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EVALUATION OF ERODIBILITY INDICES IN AKOKO REGION OF ONDO STATE, NIGERIA

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Abstract
Soil erosion is a major part of land degradation that affects the physical and chemical properties of soils resulting in nutrient loss and sediment of water resources. This study involves taking measurements of some soil parameters and carrying out laboratory test from which erodibility indices were computed. The results showed that Ayegunle-Akoko with index of 0.082 has the highest erodibility index while Ajowa-Akoko has the least one. From these findings, there is need to regulate soil loss through the use of preventive measures so as to decrease the existing amount of soil loss and enhancing productivity.

Introduction
Erosion is natural and is as old as the earth itself. It affects man and its environment. It is seen as the gradual washing away of soil through the agents of denudation which include, wind, water and man. These denudation agents loose, wear away, dislodge, transport and deposit the wear-off soil particles and nutrients in another location. Erosion is therefore defined as the wearing away of soil surface through the detachment and transportation of soil and earth materials by geomorphic agents such as water, wind, moving ice, wave and man (Ebisemiju, 1979). Erosion usually washes away the top soil on which agriculture and plant life depends.

Soil erosion is one of the most serious forms of land degradation in the world (Nanna, 1996; Sohan and Lal, 2001). More than 56% of land degradation is caused by soil erosion, raising a global concern on land productivity (Elirehema, 2001). Changes in land use due to urbanization, agricultural expansion and monoculture productions have led to accelerated and spatial increase in erosion.

Soil erosion is a detrimental process both on-site and off-site. Soil erosion not only reduces soil depth, but also reduces the capacity of soils to hold water due to sealing, and depletes plant nutrients in the soil. This reduces soil productivity and causes long term reduction in crop yields (Nanna, 1996), since the necessary plant nutrients are washed away. It is estimated that crop production becomes uneconomical on 20 million hectares of land annually (Elirehema, 2001). This raises concern about the ability of land to feed the ever-increasing population. Moreover, water erosion also creates off-site environmental problems, such as water pollution, siltation of reservoirs and degradation of coastal ecosystems. It is thus necessary to understand where erosion is taking place in order to design sound conservation measures (Kadupitiya, 2002).

Study Area
Akoko region is located north-east of Ondo State and South-West of Nigeria. The region lies within longitude $5^0$31' E to $6^0$06'E and latitude $7^0$18'N to $7^0$45'N. Akoko region covers an areal extent of about 2465.6km^2. Akoko region is situated at an altitude between 270m and 2750m above sea level. Most parts of the region have undulating terrain, which in many cases are almost completely encircled by high rugged rock outcrops, rising to a height of over 2750m in some places.

Geologically, Akoko region is a physiographic region characterized by two major crystalline basement rocks of the main African Precambrian shield. These are magmatite and granite gnesis, with quartz and pegmatite veins. These rocks belong to the migmatite-gnesis sub-classification of the basement complex of Nigeria. Akoko region is located within the humid tropical climate of the forest region, which experiences two climatic seasons namely the rainy season (April – October) and the dry season (November – March).

Soil Erodibility
Soil erodibility is an estimate of the ability of soil to resist erosion based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved structure have a greater resistance to erosion (Wall et al. 1987).

A soil with relatively low erodibility factor may show signs of serious erosion, yet a soil could be highly erodible and surfer little erosion (Nyakatawa et al. 2001). 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 (LS), crop factor (C) and control practice factor (P). This is represented in the Universal Soil Loss Equation as (Renard et al. 1997).

A = R× K× L×S× C× P.

Erodibility is the resistance of the soil to both detachment and transport. 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 standardized. Erodibility varies with soil textures, aggregates, stability, shear strength, soil structures, infiltration capacity, soil depth, bulk density, soil organic matter and chemical constituents (Agassi and Bradford, 1999).

The depth of erosion is very often determined by the soil depth. Soils 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 gravel (Morgan 2001).

The organic and chemical constituents of the soil are important because of their influence on stability of aggregates. Soils with less than 2% organic matter can be considered erodible (Evans 1980). Most soils contain less than 155 organic content and many of the sands and sandy loams have less than 2%. Morgan (2001) suggested that soil erodibility decreases linearly with increasing organic content over the range of 0 to 10%.

The objective of this study is to evaluate the soil erodibility indices of some communities in Akoko region in order to ascertain areas prone to severe erosion and to predict soil losses by erosion under the same environmental condition.

Research Methodology

Soil Erodibility Determination

The method of field test developed by Wischmeier *et al*. (1958) was used to determine soil erodibility. Samples were collected from depths ranging from 0-20, and 20-50 centimeters for soil structural classification. The in situ permeability test was also used along with the field test of dropping clods from known height.

