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Measures for Controlling Soil Erosion in Schools Located Along the River Niger in Bayelsa State, Nigeria

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Abstract

The study examined the measures for erosion control in school environment in Bayelsa State Nigeria. Three specific objectives and three research questions guided the study. The study adopted descriptive survey research design. sample for the study comprised 150 respondents, made up of 75 teachers of agriculture and 75 teachers of geography. A 32-item questionnaire, structured on a 4-point response option was used in data collection. The data collected were analyzed using weighted mean score while t-test statistics were used for testing the null hypotheses at 0.05 level of significance. The study found 10 causes, 10 adverse effects and 12 measures for controlling erosion in school environment. There was no significant difference in the mean ratings of the responses of teachers of agriculture and geography teachers on the measures for erosion control in school environment. Based on the findings of this study, researchers recommend that erodible sites near school environment should be piled, and wind-break plants should be cultivated on the windward side of the school environment.

Key words: Control Measures, School, Environment, Erosion, River Niger.

Introduction

Bayelsa State is geographically located in the Southern part of Nigeria, bounded by Delta State on the North, Rivers State on the East and the Atlantic Ocean on the Western and Southern parts. The State is located within latitude 04^{o} 15'' North, 05^{o} 4'' East, with an area of about 21,110 square kilometers (Ekiyor, 2016). Bayelsa state is a lowland maritime area characterized by tidal flood and coastal beaches, beach ridges and flood plains (Etekpe, 2019). There are numerous rivers, creeks and lagoons of varying sizes. It has a tropical climate marked by prolonged wet and short dry seasons. The vegetation comprised of four (4) ecological zones viz: coastal barriers, high forest, mangrove forest, fresh water swamp and lowland rainforest (Steve & Nkasiobi, 2022). Suffice to say that the terrain is swampy with an extensive area of land flooded for most of the year. Hence, crop production is limited to plantain, banana, cocoyam, yam, cassava, oil palm, raffia palm, coconut, pineapple and few vegetables. However, it is equally known that soil erosion is prevalent in most parts of the state (Suwari, 2010). Thus, effective land management, including efficient soil and water conservation measures, such that would negate environmental degradation are required for successful agriculture in the state (Mark, 2020).

Additionally, human activities greatly worsen soil erosion just as sea waves; rainfall or wind action. Erosion is a natural and man-made process in which rocks and soil are broken loose from the earth's surface at one location and moved to another (Osinem, 2005). In the tropics, soil erosion is seen as the washing away of the rich topsoil by such agents as wind or water so that the sub-soil, which cannot support crops is exposed. In the context of this discussion, erosion is the washing away of soil particles and plant nutrients which affects both human activities and crop growth and development by agents of wind and water (Smart, 2022). Soil erosion occurs in several parts of the state under different geologic, climatic and soil conditions. However, the degree of occurrence varies considerably from one part of the

state to another (Azaike, 2020. The incidence of soil erosion in the state is not new, as it has formed a subject for serious consideration since the beginning of the state creation (Ekiyor, 2016). Over the years, various aspects of the phenomenon have been observed and/or studied all over the state. Several communities, for example, located along the River Niger in the study area are adversely affected by soil erosion. Such communities include: Ikolo, Famgbe, Ogbogoro, Tombia-Ekpetiama and Polaku are the hardest hit. In most of these studies, attempts were made to identify the factors and processes of erosion, and to describe the morphology of the erosional features. The factors of soil erosion in Bayelsa State resolve into two components: physical (geologic or "|natural") and anthropogenic (human or "accelerated"). However, a recent study revealed that the human component is often exaggerated while the effects of the physical component are usually underestimated (Ofomata, 2021).

