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AN ASSESSMENT OF THE STATUS OF GULLY EROSION CONTROL MEASURES IN GOMBE METROPOLIS, GOMBE STATE, NIGERIA.

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ABSTRACT

The study assessed the current status of some of gully erosion sites in Gombe Metropolis using some specific objectives which included identifying the length of the controlled and uncontrolled gully erosion sites, identifying the type of control method used. Data for this study were collected through both primary and secondary sources. The primary sources included data collected from the gully sites on the gullies that either fully controlled, partially controlled, or uncontrolled at all, coordinates of each of these gullies were taken from each site for easy identification of gully location, information from relevant agencies such as state ministry of environment, NEWMAP Gombe, and other published materials were used as secondary data in the study. Tables were used to present the results of the study. The study revealed that, engineering control method is the dominant gully erosion control measures in the study area, the study further revealed that the total length of all the gullies under study was 62.64km, this represented about 3.9% of the total area covered by the study area. The length of gully sections controlled out of the total partially controlled gullies at the time of the study was 5.5km representing 8.9% of the total. On the other hand, the total length of gullies tagged fully controlled in the area was 10.4km. This implies that the total length of all the gullies sections fully controlled was 15.9km. This figure represented 25.33% out of the total gully length. The study recommend the need to identify and adopt other effective alternative control method in the study area in order to reduce cost of gully control. The study also recommend the need for government to avoid abandoning control effort half way in order to avoid the failure of the earlier controlled sections due to long neglect which as a result may leads to loss of more resources.

Keywords: Gully, Erosion, control measures, Landuse, status.

INTRODUCTION

Soil erosion remains the world's biggest environmental problem, threatening sustainability of both plant and animal in the world. Over 65 percent of the soil on earth is said to have displayed degradation phenomena as a result of soil erosion, salinity and desertification (Aliyu 2017). Gullies are channels deeper than 30cm that cannot be removed by normal cultivation. They can be spectacular to look at but over time actually lose less soil than sheet and rill erosion (Abdulfatah, Okunlola, and Akande, 2014), which affects several soil functions (food and other biomass production, water storing, filtering and transformation, habitat and gene pool, physical and cultural environment for mankind, and source of raw materials) and hence soil quality. Severe erosion on lands undergoing land-disturbing activities can be reduced if proper control measures are implemented. The timely application of erosion and sediment control measures will minimize the time that the soils are exposed, control runoff, shield the soil from erosive forces, and bind the soils (Georgia Soil and Water Conservation Commission, 2000). Today, soil erosion is one of the major environmental degradation in the developing world (Ananda and Herath, 2003). United Nations (UN) convention to combat land degradation (CCD) opines that soil erosion automatically results in reduction or loss of the biological and economic productivity and complexity of terrestrial ecosystems (Claassen, 2004). Erosion is



one of the surface processes that sculpture the earth's landscape and constitutes one of the global environmental problems. Soil erosion is perhaps the most serious mechanism of land degradation in the tropics. However, gully is visually the most impressive of all types of erosion (Abdulfatah, Okunlola, and Akande, 2014).

In Nigeria, many areas experience soil erosion but this is particularly serious in the southeastern part of the country, such as in Anambra State where Agulu, Nanka and Oko communities are areas that erosion has impacted most (Abdulfatah, et al., 2014). Mainly because the soil are predominantly sandy and usually have low organic matter status (Aliyu, 2017). However, threat to soil is not peculiar to South-Eastern part of Nigeria only, but also the Northern part particularly North Central states like Niger, Benue and Kogi, and North east region especially in Gombe State (Adewuyi, 2014). Some of the factors responsible for soil erosion in the north include urbanization, deforestation, and dug out pit created from soil mining activities (Adewuyi, 2014).

The most effective tool in controlling erosion is site planning which includes planning and installation of erosion and sediment control practices. Standards and specifications for such practices which can be utilized on areas undergoing land-disturbing activities can be applied. These standards were developed to establish state-wide uniformity in selection, design, review, approval, installation and maintenance of conservation practices. The commission established minimum requirements for planning, designing and installing the practices on disturbed areas (GSWCC, 2000).

