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Approaches to Studying Soil Erosion Problems in a Tropical Environment:An Overview

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Abstract: This study search is a contribution to the explanation of the nature, causes, problems of erosion and acceptable procedures for successfully studying the problems especially in the tropical environment where the erosion problem is most rife. Thus, the literature search has succinctly discussed the methodologies for studying the erosion problems with a view to proposing appropriate management measures.

Key words: Soil erosion problems, technique of study, an overview, tropical environment

INTRODUCTION

Erosion is a process-oriented theme that requires an in-depth knowledge of the subject matter and the methodological procedures involved in investigating it. Recently, erosion menace has become a global affair. For instance, Floyd (1964) has identified erosion problems in Nigeria as far back as 1910. Since then, the menace of erosion had been on the increase (Oyegun, 1980, 1982, 1983; Jimoh, 1994a, b, 1997, 1998) among others.

The techniques of studying this geomorphic phenomenon vary in both approach and conceptua-lisation. For example, Imoroa (1984) observed that the field of geomorphology has witnessed remarkable changes in both scope and methodology. Thus, it is crucial to evolve appropriate techniques of studying a geomorphological oriented issue. This study therefore employs literature search to expose, prospective workers or researchers to the available methodology in soil erosion studies.

Data required in erosion studies: Erosion studies is a diverse area in geomorphological investigation. Thus, the aspect of erosion study decides in most cases the type of data required to accomplish the philosophy of the work. This implies that data must be sourced with the sole intention of meeting the objectives of the study (Oyegun, 1980, 1983, 1986; Butzer, 1974; Jeje, 1982; Jeje and Agu, 1990; Kowal 1970; Lal, 1981; Lewis and Lepele, 1982; Morgan, 1978, 1980, 1985; Jimoh, l994a, b, 1995, l997a, b). But, there is the general observation from these studies that possibilities are there for these data to be grouped under rainfall and landscape variables (Oyegun, 1980; Jimoh, 1988). Rainfall variables include rainfall total amount, intensity, duration, kinetic energy, frequency of fall, terminal velocity, drop sizes and the parameters of run off, while the landscape variables include the soil factor, plant covers and the slope gradient. However, some variables in erosion studies in an environment may be socio-economic in scope.

Generally, the central tenet of any study on erosion decides the category of data required to accomplish it. Of course, it is not impossible to combine 2 or 3 categories of data to address the issue (Oyegun, 1980; Jimoh, 1998). However, Rowland depended on a category of data to address an erosion issue. This therefore means that there is the need to exercise some measure of caution in selecting the categories of data suitable for particular research question(s).

METHODS OF EROSION STUDIES

To fully address this section requires that, some problem areas on erosion must be mentioned in order to properly propose an appropriate method of collecting data for solving it. One problem area is incidence of soil loss.

The various problems put in place due to the activities of geomorphic events are known as erosion problems. These problems relate to the exposure of football pitches, foundation of houses, road networks and graves among others. Data on any of this erosion problem require that, the depth, width, length of such exposure by erosion be estimated with graduated measuring tapes. Also, the ages and construction materials of such structure may equally be sought through questionnaire administration (Jimoh, 1998). However, these approaches vary slightly with respect to a discussion on the problems of soil erosion occasioned by erosional processes. For example, Morgan (1978) observed that the required data easily generated through the installation of run-off plots. On the other hand, Jimoh (1995, 1997a, b) has consistently subscribed to the use of erosion pins.

Table 1: Previous works on erosion using run-off plots of different sizes

Author	Year	Plot sizes
U.S.D.A.	1936	6.69 m^2
U.S.D.A.	1939	0.23 m^2
Ekem	1951	0.14 m^2
Osborn	1953	0.14 m^2
Smith and Wischmeier	1954	39.20 m^2
Glymph and Wischmeier	1957	5.40 m^2
Kowal, J.M.	1970	1.464 m^2
Meeuing	1970	0.39 m^2
Chubatty	1970	1.0 m^1
Bridges and Harding	1971	0.05 m^2
Weyman and Kirkby	1974	0.11 km2, 0.3 km^1
Jeje, L.K.	1977	0.07 Km^1
More and Thomas	1979	100 m^2
Barber	1980	1.5 m^1
Oyegun R.O.	1980	1.51 m^2
Jeje and Agu	1990	100 m^2
Jimoh, H.I.	2001	0.51 m^2

