

Assessing the Impact of Gully Erosion on Soil Fertility in Ankpa Local Government Area of Kogi State

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Abstract

This study explores the impact of gully erosion on soil fertility in Ankpa Local Government Area, Kogi State, Nigeria. A systematic sampling procedure was employed, involving composite soil samples collected at varying depths (0 – 15 cm, 15 – 30 cm, and 30 – 45 cm). Physical and chemical analyses were conducted on these samples, and statistical analysis, utilizing the coefficient of variation (CV), was applied to the data. Results revealed that sand fractions dominated the surface horizons in all pedons studied, ranging from 74.10% to 80.60%. Silt content showed irregular accumulation down the profile depth, ranging from 5.00% to 6.00%. Clay content, ranging from 14.40% to 20.40%, decreased down the profile depth, indicating potential illuviation and pedoturbation processes. Bulk density values within the rooting zone were optimal for plant production. Particle size distribution suggested that the studied soils fell within the sandy loam textural class, except for one profile identified as sandy clay loam. Soil pH (H₂O) and pH (KCl) indicated highly acidic conditions. Organic carbon content was critically low, and total nitrogen levels were also critically low according to fertility ratings. Available phosphorus ranged from low to moderate levels, while calcium dominated the exchange complexes. Magnesium levels were high, potentially contributing to unstable soil structural arrangements. Potassium content was categorized as moderate, while sodium content was rated moderate with implications for soil fertility. Cation Exchange Capacity (CEC) was moderate, reflecting the general low organic matter content in the soil series. Base saturation indicated high values, suggesting minimal leaching of plant nutrients. In conclusion, the study identifies the complex interplay of soil properties affected by gully erosion, emphasizing the need for targeted interventions to improve soil fertility.

Keywords: Gully Erosion, Soil Fertility, Soil Properties, Erosion Control, Particle Size Distribution.

Introduction

Gully erosion is a process whereby runoff water accumulates over short periods and removes the soil to considerable depths (Poesena et al., 2003). Globally, about 1.1 billion ha of land is affected by erosion (Pathak et al., 2006). It is estimated that 80% of degradation on agricultural land has soil erosion (Shahrivar and Christopher., 2012). Erosion by water is a primary agent of soil degradation at the global scale, affecting about 1094 million hectares, or roughly 56% of the land experiencing human induced degradation (Nasri et al., 2009).

The United Nations Environmental Program reported that crop productivity is reduced by about 20 million ha/year due to soil erosion and degradation (Lim et al., 2005). In Iran, soil erosion rates in agricultural lands vary between 7.6 and 32 ton/ha/yr. and 4.3-22 ton/ha/yr in rangelands (Samani et al., 2009). Research conducted in Imo, Abia and Anambra States, Nigeria shows that gully erosion generates between 4.2 and 10 m³/ha/year of sediments, which constitute about 45-90% of sediment is from agriculture (Ogbonna et al., 2011). Gully erosion contributes to 50% to 80% of overall sediment production in drylands (Ogbonna et al., 2011). Global sediment yields constitute 12.1 in Ethiopia, 3.4 Kenya, 32 Niger, 16.1 Portugal, 64.9 Spain and 36.8 ton/ha/yr in the USA (Frankl, 2012), hence affecting large areas that could have been put to productive use.

According to Van-Camp et al., (2004) soil erosion is 6.7 million ha in Romania, 4.8 million ha in Bulgaria, Poland and 4.7 million ha in Poland and 3.8 million ha in Hungary. Current rates of soil erosion documented in Ethiopia range from 16-300 tons/ha/year (Itanna et al., 2011). Soil loss of more than 1 t/ha/yr is irreversible at 50-100 years (Van-Camp et al., 2004). In Africa 29 million ha of land has gullies (Pathak Et al., 2006). It is estimated that cultivated and degraded land generates 10-20 times More runoff than do forests; thus, expanding cultivation can accelerate soil

Degradation unless the land is well managed (Moges et al., 2009). Gully development is believed to spread from upslope to downslope, and the rate of soil loss has been estimated to range from 11 to 30 t/ha/yr in Ethiopia (Moges et al., 2009) through Gully erosion. According to Kodi wo et al., (2013), 23 and 8 percent of the total land Area in Kenya is severely and very severely degraded respectively. Gully erosion is More often linked to the vulnerability of the landscape and the land use/cover changes (Frankl et al., 2011).

