$$\chi^2 = \frac{\sum(O - E)^2}{E}$$

Where

O	=	observed frequency
E	=	expected frequency
Σ	=	summation

K. Problems with Data Collection

A number of problems may be faced by the researchers in the course of the administering questionnaires and collection of other information. The problems may include the unavailability of topographic and thematic maps of the study area, as well as that of geographic equipment's for field measurements or survey. These may further be compounded

by lack of finance for the execution of the research which was solved by the use of TETFUND grant. Similarly, some government agencies may not be willing to give information required because they regard such information as confidential. Some of the respondents may provide false responses, while some may not even listen to the interviewer. Because they have been answering such questions but appropriate actions are yet to be taken in their areas.

III. RESULT

The results of the data collected from the field via questionnaires were analyzed in the tables below. This is the primary source of data. They were separated into parts with comments and judgments and the interpretation. It gives an immediate translation of the data.

➤ Soil Erosion and Control

Table 1: Erosion observed in the area by the respondents

RESPONDEDNTS	FREQUENCY	%
Yes	43	94%
No	7	6%
Total	50	100

Source: Fieldwork, 2022

Table 1 above shows the percentage of the respondents that say yes that, they observed erosion in the area and those that say no. 94% of the respondents say yes while 6% say no. this implies, that most of the area is affected by erosion.

Table 2: Sources of Erosion

RESPONDEDNTS	FREQUENCY	%
Rainfall	35	70
Wind	10	20
Others	5	10
Total	50	100

Source: Fieldwork, 2022

Table 2 above shows that, 70% of the respondents viewed that the causes of the erosion is as a result of rainfall. The causes by wind also constitute 20% as viewed by some of the respondents, while others constitute 10%. Most of the erosion in the town is gully which is caused by rainfall.

Table 3: Damages done by the Erosion to houses

RESPONDEDNTS	FREQUENCY	%
Yes	30	60%
No	20	40%
Total	50	100

Source: Fieldwork, 2022

In Table 3, the respondents were asked about whether the erosion did any damage to their houses or not. 60% of the respondents said yes while 40% said no. This shows that , the erosion has made a lot damages to the houses. Below is the graphical illustration of the above table.

Table 4: Control measure taken

RESPONDEDNTS	FREQUENCY	%
Yes	37	74%
No	13	26%
Total	50	100

Source: Fieldwork, 2022

The above table shows the percentage of the respondents that said yes or no about whether they take any control measure. 74% of the respondents said yes, while 26% of them said no which implies there are some control measures adopted to subdue the effect of erosion in the community.

Table 5: Types of control measure

RESPONDEDNTS	FREQUENCY	%
Stone wall	8	16
Stone line	12	24
Stone bonds	10	20
Sand bags	20	40
Total	50	100

Source: Fieldwork, 2022

Among the types of control measures in the Table 5 above, the respondents made use of the sand bag most. Sand bags constituted 40% followed by stone line with 24% stone bonds with 20% and the least which is stone wall with 16%.

Table 5: Reclaiming the measures

RESPONDEDNTS	FREQUENCY	%
Yes	35	70%
No	15	30%
Total	50	100

Source: Fieldwork, 2022

In reclaiming the menace of soil erosion, 70% of respondents have been involved in reclaiming the menace, while the rest 30% of them did nothing to reclaim the menace.

Table 7: Any assistance received

RESPONDEDNTS	FREQUENCY	%
Yes	36	72%
No	14	28%
Total	50	100

Source: Fieldwork, 2022

On assistance received, table 7 above shows that, 72% of the respondents said yes, they got assistance. The other 28% also said no, they did not get any assistance. This implies that, most of the victims have been assisted.

Table 8: Contributors of the assistance

RESPONDEDNTS	FREQUENCY	%
Neighbors	18	36
Local Govt. Authority	14	28
Community labour	7	14
Friends	11	22
Others	0	0
Total	50	100

Source: Fieldwork, 2022

Table 8 above show the various contributors that assisted the victims in reducing the menace. The neighbors of the victims assisted most and they constituted 36% Local Government Authority 28%, Community Labour 14%, Friends of the victims 22% and others did not contribute.

