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Modeling Vulnerability Of Erosion Pattern In Institution Sites In Nigeria: The Auchi Polytechnic Experience

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Abstract: This study investigated awareness level, vulnerability perception and control measures of erosion impact in Auchi Polytechnic as institution site in Nigeria. Structured questionnaire was used to collect data from total sample of 380 respondents. Mean score, factor analysis and regression model were the major statistical techniques adopted in the data analysis. The finding showed that paved (concrete/ tarred) surfaces, lack of erosion control channels, area is waterlogged and soil texture contributed greater percentage of erosion perception vulnerability in Auchi. High rainfall intensity, blockage of drainage, poor drainage system accounted for over 80% perception vulnerability of erosion in Auchi. Build or reinforce wall fencing, use of high quality building materials, Use of sand bags, open and clear drainage, Structural stabilization and Raise building foundation at initial construction contributed to 93.5% structural control measures of erosion damage in Auchi. The model confirmed that the most determinant factor of impact of erosion in Auchi are awareness and structural control measures taken by the people in the polytechnic community during peak of rain fall throughout the year. Vulnerability impacted negatively but significantly on erosion. The study recommended that creating drainage channels to control water and digging of trenches around school compound would help in erosion control; ensuring a safe environment for quality and conducive learning alongside practicing of proper surface or land cover and land scape of the institution site and its environs will add to the beauty of the environment and control erosion menace in the institution.

Keywords: Erosion, model, environment, institution, vulnerability

I. INTRODUCTION

Erosion is classified into two: Geological erosion and man-made erosion, these are the two major classifications of erosion. Therefore, Geological erosion occurs naturally when the distribution of soils is disturbed either through soil formation or soil removal, Sule, *et al.*, (2014). While man-made erosion happens when individuals alter the land formations this can accelerate the natural erosion process. Soil erosion in general terms is a major problem in Agriculture. Tonnes of soil are lost from fields every year. This not only reduces crop production, the soil acts as a pollutant to rivers, lakes, and other water systems. Soil erosion can be controlled with the proper techniques. Soil erosion is thus the weakening of soil by the physical movement of soil particles from an area and deposited in another. Wind, water, ice, animals, and the use of tools by man (anthropogenic) are usually the main causes of soil erosion. It is a natural process which usually

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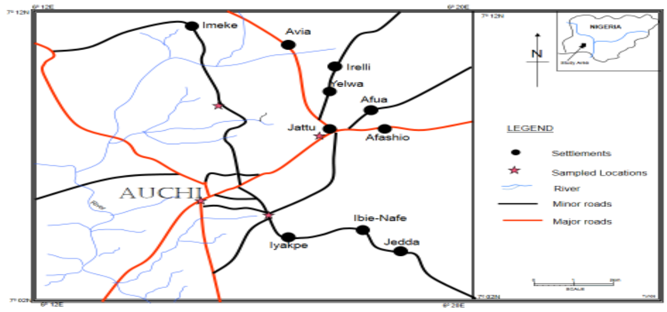
does not cause any major problems. It becomes a problem when human activity causes it to occur much faster than the normal conditions. Soil is the top layer of the earth's surface capable of sustaining life. Thus, soil is very important to man (farmers), who depend on soil to provide abundant, healthy crops each year (Jiang, et al., 2014).

Today, soil erosion is considered as one of the most serious natural resources depletion in the world. Over the year's deforestation, overgrazing and industrialization activities have contributed to the greatest soil erosion problem in the world Zhao, *et al.*, (2014). Furthermore, erosion in the study area is one of the most natural and environmental problem affecting lives and properties, it can be classified into geological erosion and human erosion or animal-induced erosion. The erosion activity in Auchi has pose a threat on lives and properties in the community, the soil in the area is generally a poorly graded and loose unconsolidated soil, thereby susceptible to incidence of soil degradation and erosion, which is being affected by water erosion with predominant gully erosion, resulting to lose of soil nutrients, change in soil structure, chemical leaching and soil degradation, and this decreases the usage and value of land in the area. This effect of erosion in Auchi and its environs is a major environmental problem in the area, more often it pose restriction to building construction and development, to roads and farm land. Erosion in Auchi is accelerated mainly by the undulating relief and sloppy nature of the land form, construction activities, deforestation and failure of the drainage system in the area. Although, erosion is not actually a proven problem worldwide Zhao, *et al.*, (2014) it intensity depends on the magnitude of the agents, the rate of erosion, and the local conditions in the area. In another vein Soil erosion is a naturally occurring process on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss each year in Auchi (Umoru, *et al.*, 2013). Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil (Umoru *et al.*, 2013)

