DETERMINATION OF ERODIBILITY INDICES OF SOILS IN OWERRI WEST LOCAL GOVERNMENT AREA OF IMO STATE

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CERTIFICATION

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DEDICATION

This work is dedicated to the Almighty God who protected and provided for me throughout my stay in the institution. My dearest Mother, Sisters and Brothers for their morals and financial encouragement toward my career.

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ABSTRACT

The determination of erodibility indices of the soils in Owerri West Local Government Area of Imo State was carried out. This is important in the design and installation of conservation structures for erosion control. This is necessary as attention is now shifted to these areas for the development of the new Owerri capital cites. However, various insitu and laboratory tests were carried out in this project works to determine the percentage of sand, silt and clay, as well as the insitu permeability test and soil structural class index from which the erodibility factors were determined. The results showed that Ohi has the highest erodibility factor followed by Orogwe, Amakohia Ubi, Okuku, Umuguma, Okolochi, Eziobodo, Oforola, Avu while Obinze and Ihiagwa has the least. Therefore, Ohi has the highest erodibility factor and is more prone to erosion than others. The predicted soil loss for this area is thus 9.462 tons/ha/yr.

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CHAPTER ONE

1.0 INTRODUCTION

BACKGROUND INFORMATION

Soil erosion is the wearing away of the Land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep. It could be defined also as the detachment and movement of soil or rock particles by water, wind, ice or gravity, (Brandy, 1974). From the above definition, the most common agent in the erosion of soil in South Eastern Nigeria is water. Wind is of secondary importance as a soil erosion agent and apart from the academic circle very little is known of ice serving as a soil erosion agent in this part of the world.

Soil erosion is one of the most important physical and social – economic problems affecting development in this part of the country today. Apart from the fact that it constitutes a menace to the environment, its destruction of our infrastructures, high ways, big structures, etc it also creates a major problem on our agricultural soil, thereby interfering seriously with the mass food production campaign. We cannot afford to over look these problems created on our soil by soil erosion because there is no real evidence that we may someday detach our lives from the soils. It is the soils that sustain us because soils are the foundation of our worldly goods. It is a basic wealth upon which existence as habitant of the earth depends.

Human activities can initiate and accelerate erosion process and to that extent, their regulation and control should be a major part of the approach to prevention and controls of soil erosion. However, the effects of soil erosion are many but the following are more prominent.

i. REDUCTION OF AGRICULTURAL PRODUCTION

Erosion removes the top soil, the zone of plant nutrients and this causes steady reduction of soil fertility (Fubara, 1986). Food crops are the most hits by this development due to their shallow rooting systems. The decline in agricultural production resulting in food shortage, high food prices and famine do adversely affect nutrition and health of the population and causes decline of labour productivity.

As erosion destroys farm land, and the section of the their crops, the population cannot find suitable lands on which to cultivate their crops. Extreme fragmentation of remaining food land may follow, which may result in man over – exploitation of the land and reduces output unless soils is being improved.

In addition, if the soil fertility is reduced the country's capacity for agriculture production will also be reduced, which will mean a reduction in the country's foreign exchange earning from agricultural (Fob. 1984).

II POLLUTION AND SILTATION

Eroded soil are deposited in water systems leading to pollution and siltation by sand and particles. This cause drastic reduction of water volume and quantity, and eventual siltation and drying up of rivers, water reservoirs and dams. Moreover, the aquatic life is eventually eliminated. Pollution and siltation of water systems, including flooding have serious adverse consequence for economic life of local communities. Water supply for domestic and industrial purpose would become scarce and more expensive.

III DESTRUCTION OF LAND RESOURCES:

There is drastic reduction in land productivity for agriculture. In case of gully erosion, the land may become submerged and not useful for any purpose.

However, soil erosion being a complex interaction process of many factors, the most basic of which are the edaphic (Soils) and rainfall factors, since other factors, namely land form, vegetation and cropping factors are amenable to changes. The soil nature and the soil erodibility concepts should be used as measures to determine the susceptibility of soil to erosion

1.1 OBJECTIVES

(a) To determine the soil erodibility indices of some towns in Owerri west Local Government area.

(b) To ascertain areas in owerri west L.G.A, where the soils are prone to erosion.

(c) To predict soil losses by erosion under the same environmental condition.

1.2 JUSTIFICATION

Agricultural production is greatly affected by the erosion process. This has extremely unfavorable consequences for food and forestry development.

The incidence of soil erosion in some towns in Owerri west local government area has created some devastating effects to the communities. Though some control measures have been applied by the inhabitants, these have not made any positive impact as the areas still surfer every year from the devastating effects of the erosion process. Some of these measures failed because adequate work on the indices involved are sometimes neglected.