Laboratory Test:

The hydrometer test was carried out to determine the percentage of sand, silt and clay in the samples of soils taken from these communities. From this, erodibility index (*K*) was determined using Bouyoucos (1935) equation.

K equation = $2.8\times10^{-7}M^{1.14}(12-a)+4.3\times10^{-3}(b-2)+3.3\times10^{-3}(c-3)$

Where K = soil erodibility factor,

M = ((100-%clay)×(%very fine sand +%silt))

A = % organic matter

B = soil structure code

C = profile permeability class

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

$$\% \text{ sand} = \frac{\text{sample weight} - \text{40 seconds reading}}{\text{Sample weight}} \times 100$$

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

% silt = 100 - (%sand+ % clay).

Erosion Prediction

Using the relationship given by Roose (1977), the rainfall factor (*R*) was determined:

$R = 0.5\ H$,

where *H* is the mean annual rainfall.

Prediction of the amount of soil loss in each of these communities was carried out putting this in the revised USLE equation:

$A = 2.24\ R\ K$,

where *A* is the soil loss converted to tons/ha/yr by multiplying by 2.24 , *R* is the rainfall factor and *K* is the erodibility factor (Hudson 1995).

Results

The results of the determined erodibility indices in the study area are shown in Table 1. From the erodibility indices of the soils in the various communities, it was observed that the soils in Ayegunle Akoko were more erodible with a value of 0.082. The least index was found in soils at Ajowa Akoko (0.056). The results of the predicted soil losses in the study area are also shown in Table 4.2. Ikare Akoko had the highest predicted soil losses of 9.69tons/ha/yr. This is followed by Ayegunle Akoko (9.63tons/ha/yr) and Ayepe-Iwaro Akoko (9.40 tons/ha/yr). Ajowa Akoko has the least predicted soil losses of 5.99 tons/ha/yr.

From the particle size analysis sandy soils were found to be the most common. Sandy soils are known to have low cohesive force and therefore are more prone to detachment and transportation by water and wind. Furthermore, high sandy soil content encourages high rate of permeability of water into the soil which induces landslide and erosion. The estimated annual soil loss rates were classified into five severity classes in a modified version after Chinatu (2007) that is

no erosion (0-1 tons/ha/yr), slight (1-5 tons/ha/yr), moderate (5-10 tons/ha/yr), severe (10-20 tons/ha/yr) and very severe (>20 tons/ha/yr). According to Chinatu (2007), the appropriate measure of soil loss over which agriculturist should be concerned is 10 tons/ha/yr. The predicted soil loss rates for the study area are generally moderate. The annual soil loss erosion predictions for the study area ranged from 5.99 tons/ha/yr at Ajowa-Akoko to 9.69 toons/ha/yr at Ikare Akoko. Determining soil loss rates helps in understanding the efforts needed to save the physical quality of land and ultimately holds valuable information for developing necessary conservation strategies.

Table 1. Erodibility Index (K) and predicted soil losses for the various communities using Hudson (1995) equation

S/N	Location	Average k-index	Soil loss (tons/ha/yr
1	Akungba Akoko	0.072	8.46
2	Oba Akoko	0.066	7.75
3	Ayegunle Akoko	0.082	9.63
4	Oyin Akoko	0.071	7.56
5	Ifira Akoko	0.072	8.60
6	Ipe Akoko	0.072	8.60
7	Auga Akoko	0.072	8.83
8	Ikaram Akoko	0.061	6.52
9	Erusu Akoko	0.074	7.91
10	Apepe-Iwaro Akoko	0.080	9.40
11	Ikun Akoko	0.064	7.52
12	Ajowa Akoko	0.056	5.99
13	Epinmi Akoko	0.057	6.81
14	Supare Akoko	0.062	7.28
15	Ikare-Akoko	0.079	9.69
16	Oke-Agbe Akoko	0.074	7.91
17	Afin-Akoko	0.071	7.59
18	Ugbe-Akoko	0.069	8.47
19	Isua-Akoko	0.067	8.00
20	Arigidi-Akoko	0.072	7.70

Conclusion

The soil erodibility factor (K) represents the combined effects of susceptibility of soil to detachment and transportability of the sediment, and the amount and rate of runoff given particular rainfall erosivity. Data analysis showed that Ayegunle Akoko with index of 0.082 had the highest erodibility index while Ajowa Akoko with 0.056 had the least one.

In order to prevent soil erosion, some preventive measures planting cover crops and mulching should be put in place. Vegetation is the key to the prevention of soil erosion. If all soils were perpetually covered with mature forests or grass, accelerated erosion would not be a problem. So, there is need to discourage deforestation and also in areas where the erodibility indices were high for example at Ayegunle-Akoko, there is need to plant cover crops such as leguminous species in order to add nutrients to the soil as well as checking the soil.

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