In the view of Ekpebu and Ukpong (2013) soil erosion by water is influenced greatly by precipitation, land slope, soil type, and nature of groundcover and land use. The intensity, duration and frequency of rainfall governs the rate and volume of run-off. A light rain that can be easily absorbed in the soil, causes no run-off and soil loss (Gijo, 2015). When the intensity of rain is more than infiltration, it causes run-off and soil loss. According to Suwari (2017), the speed and the extent of run-off depend on the degree and length of slope of the land. If the land slope is increased, the velocity of the water flowing on the slope is approximately doubled. If the velocity of the run-off water is double, its erosive power is increased because the latter varies as the square of the velocity. Hence the quantity of the material of a given size that can be carried is increased, and the size of the particles that can be transported by pushing or rolling is increased (Adeyemo and Zuofa, 2012). Also, soil structure, texture, organic matter, infiltration and permeability influences the run-off and soil loss. Fine soils are more susceptible to erosion than coarse soils. Gijo (2015) expound that thick mantle of plants reduces erosivity of rainfall and most of the water, either quickly percolates through the soil or move over the surface with non-erosive velocity. While areas without thick vegetative cover are prone to the effects of erosion. Similarly, wind erosion occurs in areas devoid of vegetation, where the wind velocity is high. The finer fertile soil particles are blown away by wind and the subsoil is exposed, as a result, the productive capacity of the soil is considerably reduced. Leaching results in the loss of nutrients such as potassium, calcium, magnesium, and molybdenum and the accumulation of aluminum, hydrogen, iron, manganese, phosphorus and b oron ions which become acidic and toxic to plants (Iniaghe, Tesi & Iniaghe, 2018).

Investigation by Gijo (2015) revealed that these aforementioned factors (precipitation, slope, soil type, nature of ground cover, wind and leaching) had worsened the degree of erosivity in the study area including school environment. For instance, all the schools in each community which are located along the River Niger, are suffering from the adverse effects of erosion; ranging from removal of topsoil together with plant nutrients, ruining farmlands and access roads with ditches, channels and gullies to logging (falling) of planted crops and deroofing of school farm buildings/structures by wind erosion. Consequently, both the effective teaching and learning process and students' academic achievement are grossly affected. This is because both the access roads to the school farms, including the school farm with crops and livestock are eroded off. In such schools, students are thus, denied of acquiring practical skills; culminating into the graduation of "half baked" students into the society that orchestrate crime and criminality. Little wonder Azaike (2022) decried that the Niger Delta region is characterised by youth's restiveness, destruction of crude oil pipelines among others. It was on this promise that Mark (2020) indicted that: clamor for resource control, unemployment, personal needs, paucity of communication, expectations and perception and interpretation were responsible for youth's restiveness in the region. Therefore, it becomes imperative to investigate the causes and measures for controlling erosion in school environment hence this study.

Specifically, the study sought to:

1. identify the causes of erosion
2. ascertain the effects of erosion on school environment; and
3. determine measures for controlling erosion in school environment.

Research Questions

The following research questions were raised to guide the study.

1. What are the causes of erosion?
2. What are the adverse effects of erosion on school environment?
3. What are the measures for controlling erosion in school environment?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the causes of erosion on school environment.

$H0_2$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the adverse effects of erosion on school environment.

$H0_3$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the measures for controlling erosion on school environment.

Methodology

The study was conducted in Bayelsa State, Nigeria. The study adopted a descriptive survey research design. Three specific objectives and three research questions guided the study. The target population for the study comprised all the teachers of agriculture and teachers of geography teaching (SSS) III classes. The rationale for the choice for agricultural science teachers and geography teachers is because they are the respondents that can provide the needed information for the study since erosion control topic is enshrined in both agricultural science and geography syllabus. There are seventy-five (75) teachers of agriculture and seventy-five (75) teachers of geography teaching the Senior Secondary School (SSS) III classes, which are spread across the one hundred and fifty (150) public Senior Secondary Schools in the study area; totaling one hundred and fifty (150) respondents. These one hundred and fifty (150) respondents constituted the target population for the study. The entire 150 respondents constituted the target population for the study. The entire one hundred and fifty (150) respondents were adopted as the sample for the study because of its manageable size, accessibility and well-defined nature; hence the census sample was used.

The instrument for data collection was a 32-item questionnaire, structured on a 4-point response option of Strongly Agree, Agree, Disagree and Strongly Disagree, with corresponding numerical values of 4,3,2 and 1 respectively. The instrument was face-validated by three experts, one in Agricultural Education of the Department of Vocational and Technology Education, one in Measurement and Evaluation in Educational Foundations while the last one in Geography/Environmental Education in same Educational Foundations, all in the Niger Delta University, Bayelsa State, Nigeria. For purposes of determining the internal consistency of the instrument, it was trial tested on eighteen (18) respondents: nine (9) teachers of agriculture and nine (9) teachers of geography in Rivers State, Nigeria who have similar training and work experience in terms of environmental erosion issues. The Cronbach Alpha method was used to determine the internal consistency of the instrument, which yielded a reliability coefficient of 0.78, meaning that the instrument was reliable for the study. Since the instrument was not dichotomously scored and the reliability coefficient was above the acceptable level according to Kline (1999), the instrument was adjudged exceptionally reliable and used for the study.