The driving forces of soil erosion are physical, ecological, social and economic (Van- Camp et al., 2004). Soil erosion is driven by the forces of climate (energy of wind and Rainfall), and also when vegetation and upper soil horizons have their storage and Regulation functions impaired or diminished under the influence of human actions. Pollution, cultivation and land leveling lead to loss of the capacity of the soil and its Ecosystem. According to Van-Camp et al., (2004) the driving forces for erosion Include land use changes such as change in scale and intensity, abandonment, and Desertification, forest fires, land levelling and soil displacement by tillage, climate Change (change in frequency and magnitude of events). Therefore, the identification of Driving forces in gully erosion is important for effective rehabilitation. Socioeconomic variables are important determinants of soil erosion, since human Actions are drivers of erosion processes. Most soil erosion studies do not take into Account socioeconomic factors of soil erosion (Udayakumara, et al., 2010), and this Aspect therefore needs to be investigated. This is because of the ongoing argument on Whether natural resources are best managed by the people who use or by governments (Udayakumara, et al., 2010). However, consideration of community member's Perception is essential when making decisions on gully rehabilitation. If there was More awareness and concern by government and local communities on loss of capital and future opportunities

(Van-Camp et al., 2004), then every effort would be put in Addressing the driving forces on fragile lands. Some of the driving forces have been studied and reveal strong increases in gully Erosion as a consequence of land use changes, in combination with extreme rainfall events and further induced by socio-economic changes. In Ethiopia erosion is estimated to range from 1,248 -23,400 million ha per year from 78 million ha of Pasture and range lands and cultivated fields (Itanna et al., 2011). The organic matter Loss is 15-1000 kg/ha/year which amounted to 1.17-78 million ha of organic matter lost Per year from cultivated and grazing lands in Ethiopia (Itanna et al., 2011). According to Titilola et al., (2008), soil loss through erosion prompted by poor land use practices could be as much as 15 tons per hectare per year on a bare ploughed soil in Western Nigeria. About 850,000 hectares of land are badly affected annually or rendered useless for agricultural purposes and human settlement (Titilola et al., 2008).

Therefore, the consequences of soil erosion are severe and every effort should be put to prevent it.

Gullies are in soils subjected to loess, (North America, European belt, Chinese Loess Plateau) and sandy soils such as the ones that are dominant in the study area, hence further accelerating the driving forces and pressures of gully erosion. Therefore, the rate of Gully erosion depends on the gradient of the gully channel, soil characteristics, size and Shape of the gully and drainage (Geyik, 1986). Gully erosion studies are concerned with Off-site impacts. Exploitation of land resources in upper catchments results in sediment yield and nutrient loads in runoff, thus affecting downstream users (Poesena et al., 2003), hence the need to study the effects of gully erosion on communities.

Statement of Research Problem

Gully erosion poses a significant threat to soil fertility and agricultural productivity in Ankpa Local Government Area of Kogi State, Nigeria. Despite previous studies such as Umoru et al. (2015) which focused on the geotechnical aspects of gully erosion in the area, there remains a gap in understanding the specific impact of gully erosion on soil fertility in Ankpa. This study seeks to address this gap by assessing the impact of gully erosion on soil fertility in Ankpa Local Government Area, Kogi State, with the aim of providing valuable insights for sustainable land management and agricultural practices in the region.

Objectives of the study

- i. To characterize the physical properties of soil affected by gully erosion, including texture, structure, and porosity.
- ii. To assess the chemical properties of soil affected by gully erosion, including pH, organic matter content, and nutrient levels.
- iii. To recommend soil management practices to improve soil fertility and mitigate the impact of gully erosion in Ankpa Local Government Area.

Research Questions

- i. What are the physical properties (texture, structure, porosity) of soil affected by gully erosion in Ankpa Local Government Area?
- ii. What are the chemical properties (pH, organic matter content, nutrient levels) of soil affected by gully erosion in Ankpa Local Government Area?
- iii. What soil management practices can be recommended to improve soil fertility and mitigate the impact of gully erosion in Ankpa Local Government Area?

Study Area

Ankpa is a Local Government Area in the Eastern part of Kogi State, Nigeria. The people are predominantly Igala speaking. Farming and trading are the major occupations of the people. Ankpa LGA lies between longitude 7°36'E to 7°39' E and latitude 07°23' N to 07°26' N (Figure 3.1). Ankpa has an area of 1,200km² and a population of 267,353 at the 2006 census (Ishaka, 2012).

Ankpa falls within the Anambra Basin whose genesis has been linked with the development of the Niger Delta Miogeosyncline and the opening of the Benue Trough, Murat (1972). The stratigraphy comprises of cyclic sedimentary sequence that started in the early Cretaceous time, Reyment (1965), Marine and fluvial sediments comprising friable to poorly cemented sands, shales, clays and limestone were deposited, with occasional coal, peat and thin discontinuous seams of lignite.