This project is to help in determining some of these erodibility indices of the soils in Owerri West Local Government Area of Imo

State, which provide the required information and data for soil conservation and erosion control purposes.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 DEFINITION OF SOIL

The word soil is derived through French word solum, which means floor or ground. Soil is a natural body of loose unconsolidated material, which constitutes a thin layer several meters deep on the earth's surface (Faniran and Arecola 1978). It also refers essentially to the synthesized products of weathered rocks plus organic matter (Ahn 1979). However, Faniran and Arecola (1979), defined soil also as an indispensable agricultural resource which nourishes and provides mechanical support for growing plants.

The major components of soil are:

(i) Organic materials in various stages of decomposition

(ii) Mineral particles

(iii) Air

(iv) Water

The organic material and mineral particles are intimately associated with the topsoil. If the organic material is removed or destroyed, the mineral particles will remain. The soil or mineral particles can be divided up conveniently according to the diameter of the particles

Clay less than 0.002 mm in diameter

Silt between 0.002 – 0.02mm in diameter

Sand between 0.02 – 2.00mm in diameter

2:2 SOIL TYPES IN IMO STATE AND CLASSIFICATION

With the soil map of Imo State, using the united state Department of Agriculture (USDA 1976) and food and Agricultural organisation of the united nations (FAO 1947) classification system. There are three classes of soil in Imo State, which are:

a. Ferralite soil (ferralsols and lithosols)

b. Hydromorphic soil (gleysola and cambisols)

c. Alluvial soils (Plunsols)

2:2:1 FERRALITIC SOIL

These are soils from the coastal plain sand and of the escapement occupying an area of about 7798 square kilometers, that is 61% of the total area of flat to undulating topography characterised by good drainage.

2:2:2 HYDROMORPHIC SOIL

These include those soils from plateau and Cross River plain occupying an area of about 31% of the total area and have developed along the escapement found in the North eastern part of the State.

2:2:3 ALLUVIAL SOIL:

Alluvial soils occupy about 8% of the total area of the state and are found along the low terrace of the cross-river and Orashi River. They are poorly drained and are subject to permanent or periodic flooding.

2:3 SOIL ERODIBILITY

Erodibility is defined as the resistance of the soil to both detachment and transport. Although soil resistance to erosion depends partly in topography that is elevation of place, slope steepness and the amount of disturbance created by man for example, during tillage which affects the soil erodibility (Brayan 1968).

However, erodibility is often interchanged with the term "Soil erosion" to the extent that they are used more or less interchangeable. A soil with relatively low erodibility factor may show signs of serious erosion, yet a soil could be highly erodible and surfer little erosion (Thrones 1980). This is because soil erosion is a function of many factors as stated in the universal soil loss equation (USLE). These factors include rainfall factor R. soil erodibility factor K, slope length L, crop factor C and control practice P; This is represented in USLE equation thus,

A = RKSCP (Wischemeir and Smith 1978).

The USLE is an erosion model designed to predict the long – time average soil losses due to run-off from specific fields in dropping and management systems. The soil erodibility factor K is a quantitative expression of the inherent susceptibility of a particular soil to erode at different rates when the other factors that affect erosion are standardised. Erodibility varies with soil textures, aggregates, stability, shear strength, soil structures, infiltration capacity, soil depth, buck density and soil organic matter and chemical constituents Lal (1977).

(i) SOIL TEXTURE:

Soil texture refers to the coarseness or fineness of the soil. Specifically, texture is the relative proportions of sand, silt and clay often soil texture is related to the erosion hazard it is generally accepted that organic matter, clay and sand have negative effect on soil erodibility (K) factor whereas silt has a positive effect Lal (1977). Large particles are resistance to transport because of the greater force required to entrain them and fine particles are resistance to detachment because of their cohesiveness (Brayan

(1968). The least resistance particles are silts and fine sands. Soil with a high silt content are erodible. Richter and Negendack (1977) stated that soil with 40 to 60 percent silt content are the most erodible.

(ii) AGGREGATE STABILITY

Bryan (1974) and Imerson (1974) reported that proportion of water stable aggregate less than 0.5mm is a good index of soil erodibility. In other worlds the greater the proportion of aggregates less than the limit, the greater is the erodibility of the soil. Sandy soils are generally more erodible than clayey soil because the weak aggregates of sandy soils facilitate slaking. Thus crusting or surface sealing soil with higher clay and organic matter contents have more stable aggregates because of the strong inter-colloidal bonds Greenland (1965) and are more resistant to erosion.

(iii) SHEAR STRENGTH

The shear strength of the soil is a measure of its cohesiveness and resistance to shearing forces. Although this is relevant to the response of the soil to the impact of running water and wind it is more useful as an indicator of potential mass movement Bryan (1968).