II. LOCATION OF THE STUDY AREA

Auchi Polytechnic is located in Auchi, the Headquarter of Etsako West Local Government Area of Edo State, Nigeria. The area is situated on latitude 7° 04ᴵ N and longitude 6° 15ᴵ E of the Greenwich meridian. The institution is hosted by communities namely Iyekhe Igbe and Ibie. The community is settled in an undulating terrain susceptible to incidence of erosion. The area can be access by the Benin-Abuja express way, Sabogida-Afuze road or through Igarra-Auchi route. Auchi is within the western part of the Country.



Source: Authors

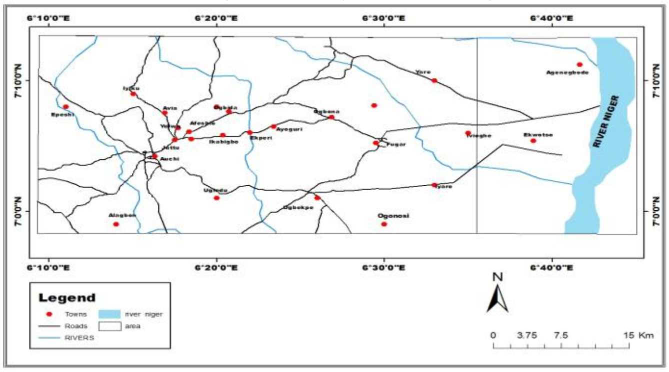
Figure 1: Map of Auchi and its environs showing the sampled (snapshot) locations

III. GEOMORPHOLOGY OF THE STUDY AREA

The area has an undulating relief with a ruggy and sloppy land forms. Auchi have two main seasons, which are rainy season and the dry season. The rainy season spans April to October which is usually heavy. It covers nearly all year round except when there is change or variation in climate, while dry season span from November to March. The type of soil in the area is more of fine sand grains than clay and silt, which is generally poorly graded and loose clayey sandy soil. Within the Avielle axis and Igbira-camp it is more of terrogenous sandstone Auchi is an unlevelled ground surface with few grasses and trees up to a height of about, 6 to 8 metres tall with exceptional trees of about 10 to 12 metres tall.

IV. DRAINAGE SYSTEM

The drainage in the area is of dendritic pattern and some areas with rectangular drainage pattern. The rivers or streams in the area were being drained by the river Niger.



Source: Authors

Figure 2: Map of Auchi and environ showing the drainage pattern from River Niger

Many inevitable consequences will arise if the subject under investigation "Erosional effect in Auchi is ignored or neglected. This study is motivated by glaring total breakdown of access road within and outside the community; threat to industrialization in the community, loss of soil in surrounding buildings which will in turn affect stabilisation, thus causing collapse of buildings and obvious possibilities of turning most part of the community into a dump site, as a result of wastes, and other erosional deposit. The purpose of this work is the modelling erosion vulnerability in Auchi with specific objectives of:

- ✓ determining the effects of socio-economic characteristics of erosion in the study area
- ✓ identifying the major factors of awareness, vulnerability and control measures of erosion
- ✓ developing model to evaluate impact of erosion in institution site in Auchi.