Ankpa LGA falls within the Nigeria meteorological zone that is characterized by warm temperature days and moderately cool nights. Two distinct climatic divisions are demarcated as the dry and rainy seasons representing two broad periods of significant but contrasting variations of weather parameters. The area has warm Tropical Savanna Climate with clearly marked wet and dry seasons (Ali, 2010). Rainfall is well distributed and is of double maxima (Iloje, 1972). The amount of rainfall ranges between 1,000mm to 1,750mm. Temperature is moderately high throughout the year, averaging 25°C. The maximum temperature of the area lies between 29.70°C – 35.60°C while the minimum temperature ranges between 23.30°C and 25.20°C (Ali, 2010).

The climate of the area is thus affected by two main air masses: the tropical maritime, MT and the tropical continental, CT. Rainfall is heavy within the rainy months with an average of about 1500 – 2000mm annually, (Ocholi, 2007).

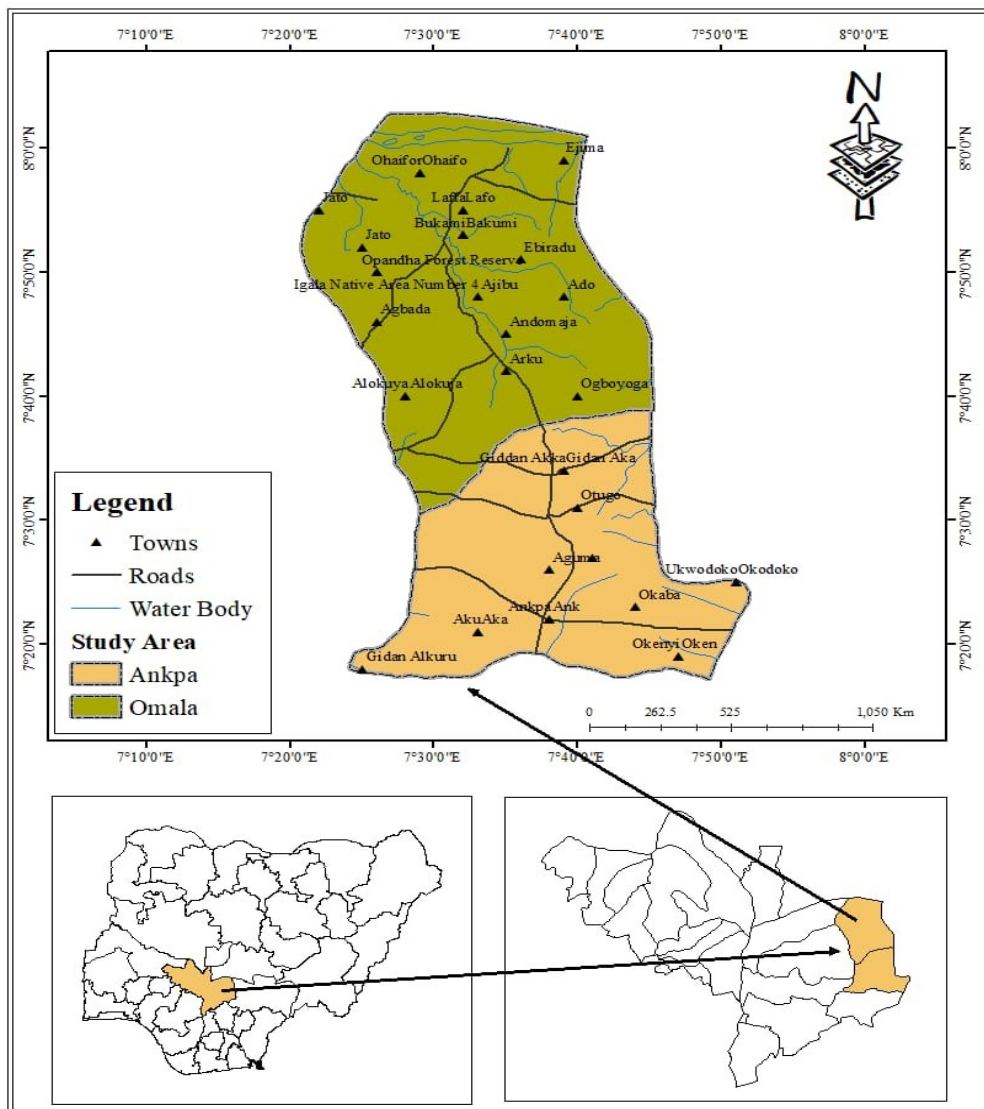


Fig 1.1: Map of the Study Area

Source: QGIS (Authors Analysis)

Materials and Methods

Sampling Procedure

One method of sampling collection was achieved in the study area, namely; composite soil sampling at varying depths of 0 – 15 cm, 15 – 30 cm and 30 – 45 cm. The samples were characterized, crushed, air-dried and sieved in a 2 mm sieve for laboratory physical and chemical analysis. Data obtained from the analysis were subjected to statistical analysis, using coefficient of variation (CV).