(iv) SOIL STRUCTURE

Ritchie and Negenedark (1977) stated that structure is a characteristic for soil types and may become important indicator of the erosion susceptibility of the soil. Schwab et al (1986) also stated that soil structure is that physical property relating to the arrangement of the individual soil particle into the groups of aggregates in the soil. The structure of the soil determines the porosity or the degree of air spaces in the soil, and so soil structure has a marked influence on the air and water relationship in the soil. Soil structure helps to determine the susceptibility to or the ease of the soil movement by the agent of erosion. Soil with plenty or abundant air is able to resist erosion better. As such erosion of soils can be predicted to some extent when the structural type of soil is known.

(v) INFILTRATION CAPACITY

The infiltration capacity of a soil is greatest at the beginning of a storm. As rainfall progress, the infiltration capacity is reduced because the easily accessible pores are filled with water, the soil surface depending on the structural stability is packed by rain drop impact, colloids in the soil swell and reduced the pore sizes, fine particles are washed down into the ground plugging up the pores and also because the continous sheet of water of the soil to escape and to make room for water entering Kohnke (1955). Provided the rainfall intensity is lower than the soil infiltration, water enters the soil as fast as the rainfall intensity. If on the other hand, the rainfall intensity exceeds the infiltration capacity then water ponding occurs and either of two things can happen. The water can be stored in depression on the soil surface or it can increase the erodibility of the soil.

(vi) SOIL DEPTH

The depth of erosion is very often determined by the soil depth. Soil layers below the plough layers are often compact and less erodible. Rills will develop in areas where resistance bedrock is close to the surface if the parent material is unconsolidated such as sands and gravels or loss deep gullies can be out McIntyre (1958). This is example by probably one of the worst degraded land area in the South Eastern part of the country.

(vii) ORGANIC MATTER AND CHEMICAL CONSTITUENT

The organic and chemical constituent of the soil are important because of their influence on aggregates stability. Soils with less than 2 percent organic matter can be considered erodble Evans (1980). Most soils contain less than 15 percent organic content and many of the sands and sandy loams have less than 2 percent. Voroney et al, (1981) suggested that soil erodibility decreases linearly with increasing organic content over the range of 0 to 10 percent.

2.4 MEASUREMENT OF SOIL ERODIBILITY

The soil erodibility can be estimated using:

(i) Direct field plot technique

(ii) Wischmeire monograph and

(iii) Emperical indices

(iv) Indirect measurement

i. DIRECT FIELD PLOT TECHNIQUE:

Wischmeier and Smith, (1978) defined K as the rate of soil loss per unit of erosion index as measured in a unit plot" which is 22.2m long with uniform lengthwise slope of 9% in continuos fallow tilled up and down the slope. By selecting characteristic slopes and correcting the results of the topographical factors (LS), the soil erodibility may be calculated as

$$K = \frac{A}{E \times LS + 2.24}$$

Direct measurement of K reflect the combined effects of all soil properties that significantly influence the ease with which unprotected soil is eroded by rainfall and run-off. Knowledge of how soil properties affects K is essential because it allows predictions of soil vulnerability. The direct methods is generally expensive and time consuming, it is also difficult to establish field studies in remote areas and this is why researchers have resorted to the use of rainfall simulators, plot sizes usually less than $2m^2$ used with portable rainfall simulators supplying rain with pre-determined energy. Materials splashed or washed from the plots are weighed and used as independent variable to establish the erodibility factor.

ii. INDIRECT MEASUREMENT:

This can be carried out with less effort, expenses and time than are required for experimental assessment either under simulated or natural rainfall conditions. Many researchers have therefore attempted to establish erodibility factors or erodibility indices for direct use in quantitative soil loss by predicating K from consummations of selected basic soil parameters (Wischmeier and Mannerineg, 1969). The general finding is that a very large number of soil properties are necessary to accomplish a reasonably full account of soil erodibility. Wischmeier et al, (1971) were able to

Mannery, 1969). The general finding is that a very large number of soil properties are necessary to accomplish a reasonably full account of soil erodibility. Wischmeier et al, (1971) were able to achieve approximate erodibility fraction using four parameters, namely, texture, organic matter, structure and permeability. Also they found that very fine sand particles (0.1-0.05mm) and silt particles have similar effect on erodibility which led to inclusion of a particle size parameter "m" into the erodibility equation, where

$$M = (\% \text{ Si} + \text{Vfs})\,(100 - \% \text{ clay}).$$

When the silt fraction does not exceed 70%, they found that erodibility was described by the equation

$$K = m^{1.14}$$

The prediction equation was improved by including organic matter. Soil structure and permeability as expressed in the equation below.

$$100\,k = 2.1m^{1.14}\,(10^{-4})\,(12 - a) + 3.25\,(b - 2) + 2.5\,(c - 3)$$

Where k = erodibility matter

a = % organic matter

b = soil structure code

c = permeability class

(viii) Attempt have been made to evaluate soil erodibility from various detachability indices. There are quite a number of indices, but the more popular ones include indices based on properties affecting soils dispersion.