The speed and duration of the wind have a direct relationship to the extent of soil erosion. Ajaero and Mozie (2011).Soil moisture levels can be very low at the surface of excessively drained soils or during periods of drought, thus releasing the particles for transport by wind. This mostly occurs in freezing and drying of the earth surface during winter months. Furthermore, Sule, *et al.*, (2014) stated that very fine particles can be suspended by wind and then transported from one place to another. In the same sense fine and medium size particles can be lifted and deposited, while coarse particles can be blown along the surface. This process is commonly refers to as the saltation effect Ajaero and Mozie (2011).The abrasion that results from the blown up particles can further reduce soil particle size and increase the soil erodibility.

V. EFFECT OF EROSION OCCURRENCE

STREAM AND DITCH

This happens when pressure falls below a certain critical amount, small bubbles of water vapour form and the water foams. As soon as the velocity is decreased by friction against the flow or side of the channel, and so the internal pressure increases again and the form becomes explosively or implosively unstable. Furthers stated that the bubbles then suddenly and violently collapse with the production of shock waves which may shatter the adjoining surface with hammer like blows and by so doing release particles ready to be carried away. This process is called "cavitation" and wherever it occurs, the rate of erosion is greatly sped up. Cavitation accounts for hallows in stream beds, and potholes in our roads.

(a)

(b)

(c)

(d)

Source: Authors

Figure 3: (a, b, c and d) showing gully erosion between Chemical Engineering building and Alumni Building Auchi Polytechnic

ON-SITE EFFECTS

The effects of soil erosion extend beyond the removal of valuable topsoil. Crop emergence, growth and yield are directly affected through the loss of natural nutrients and applied fertilizers with the soil Ajaero and Mozie (2011) stated in their work that seeds and plants can be disturbed or completely removed from the eroded site. Organic matter from the soil, residues and any applied manure, is relatively lightweight and can be readily transported off the field, particularly during rainfall. There are believes that soil quality, structure, stability and texture can be affected by the loss of soil. The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure and even change the texture.

OFF-SITE EFFECTS

Off-site impacts of soil erosion are not always as apparent as the on-site effects. Eroded soil, deposited down slope can inhibit or delay the emergence of seeds, burring small seedling and necessitate replanting in the affected areas. Adekalu (2007) stated that sediment can be deposited on down slope properties and can contribute to road damage. Sediment which reaches streams or watercourses can block drainage ditches and stream channels. The study concluded that pesticides and fertilizers frequently transported along with the eroding soil can contaminate or pollute downstream water sources and recreational areas.

RAINFALL INTENSITY AND SLOPE GRADIENT

Zhao, *et al.*, (2015), conducted a laboratory analysis to determine the effect of rainfall intensity and slope gradient on runoff generation, of sediment yielding, on erosion rate, of red soil slope. Zhao, *et al.*, (2015), simulated rainfall in the laboratory using three slope gradients (5°, 15°, and 25°) which was subjected to seven rainfall intensities (30, 60, 90, 120, 180, 210, and 270 mm/h). Their results shows that runoff generation of red soil slopes was influenced by both the slope angle and rainfall intensity. The results further indicates that runoff rate was in a steady condition after an initial trend of an unsteadily increased with increasing rainfall duration, while it did not increase with the increasing slope gradients, especially under the high rainfall intensity. But sediment yielding of the red soil slope was controlled by the detachment limitation followed by transport limitation under low rainfall intensity. Under low and moderate rainfall intensities, Zhao, *et al.*, (2015), concluded that erosion rate increased with slope angle due to the factors related to slope angle which can also enhance soil detachment and limit the protective effect of surface layer. This is an indication that rainfall intensity and slope gradient enhances erosion activities in the study area.