Laboratory analysis was undertaken on the collected samples for their physical and chemical properties as described in Table 1.1.

Table 1.1: Test and standard specification for soil fertility analysis of retrieved samples

Property Class (Col. 1)	Specific Soil Property (Col. 2)	Standard Test Specification (Col. 3)
Physical properties	Particle size distribution: Percentage sand, Percentage silt and Percentage clay	Bouyoucous hydrometer method
	Moisture content	Gravimetric method
	Textural classification	Soil textural triangle calculator
	Bulk density	Core method
Chemical properties	pH	1:2.5 Soil-liquid (KCl water) ratio
	Total exchangeable acidity: Aluminum and Hydrogen	Extraction and titration method
	Cation exchangeable capacity	1 M ammonium acetate (NH ₄ OAC) saturation method
	Base saturation	Summation of NH ₄ OAC extractable base + 1 M KCl extractable method
	Exchangeable bases: Calcium, Magnesium, Potassium and Sodium	Neutral ammonium acetate method and flame photometer for Na and K.
	Total Nitrogen	Micro-Kjedahl digestion technique method
	Phosphorus	Bray No.2 method

Method of Data Analysis

statistical analyses such as descriptive statistics and also the coefficient of variation were undertaken to establish significant agreement by comparing with recommended standards in order to determine the effectiveness of the nutrients within the investigated soils and the necessity of fertilizer application to boost soil fertility and plant growth.

Discussion of Results

Results of the physical properties presented in Table 1.2 revealed that sand fraction recorded higher level on the surface horizons over the sub-surface horizons in all the studied

pedons. Mean percentage of sand ranged from 74.10 - 80.60%, with low significant variation across the treatment means of soils of the gully locations. Also considering the pedons investigated, percentage sand proportion were found highest (80.60%) at Ogaji water-works pedogenic area. The dominance of sand in the varied gully locations is attributable to the similarity of climate and parent materials in which the soils are formed and as such implies higher percolation and infiltration of water and nutrients in the soils of the study area.

Silt was the least aggregate fraction among the soils studied with irregular accumulation trend down the profile depth. Its content and distribution in the gully affected soils ranged from 5.00 – 6.00 % and they varied significantly across the treatment means. Lower silt content recorded in the gully locations is probably due to washing away of its particles by erosional processes. However, the effect of silt to overall soil fertility cannot be overlooked, since studies have reported that silt fractions are important in retaining limited nutrients and holds onto water.

Clay content (14.40 – 20.40 %) was next to sand in terms of dominance in the gully areas, but unlike sand, clay decreases down the profile depth with significant variations across the treatment means of the soils. The higher clay content observed in the subsurface horizons of the studied soils may be attributed to illuviation and pedoturbation processes. Studies have shown that clay have large surface area by virtue of its small size. It is the most active mineral that aids in the aggregation of primary soil particles and ensure stability of such aggregate (Idoga, 1985). Therefore, the relatively high clay content of the studied soils showed that the soils will have good water and nutrient retention potentials, if properly managed.

Bulk density values showed no significant ($p=0.05$) variations across the gully areas. These low variations across the gully areas point to the similarity in mineralogy, clay content and structural development. The mean values of bulk density ranged from 1.19 – 1.38 g/cm³ for the soils of the gully locations studied. Bulk density values between 1.7 and 1.8 g/cm³ for sandy soils and between 1.45 and 1.65 g/cm³ for clayey soil have been shown to inhibit root growth (Veighmeyer and Hendrison, 1948). As can be confirmed from Table 1.2, the bulk density values within the rooting zone in the studied soils are optimal for good plant production.

The major textural classes of soil are defined by the percentage of sand, silt and clay obtained from the soil particle size analysis. A mixture of sand, silt and clay particles that exhibit the properties of those separate in about equal proportions are considered as loamy (Brady and Weil, 1999). However, a loam in which sand and clay is dominant is classified sandy loam, sandy, loamy sands, sandy clay, clay loam and sandy clay loam. It is therefore suggested from the result of particle size distribution (Table 1.2) that the soils of the study area fell within sandy loam textural class with an exception of Profile 3, which is sandy clay loam (Figure 1.2a & b). This textural classification of the studied areas, however implied that the soil erosion in the areas may be as a result of the function of flood erosivity and soil

erodibility factors, and this is supported by Gosh and Maji (2011), whose findings indicated that medium and coarse particle are more easily detached from the soil mass, therefore more erodible.