Gully erosion control measures are usually grouped into agronomic and engineering. Agronomical control method provides the soil with physical protection against scour and in slowing down the velocity of flow by increasing the hydraulic resistance of the channel (Lal, 1988 as cited in Amongabara 2012). While that of engineering method involves the engineering design of structures to control runoff and gully erosion in the field where biological control practices alone are insufficient to reduce gully erosion to permissible levels. Therefore, for effective erosion control, a combination of these measures must be employed. Alternates may be approved for individual gully and sediment control plans. In general, they fall into the rather broad categories of structural practices and vegetative measures (GSWCC, 2000).

The incidents of gully have caused much concern to successive governments of Gombe state and other stakeholders where concerted efforts of control were taken each year. Various methods adopted by government and residents of Gombe metropolis in gully erosion control measures include engineering, tree planting or vegetation, stone wall, sand bag and diversion of runoff. However, the control has not kept pace with rate of gully expansion or growth, as some of these measures have been fully or partially successful while others have failed, partly due to inadequate fund to adopt holistic method of control that may involve the combination of both or single methods of Engineering/mechanical, vegetative/biological as well as stone/gabion method that stand the test of time (Mbaya, 2017).

studies conducted in Gombe Metropolis on erosion control by the Ministry of Environment in 2003 on the yearly physical assessment of gully situation after each rainy season shows that the total length of gully within the metropolis is about 121.5km, out of this only 5.6km in length have been controlled while 7.62km have been partially controlled leaving about 107.3km still uncontrolled, State Economic Empowerment Development and Strategy (2006) in Mbaya (2017). Comparing the result of the manually digitized gully and ground truth measurements in 2016 shows that most of the previous uncontrolled or partially checked gullies have increased in length to 131.02 km as against the 121.50 km in 2003. This represent an increase of 9.72 km (7.42 %) over the 13 years period or about 75 meters annual increase in gully length, despite various control measures taken by previous and current government (Mbaya, 2017).

This study attempted to assess the current status of gullies in the study area and to determine the percentages of gully controlled and uncontrolled as well as the type of control measures currently practicing in gully erosion control in the study area. This could be achieved using the objectives that included: determining the current status of gully control measures in the area, identification the control method adopted in gully control as well as suggest recommendation based on the study findings.

MATERIALS AND METHODS

The Study Area.

Gombe Metropolis is located between latitude $10^{\circ} 14' 30''\text{N}$ to $10^{\circ} 20' 30''\text{N}$ and longitude $11^{\circ} 7'\text{E}$ and $11^{\circ} 14'\text{E}$. It has a common boundary with Akko LGA in the south and west; Yamaltu-Deba to the east and Kwami to the north, as a metropolis. The metropolis occupied a total land mass of about 45Km^2 (Ibrahim and Jauro 2016). According to Gombe State of Ministry of Environment (2021), there were about two hundred (200) active gullies in Gombe State, seventeen (17) of which are active out of about 30 most prominent gully sites and are distributed cutting across different land use areas such as residential, educational, commercial, as well as agriculture in the metropolis. The study further showed that gully erosion is most prevalent in the southern part of Gombe metropolis, which is characterized by high slope values, this was attributed to the fact that the southern part of Gombe metropolis is dominated by hills and uneven terrain.