O	E	O-e	(O-E) ²	(O-E) ² /E
35	16.6	18.4	338.56	20.3951
10	16.6	-6.6	43.56	2.6241
5	16.6	-11.6	134.56	8.1060
				Σ = 31.1252

Table 9: Sort of Assistance

RESPONDEDNTS	FREQUENCY	%
Monetary	14	28
Cement	7	14
Sand	11	22
Gravels	18	36
Total	50	100

Source: Fieldwork, 2022

The table 9 above shows the sort of assistance received by the victims. Monetary assistance constitutes 28%, cement 14%, sand 22% and lastly gravels 36% which is the highest of the table. The sort of assistance has helped the victims in reducing the menace of soil erosion.

Table 5.10: Role of government on erosion control

RESPONDEDNTS	FREQUENCY	%
Yes	32	64%
No	18	36%
Total	50	100

Source: Fieldwork, 2022

Table 10: above shows the percentage of the respondents that say yes and no on whether the government is doing enough on erosion control. 64% of the respondents say yes while the rest 36% say no. This implies that, the government is doing enough in the control of soil erosion in Dakingari town.

➤ Hypothesis Testing.

From the table below that the major causes of this erosion is not as a result of wind.

Table 11:

RESPONDEDNTS	FREQUENCY	%
Rainfall	35	70%
Wind	10	20%
Others	5	10%
Total	50	100

Source: Fieldwork, 2022

The chi-square methods were used as one row one column alternative with the formula:

$$X^2 = \frac{\sum(O - E)^2}{E}$$

Where O = observed frequency
 E = expected frequency
 Σ = summation

Therefore from the frequency above

$$\frac{\sum \times}{n} = \frac{50}{3} = 16.6$$

df = n-1

Where df = degree of freedom
 n= number of frequency
 df - n 1
 =3 - 1
 =2

Hence X² = 31.1252, that is the calculated value. The official value = 5.99 at 0.05 significance level. Therefore, this implies that, the null hypothesis (Ho) be rejected, hence the chi-square calculated value is greater than the chi-square critical value at 0.05 significant level. Therefore, the alternative hypothesis (H1) is accepted, thus wind is not the main causes of erosion in the area and null hypothesis (Ho) be rejected.

Table 12 That the main control measure is not the use of stone line

RESPONDEDNTS	FREQUENCY	%
Stone	8	16
Stone line	12	24
Stone bonds	10	20
Said bags	20	40
Total	50	100

With the used of the chi-square formula again

$$X^2 = \frac{\sum(O - E)^2}{E}$$

From the above table

$$\frac{\sum \times}{n} = \frac{50}{4} = 12.5$$

O	E	O-e	(O-E) ²	(O-E) ² /E
8	12.5	-4.5	20.5	1.62
12	12.5	-0.5	0.25	0.02
10	12.5	-2.5	6.25	0.5
20	12.5	-7.5	56.25	4.5
				Σ = 6.64

df = n - 1
 df = n - 1
 = 4 - 1
 = 3

Hence X² = 6.64 (calculated value), critical value = 7.82 at 0.05 level of significance. Therefore this implies that the null hypothesis (Ho) is accepted since the chi-square critical value at 0.05 level of significance.

The initial hypotheses are as follows:-

- Ho: That wind is not a major factor causing soil erosion in Dakingari town
- H₁: That the main control measure is not the use of stone line

Thus from the findings above, the following observations are made:

- That part of the town has been affected by soil erosion. The causes of this erosion are mainly rainfall and wind. The activities of human being also have also caused soil erosion such as building construction, road constructions and cutting down of trees and bush clearing for farming.
- The erosion has made serious damages on houses and other structures like schools and electricity poles. Control measures have also been taken in reducing the menace. The types of control measures include stone wall, stone line, stone bonds and sand bags. Most of the victims have engaged in reclaiming the menace with the use of the assistance they received from their neighbours, Local Government Authority, Community labour and friends.
- The sort of assistance includes monetary, cement, sand and gravels. The Local Government Authority also plays vital role in assisting the victims in reducing the menace. It has supplied gravels and sand to the victims together with monetary assistance. It has also constructed culverts and drainages for the easily draining of surface flow during rainfall.