To ensure quality data collection, seven (7) trained research assistants joined the researcher, totaling eight (8) enumerators to obtain data from the respondents in each of the eight L.G.As; viz: Brass, Ogbia, Nembe, Ekeremor, Sagbama, Kolokuma/Opokuma, Southern Ijaw and Yenagoa. All the one hundred and fifty (150) copies of the questionnaire administered to the respondents were completely filed and returned, which were used for the analysis, representing 100% rate of return. The data collected were analyzed, using weighted mean while the t-test statistics was used for testing the null hypotheses at 0.05 level of significance. A cut-off value of 2.50 on the 4-point rating scale was used to interpret the result as Agree or Disagree. This implied that any questionnaire item with a mean value of 2.50 to 4.00 was considered as Agree while any item with a value of 0.5 to 2.49 was regarded as Disagree. Also, any item with a standard deviation between 0.00 and $\pm$1.96 revealed that the respondents were close to the mean and the opinion of one another, in which case, the item was adjudged valid. In testing the hypothesis, the study upheld hypothesis of no significant difference for any item whose t-calculated value was less than the t-table value at 0.05 level of significance and 148 degrees of freedom.

Results

The results were obtained based on the research questions answered and hypotheses tested.

Research Question 1:

What are the causes of erosion?

$H0_1$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the causes of erosion on school environment.

Table 1: Mean ratings and t-test analysis of the mean responses of teachers of agriculture and teachers of geography on the causes of erosion.

Item No.	Causes of Erosion	Agric teachers		Geography teachers		t-cal	Remarks
		$\overline{X_1}$	SD_1	$\overline{X_2}$	SD_2		
1.	Increased amount of rainfall.	3.10	0.87	3.40	0.69	1.66	NS
2.	Increased amount of surface run-off water.	3.83	0.37	3.82	0.65	0.11	NS
3.	Decreased vegetation cover.	2.62	1.19	2.68	1.33	0.29	NS
4.	Farm mechanization.	2.62	1.19	2.68	1.33	0.29	NS
5.	Action of glacier.	2.98	1.09	2.08	1.08	0.52	NS
6.	Action of wind	3.32	0.73	3.20	0.95	0.81	NS
7.	[Agricultural activities e.g. clean clearing, tillage].	3.60	1.03	3.29	0.82	1.91	NS
8.	Over-grazing	3.10	0.94	3.38	0.69	1.68	NS
9.	Frost action	2.78	1.12	2.92	1.11	0.73	NS
10.	Waves	3.08	0.87	3.11	0.93	0.18	NS
11.	Irregular supply of electricity.	2.67	1.22	2.70	1.20	.16	NS

Key: *$\bar{X}$ = Mean; SD = Standard Deviation; t-cal = Calculated t-value; t-tab = Tabulated t-value ($\pm$1.96); DF = Degrees of Freedom (148); NS = Not Significant; S= Significant.*

Data presented in Table 1 revealed that all the eleven (11) statements had their mean ($\bar{X}$) values ranged from 2.62 to 3.83 and were all above the cut-off point of 2.50. They are, therefore, interpreted as agree. This implied that all the respondents agreed that the eleven (11) statements were causes of erosion in the school environment. The standard deviation values ranged from 0.37 to 1.19 which are below 1.96 showing that the respondents were close to one another in their responses; meaning that the statements were valid. Table 1 show further that all the ten statements had their calculated t-values ranged from 0.11 to 1.91 which were less than the tabulated t-value of $\pm$1.96 with 148 degrees of freedom at 0.05 level of significance. This implied that there was no significant difference in the mean ratings of teachers of agriculture and geography teachers on the causes of erosion in school environment. Thus, the postulated null hypothesis of no significant difference was upheld for all the 11 items.

Research Question 2

What are the adverse effects of erosion on school environment?

$H0_2$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the adverse effects of erosion on school environment.

Table 2: Mean ratings and t-test analysis of the mean responses of teachers of agriculture and teachers of geography on the effects of erosion on school environment.