The table 1.3 shows that the soil pH (H₂O) of Ankpa gully affected soils were classified very strongly acidic. Mean values ranged from 4.53 – 5.24, with low significant variation across the treatment means. Similarly, pH (KCl) were from 3.94 – 4.25 reaction level, and these value ranges, fell within the scale of extremely acidity. The implication of the obtained soil reaction levels was that the soil of the study area is highly acidic owing to the prevalent high temperature and rainfall in the humid tropical region which Ankpa is part of, coupled with continuous erosional processes and higher leaching and eluviation of soluble salts from the topsoil to the subsoil (Rahman, 1992). To ameliorate the toxic levels of this acidity therefore, soil amendment with liming materials should be applied within the gully areas to bring the pH values to a preferred (5.5 – 7.0) range optimum for most plants as reported by Landon (1991).

Ferruginous soils common in the tropics are characterized by low organic carbon content. Hence, the soil organic carbon as distributed (0.27 – 0.52%) across the gully areas were rated critically low (<1 %) in line with fertility rating according to Esu (1991). Similar low carbon content had been reported by Sim (1990), and this could be due to rapid decomposition and mineralization of organic matter under high temperature and moisture condition (Olowolafe and Kazeem, 2007).

The mean Total Nitrogen for the soils of the gully locations under investigation varied from 0.02 – 0.05 g/kg. Comparing the values recorded, it was observed that the mean total nitrogen was critically low (<0.1 g/kg) according to fertility rating of Esu (1991). Studies have shown that low total nitrogen is a common phenomenon in the soils of humid and sub-humid tropical regions, which is a result of high nitrogen losses occurring in these soils through the leaching of nitrates, as well as the rapid mineralization of organic matter under the iso-hyperthermic soil temperature regime (Eshett, 1987; Eshet et al., 1990). It is therefore suggested that the key to reducing nitrogen cost is to reduce nitrogen losses through appropriate agronomic practices.

Content and distribution of available phosphorous had low and moderate significant variation across the treatment means of the gully affected soils. Mean values were 7.04, 8.12, 6.65, 6.18 and 7.10 (mg/kg) for the various pedogenic areas respectively. These values were low and translates low phosphorous in the soil series. Ayuba (1992) observed that, the Nigerian savannah is characterized by low phosphorous, probably due to its fixation as Al and Fe phosphate. There is need to set up phosphorous level in this prone gully sites to meet the demand for phosphorous, more especially when planting local provenance and exotic plants in checking gully erosion in the study area.

Calcium moderately (2.43 – 2.84) dominated the exchange complexes of the soil studied. It has been reported that Ca usually dominates the exchange sites of most soils with Mg, K,

NH₃ and Na having lower concentrations (Enloe et al., 2006). The reason could be due to in-situ weathering of parent materials rich in Ca-bearing feldspars.

The soil magnesium level across the studied position is rated high (>1.0) with no significant variation across them. This high level of magnesium proves the unstable soil structural arrangement in the gully site, because studies have shown that soils with high magnesium tends to have poor structure and also tends to inhibit potassium (K) uptake by plant.

Potassium content of the soils were categorized moderate (0.21 - 0.40 Cmol/kg) with low significant variation across the treatment means and some few exceptions that varied significantly. This result implies that potassium is not a constraint to the fertility of the area, but however, needs to be improved upon to counter the inhibiting effects of the higher magnesium content of the soils.

There was no significant variation ($p=0.01$) in the sodium content of the soils studied. Mean values across pedons ranged from 0.20 – 0.22 Cmol/kg and accordingly was rated moderate in line with soil fertility rating (Esu, 1991). This means any further increase on sodium ion concentration of the soil will have negative effect on soil fertility and hence retard the growth of plant such as vetiver and carpet grass etc. regarded as the most effective bioremediation plant species for the control of gully erosion because of their affordability, accessibility and adaptability.

Cation Exchange Capacity (CEC) is the overall assessment of the fertility of a soil and the values depend on pH (Brady and Weil, 1999). The CEC of the studied soil is rated medium or moderate with average mean values between 6.01 and 7.18 Cmol/kg with low significant variation across them respectively. This therefore implies that the overall amount of CEC in the study sites is moderate. These moderate CEC values of soils in the study areas largely reflect the general low organic matter content in the soil series. The predominant clay mineral, kaolinite in all the soil series, probably has low capacity to absorb nutrient cations of CEC.

