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DETERMINATION OF THE SOCIO-ECONOMIC IMPACT OF GULLY EROSION IN KURMIN-GWARI SETTLEMENT

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ABSTRACT
Sustainable development is the positive socio-economic change that does not undermine the ecological and social systems upon which communities and social systems are dependent. Land provides services to humans and other life forms as well as providing raw materials in production process. Land provides waste assimilation services as well as other ecosystem functions. The aim of this study is to assess the impact of gully erosion on the residents of Kurmin Gwari settlement, Kaduna State, Nigeria. The study intends to identify the percentage of the residents according to localities that have suffered socially and economically from gully incidents. It also intends to determine the relationship between adverse social and economic effects suffered by the affected people in the various localities of the study area. The Primary sources of data are direct observation from fieldwork and the use of questionnaire, while the secondary sources are topographic map and library materials. Descriptive statistical tools were applied to deal with the techniques of summarizing and describing data collected. Percentages, proportion and mean were applied to get expected frequencies. The result revealed that at Layin Pumpo 65% of respondents are affected by destruction of ancestral homeland by gully erosion. 100% are affected by loss of source of water supply. 72.5% find the gully site frightful. 92.5% experience trauma as a result of gully erosion in the area and 57.5% lost relatives. The study recommended that due to gully erosion and other natural environmental disasters, the need for an integrated environmental planning is paramount.

KEYWORDS: Gully Erosion, Socio-Economic, Impacts, Settlement, Kurmin-Gwari

INTRODUCTION

Soil erosion is caused by a variety of factors such as natural phenomena of neotectonics and paleotectonics, soil/rock features (pedology/geology), wind/water dynamics; and human phenomena such as population density, anthropogenic activities including engihanic effects (Egboka and Nwankwor, 2011). In the execution of colossal or small-scale projects of Industrial or engineering nature, the textural, coherence and plasticity characteristics of the soil are not considered. Irrigation schemes, major road network, small and large dams, urbanization, deforestation, sand and laterite mining are carried out without cognizance of the warnings of environmental experts and/or professionals. Similarly, sensitive drainage areas, wetlands and flood channels are encroached upon by hungry land developers. In view of these activities, sheet, rill and gully erosion are known to progressively develop over several years (Egboka, *et. al.*, 2015 and White, *et. al.*, 2015).

Chemical and physical deterioration of soil have major implication on agricultural productivity and housing development. In Nigeria agricultural production is the most important source of income to the people. Soil quality has a major impact on the capacity of the rural farmers to achieve food security. Soil erosion increment results in an unsustainable development of the living standard of the people (Burtons, *et. al*., 2010 and Egboka; Nwankwor, 2011 and White, *et. al.*, 2015). Sustainable development is the positive socio-economic change that does not undermine the ecological and social systems upon which communities and social systems are dependent. Land provides services to humans and animals, as well as providing raw materials in production process where waste assimilation services as well as other ecosystem functions. It also provides utilities for recreation, health, cultural and ecological cycles and functions.

The removed surface by sheet outwash or overland flow occurs in thin layers during rainfall and flooding. Where rill erosion is observed, soil particles are removed by runoff from small channels or rills that may be parallel to one another or may be connected in a finger like manner. Soils are further eroded from widened flood channels and streams/river banks by channel/bank erosion (Ofomata, 2010; Egboka, *et. al.*, 2016 and Kates, 2012). The large channels and river banks continuously collapse, and the soils eroded away as a result of the instability of the slopes during flooding. The eroded sediments are then transported away to expose new surface areas for more erosion. The competence of the eroded materials renders the transporting flood, streams or rivers brownish or even blood-red in colour, the deepness of the colour signifying the degree of erosion within the watershed (Stocking, 2004; Stocking, 2009 and Sheng, *et. al*., 2011).

Study Area.
Kurmin Gwari is located within Kaduna South Local government Area. It is located between latitude 10^0 20' and 10^0 33'North and longitude 7^0 45' and 7^0 55'East and occupies an area of approximately 453 square kilometer and has a population of 166,562 thousand (NPC, 2006).