Item No.	Effects of erosion on school environment	Agric teachers		Geography teachers		t-cal	Remarks
		$\overline{X_1}$	SD_1	$\overline{X_2}$	SD_2		
1.	Soil infertility.	3.68	4.47	3.68	0.47	0.07	NS
2.	Poor soil texture and structure.	3.38	0.49	3.29	0.71	0.90	NS
3.	Destruction of crops through logging.	3.08	0.87	3.11	0.93	0.18	NS
4.	Ditches, channels, gullies caused by erosion ruins farm mechanization.	3.60	0.81	3.53	0.89	0.47	NS
5.	Soil erosion destroys access roads.	3.20	0.76	3.19	0.62	0.06	NS
6.	Deroofing of school buildings.	3.79	0.42	3.78	0.59	0.32	NS
7.	Destruction of farm buildings and farm structures.	3.68	4.47	3.68	0.47	0.07	NS
8.	Pollution of aquatic environment by chemicals from farmland.	3.23	0.98	3.12	0.95	0.95	NS
9.	Destroyed school farm by agents of erosion losses its value, as instructional material.	3.08	0.87	3.11	0.93	0.18	NS
10.	Poor academic achievement in agricultural science due to eroded school farm.	2.73	1.12	2.92	1.11	0.75	NS

Key: *$\bar{X}$ = Mean; SD = Standard Deviation; t-cal = Calculated t-value; t-tab = Tabulated t-value ($\pm$1.96); DF = Degrees of Freedom (148); NS = Not Significant; S= Significant.*

Data presented in Table 2 showed that all the ten (10) statements had their mean ($\bar{X}$) values ranged from 2.73 to 3.79 and were all above the benchmark of 2.50. Hence, they are, interpreted as agree. This implied that all the respondents agreed that the ten (10) statements were adverse effects of erosion on school environment. The standard deviation values ranged from 0.42 to 1.12 which are below 1.96, indicating that the respondents were close to one another in their responses; meaning that the items were valid. Table 2 show further that all the ten statements had their calculated t-values ranged from 0.06 to 0.95 which were less than the tabulated t-value of $\pm$1.96 with 148 degrees of freedom at 0.05 level of significance. This implied that there was no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the adverse effects of erosion on school environment. Thus, the postulated null hypothesis of no significant difference was maintained for all the 10 items.

Research Question 2

What are the measures for erosion control on school environment?

$H0_3$: There is no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the measures for controlling erosion on school environment.

Table 3: Mean ratings and t-test analysis of the mean responses of teachers of agriculture and teachers of geography on the measures for controlling erosion on school environment.

Item No.	Erosion control measures	Agric teachers		Geography teachers		t-cal	Remarks
		$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2		
1.	Contour farming.	3.18	0.87	3.40	0.69	1.68	NS
2.	Ridging land across the slope.	2.98	1.09	2.08	1.08	0.52	NS
3.	Cover cropping	3.32	0.73	3.20	0.95	0.81	NS
4.	Mulching	3.10	0.94	3.38	0.69	1.68	NS
5.	Cultivation of wind-breaks round the campus.	3.10	0.94	3.38	0.69	1.68	NS
6.	Adoption of zero-tillage techniques.	3.63	0.71	3.59	0.69	0.57	NS
7.	Embarking on structural alteration of land.	2.52	1.24	2.39	1.29	0.34	NS
8.	Enforcement of anti-erosion laws.	3.60	1.03	3.29	0.82	1.91	NS
9.	Public enlightenment campaign on the menace of erosion.	3.63	0.71	3.59	0.69	1.68	NS
10.	Piling school erodible sites with solid materials.	3.18	0.87	3.40	0.69	1.68	NS
11.	Terracing	2.98	0.93	2.97	0.85	0.11	NS
12.	Strip cropping.	2.63	1.20	2.69	1.33	0.30	NS

Key: *$\bar{X}$ = Mean; SD = Standard Deviation; t-cal = Calculated t-value; t-tab = Tabulated t-value ($\pm$1.96); DF = Degrees of Freedom (148); NS = Not Significant; S= Significant.*

Data presented in Table 3 shows that all the twelve (12) statements had their mean ($\bar{X}$) values ranged from 2.52 to 3.63 and were all above the cut-off point of 2.50. Therefore, they are interpreted as agree. This implied that all the respondents agreed that the twelve (12) statements were measures for controlling erosion on school environment. The standard deviation values ranged between 0.71 and 1.24, which are below 1.96, indicating that the respondents were close to one another in their responses; meaning that the items were valid. Table 3 further revealed that all the twelve statements had their calculated t-values ranged from 0.11 and 1.91 which were less than the tabulated t-value of $\pm$1.96 with 148 degrees of freedom at 0.05 level of significance. Therefore, this implied that there was no significant difference in the mean ratings of the responses of teachers of agriculture and teachers of geography on the measures for controlling erosion of school environment. Thus, the postulated null hypothesis of no significant difference was maintained for all the 12 items.