IV. DISCUSSION OF MAJOR FINDINGS

The findings of the research revealed that rainfall and wind are the major physical agents that caused soil erosion in Dakingari town. This is the same with what [10] [11] and [12] have stated in their respective findings as the causes of erosion in Birnin Kebbi, Kangiwa and Zuru respectively. Apart from the physical factors, other human activities have also led to the causes of soil erosion in Dakingari town as stated by [12] in his study of soil erosion in Birnin Kebbi Town. He positioned that, among the human activities that caused soil erosion include bush burning, bush clearing for agricultural production and for collecting firewood. The types of soil erosion in Dakingari town are sheet erosion, rill erosion, and gully erosion. These types of erosion have been observed by [13] as the main types of soil erosion in Kangiwa town. Among the three types of soil erosion in Dakingari town, gully is the most destructive. It has made damages to houses and other structures like schools and electricity poles. This is also the same with what [13] has come out with. The control measures which were used in Zuru town as stated by [11] are gravels, big stones, concrete walls and some walls and grass barriers. Among these measures stone walls and gravels were used in Dakingari town for reducing the menace on rills and sheet wash. The Local Government has helped in reducing the menace in Dakingari unlike Zuru and Kangiwa. But in Birnin Kebbi town both the State and Local Governments have assisted. The government has constructed bridges and culverts in the town and along the river Dukku to control the gullies.

V. SUMMARY OF THE STUDY

Soil erosion as the removal of solid particles of the soil depends upon climatic parameters such as rainfall and wind. The soil in Dakingari town is sandy in nature except areas around the riverside. Rainfall and wind easily act on the soil, wearing away the top soil and collapses some building structures.

The rainfall has produced rills which developed further into gullies due to negligence of the people and government. But later due to the fact that, the gullies have made some damages, both the people in the town and the government participated in reducing the menace.

Human factor is also an important factor on soil erosion. The activities of human being that caused soil erosion in Dakingari town include building construction and road construction. Building construction leads to erosion because some people fetch sand from the fringe of the town.

The types of soil erosion in Dakingari town are mainly rill and gully erosion. The rills and caused by surface run-off during and after rainfall which produce channels of varying size from small channels to big ones. While the gullies were developed by the process whereby the rills developed into deep channels. It has resulted to the total loss of most part of the land in the affected areas. On soil conservation and erosion control, most of the people make use of sand bags. Other methods of controlling the menace which I suggested to be useful are stone lines, stone walls, stone bands, and construction of good drainages and culvert.

VI. RECOMMENDATIONS

As a matter of fact, soil erosion is still destroying most of the areas within Dakingari town. It is better to suggest ways of controlling the menace in the town to be free from that situation.

Therefore, the following endorsements were made from respondents and the researcher:-

- The government is urged to construct good drainages system and culverts for proper flowing of water during and after rainfall.
- Areas where the erosion has just started, gravels can be used to control such erosion to prevent the place from developing into large channels.
- Sand bags are also supposed to be used in controlling rills not to develop into deep gullies
- The people that are fetching sand at the fringe of the town when construction of houses have to stop it.
- Government should mount public enlightenments campaign to educate the people on the danger of soil erosion and its possible control measures.
- The Local Government has to make necessary contacts with the State Government on the issue of projects on erosion control.
- Footpaths that linked Dakingari with surrounding villages developed into rills. Therefore, roads, have to be constructed to link all the villages.

VII. CONCLUSION

The result of the study provided the idea around controlling soil erosion in Dakingari town which is perceived as distant dream. However, there is a great need for government and non-governmental organizations to help victims of the erosion as much as possible to cushion the lost encountered and in reducing the menace. This control measure has to be taken immediately in order to prevent the areas that are yet to be affected.

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