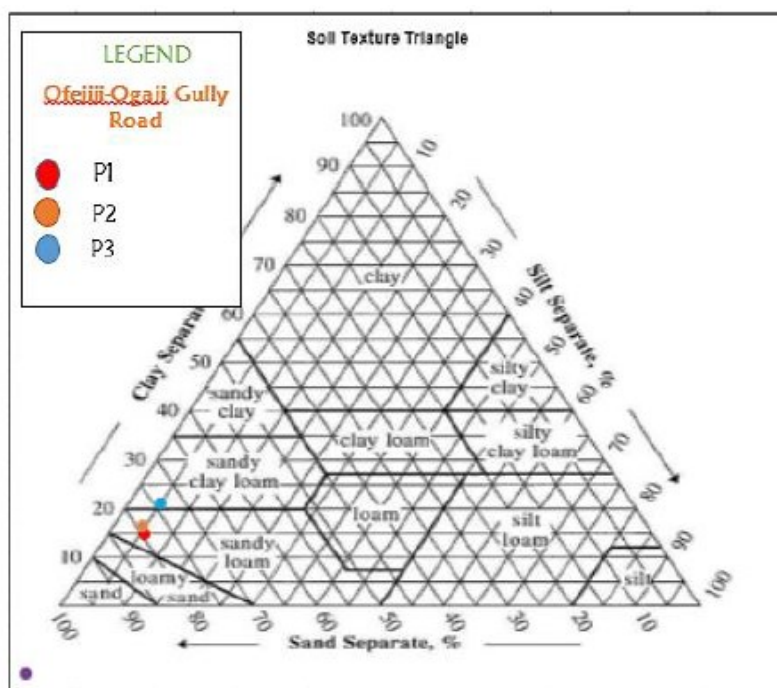
Base saturation (BS) recorded low significant variation among the soils under different gully locations. Mean values of these soils were from 88.15 to 93.01 % and these values implied a high base saturation of these soils. It's also an indication that leaching of plant nutrient was minimal in these soils (Lawal et al., 2012). Atofarati et al. (2012) described medium to high percentage base saturation to reflect the dominance of basic cations in the exchange complexes of the soil.

Table 1.2: Results of physical properties of soils investigated for soil fertility

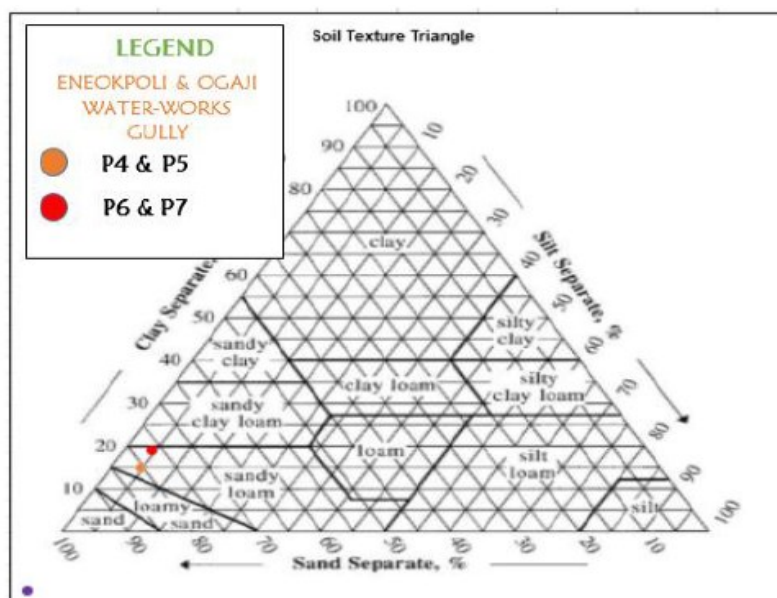
Ofejiji-Ogaji Gully Road						
Profile/sampling No.	Descriptive	Sand (%)	Silt (%)	Clay (%)	Textural Class	Bulk density (g cm⁻³)
P ₁ (Main-Gully)	Mean	79.62	6.00	14.40	SL	1.38
	S.D	6.03	2.45	5.83		0.11
	CV	7.57	40.82	40.49		7.97
	Ranking	L.V	W.V	W.V		L.V
P ₂ (Main-Gully Finger)	Mean	79.10	5.00	15.90	SL	1.31
	S.D	2.96	3.00	5.72		0.14
	CV	3.74	60.00	35.99		10.68
	Ranking	L.V	W.V	W.V		L.V
P ₃ (Main-Gully)	Mean	74.10	5.50	20.40	SCL	1.19
	S.D	2.18	2.60	3.16		0.03
	CV	2.94	47.24	15.50		2.52
	Ranking	L.V	W.V	M.V		L.V
Eneokpoli Gully						
P ₄ &P ₅	Mean	76.60	5.00	18.40	SL	1.28
	S.D	1.00	.00	2.00		0.02
	CV	1.31	20.00	10.87		1.56
	Ranking	L.V	M.V	L.V		L.V
Ogaji Water-works Gully						
P ₆ &P ₇	Mean	80.60	5.00	14.40	SL	1.33
	S.D	7.00	1.00	6.00		0.16
	CV	8.68	0.00	41.67		12.03
	Ranking	L.V	M.V	W.V		L.V