Theoretical framework
The Davison theory is the earliest cause and effect-oriented theory on soil erosion. It holds that steep slopes are faster eroded than gentle slopes and that stream or runoff velocities are solely dependent on bed slopes, which got their derivation from this axiom. This law is tantamount to an obvious conclusion by Press, (2010) and Onyegbule, (2015) that the rates of change of landforms as well as other geometric impact magnitudes are functions of local relief. It therefore implies that the progressive changes on the terrain by the effects (impacts) of soil erosion are accepted to be universally associated with a progressive landscape evolution where the geometry of individual landforms and the rate of their erosion changes are both subject to sequential transformation through time.
Interaction Matrix Approach (IMA) has been earlier put forwards by Leopold In Onyegbule, (2015) as the first environmental impact assessment approach. It consists of ten (10) general categories of action on the abscissa or horizontal axis. This consist of about eight hundred and eighty-eight (888) environmental factors or characteristic such as soil, flora and land uses. The vertical axis or ordinate has four (4) general categories with many impact characteristics. There are eight thousand eight hundred (8800) cells (that is 100 x 88) on a full matrix. It is denoted by (M/I) where M is the magnitude of interaction and I is the importance of Interaction (Egboka, *et. al.,* 2015; White, *et. al.,* 2015 and Egboka, *et. al.,* 2016).

Consequently, Kates (2012) concluded that hazard occurrences merely represent the extreme of natural processes and their distributions and in a slightly different context would often be regarded as natural resource. The study is based on this theory.

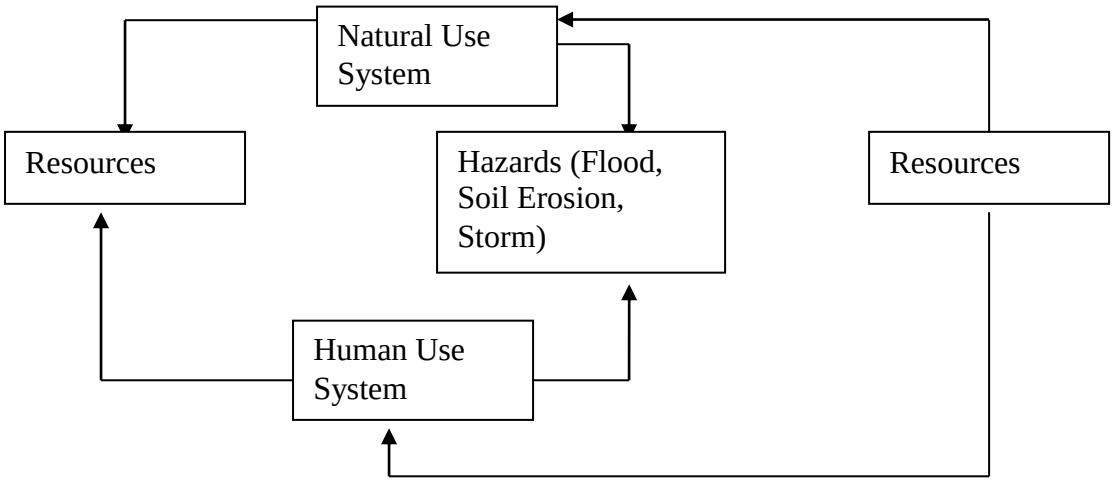

Fig.1: Natural Hazard as an Ecological Framework.
Source: Onyegbule, (2015)

This study is mainly on the assessment of gully erosion effect on the inhabitants of Kurmin Gwari. Burton *et. al.,* (2010) and Egboka, *et. al.,* (2016) utilizes questionnaire as a tool for psychological enquiries into hazards. This will be employed in this study. This model gives man a central role and it is armed with ecological frameworks that involve the use of psychological enquiries.

RESEARCH METHODOLOGY
Sampling Method and Instruments of Data Collection
Simple random sampling was adopted in the course of this research for the purpose of selecting households and respondents affected by gully erosion living at the gully proximate areas. The instrument used in data collection include, observation, questionnaire and measurements.

Table 1: Collation of Questionnaire Instrument.

Gully Erosion Area	Number Distributed	% of the No. Distributed	Number Collected	Percentage (%) Return Rate
LAYIN PUMPO	80	20	80	100
LAYIN KOLTA	80	20	80	100
LAYIN GIDAN SARKI	80	20	78	97.5
LAYIN ASIBITI	80	20	62	77.5
KONAN KASUWA	80	20	72	90.0
TOTAL	**400**	**100**	**372**	**93**

Source: Field Work, 2020

Research Hypotheses

The research questions and objectives translate to the following research hypotheses that are applied to this study.