A Water stable aggregates (W.S.A). This is calculated as percent of the water stable aggregates greater than 0.5mm.

B. Wet –Sieving (yoder, 1936). Is the weighted mean diameter of water stable aggregates.

C. Vozneksy and Artsaruvies Index (1940). This index E. measures all properties governing soil resistance to erosion

$$E = \frac{d \times h}{a}$$

Where

d = measure of dispersion

h = measure of water retaining retaining capacity

a = Index of aggregation which is 15% of aggregate (WSA) greater than 0.25mm.

D. Miscellaneous soil detachability indices

Instability index "LD" (De leeheer et al, 1959). This is defined as the difference in the mean weight diameter between the aggregate distribution in the dry and wet sieve analysis

E. Middleton's dispersion ratio (Middleton's 1930)

This is ratio of the total amount of silt + clay in dispersed state. This ration was based on the theoretical assumption that only erodible materials in a dispersed condition could be eroded.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 DESCRIPTION OF THE PROJECT AREAS

The Owerri West Local Government Area with its headquarters at Umuguma enclosed in a Latitude of 5^0 23 and 5^0 34W and longitude between 6^0 50 and 7^0E, has about 15 communities such as Obinze, Avu, Nekede, Ihiagwa, Amakohia Ubi, Ndegwu, Okuku, Eziobodo, Oforola, Ohi, Umuguwa and Orogwe.

The people practice shifting cultivation and crops grown on the area are maize, melon, yam, cocoyam, etc. It also lies within the rain forest region of Nigeria, which has its peak rainfall within June, July, September and October and low rainfall in December, January and February.

Various erosion and flooding sites are located in Oregwe, Obinze, Avu, Umuguma, Nekede, Irete, Ohi and Okuku. While there are presence of flood in some locations that do not have erosion sites as shown in the table below.

TABLE 3.1 SITE INVESTIGATION

LOCATION	EROSION SITE	FLOOD
NDEGWU	NONE	PRESENT
OROGWE	PRESENT	PRESENT
AMAKOHIA UBI	NONE	NONE
OBINZE	PRESENT	PRESENT
OFOROLA	NONE	PRESENT
AVU	PRESENT	PRESENT
UMUGUMA	PRESENT	PRESENT
OKOLOCHI	NONE	PRESENT
EMEABIAM	NONE	NONE
EZIOBODO	NONE	NONE
IHIAGWA	NONE	PRESENT
NEKEDE	PRESENT	PRESENT
IRETE	PRESENT	PRESENT
OHI	PRESENT	PRESENT
OKUKU	PRESENT	PRESENT

3.2 SOIL ERODIBILITY DETERMINATION

This chapter is dedicated to several methods available for determining the erodibility indices of soil in Owerri West Local government area, It involves field and laboratory test.

a. **FIELD TEST:** Soil structural class index: This method involves the grouping of soils into four classes, thus, very fine granular, fine granular, medium or coarse granular and blocky or platy or massive and this classes are denoted from one to four respectively. The structural class index of soil was developed by Wischmeier (1963). It is determined by taking soil clods from each plot and at each depth and dropping them from a known height of about 1.2m and also taking note of how the clods were broken for classification unto the following groups, as shown in the Table.

TABLE 3.2A SOIL STRUCTURAL CLASS INDEX (S.S.I)

GROUP	STRUCTURE	CLASS INDEX
I	Very fine granular	1
II	Fine granular	2
III	Medium of coarse granular	3
IV	Blocky or platly or massive	4

For this project, at every site the samples were collected from each depth range 0-20cm, 20cm-40cm, 40cm-60cm for soil structural classification.

b. **INSITU PERMEABILITY TEST:** This is the determination of the insitu permeability of soil at different depths. This was developed by Olson and Wischmeier (1963). It is based on determination of time it will take a given quantity of water to infiltrate into the soil at its natural state. That soil is classified based on the range as shown below.