Source: Oyegun (1980) and updated by Jimoh (1997)

Application of run-of plot: Normally, sediment traps should be installed on the identified land use types. Usually, the sizes of the traps vary from 100-0.51m^2 (Table 1). In any case, the sizes of sediment traps decided upon might be informed by a number of factors. The first is that the experimental site is homogenous in terms of the geology, soil, among others. Another factor, is the monetary cost involved in constructing sediment traps (Ameyan, 1986). Finally, there is the necessity of sample small plots because the collection and weighing from large traps could be cumbersome. It is therefore necessary to extrapolate data from small field plots to large ones representative of the small ones (Smith and Whischmeier, 1962). Essentially, the materials for constructing sediment traps may be wooden or metallic in nature. However, the materials must be capable of resisting both decay and desiccation. The sediment traps must be sufficiently high (i.e. 10 cm out of which 2 cm must be designed to be buried in the ground). This type of height is expected to prevent both water and sediments from splashing into them on the site (Fig. 1 and Plate 1).

Application of erosion pins: This is perhaps one of the conventional techniques for estimating erosion rates over a given land use type (King, 1966; Goudie, 1981). Erosion pins may be a sharp wood or iron rod. Also, the nature of the materials must be robust enough to withstand decay and desiccation (Garland, 1987). The iron pins can be marked with gloss paint at predetermined intervals from tip to the middle of it. Also, the top of the pin may be painted in red colour to make pins visible to the eye while on the field. Although, the application of erosion pins to estimate erosion rates indicate the rate of ground lowering at a point. However, where an appropriate number of erosion pins have been installed, a fair knowledge of erosion rates over the land use type

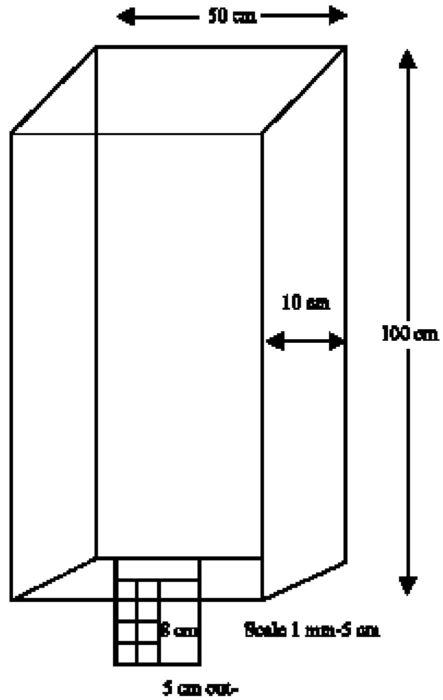

Fig. 1: Diagram showing a typical sediment trap

Plate 1: A typical way of installing Sediment traps and Erosion Pins. Note: a-Sediment traps, b-Erosion Pins, c-Cellophane paper covering the rubber containers

can easily be estimated. Thus, while installing pins it will be much more rewarding to insist in determining the required number of erosion pins. This indeed brings us to the next section of this discussion.

Determination of the appropriate sample size: This involves the conduction of a pilot survey in order (a) to create a base for explaining the minimum sample size required for the research work conceived and (b) to ascertain the performance level of the research tools. In the process, install a convenient number of erosion pins say 15 pins over each of the land use type identified during the preliminary stage of the investigation. Further, take reading for 5 or 10 consecutive times. In addition, calculate the condescriptive statistics on the collected

data from the pilot survey. Then, using the equivalent or formula of Snedecor and Cochran (1967), the minimum sample size can be determined.
The formula is of the form:

L = 28 n (n = Size of preliminary survey) N = $482/L^2$ at 95% level probability.

N = $6.68^2/L^2$ at 99% level probability Where, N = minimum sample size.