Ho: There is no significant relationship between the social and the economic impacts of gully erosion in Kurmin-Gwari settlement.

RRSULT AND DISCUSSIONS

Cross Bed Analysis

A total of 30 cross beds were measured at Kurmin Gwari gully site. This was done with the help of Bruton Compass to measure the dip and azimuth of the observed cross beds.

Table 2: Cross Bed Data of Kurmin Gwari Sandstone

S/No.	Azimuth	Dip
1.	N40E	37
2.	N60E	48
3.	N70E	30
4.	N30E	27
5.	N30E	10
6.	N45E	27
7.	N60E	47
8.	N60E	45
9.	N60E	45
10.	N85E	30
11.	N40E	5
12.	N40E	5
13.	N60E	25
14.	N60E	20
15.	N60E	25
16.	N290W	8
17.	N300W	10
18.	N60E	45
19.	N70E	25
20.	N280W	30
21.	N290W	15
22.	N60E	35
23.	N280W	55
24.	N80E	20
25.	N70E	25
26.	N70E	15
27.	N280W	10
28.	N310W	35
29.	N305W	12
30.	N280W	25

Source: Field Survey, 2020

Table 2 shows 30 cross bed azimutal and dip measurements obtained in Kurmin Gwari gully erosion site. The palaeocurrent direction showing a unimodal pattern in a north-east current direction and other supporting evidences can be used to trace the possible source of the Sandstone in the study area. Palaeocurrent study reveals a Northeastern provenance. The general strike direction is N285W, S105E with average dip amount of 35^{o}.

Table 3: Statistical Data for Cross Bed Analysis

Class Interval (30)	Frequency	Frequency (%)	Scale 5:1
30-59	6	20	4
60-89	15	50	10
90-119	-	-	-
120-149	-	-	-
150-179	-	-	-
180.209	-	-	-
210-239	-	-	-
240-269	-	-	-
270-299	6	20	4
300-329	3	10	2
330-359	-	-	-

Source: Field Survey, 2020

The abundance of poorly sorted, sub-rounded quartz grains in the Sandstone of the Kurmin Gwari Sandstone suggest long transportation and weathering in the humid region from the source rock to the place of deposition. The absence of Feldspar and other soil cementing minerals suggests that the Sandstone went through several cycles or recycling deposition and weak, hence its is easily eroded.

Social impacts of Gully Erosion on Kurmin-Gwari Settlement

Table 4 shows the adverse social effects of gully erosion in Kurmin Gwari settlement, At Layin Pumpo 65% of respondents are affected by destruction of ancestral homeland by gully erosion. 100% are affected by loss of source of water supply. 72.5% find the gully site frightful. 92.5% experience trauma as a result of gully erosion in the area and 57.5% lost relatives.

Table 4: Social Impacts of Gully Erosion on Kurmin-Gwari Settlement

Items	Layin Pumpo		Layin Kolta		Layin Gidan Sarki		Layin Asibiti		Konan Kasuwa	
	Resp.	%	Resp.	%	Resp.	%	Resp.	%	Resp.	%
Destruction of ancestral Homeland	52	65.0	57	71.25	5.3	67.95	10	16.13	8	11.11
Loss of source of water supply	80	100	80	100	78	100	62	100	72	100
Frightful scenic environment	58	72.5	55	68.75	56	71.79	43	69.35	50	69.44
Experience of Trauma	74	92.5	72	90.0	71	91.03	55	88.71	65	90.28
Loss of Relatives	46	57.5	52	65.0	40	51.28	36	58.06	32	44.44

Source: Field Survey, 2020

At Layin Kolta 71.25% of respondents constitute those that suffered from destruction of ancestral homeland. 100% comprise those that lost source of water supply. 68% 75% and 90% are those that find the gully sites frightful and those that experienced trauma respectively as a result of gully erosion. 67.95% affected by loss of ancestral homeland in Layin Gidan Sarki, All the respondents are affected by loss of source of water supply, while 71.79% and 91.03% find gully sites frightful and experience trauma respectively. 51.28% lost relatives in Layin Gidan Sarki.