TABLE 3.3B PERMEABILITY INDEX DETERMINATION (P.I.D)

Time (Mins)	Soil Class	Remarks
1-10	Class 1	Sandy Soil
11-20	Class 2	Sandy Soil
21-30	Class 3	Sands, Silts
31-40	Class 4	Sands and Silts
41-50	Class 5	Sands and clay
51 above	Class 6	Silts, clay

In this project insitu permeability test were carried out on each site on various depth such as 0-20cm, 20cm-40cm, 40-60cm, following this method.

c. **SOIL RESISTANT TEST:** The permeability is used to determine the resistance of soil to pressure. Its advantages include the fact that soil is at insitu condition but the antecedent moisture content of the soil can effect the reading. In the project soil resistance to pressure was measured at 0-20cm, 20-40cm, 40-60cm at different points after which an average value was taken.

3.3 LABORATORY TEST:

A. **HYDROMETER TEST**: Hydrometer test is the same as percentage silt, % sand and % clay. These tests were used to determine the percentage of sand, silt and clay in a given quantity of soil from various depth of 0-20cm, 20-40 make cm, 40-60cm. That is from each of the community, soil was collected at depth 0-20cm, 20-40cm, 40-60cm respectively for hydrometer analysis, using the sodium hexemeta phosphate (calgon) as dispersing agent, it separate the soil particles into sizes which can be grouped into sand, silt and clay. Using this samples, the value of erodibility index (k) can be determine using Boyoucos (1935) equation.

Samples of the soils were collected from locations selected at depths, namely 0-20cm, 20-40cm, 40-60cm. 50g of soil from each depth was placed in a 300ml Erlenmyer flask containing 100ml of 5% calgon solution (dispersing agent). The flask was thoroughly shaken and allowed to stand over night. Thereafter the soil and the dispersing agent were transferred to the dispensing cup of an electric mixer which was then filled with water to about 3mm from the top of the cup. The cup was attached to the mixer and stirred for 2mins. After which soil was transferred to a 100ml measuring cylinder, distil water was added to fill the cylinder to the 100ml mark and the plunger used for stirring until the soil was uniformity suspended in water.

Two hydrometer readings are made after the plunger was removed. The sand settles in about 40 seconds and a hydrometer reading taken at 40 seconds determines the grams of silt and clay remaining in suspension. Subtraction of the 40 second reaching from the sample weight gives the grams of sand. After about 8 hours, most of the silt has settled, and a hydrometer reading taken at 8 hours determines the grams of clay in the same. The silt is calculated by difference: Add the percentage of sand to the percentage of clay and subtract from 100%.

The percentage of sand, silt and clay were determined as follows.

$$\% \text{ sand} = \frac{\text{Sample weight} - 40 \text{ seconds reading}}{\text{sample weight}} \quad \text{-----} \quad 3.1$$

$$\% \text{ clay} = \frac{\text{8 hours reading}}{\text{Sample weight}} \times 100 \qquad \text{------} \quad 3.2$$

$$\% \text{ silt} = 100\% - (\% \text{ sand} + \% \text{ clay}) \qquad \text{------} \quad 3.3$$

3.4 EROSION PREDICTION

Roose (1977) provided an equation for determining the rainfall factor R

Where R = 0.5H

And R is the mean annual rainfall factor over 5 -10 years return period. H is the mean annual rainfall. Using the equation, the rainfall factor R can be determined and used in revised USLE equation.

$$\text{Thus } A = 2.24RK \qquad \text{----} \quad 3.4$$

Where A = Soil Los in tons/ha/yr

R = Rainfall factor

K = erodibility factor

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 DETERMINATION OF ERODIBILITY INDICES

The erodibility indices of the soils in the various communities as shown in Table 4.1 The results indicate that Ohi is more erodible with a value of (0.044). This is closely followed by Orogwe (0.04), Amakohia Ubi (0.04), Okuku (0.037), Umuguma (0.036), Nekede (0.034), Emeabiam (0.033), Eziobodo (0.032), Oforola (0.032) and Avu (0.030). The least erodible indices of soils are in communities of Obinze (0.029) and Ihiagwe (0.029).

TABLE 4.1:AVERAGE ERODIBILITY INDEX (K) OF PROJECT LOCATIONS

LOCATION	AVERAGE K - INDEX
NDEGWU	0.035
OROGWE	0.040
AMAKOHIA UBI	0.40
OBINZE	0.029
OFOROLA	0.032
AVU	0.03
UMUGUMA	0.036
OKOLOCHI	0.036
EMEABIA	0.033
EZIOBODO	0.032
IHIAGWA	0.029
NEKEDE	0.034
IRETE	0.036
OHI	0.044
OKUKU	0.037

4.2 PREDICTD SOIL LOSSES ANALYSIS

Ohi being the most erodible has the high-test predicted soil losses of 9.462tons/ha/yr using eq. 3.4. This is followed by Amakohia-ubi (8.602tons/ha/yr) and Orogue (89.6 tons/ha/yr). Obinze and Ihiagwa have the least predicted soil losses of 6.236 tons/ha/yr each as shown with Table 4.2.