Source: Field work, 2023

SL = Sandy loam, LS = Loamy sand, S = Sandy, SCL = Sandy clay loam, S.D = Standard deviation, C.V = Coefficient of variation, L.V = Low Variation, M.V = Moderate Variation, W.V = Wide Variation



(a)



(b)

Fig 1.2a & b: USDA Soil Textural Classification

Table 1.3: Test summary results of soil chemical properties

Ofejiji-Ogaji Gully Road													
Profile/sampling No.	Descriptive	pH		OC (%)	OM (%)	T.N (g/kg)	Avail. P (mg/kg)	Ca ⁺⁺	Mg ⁺⁺	K ⁺	Na ⁺	CEC	B.S (%)
		H ₂ O	KCl										
P ₁ (Main-Gully)	Mean	4.67	4.05	0.52	0.90	0.05	7.04	2.68	2.72	0.22	0.20	6.55	88.21
	S.D	0.32	0.09	0.12	0.21	0.01	0.56	0.20	0.11	0.02	0.02	0.34	4.54
	CV	6.74	2.19	23.93	26.73	31.14	7.90	7.49	4.21	8.63	8.10	5.21	5.15
	Ranking	L.V	L.V	M.V	M.V	M.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V
P ₂ (Main-Gully Finger)	Mean	4.53	3.94	0.27	0.46	0.02	8.12	2.70	2.62	0.40	0.20	6.21	92.03
	S.D	0.11	0.11	0.11	0.18	0.01	1.60	0.20	0.24	0.30	0.01	0.49	2.75
	CV	2.38	2.90	39.71	39.60	48.43	19.68	7.36	9.07	75.32	6.58	7.87	2.98
	Ranking	L.V	L.V	W.V	W.V	W.V	M.V	L.V	L.V	W.V	L.V	L.V	L.V
P ₃ (Main-Gully)	Mean	4.84	4.05	0.30	0.52	0.03	6.65	2.84	3.02	0.25	0.22	7.18	88.15
	S.D	0.40	0.06	0.10	0.18	0.01	0.92	0.28	0.25	0.01	0.01	0.47	4.50
	CV	8.25	1.57	34.96	35.01	30.15	12.83	9.90	8.31	3.35	5.97	6.60	5.10
	Ranking	L.V	L.V	M.V	W.V	M.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V
Eneokpoli Gully													
P ₄ &P ₅	Mean	5.24	4.25	0.30	0.51	0.03	6.18	2.43	2.38	0.21	0.20	6.01	86.71
	S.D	0.10	0.22	0.09	0.15	0.005	1.60	0.06	0.03	0.01	0.005	0.06	1.53
	CV	1.91	5.06	28.81	29.41	20.00	19.68	2.47	1.26	7.32	2.56	1.00	1.77
	Ranking	L.V	L.V	M.V	M.V	M.V	M.V	L.V	L.V	L.V	L.V	L.V	L.V

Ogaji Water-works Gully													
P6&P7	Mean	4.95	4.06	0.49	0.84	0.04	7.10	2.74	2.81	0.25	0.21	6.44	93.01
	S.D	0.07	0.06	0.03	0.04	0.00	0.10	0.06	0.06	0.01	0.005	0.07	0.86
	CV	1.52	1.48	5.15	4.76	0.00	1.41	2.38	1.96	2.04	2.44	1.09	0.92
	Ranking	L.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V	L.V

Source: Field work, 2023

OC= Organic carbon, OM = Organic matter, T.N = Total Nitrogen, Ca++ = Calcium, Mg++ = Magnesium, K+ = Potassium, Na+ = Sodium, CEC = Cation exchange capacity, BS = Base saturation and P = Phosphorous, C.V = Coefficient of variation, S.D = Standard deviation, L.V = Low Variation, M.V = Moderate Variation, W.V = Wide Variation