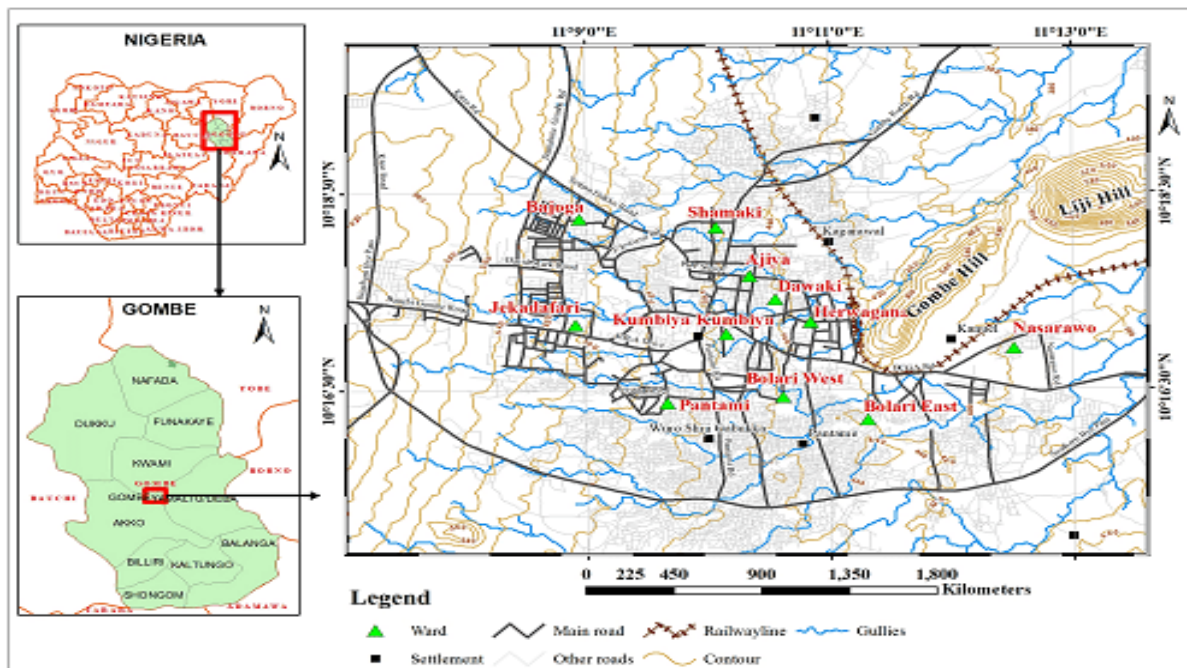


Figure 1: Map of Gombe Metropolis
Source: GIS Map Services (2022).

METHODS

The sources of data for this study was derived from researcher constructed data commonly called primary data and documented sources otherwise referred to as secondary sources of data. The primary data includes data obtained from the gully sites on the sections of gullies that are partially or fully (length of partially and fully controlled gullies obtained through field measurement and ground truthing exercise) in order to validate the data obtained from State Ministry of Environment, classification and analysis of satellite image, to give a view of the gully partially, fully or uncontrolled, using Arc GIS.



Secondary data included relevant information on the subject matter, reports and documents that are related to the selected gullies such as list of active gully erosion in the study area, list of gully erosion under control with percentage control level as well as other relevant literature that may be extracted from published and unpublished sources. Purposive sampling was used to determine the sampled gullies used for this study. Data collected were analyzed using description statistics. Descriptive statistics were used in presenting the results of the study.

RESULT AND DISCUSSION

This section discussed the results of this study on the status of gullies under control measures in attempt to achieve the research objectives. The status of these gullies are categorised into partially, fully controlled as well as uncontrolled and are presented in table 1. Table 1 and figure 2 presented the result of the analysis of the status of some of the gully erosion sections that are under controlled in the study area and the method adopted in controlling them.

According to Gombe state Ministry of Environment (2021), the total length of major gully erosion sites in the study area was sixty two thousand, six hundred and thirty nine Meters (62,639m) which is equivalent to 62.6km, out of which, total length of gully sections under control measures were twenty thousand and ninety meters (20,090M) (Table 1) with mean value of one thousand five hundred and forty five point four Meters (1545.4M). Out of this figure, about 10,357 metres were fully controlled while 5,514.1 were partially controlled. This give a total of fifteen thousand eight hundred and seventy one meters (15871M) with mean value of (1220.8) that were controlled while sections covering four thousand two hundred and nineteen meters (4219M) are partially uncontrolled as at the time of this study. This represented 9.9% of the total uncontrolled gullies. Ground truthing conducted during field work (2023) on these gullies indicated that the control effort terminated half way and with low effort made to complete them, hence led to collapse of the controlled parts with exception of Bello Sabonkudi Bridge and Aliyu Modibbo road where rehabilitation work was carried out in order to re-controlled the earlier failed section of the gully that destroyed due to flooding. For example, the mummy market-Abubakar Umar Primary School Army Barrack was 65% completed with 35% of still uncontrolled, this earlier controlled part began to fail again due to long period of neglect in completing the control project. The implication of this is that, the slow face in the implementation of the control measures caused the previously control section to fail which may continue to threaten properties along the catchment and increases the cost of the gully control.