4.3 DETERMINATION OF PERCENTAGE OF SAND, SILT AND CLAY

From the particle size analysis, the soils in the various locations where found to be more of sands, (Table 4.3). The higher erodibility factors of Ohi, Orogwe and Amakohia-ubi communities are due to the presence of high amount of sandy soils in these areas, which have low binding and low cohensive forces and cannot resist the force due to detachment and transportation by water and wind.

Furthermore, this presence of high sandy soils encourages high rate of permeability or water penetration into the soil, which induces landslide and erosion. Communities with high clay content have low erodibility factor because of the higher binding and interbinding forces that tend to help in resisting the detachability and transportability of soil by wind and water erosion. Most of the locations have the same type of soil due to their close proximity to each other.

TABLE 4.3: PARTICLE SIZE ANALYSIS OF PROJECT LOCATIONS.

LOCATION	SOIL TYPE
NDEGWU	Graded silty sands
OROGWE	Graded silty sands
AMAKOHIA UBI	Graded silty sands
OBINZE	Sandy loam & silt
OFOROLA	Sandy loam
AVU	Sandy loam
UMUGUMA	Sandy loam
OKOLOCHI	Sandy silt
EMEABIA	Sandy clay
EZIOBODO	Sandy clay
IHIAGWA	Sandy silt
NEKEDE	Sandy silt
IRETE	Graded silt Sands
OHI	Graded silt Sands
OKUKU	Sandy loam

4.4 COMPARISON OF COMPUTED AND STANDARD ERODIILITY INDICES

The erodibility indices for the sample of soils from the fifteen communities when compared with standard erodibility indices of Olson (1984) Showed that the erodibility indices of the communities in Owerri West Local Government Area fall into group I indicating that the soils are permeable, well drained with stony sub strata (Table 4.4).

TABLE 4.4: STANDARD ERODIBILITY INDICES BY OLSON W. GERAID

GROUP	K-FACTOR	NATURE OF SOIL
I	0 – 0.1	Permeable gracia outwash well drain soils having stony sub strata.
II	0.11 – 0.17	Well drain soils in sandy graded free material.
III	0.18 – 0.28	Graded loams and silt, loam.
IV	0.29 – 0.48	Poorly graded moderately fine and textured soil.
V	0.49 – 0.64	Poorly graded silt or very fine sandy soil, well and moderately drain soils.

SOURCES: OLSON .W. GERAID

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The determination of the erodibility indices of soils in Owerri West Local Government Area of Imo State has been studied and from the various results obtained, it showed that the soils in Owerri West local government area are mainly sandy soils, which was confirmed by the results of the structural index classification and insitu permeability test.

The hydrometer test used in the computation of the erodiblity indices revealed that Ohi has the highest erodibility indices of 0.044 followed by Orogwe and Amakohia Ubi with 0.040. The least erodibility indices was obtained in Obinze and Ihiagwe towns both with erodibility indices of 0.029. The results of this study will be a useful guide in the design and construction of conservative structures that can adequately check the menace of erosion in these communities in Imo State.

5.2 RECOMMENDATION

I wish to recommend that the government should use these data for the provision of adequate soil conservation structures for not only the entire local government area but also for Umuguma Avu and Nekede which will serve as the main new Owerri capital cities.

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Soil	-	Sandy loam
Topography	-	Undulating
Erosion	-	Presence of flood
Flood	-	Dense
Vegetation	-	mixed farming with shifting cultivation
Land Drainability	-	fair

7. **UMUGUMA**

Geology	-	Coarse to medium unconsolidated sands.
Soil	-	Sandy loam
Topography	-	Undulating
Erosion	-	Massive erosion
Flood	-	Massive flood
Vegetation	-	Dense
Land Use	-	Shifting cultivation
Land Drainability	-	Poor

8. **OKOLOCHI**

Geology	-	Coarse to medium unconsolidated sands.
Soil	-	Sandy silt
Topography	-	Flat
Erosion	-	-
Flood	-	-
Vegetation	-	Dense