Discussion of the Findings

The discussion of the findings of the study followed the order of the research questions. From the analysis of the data in Table 1, the study identified the following causes of erosion on school environment: rainfall, run-off, decreased vegetation cover, farm mechanization, wind, tillage, clean clearing, frost, waves and over-grazing. The findings of this study are in harmony with the report of Suwari (2017) who decried the level of environmental degradation in the Niger Delta region occasioned by soil erosive agents such as rainfall, run-off, agricultural activities and wave action. The findings of the study in Table 1 further revealed that there was no significant difference in the mean ratings of teachers of agriculture and geography teachers on the causes of erosion in school environment. The findings of this study corroborate the works of Ofomata (2001) who opined that the views of teachers of agriculture and teachers of geography are the same because the environment and erosive agents are the same hence significant difference seldom occur or exist between the agricultural and geography teachers in their opinions.

The findings of the study in Table 2 revealed the following effects of erosion on school environment: destruction of access roads, school buildings, farm structures and farm buildings, destruction of school farm and poor students' academic achievement. The findings of the agrees with the report of Mark (2020) who decried on the adverse effects of erosion on school environment. Hence, Osinem (2005) advocated for contour farming, terracing, strip cropping, cover cropping, mulching, wind-breaking, zero tillage technique, enforcement of anti-erosion laws and piling of school erosive areas, as contained in Table 2 of the research work. The findings of the study in Table 2 further revealed that there was no significant difference in the mean responses of teachers of agriculture and geography teachers on the effects of erosion on school environment. The findings of this study are in line with the evidence presented by Ekiyor (2016) who averred that the opinion of teachers of agriculture and geography teachers on the effects of erosion on school environment are synonymous. In furtherance of the above, the study found and advocated twelve (12) measures for controlling erosion of school environment as contained in Table 3. The findings of the study in Table 3 agrees with the report of Aziaki (2022) who maintained that contour farming, strip cropping, terracing, wind breaking, mulching, zero tillage practices, enforcement of anti-erosion laws and piling of school environment, would help control erosion problems in school environment. Table 3 further revealed that there was no significant difference in the mean ratings of teachers of agriculture and geography teachers on the measures for controlling erosion on school environment. The findings of the study confirmed the submission of Etekpe (2019) who stated that the view of the teachers of agriculture and geography teachers concerning erosion control measures of school environment, are one and the same because both are working in same academic environment hence no significant difference in their mean responses of the former and latter (Ofomata & Phil-Eze 2021; Ekpebu & Ukpong, 2013; Adeyemo & Zuofa, 2012).

Conclusion

Erosion menace has degraded academic environments in Bayelsa State which had adversely affected the teaching and learning process. The study therefore, found 11 causes, 10 effects of erosion and 12 measures of controlling erosion on school environment. There was no significant difference in the mean responses of teachers of agriculture and geography teachers on the measures for erosion control in school environment. If the findings of this study therefore, are developed into training manual and packaged for students, teachers, soil scientists, environmentalists and policy makers in the educational sector, it will mitigate the menace of erosion of school campuses and conserve the academic environment for effective teaching and learning process.

Recommendations

Based on its findings and conclusion, the study recommends that:

1. Teachers of agriculture with the help of the students should cultivate wind-break plants on the windward side of the school environment to control wind erosion.
2. The state government through the ministry of education should pile erodible sites in school campuses with solid materials to mitigate erosion.
3. The teacher of agriculture should encourage contour farming, cover cropping, zero tillage, terracing and strip cropping with the students in the school.
4. Anti-erosion laws should be enforced by the government agencies.

5. Public enlightenment campaign on the menace of erosion should be conducted by the government, environmentalists and forestry agents.

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