(a)

(b)

(c)

Source: Authors

Figure 4: (a, b and c) showing gully erosion between school of Art and Design and school of Environmental Auchi Polytechnic, Auchi

EFFECTS OF SLOPE GRADIENT ON SOIL EROSION

Zhang *et al.*, (2015), carried out a study to develop an appropriate plan of land use under suitable slope gradient to control soil erosion by using the GeoWEPP (Geo-spatial Interface for the Water Erosion Prediction Project) model. Zhang *et al.*, (2015), calibrated and validated the model by using monitoring data of the outlet from 2010 to 2012, in which the 2010 and 2012 annual total runoff and sediment yield data were used for calibration, and the 2011 monthly runoff and sediment yield data for validation. They used the model to simulate four typical land use (forest, farm, plantation, and fallow land) in the study area to evaluate their impacts on soil erosion production. Their results showed that the erosion increased with increasing of the slope gradient. Zhang *et al.*, (2015), concludes their study by inferring that good scientific evidence is needed for developing an appropriate plan of land use in erosion prone area.

VI. PREVENTION AND CONTROL OF SOIL EROSION

To prevent and control soil erosion in some parts of Auchi the land need to be covered with vegetation, the roots of the plants and trees interlock and interlace to bind the soil particles together. This helps in two ways:

- ✓ It prevent the soil particles to be carried away by wind or water
- ✓ It prevent free flow of water over the soil which prevent erosion of soil by flowing water

Ajewole and Oni (2010) also recommended in their research, the design and construction of drainage channels to prevent soil loss to surface runoff, proper housing layout, with regular environmental education programmes to sensitise the public.

VEGETATION

The simplest and most natural way to prevent erosion is through vegetation planting. Plants establish root systems, which stabilizes soil and prevents soil erosion. Soil erosion potential is increased if the soil has no or very little vegetative cover of plants and/or crop residues Anejiounu *et al.*, (2013) The plants and residue cover protects the soil from raindrop impact and splash, this tends to slow down the movement of surface runoff and allows excess surface water to infiltrate Adekalu (2007). The erosion reducing effectiveness of plant and/or residue covers depends on the type, extent and quantity of cover. Vegetation and residue combinations that completely cover the soil, and which intercept all falling raindrops at and close to the surface present the most efficient in controlling soil erosion. Adekalu, (2007). Partially incorporated residues and residual roots are also important as these provide channels that allow surface water to move into the soil. The effectiveness of any crop, management system or protective cover also depends on how much protection is available at various periods during the year, relative to the amount of erosive rainfall that falls during these periods Anejiounu *et al.*, (2013).

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Sources: Authors.

Figure 5: Vegetation cover

PLANTING OF STRUCTURAL TREES

Planting of structural trees to further stabilize the land (Thiemann, *et al.,* 2005) suggest a special modification of this is the riparian vegetation that is grown at the interface of any land and water line. The objective is to prevent soils from migrating into water line, or to prevent water from seeping onto the land and carrying the soils away with it. This also helps in the prevention of further erosion (Thiemann, *et al.*, 2005). furthermore, planting of trees in other to control erosion the following must be put into consideration

- ✓ Make sure to plant trees that are native to the area to ensure that they can survive in the climate. (Willow trees, black locust trees and elderberries) are good selections for this purpose, Fiener *et al.,* (2011)
- ✓ Space them so that the entire area under threat will be served by the tree root system

SOIL ERODIBILITY

Soil erodibility is an assessment of the ability of soils to resist erosion, based on the physical characteristics of each soil Thiemann, *et al.,* (2005). Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion (Ezezika and Adetona, 2011). Besides other soil features sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. Decreased infiltration and increased runoff can be a result of compacted subsurface soil layers. This decrease in infiltration can also be caused by a formation of a soil crust, which tends to "seal" the surface. However, a corresponding increase in the amount of runoff water can contribute to greater rill erosion problems.

REDUCING WATER FLOW INTO GULLIES

Gullies are channels of erosion that have deep cut into the earth USDA (2008) reducing the flow of water into gullies, will control erosion, and also allow the surrounding vegetation to flourish USDA (2008) Reducing the amount of water pouring into gullies by addressing the situation at the top of the gully. Once enough topsoil and subsoil has been washed away, there will be no barrier to keep heavy rains from washing away soil. Also in stabilizing the gully channel and banks, this involves the construction of earth embankments with or without rock facing on the gully floors parallel and close to the toes of the gully slopes (Musa *et al.,* 2016). The embankments wedge prevents soil from being detached by flood and rain splash.