Table 1 and Figure 2 presented the analysis of the fully control gully sections in the study area. The result show that the total length of fifteen thousand eight hundred and seventy one meters (15,871M) (15.9KM) has been fully controlled with 100% completion level. Further analysis of Table 1 indicated that length of gullies controlled in all the area under study was fifteen thousand eight hundred and seventy one meters (15,871M) out of the total gully length of sixty two thousand six hundred and thirty nine meters (62,639M) while the total uncontrolled gully sections under study was 46,768M (46.8KM) out of the total 62, 639 Representing about 25.33% for controlled gully sites and 74.66% for the uncontrolled gully sites respectively.

The implication of this study is that gully control effort in the study area is still slow, looking at the level of control so far carried out in the study area (25.33%), this slow effort might be due to the control method adopted and the cost of implementing it. This agreed with other Studies such as that conducted by Mbaya (2017), Meseret et al (undated), Amangabara (2014), and Li (1992) whom also suggested an alternative and cheaper gully control measures such as use of vegetation and forest planting as well as need for landscape design to be adopted as an alternative to gully prevention and control as revealed by study conducted by Igwe, Chinedu, Nlem, Nwezi & Ezekwu (2018). Mbaya (2017) further stated that in Gombe Metropolis,

vegetation method was used mostly through community effort and mostly at informal level in the study area. Most of the areas where vegetation method was used are found to be low income and sub urban areas where gully erosion menace is devastating and government intervention in terms of engineering method did not reached.

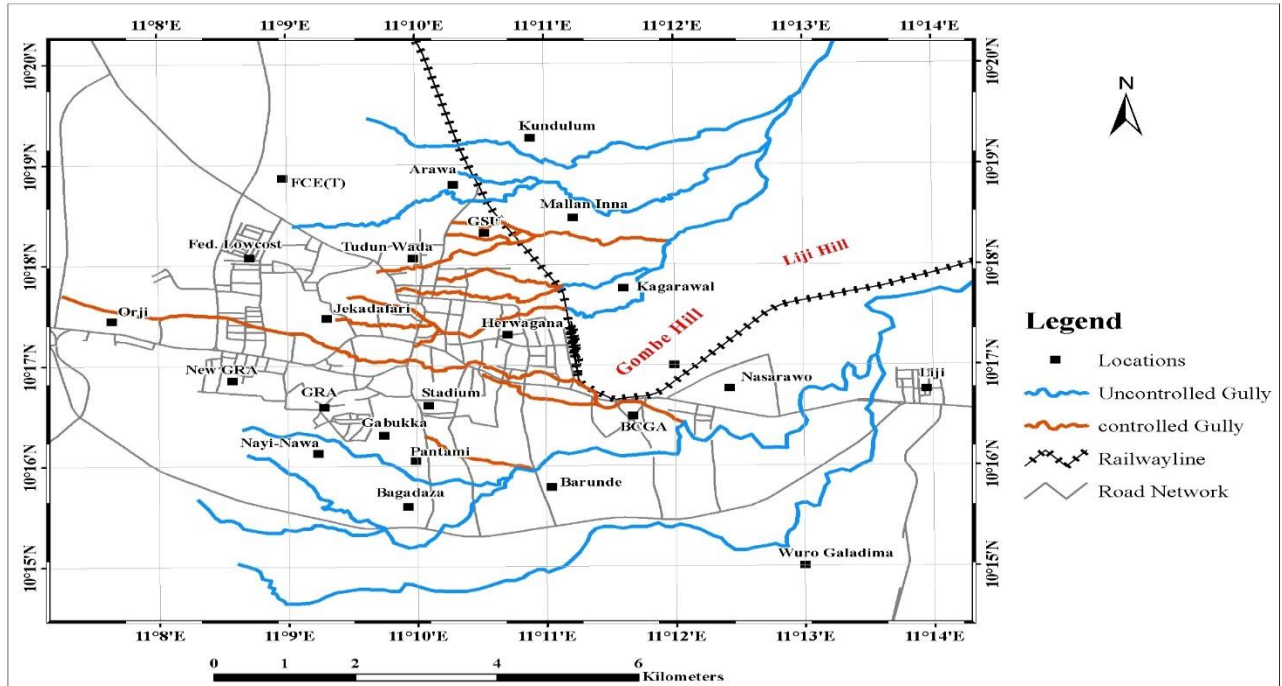


Figure 2: Image showing the controlled and uncontrolled gully site

Source: GIS Map Services (2023).