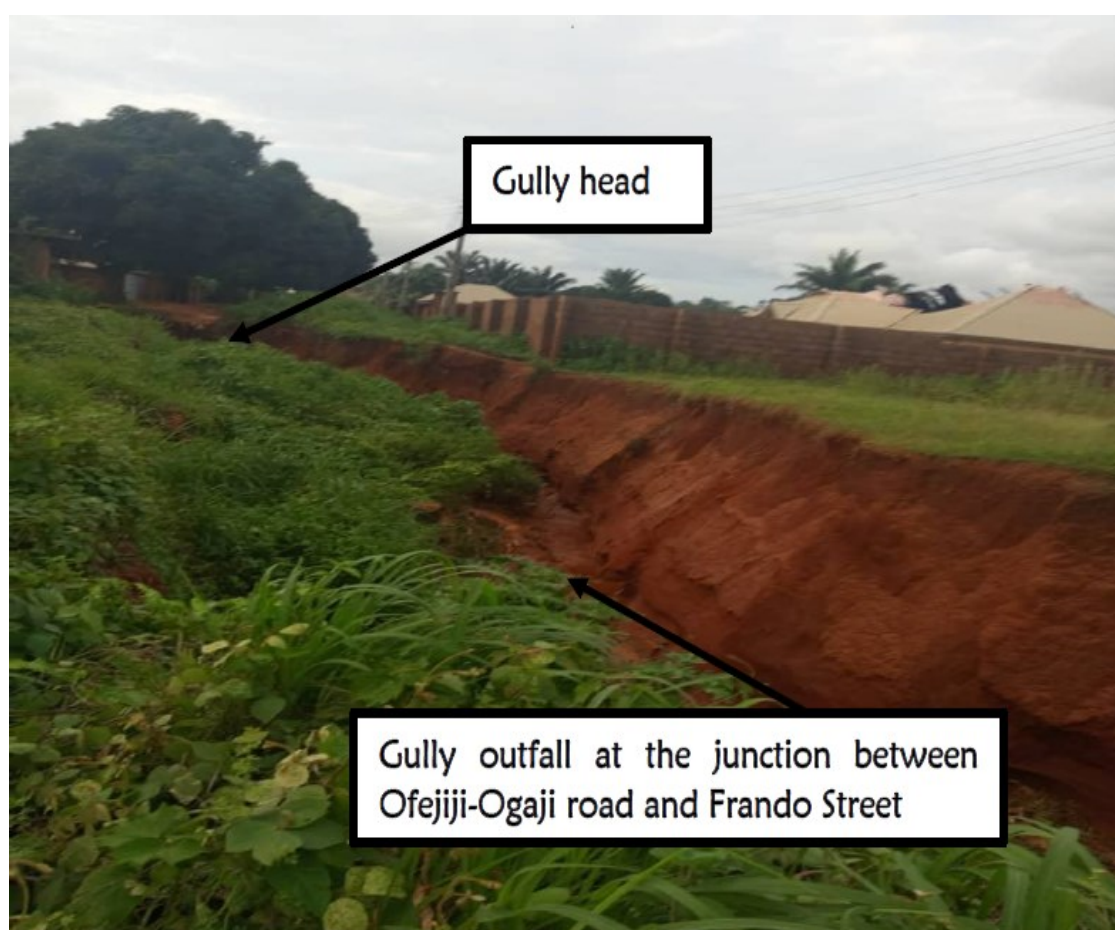


Plate 1.1: Gully along Frando Street

Source: Field work, 2023.



Plate 1.2: Linear shaped gully in Abache.

Source: Field work, 2023.

Conclusion

The physico-chemical analysis of soil showed that gully erosion has negatively impacted on the soil quality of the study area. The particle size distribution of the soil showed that the soils of the study area fell within sandy loam textural class, sand fraction recorded higher level in all the studied pedons. Results showed that the soil pH is highly acidic and also the soil is characterized with low organic carbon, low Total Nitrogen, low available phosphorous which is an indication that the gully has detrimental impacts on the soil fertility of the study area.

Recommendations

Based on the findings of this study, the following recommendations are suggested:

- i. Deficient plant nutrients such as nitrogen, phosphorous and potassium should be replaced and boosted with N: P: K 15:15:15 in a 1:1:1 ratio to improve their levels and general over-all productivity of the soils.
- ii. Apply urea fertilizer by foliar application after emergence of the grasses for sustenance of good quality turf.
- iii. Harrow the soil properly to break-up clods, and to provide a finer finish, a good tilth or soil structure that is suitable for plant or seed establishment.
- iv. Water the soil properly after the harrowing to consolidate the soils.
- v. Broadcast 350 kg/ha of lime material (quicklime) uniformly to raise the soil pH values to about 5.5 – 6.5 reaction level, optimum for biochemical activities and sustenance of good quality turf production. However, this must be done 2 – 6 months before the establishment of vegetation.
- vi. Mulch the soils as soil stabilization or erosion control measure with materials such as grass, hay, woodchips, wood fibers and straw etc. to reduce the speed of run-off and over-time add organic matter to the soil.

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