VII. METHODOLOGY

Total of 750 questionnaires were randomly administered to participants comprise of students and staff (academic and non-academic). Six hundred and ninety eight (698) were returned but sample of 380 respondents were considered to be appropriate for the analysis. The questionnaire contained five parts with section A focusing on socio-economic characteristics of the respondents. Section B evaluates the awareness of erosion vulnerability. Section **C** is the perception of erosion vulnerability. Section D is the erosion loss control measures and finally section E investigates the impact of erosion evaluation in Auchi. The scale of measurement use in the questionnaire includes nominal (Yes or No), ordinal (in order of magnitude) and interval scale a 5- point Likert scale of 1-strongly not agreed to 5-strongly agreed. Also, a 3- point Likert scale of 1 no impact, 2 little to 3 severe is adopted during the data collection process. The level of reliability test of the research instrument using Cronbach Alpha confirms that the value of correlation was 0.875 which suggests that the research instrument is reliable at 87.5%.

VIII. MODEL SPECIFICATION

The impact of erosion is modelled based on the multiple regression technique containing three predicting variables (awareness level of erosion (AW), vulnerability perception (VE) and control measures of erosion (CM)). Thus, prediction equation of the three dimensions of the erosion factors on impact of erosion in Auchi is as follow:

$$Y = f\left(X_1, X_2, X_3\right) \quad (1)$$

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \varepsilon \quad (2)$$

$$Y = \alpha_0 + \alpha_1 AW + \alpha_2 VE + \alpha_3 CM + \varepsilon \quad (3)$$

Where:

Y = (the dependent variable) Impact of erosion (IME)

α_0 = intercept or regression constant

α_i = the slope, or regression coefficient of each variables.

the independent variables

X_1 = Awareness (AW)

X_2 = Vulnerability perception of erosion (VE)

X_3 = Control measures of erosion (CM)

ε = Error terms assumed to have zero mean and constant variables

Equation (1) is the model of erosion in functional form, equation (2) and (3) represent the model and model specifications.

IX. TECHNIQUES OF DATA ANALYSIS

DESCRIPTIVE ANALYSIS

This was used to assemble all the demographic background data of the respondents such as age, educational status, gender, accommodation type among others. In addition, frequency and percentage method was used to analyze the distribution of data on the assessment of erosion vulnerability.

PEARSON'S CORRELATION COEFFICIENT

Pearson Coefficient Correlation is considered one of the most useful and widely used forms of statistical approaches. The strength and direction of the relationship between two variables are measured using correlation analysis. Pearson's correlation was used to decide the degree of linear relationship between any two of the image variables. It can be used to calculate all summation scores to explore the simple bivariate relationships between variables. According to Pallant, if the Correlation Coefficient value is (+1), it shows that the relationship is positive and strong, and if it is (-1) the relationship is strong but inverse, therefore the Correlation Coefficient should not be more than (+1) and should not be less than (-1), while (0), indicates no relationship, and is either positive or negative. Table 1 shows the directions on how to interpret the Pearson correlation.

Strength of the relationship	r Values
Small correlation	- 0.10 to – 0.29 and + 0.10 to + 0.29
Medium correlation	- 0.30 to – 0.49 and + 0.30 to + 0.49
Large correlation	- 0.50 to – 1.00 and + 0.50 to + 1.00

Source: Cohen Rule of Thumb (1988).

Table1: Cohen's Strength of Relationship between Two Variables

Data collected are analysed using various statistical techniques both descriptive and statistical inference. The descriptive statistics deals with the mean scores of the response to the research questions. The frequency analysis of responses adopted the using simple percentage, mean response score is used for comparing the values of different categories when they are independent of each other.