In Layin Asibiti 16.13% agree to have lost ancestral homeland, while 100% of respondents lost sources of water supply. 69.35% find gullies frightful, 88.71% experienced trauma as a result of gully erosion in the area, and 58.06% lost relatives. At Konan Kasuwa, 11.11% are affected by destruction of ancestral homeland, 100% lost source of water. 69.44% are frightened by the erosion, 90.28% experience trauma and 44.44% lost relatives.

Economic impacts of Gully Erosion on Kurmin-Gwari Settlement

Table 4 shows the economic effects of gully in the study area. 38.75%, 30%, 61.54% suffered from loss of building and furniture in Layin Pumpo, Layin Kolta and Layin Gidan Sarki respectively. 92.5%, 87.5%, 80-77%, 24.19% and 11.11% are affected by loss of farmland in Layin Pumpo, Layin Kolta, Layin Gidan Sarki, Layin Asibiti and Konan Kasuwa area respectively.

Table 4: Economic impacts of Gully Erosion on Kurmin-Gwari Settlement

Items	Layin Pumpo		Layin Kolta		Layin Gidan Sarki		Layin Asibiti		Konan Kasuwa	
	Resp.	%	Resp.	%	Resp.	%	Resp.	%	Resp.	%
Loss of building and furniture	31	38.75	24	30.0	48	61.54	-	0	-	0
Loss of farmland	74	92.5	70	87.5	63	80.77	15	24.19	8	11.11
Loss of planted crops	62	77.5	65	81.25	70	89.74	40	64.52	32	44.44
Loss of economic trees	78	97.5	72	90.0	64	82.05	60	96.77	70	97.22
Loss of monetary contributions to	80	100	80	100	78	100	62	100	72	100

Source: Field Survey, 2015

77.5% Respondents in Layin Pumpo suffered from loss of planted crops, and 97.5% lost of economic trees 81.25% and 90% of respondents lost planted crops and economic trees in Layin Kolta respectively. In Layin Gidan Sarki 89.77% lost planted crops and 82.05% lost economic tress while 64.52% and 96.77% suffered the lost of planted crops and economic trees respectively 100% of all respondents from Layin Pumpo, Layin Kolta, Layin Gidan Sarki, Layin Asibiti and Konan Kasuwa lost money as a result of community contribution to gully erosion in the area. In Konan Kasuwa 44.44% lost planted crops and 97.22% lost economic trees

Test of Hypotheses.
Null Hypothesis (Ho) III:
It states that "There is no significant relationship between the socio-economic impact of gully erosion in Kurmin-Gwari settlement".

The third Ho attempts to compare the difference that exists between the adverse socio-economic impacts of gully erosion in Kurmin-Gwari settlement.

Table 5: Pearson's Correlation coefficient

S/No.	1	2	3	4	5
Social Effects of Gully Erosion	180	372	362	337	206
Economic Effects of Gully Erosion	103	230	269	344	372

Source: Researchers Computation, 2020
The correlation analysis computed for the relationship in the extent of the adverse social and economic impacts is 0.2573. The critical values at 0.10 and 0.05 are 1.7638 and 2.353 respectively.

Table 6: Frequency table for correlation coefficient

S/No.	X	Y	X^2	Y^2	XY
1	180	103	32400	10609	18540
2	372	230	138384	52900	85560
3	362	269	131044	72361	97378
4	337	344	113569	118336	115928
5	206	372	42436	138384	76632
Σ	**1457**	**1318**	**457833**	**392590**	**394038**

Source: Researchers Computation, 2020

The decision rule is, reject Ho if the calculated value of chi-square (0.2573) is greater than the critical values at 0.05 which is 2.353, and, also at 0.1 the critical value 1.638. Therefore, Ho is accepted since the calculated value is less than the critical values. Hence it is concluded that "There is no significant relationship between the social and economic impacts of gully erosion in Kurmin- Gwari settlement".

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of the findings:
The study established that there is a significant difference between the social effects of gully erosion and the expected social standard of living. It also established that there is a significant difference between the economic effects suffered by the residents in Kurmin Gwari settlement. The study also established that there is a significant difference between the extent of the social and economic effects of gully erosion in the various localities of Kurmin Gwari settlement.

CONCLUSION
The holistic approach of this assessment process is aimed at bringing to the fore the social and economic effects of gully erosion in the area. The study established that there is a significant difference between the social effects of gully erosion and the normal social situation. It also established that there is a significant difference between the economic effects suffered by the residents in Kurmin Gwari settlement.