STD = Standard deviation, L limit of accuracy of the estimated means.

Jimoh (1997) applied this equivalent with high level of success. Erosion pins should be carefully driven into the required land use type until the last marked portion reaches the ground level, which is usually indicated by the pin washer. After each rainfall as the case may be, the pins should be inspected in turn to see the depth of the marked portion that have been exposed. Such exposed portion can then be collated and recorded as the depth of erosion for the land use surface under investigation. It is important to note that, the use of erosion pins for studying erosion rates on different land use types as the case may be, can be complemented with the application of sediment traps (Jimoh, 1997, 2001).

ANALYTICAL FRAMEWORK

The aspect of erosion problems under investigation also suggests the appropriate analytical framework to employ. But, generally, the following analytical tools are well known in soil erosion studies.

Descriptive analytical techniques in erosion studies: Descriptive statistics such as mean or average, mean deviation, standard deviation, range, variable and coefficient of variation among others are commonly used in erosion studies (Hammond and Mccullagh, 1974; Silk, 1979). This method of analysis especially mean or average can tremendously assist in data summary, which enhances representation. Since, generation of data in erosion studies is in most cases massive, this analytical tool is therefore invaluable.

Bivariate analytical techniques in erosion studies: The Pearsonian product moment correlation coefficient is required in establishing the degree of relationship between pairs of data and to also explain how a change in one set of data can affect the other pair. Put simply, the assumption underlying the applications of Pearsonian product moment correlation are basically two folds (Jimoh, 1997):

- To ascertain the degree of interrelationships among the parameters.
- To ideniify those parameters that has strong relationship with the dependable variable.

The simple bivariate correlation coefficient does not only summarise the strength of associations between 2 variables, but also provides a simple means for comparing the strength and direction of the relationship. However, this analytical tool is not able to resolve the problems of multicollinearity. Thus, to address the problems of multicollinearity requires an application of a further statistics i.e. multiple or bivariate regression equations with reasonable R^2 value. Regression model is usually in two main forms of simple and multiple regression. The application of simple regression model in research works is common among scholars such as Oyegun (1980), Morgan (1980) Jimoh (1998, 1994, 1997a) among others.

However, multiple regression analysis have been observed by many scholars to handle a large mass of data, asserts relative explanation of each variable to research problems and indicate the nature of relationships between data (Mason, 1967; Wonnacott and Wonnacott, 1977; Ebisemiju, 1976; Dubois, 1979).

Generally, in the application of regression models, efforts are usually on obtaining regression coefficients that are not only stable and reliable but at times with a high coefficient of multiple detennination (R^2).

Multiple regression. Models in erosion studies: The stepwise multiple regression is essentially a search procedure with a prime focus on identifying the independent variable that actually posses strong relationship with the dependent variable(s). As a matter of fact, this analytical tool involves adding one variable at a time to the regression equation (Draper and Smith, 1966) and this form of adding variable in turns to the equation based on their partial correlation with the dependent variable(s). In entering a variable into a regression equation, F-test is immediately performed to show whether the contribution of the variable to the explanation of the variance is significant. Also, a new R^2 is computed and its significance is again ascertained by an F-test. This process is continuous until the recently entered variable is found insignificant by the partial F-test (Ebisemiju, 1976; Oyegun, 1980) for further explanation. The method of stepwise multiple regression assists greatly in resolving the problems of muiticollinearity. Further, it has the strength to produce models that utilize a small number of predictor variables judged significant by the partial F-test. Thus, this technique of stepwise multiple regression is very rewarding for predictive purposes.

Generally, the application of this analytical tool can greatly assist in generating bivariate regression models and have the ability to enhance predictions too.

CONCLUSION

The problems of soil erosion in any region are steadily increasing. This means either that erosion problem does not receive adequate attention or the approaches to its study have been most inadequate. In this study various aspects of erosion problems have been highlighted, the required data carefully spelt out and the analytical framework equally discussed. It is therefore hoped that, the seemingly intractable problems of soil erosion may soon be halted or reduced to minimal level, within a given period of time in any place where the incidence of soil erosion has taken place.

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