Methods of Analysis	Formula	Items	Data type/Scale	Analytical Procedure	Package
Simple Percentage Analysis	Frequency of Response*100 total response	Age, Sex, status, Educational Qualification, Accommodation	Nominal, ordinal and interval scale	Electronic method (the use of computer)	Statistical package for the social sciences (SPSS) version 20.0
Factor Analysis	Principal Component Analysis	All the items for assessing erosion in Auchi	Interval scale	Electronic method using computer system	Statistical package for the social sciences (SPSS) version 20.0
One-sample T-test	$t_{cal} = \frac{\bar{X}}{S/\sqrt{n}}$ $\bar{X}$ is the mean score differences of response on the research items, s is the standard deviation and n is sample size. $S/\sqrt{n}$ is the standard error.	Age, Sex, Marital status, Educational Qualification, Religion, Locational information with the assessment of erosion based on the research items	Nominal, ordinal and interval scales	Electronic method using computer system	Statistical package for the social sciences (SPSS) version 20.0
Correlation Analysis	Pearson Product moment method	Reliability measures of the research items for assessing erosion in Auchi	Interval scale	Electronic method using computer system	Statistical package for the social sciences (SPSS) version 20.0

Source: Researcher technique chart, 2016.

Table 2: Summary of process of data Computation

This study used structured questionnaire to gather information from the respondents. Simple frequency, correlation, analysis of variance and multiple regressions were used to interpret the direction of the relationship between dependent variable (Impact of erosion) and independent variables (awareness, vulnerability, control measures and perception) based on the signs (+/-) of the alpha (α) coefficients. If the coefficient of alpha (α) is positive, then the relationship of erosion measures will influence the impact of erosion which will also be positive, if the coefficient of alpha (α) is equal to 0 then there is no relationship between the variables. Alpha (α) less than zero (α <0) implies that negative impact. Thus, the higher the alpha value the greater the impact of independent (exogenous) variables on the dependent (endogenous) variable.

X. RESULTS

The descriptive analysis of the questionnaire distribution and respondents' demographics characteristics were presented.

Demographic and Socio Economic Characteristics	N	Mean Score	Likert Scale Rating	Response selected Option
Age	320	2.19	1	15-25years
Gender of household head	320	1.09	1	Male
Status	320	1.09	1	Student
Educational status	320	3.97	4	Tertiary
How long have been in Auchi?	320	2.20	2	1-3years
What type of accommodation do you have?	320	4.80	5	Flat/Bungalow

Source: Field Survey, 2016

Table 3: Demographic and Socioeconomic Characteristics Analysis of the Respondents

Research Items	N	Mean Difference	Std. Error Mean	t	df	Sig. (2-tailed)
Age	380	2.289	.067	34.394	379	.000
Gender of household head	380	1.095	.029	37.833	379	.000
Marital status	380	1.789	.070	25.394	379	.000
Ethnic group	380	3.742	.116	32.253	379	.000
Educational	380	2.974	.055	53.939	379	.000

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status						
Length of stay	380	1.200	.028	42.878	379	.000
What type of accommodation do you have?	380	2.408	.075	32.232	379	.000

Source: Field Survey, 2016

Table 4: One-Sample Statistics Mean Scores Analysis of Research Items Analysis

DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS

Demographic and socioeconomic characteristics of the respondent on perception analysis of erosion in the study area reveals that the age distribution of the respondents fall within 15-25years of age and the gender of the household are predominantly male with 1-3 years length of stay in Auchi. In addition, most of the respondents have tertiary educational qualifications and they are claimed to have stayed in flat/bungalow type of accommodation (table 3). From the table 4 showing the results of one-sample t-statistic of the research items using structured questionnaire indicates that all the responses to the research items are statistically different as the probability values (p-values) of the associated t-calculated values are 0.000 which are less than 0.01 and 0.05 at 1% and 5% levels of significance with equal degrees of freedom (df=379). Hence, the responses are found to be statistically significant. This finding confirms the worthiness of the research in the study area.