APPENDIX

TABLE A1: RESULT OF THE SHEAR STRENGTH PERCENTAGE MOISTURE CONTENT, SANDS, SILTS AND CLAY

LOCATION	HORISON (cm)	SHEAR STRENGTH (kn/m2)	% M.C	% SAND	% SILT	% CLAY	AVERAGE K
NDEGWU	0-20	379.23		44.60	30.30	25.10	
	20-40	482.65	7.00	56.10	23.20	20.70	0.035
	40-60	275.80		51.60	27.30	21.10	
OROGWE	0-20	310.28		39.50	34.50	26.00	
	20-40	586.08	5.79	50.80	28.92	20.28	0.040
	40-60	620.55		59.62	24.34	16.04	
AMAKOHIA UBI	0-20	379.23		41.98	32.94	25.08	
	20-40	586.08	8.26	57.80	23.60	18.60	0.040
	40-60	551.60		59.80	22.60	17.60	
OBINZE	0-20	448.18		42.10	31.30	26.60	
	20-40	224.09	3.78	50.80	24.90	24.30	0.029
	40-60	413.70		49.98	29.64	20.38	
OFOROLA	0-20	775.69		40.60	32.20	27.20	
	20-40	413.70	5.69	53.50	24.20	22.30	0.032
	40-60	758.45		50.20	27.18	22.62	
AVU	0-20	482.65		38.40	34.10	27.50	
	20-40	172.38	6.80	48.02	27.34	24.64	0.030
	40-60	275.80		51.90	24.4	23.70	
UMUGUMA	0-20	620.55		47.88	32.52	26.28	
	20-40	275.80	4.82	51.30	29.04	21.30	0.036
	40-60	241.33		52.20	24.40	19.40	
OKOLOCHI	0-20	620.55		41.20	32.52	26.28	
	20-40	999.78	3.94	49.26	29.04	21.30	0.036
	40-60	482.65		56.20	24.40	19.40	
EMEABIA	0-20	620.55		40.68	37.46	21.86	

	20-40	413.70	4.08	43.72	29.66	26.62	0.033
	40-60	275.80		50.02	27.68	22.30	
EZIOBODO	0-20	341.00		48.02	27.08	24.90	
	20-40	442.00	2.13	48.30	30.30	21.40	0.032
	40-60	561.00		50.12	24.50	25.32	
IHIAGWA	0-20	275.80		47.70	26.96	25.28	
	20-40	344.75	3.43	40.70	33.40	25.90	0.029
	40-60	275.80		41.30	31.60	27.16	
NEKEDE	0-20	248.00		52.00	24.00	21.00	
	20-40	324.00	3.24	43.00	28.00	22.00	0.034
	40-60	268.00		47.00	22.00	20.60	
IRETE	0-20	210.00		42.00	29.00	21.00	
	20-40	421.50	6.20	45.00	24.00	18.00	0.036
	40-60	562.70		49.00	22.00	19.00	
OHI	0-20	180.00		43.00	23.00	20.00	
	20-40	342.00	6.60	48.00	20.20	16.00	0.044
	40-60	512.00		52.00	21.00	13.00	
OKUKU	0-20	610.00		51.00	26.00	21.00	
	20-40	242.00	7.40	53.00	27.00	23.00	0.037
	40-60	182.00		55.00	24.00	21.00	

TABLE A2: SITE INVESTIGATION REPORT

1. NDEGWU

Geology - Coarse to medium granular unconsolidated sands.

Soil - Graded silty sands

Topography - Flat

Erosion - -

Flood - present

Vegetation - dense

Land Use	-	mixed farming with shifting cultivation
Land Drainability	-	fair

2. OROGWE

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Graded silty sands
Topography	-	Undulating
Erosion	-	Presence of erosion
Flood	-	Present, there is landslide
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Fair

3. AMAKOHIA

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Graded silty sands
Topography	-	Flat
Erosion	-	-
Flood	-	-
Vegetation	-	dense
Land Use	-	mixed farming with shifting cultivation
Land Drainability	-	good

4. **OBINZE**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Sandy loam and silt
Topography	-	Undulating
Erosion	-	Presence of erosion
Flood	-	Presence of flood
Vegetation	-	mixed farming with shifting cultivation
Land Drainability	-	poor

5. **OFOROLA**

Geology	-	Coarse to medium unconsolidated sands.
Soil	-	Sandy loam
Topography	-	Flat
Erosion	-	-
Flood	-	presence of flood
Vegetation	-	mixed farming with shifting cultivation
Land Drainability	-	fair

6. **AVU**

Geology	-	Coarse to medium granular unconsolidated sands.

Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Fair

9. **EMEABIAM**

Geology	-	Coarse to medium unconsolidated sands.
Soil	-	Sands clay
Topography	-	Flat
Erosion	-	-
Flood	-	-
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Good

10. **EZIOBODO**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Sandy clay
Topography	-	Flat
Erosion	-	-
Flood	-	-
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Good

11. **IHIAGWA**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Sandy silt
Topography	-	Flat
Erosion	-	-
Flood	-	presence of flooding
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Fair

12. **NEKEDE**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Sandy silt
Topography	-	Hilly
Erosion	-	Massive erosion
Flood	-	Present
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Fair

13. **IRETE**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Graded silty sands
Topography	-	Undulating
Erosion	-	Present
Flood	-	Present
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Fair