Table 1: Status of Gully Erosion Control and Type of Control Measures

S/N	Gully Site	Total Length (M)	Length Control (M)	Percentage	Length Uncontrolled	Percentage	Type of Control	Coordinate
1	London mai Dorawa to G.S.U	1,625	503.8	31	1117.2	69	Engineering	Lat. 10°18'10.02''N Long. 11°9'38.44''E
2	Behind Joy Academy -Buba Shongo	502	251	50	251	50	Engineering	Lat. 10°17'32.31''N Long. 11°8'50.72''E
3	Makwalla Darazawa Junction- Sani Labaran House	605	102	17	503	83	Engineering	Lat. 10°17'11.65''N Long. 11°9'58.67''E
4	Mammy Market- Abubakar Umar Memorial Pri. Sch. Army Barrack	485	315.3	65	169.7	35	Engineering	Lat. 10°16'26.93''N Long. 11°10'54.32''E
5	FRSC Office New GRA- Tula Road, behind former quarters	2,246	561.5	25	1684.5	75	Engineering	Lat. 10°16'51.55''N Long. 11°8'58.72''E
6	Herwagana Modibbo-Railway	1,920	1728	90	192	10	Engineering	Lat. 10°17'19.86''N Long. 11°10'13.95''E
7	Kasuwan Shanu-Tudunwada Pri. Sch.	1,100	990	90	110	10	Engineering	Lat. 10°17'57.06''N Long. 11°9'47.45''E
8	Pantami-barunde-madaki-Doma phase II	1,250	1062.5	85	187.5	15	Engineering	Lat. 10°16'38.31''N Long. 11°11'38.42''E
9	Nassarawo Phase A and B	957	957	100	0	0	Engineering	N/A
10	Wuro Bundu-Tumfure	560	560	100	0	0	Engineering	Lat. 10°17'27.18''N Long. 11°6'6.85''E
11	Pantami-Barunde-Madaki-Doma phase I	890	890	100	0	0	Engineering	Lat. 10°16'29.54''N Long. 11°10'6.02''E
12	Herwagana Primary School	250	250	100	0	0	Engineering	Lat. 10°17'7.49''N Long. 11°10'36.80''E
13	G.S.U-Mallam Inna-Kagarawal	7700	7700	100	0	0	Engineering	Lat. 10°18'6.92''N Long. 11°10'16.244''E
Total		20090	15871		5514			
Mean		1545.4	1220.8		424.2			

Source: Researcher Constructed (2023).



CONCLUSION AND RECOMMENDATION

Conclusion

The result of the study indicated that majority of the gully sections in the study area are still uncontrolled, the status of gully erosion in the study area indicated the fully and partially controlled gullies. Some gullies identified are fully controlled with 100% completion level while others are partially controlled and are at various completion level. The dominant gully controlled method adopted in the study area is the engineering method as seen in all the gully sites under control.

Recommendation

- a) The study recommends the need for government to avoid abandoning control effort halfway in order to avoid the failure of the earlier controlled sections due to long neglect which as a result may leads to loss of more resources.
- b) Gombe metropolis being located naturally in lowland; there is need for holistic approach in watershed management for effective gully control effort.
- c) Government at all level should speed up the gully control effort by allocating more resources for an alternative gully control method that are relatively cheaper and effective.
- d) There is need for communities around these gully erosion sites to be sensitized and encouraged about the need for community effort in developing local gully control strategies and prevention of waste disposal inside the gullies.
- e) Government should leverage on more resources from funding/donor agencies, borrowers such as World Bank, African Development Bank, Islamic Development Bank as well as draw more resources from the ecological fund in order to effectively control more gullies and tame their expansion, and ease the burden and threat they pose on the nearby communities.



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