Awareness of Erosion Vulnerability	Extraction
Blockage of drainage	.964
High rainfall intensity	.912
Low land area	.919
Soil type	.947
Soil texture	.931
Paved (concrete/ tarred) surfaces	.611
Poor drainage system	.935
High sediment transportation/ deposition	.883
Velocity of flow	.936
Lack of erosion control channels	.970

Extraction Method: Principal Component Analysis.

Table 5: Factor Analysis of Awareness of Erosion Vulnerability

Erosion vulnerability perception	Component 1
Blockage of drainage	.678
High rainfall intensity	.942
Soil type	.739
Soil texture	.788
Paved (concrete/ tarred) surfaces	.510
Poor drainage system	.881
High sediment transportation/ deposition	.656
Velocity of flow	.683
Lack of erosion control channels	.923

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 6: Erosion vulnerability perception

Structural Erosion Control measures	Component
Build or reinforce wall fencing	.967
The use of high quality building materials	.938
Use of sand bags	.952
Soil texture	.912
Open and clear drainage	.960
Structural stabilization	.970
Raise building foundation at initial construction	.935
Build drainage channels to control water	.890
Digging of trenches around compound	.886

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 7: Structural Erosion Control measures

FACTOR ANALYSIS

Communalities of the factors extractions of awareness of erosion vulnerability analysis in table 5 shows that all the research items of erosion and perception in Auchi are extracted as the eigen values of the Principal Component Analysis values are greater than 0.5. Therefore, all the factors that make up the erosion awareness of the respondents in Auchi are extracted. Many of the factors extracted based on eigen value of greater than 0.5 contributed over 90% awareness of erosion. Paved (concrete/ tarred) surfaces contributed to 60% awareness of erosion vulnerability in Auchi. Two components 1 and 2 of the principal component analysis of the research items of awareness of erosion vulnerability by the respondents in Auchi explained total variation by the 91.7%.

Component rotated matrix in table 6 confirms that lack of flood control channels 92.3%(0.923), Blockage of drainage 67.8%(0.678), Lowering of river bank 76.2%(0.762), Area is waterlogged 79%(0.790), steepness of terrain 73.9%(0.739), High water table 70.2%(0.702), and soil texture 0.78%(0.788) perception of erosion vulnerability among the respondents in Auchi. For component 2, High rainfall intensity contributes 94.2% (0.942), Blockage of drainage 71% (0.710). In addition, soil type (0.633) and Velocity of flow (0.685) contribute over 60% of erosion vulnerability perception while Poor drainage system (0.881) accounts for over 80% perception vulnerability of erosion in Auchi. In table 7, build or reinforce wall fencing is 0.967 (96.7%), use of high quality building materials is 0.938 (93.8%), Use of sand bags is 0.952(95.2%), Open and clear drainage is 0.960(96%), Structural stabilization is 0.970(97%) and Raise building foundation at initial construction accounts for 93.5% (0.935) structural measures of flood damage in Auchi. Build drainage channels to control water contributes 89% (0.890) and Digging of trenches around compound accounts for 88.6% (0.886) erosion vulnerability perception.

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Variables	R	P	Level
Erosion Impact (EI)	--	--	--
Awareness (AW)	0.567**	0 .000	Medium
Vulnerability Perception (EV)	-0.399**	0 .000	Small
Control Measure (CM)	0.436**	0 .048	Medium

*** Correlation is significant at 0.01level (2 tailed)*

Table 8: Correlations of the Measure of Erosion Impact

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.811[a]	.573	-.881	.22084

a. Predictors: (Constant), AW, VE, CM

Table 9: Model Summary

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	0.058	4	0.015	0.298	.031[a]
	Residual	0.098	2	0.049		
	Total	0.156	6			

a. Predictors: (Constant), AW, VE, CM

b. Dependent Variable: IME

Table 10: ANOVA[b]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	-.077	1.025		-.075	.947
AW	.360	.741	.203	.486	.005
VE	-.406	.785	-.445	-.518	.006
CM	.794	1.003	.387	.791	.003

a. Dependent Variable: IME.