14. **OHI**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Graded silty sands
Topography	-	Undulating, landslide
Erosion	-	Massive erosion
Flood	-	Present
Vegetation	-	Dense
Land Use	-	Mixed farming with shifting cultivation
Land Drainability	-	Poor

15. **OKUKU**

Geology	-	Coarse to medium granular unconsolidated sands.
Soil	-	Sandy loam
Topography	-	Flat
Erosion	-	Massive erosion
Flood	-	Massive flood
Vegetation	-	Dense
Land Use	-	mixed farming with shifting cultivation
Land Drainability	-	fair

TABLE A3: PERMEABILITY INDEX DETERMINATION (P.I.D)

LOCATION	HORISON (cm)	TIME (Min)	SOIL CLASS
NDEGWU	0-20	3.78	1
	20-40	3.58	1
	40-60	7.58	1
OROGWE	0-20	2.50	1
	20-40	5.08	1
	40-60	17.00	2
AMAKOHIA UBI	0-20	2.50	1
	20-40	6.00	1
	40-60	17.00	2
OBINZE	0-20	5.38	1
	20-40	7.75	1
	40-60	18.00	2
OFOROLA	0-20	11.00	2
	20-40	7.37	1
	40-60	19.90	2
AVU	0-20	5.25	1
	20-40	3.25	1
	40-60	11.75	2
UMUGUMA	0-20	8.37	1
	20-40	6.12	1
	40-60	12.00	2
OKOLOCHI	0-20	2.17	1
	20-40	15.00	2
	40-60	14.33	2
EMEABIA	0-20	1.83	1
	20-40	11.67	2
	40-60	16.70	2

EZIOBODO	0-20	1.25	1
	20-40	4.67	1
	40-60	5.00	1
IHIAGWA	0-20	1.25	1
	20-40	4.67	1
	40-60	5.00	1
NEKEDE	0-20	1.20	1
	20-40	4.29	1
	40-60	4.41	1
IRETE	0-20	4.69	1
	20-40	9.84	1
	40-60	0.35	1
OHI	0-20	2.48	1
	20-40	6.12	1
	40-60	1.13	1
OKUKU	0-20	9.47	1
	20-40	14.40	2
	40-60	9.55	1

OKOLOCHI	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
EMEABIA	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
EZIOBODO	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
IHIAGWA	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
NEKEDE	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
IRETE	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
OHI	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2
OKUKU	0-20	Fine grannular	2
	20-40	Fine grannular	2
	40-60	Fine grannular	2

TABLE A5: RAINFALL AMOUNT FOR OWERRI (2001).

MONTH	RAINFALL (MM)	RAINFALL DAYS
JAN.	5.5	2
FEB.	62.0	7
MARCH	206.4	11
APRIL	172.2	8
MAY	140.8	10
JUNE	385.4	21
JULY	301.7	14
AUGUST	348.7	21
SEPT.	430.8	20
OCT.	213.4	14
NOV.	22.6	5
DEC.	14.8	6
TOTAL	**2304.3**	**139**

SOURCE: DEPT. OF METROLOGICAL SERVICES, OWERRI.

OKOLOCHI	0-20	41.20	32.52	26.28	0.028		
	20-40	49.26	29.04	21.30	0.038	0.036	0.036
	40-60	56.20	24.40	19.40	0.042		
EMEABIA	0-20	40.68	37.46	21.86	0.036		
	20-40	43.72	29.66	26.62	0.028	0.033	0.033
	40-60	50.02	27.68	22.30	0.035		
EZIOBODO	0-20	48.02	27.08	24.90	0.030		
	20-40	48.30	30.30	21.40	0.038	0.032	0.032
	40-60	50.12	24.56	25.32	0.029		
IHIAGWA	0-20	47.70	26.96	25.28	0.030		
	20-40	40.70	33.40	25.90	0.029	0.029	0.029
	40-60	41.30	31.60	27.16	0.027		
NEKEDE	0-20	52.00	24.00	21.00	0.036		
	20-40	43.00	28.00	22.00	0.032	0.034	0.034
	40-60	47.00	22.00	20.60	0.033		
IRETE	0-20	42.00	29.00	21.00	0.034		
	20-40	45.00	24.00	18.00	0.038	0.036	0.036
	40-60	49.00	22.00	19.00	0.037		
OHI	0-20	43.00	23.00	20.00	0.033		
	20-40	48.00	20.20	16.00	0.043	0.044	0.044
	40-60	52.00	21.00	13.00	0.056		
OKUKU	0-20	51.00	26.00	21.00	0.037		
	20-40	53.00	27.00	23.00	0.035	0.037	0.037
	40-60	55.00	24.00	21.00	0.038		