The study also established that there is a significant difference between the extent of the social and economic effects of gully erosion in the various localities of Kurmin Gwari settlement. Gully erosion in the study area is seasonal and usually occurs during the wet season. The study area is geologically underlain by unconsolidated Kurmin Gwari Sandstone with steep slopes exacerbated by landslide.

It is evident that gully erosion and landslide are steadily chasing the people away from their land. In most places gully avenge the concerted and drastic control measures it got from the affected people as it deepened and widened thereby, sending many of the people away from their ancestral homes.

Recommendations
The study recommends that Government, Non-Governmental Organizations, Cooperate Organizations, Federal emergency relief agency and spirited individuals should get closer to the affected settings and assist the victims. This requires urgent response.

The study recommends that before engaging in any erosion control measure as some attempts at solving erosion problems have, in fact, precipitated even worse erosion disasters, advocate that well designed soil erosion control method should depends on how well the nature of the erosion problem has been identified, and on the suitability of the selected soil conservation measures.

The study also recommends that low runoff rate and the protective cover of plant litter on the surface of soil can reduce erosion rates, hence, effective reforestation/afforestation of gully erosion prone areas using trees should be encouraged.

REFERENCE

Burtons, I.; Kates, R. W.; AND White, G. F (2010) "The environment as Hazard" Oxford Unv. Press N. Y Pp3-6.

Davis, W. W. (2000)" Environmental impact studies on erosion affected parts, of Boston" geographical essays. Boston. USA, Pp. 77-77.

Egboka, B.C.E. and Nwankwor, G. I. (2011) "The hydrogeological and geotechnical parameters and agents for the expansion of Agulu-Nanka Gully, Anambra State, Nigeira". J. of Afr. Earth Sc., Vol. 3, No. 4, pp. 417-425.

Egboka, B.C.E., Orajaka, I. P. and Nwosu, V. C. (2015) "Redox activities as additional causative factors in generation of gully erosion in Agulu-Nanka area of Nigeria". Science of the Total Environment (STOTEN), Vol. 53, No.3, pp. 217 – 232.

Egboka, B.C.E., Nwankwor, G. I. and Orajaka, I. P. (2016) "Implications of Palaeo-and-Neo-tectonics in gully erosionprone areas of southeastern Nigeria". Natural Hazards Journal, The Netherlands, Vol. 3, No. 31, pp. 219 – 232.

Kates, R. W. (2012) "National hazards in human Ecological prospects Hypothesis and model" Econ. Geog. Vol. 47: Pp 438.

NPC, (2006). Population and Housing Census, 2006. *National Population Commission*, Abuja, Nigeria.

Ofomata, G. E. K. (2000) "Erosion in the rain forest of Nigeria" Paper presented at the annual conference of the Nigeria geographical Association, University of Nigeria, Nsukka.

Onyegbule, P. (2015) "Geophysiographic factors of Agulu-Nanka gully Erosion Southeastern Nigeria" Seminar paper presented to Department of geography, Met and Environmental Management, Nnamdi Azikiwe university, Awka.

Press, F. (2010) "solution to global problems require commitment to change". Geotimes, vol. 35 No. 2, P 7.

Sheng, T. C.; Jackson, J. K.; Krmyenhagen, J.; Nakasthin, N. and Watnapreteep, P. (2011) "Effects of differential strctures on Erosion and run-off" In T. Tangsanchalli and Eggers (eds.) Problems of soil erosion and sedimentation. Southeast Regional symposium. Asian Institute of Technology, Bangkok, Thailand, Pp. 311 – 316.

Stocking, M. A. (2004) "Assessing vegetation cover and management effects" In Lal, R. (eds.) soil erosion research methods St. Lucie Press. Soil and Water Conservation society, Florida Pp. 211 – 232.

Stocking, M. A. (2009) "Examination of the factors controlling gully growth, in De Boodt" in Gabriels, D. (eds.). Assessment of erosion John Wiley and Son London, New York. Pp. 505 –520.

White, A. W.; Bruce, R. R. JR.; Thomas, A. W.; Langdale, G. W. and Perkins, H. F. (2015)" Characterizing productivity of eroded soils in the Southern Piedmont" Erosion and soil productivity. Am. Soc. Of Agric. Engrs. St. Joseph, Michigan Publication No. 8. Pp. 83 – 95.