Table 11: Coefficients[a]

XI. DISCUSSION OF RESULTS

The data collected was analyzed using Pearson correlation to determine the relationship. The results as shown in Table 4.8 depicted that the measure of impact of erosion in Auchi were found to be; Awareness (AW) (r = 0.567; p =0.000), Vulnerability perception of erosion (EV) (r = 0436; p = 0.048) and control measure (CM) (r = -0.183; p = 0.024). This suggests that variables of structural control measures and awareness of erosion have positive and significant relationship with impact of erosion on Auchi. Vulnerability perception of erosion has negative impact on erosion in Auchi. Therefore, the alternate hypothesis was accepted which states that there is a significant relationship between the dimensions of factors on the erosion (awareness, perception of vulnerability and structural control of erosion) and impact of erosion in Auchi. This suggests that when there is any change to any of these factors, it will have an effect on the impact of erosion in general.

From Table 4.9, it was depicted that the R-square for the model was .373 which implies that the dimensions of the factors (awareness, perception of vulnerability and structural control of erosion) explained about 57.3% of the variance in impact of erosion. Thus, the remaining 62.7% is due to other factors and residuals. Also, the multiple R (R= .811) revealed a significant high relationship between independent variable (awareness, perception of vulnerability and structural control of erosion) and dependent variable.

Table 4.10 indicates that the result of the analysis shows that F value was significant (F= 0.298, p=.861). This shows that the model was valid. Thus, based on the findings it can be concluded that there was a linear relationship between the predictors (awareness, perception of vulnerability and structural control of erosion) and impact of erosion. In comparing the contribution of each independent variable in table 11, beta values are used. As illustrated in the standardized coefficient column, control structural measure (CM) makes the strongest unique contribution to explaining impact of erosion with (β= .387) followed by awarenes (AW) with (β= .363). Vulnerability perception (VE) has negative contribution, (β= -.445) in predicting impact of erosion in Auchi. The outcome of the result indicates that increase in control structural measure and awareness will increase opportunity of the general public to understand the impact of erosion in Auchi. Perception of erosion vulnerability decreases the impact of erosion.

Development of impact of erosion model is one of the key measures of assessing the level erosion of vulnerability, awareness and control measures that can be adopted to ameliorate the scourge of erosion. The findings of dimension of factors that mostly predicts impact of erosion are summarized as follow:

- ✓ There is agreement that perceive factors of erosion in Auchi have significant effect in terms of awareness, perception and control measures.
- ✓ Positive correlation in the strength of medium and small scale exists among of the awareness, perception, control measures and impact of erosion in Auchi.
- ✓ Awareness and control measures impacted positively and significantly on erosion while perception of vulnerability has negative effect on erosion.
- ✓ There is negative economic impact of perception of vulnerability on erosion and also have significant effect on the awareness, age, sex, status, length of stay in Auchi and government efforts.
- ✓ Erosion menace has affected the people of Auchi community in terms of road network, farmland loss, health challenges, and groundwater pollution among others.

XII. CONCLUSION

The present study was conducted on the basis of assessment of factors on the impact of erosion in Auchi and its environs in accordance with the theoretical framework, and the conceptual model of this study, research objectives, and hypothesis predictions were developed in consonance with previous literature that explored the contributions of various constructs towards explaining effects of factors of erosion. The research found out that the most determinant factor of impact of erosion in Auchi are awareness and structural control measures taken by the people in the community during peak of rain fall through the year. Vulnerability impacted negatively but significantly on erosion.

XIII. RECOMMENDATIONS

This study recommends a continual awareness of erosion among the residence of the community through community meetings and interaction as the rain set to effectively utilized the needful structural measures to control erosion impact in Auchi. The creating access road devoid of pot holes which can place restriction on soil transportation to avoid erosion and encroachment tendencies. Also, practicing of proper surface or land cover and land scape of the institution site and its environs will add to the beauty of the environment, and ensuring a safe environment for quality and conducive learning and housing.

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