EFFECTS OF SURFACE RUNOFF ON AGRICULTURAL ROADS IN OFFA LOCAL GOVERNMENT AREA OF KWARA STATE

By

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BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN AGRICULTURAL AND BIO RESOURCES ENGINEERING.

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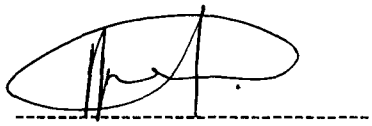
DECLARATION

I hereby declared that this project is a record of a research work that was undertaken and written by UTHMAN ABDULWAHEED. It has not been presented before for any degree or Diploma or Certificate at any University of institution information derived from personal communications, published and unpublished works of others were duly referenced in the text.



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CERTIFICATION

This project entitled "Effects of Surface Runoff on Agriculture Roads in Offa Local Government Area of Kwara State" by UTHMAN ABDULWAHEED meets the regulation governing the award of the degree of Bachelor of Engineering (B. ENG) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentations.

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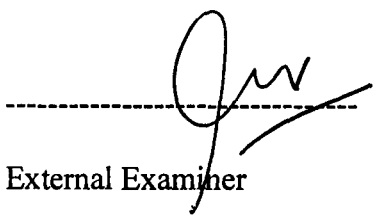

External Examiner

18/11

Date

DEDICATION

The report of these studies is dedicated to Almighty Allah, the most gracious, and the most merciful and most passionate for his incomparable blessing and mercy showered on me throughout my studies.

It also dedicated to my beloved Mothers Alhaja Afsat Aduke Aderibigbe Usman and Mrs. Sidiqot Adeduntan Arinpe Bisiriyy (S.A.A.B).

Also to Arch. (Sheik) Sulyman Hussayn's family, Engr. Muhi-deen Olasunjo Bisiriyy Uthman's family, Mr. Sulyman Aderibigbe's family, Chief Abdulrasaq Kukogi's family and the entire Usman Aderibigbe's family.

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ABSTRACT

The Degradation of agricultural roads is mostly depends on the surface runoff. The effects of this surface runoff on Agricultural roads need to be corrected. Two questionnaires were designed for the purpose of this study. One went to the farmers and the second one went to the drivers. After the completed questionnaire were returned, they were subjected to two statistical analysis namely: regression analysis and analysis of variance (ANOVA).The regression analysis result based on statistical significant level and the probability value of the parameters considered, three parameter were emphasized. These were maintenance level, problem encountered during raining season, and blocked drainage system with probability value of 0.00, 0.06 and 0.005 respectively. The standard statistical value is 0.05 for significant level while any value greater than 0.05 is insignificant, by comparism, one can see that maintenance level, problem encountered during raining season and blocked drainage system are significant in surface runoff control scheme. Then it concluded that, to have a smooth roads, the roads are need to be maintained, adequate road side drainages must be made available, increase depth of the existing drainage systems and re-construct the dilapidated drainage system.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Runoff is the portion of the precipitation that makes its way towards stream, channel or oceans as surface or sub-surface runoff. When snow or rain falls onto the earth surface, it moves a coding to law of gravity, a portion the precipitation seeps into the ground to replenish earths ground water, most of it flows down hill as runoff (Perlman, 2005).

Runoff occur only when rate of precipitation exceed the rate at which water infiltrates into the soil after infiltration rate is satisfied water begins to fill depressions small and large, once the depression are filled, overland flow of water beings (Schwab, 1981)

Runoff is extremely important not only does it services rivers and streams, but also changes the landscape by action of erosion (Perlman, 2005) water erosion is the r removal of sol from earths surface by running water. Water transportation involves kinetic energy which removes a transports the soil particles and the resisting forces which retards erosion.

Flowing water has tremendous power, it can move boulder and carve out Canyons (Perlman, 2005). There two main types of erosion namely: - water erosion and wind erosion the water erosion needs to be controlled to maintain motor-able agricultural roads crop productivity sedimentation and pollution in streams. Erosion problem are principally cause by human exploitation of natural resources and the removal of protective over of natural vegetable (Schwab, 1981).

Runoff can be explained further a the part of precipitation , snow melt or in uncontrolled surface, stream, rivers, drain, severs or roads, runoff may be classified according to the speed of appearance after rainfall or melting snow as direct runoff or base runoff according to the source as surface runoff, storm inter flow or groundwater runoff (Perlman, 2005).

1.2 Surface runoff

Surface runoff is the term used to describe the flow of water form rain, snow melt, or other sources over the land and is a major component of water cycle. Runoff that occurs on surface before reaching a channel is called onn point source if non point source contains man made contaminants, the runoff is called non point source pollution .. A land area which produces runoff due to common point is called watershed. When runoff flows along the ground, it can pick up soil contaminants in particular herbicides and insecticide that became discharge or non point source pollution. Water shed is absorbed into soil by infiltration, stored as ground water and slowly discharge into stream through seeps an springs (Wikipedia, 2007).

As watershed is urbanized, much of the vegetation is replaced by impervious surface, thus reducing the area where infiltration to ground water can occur. Thus, the more the storm water runoff occurs, the more the runoff that must b collected by expensive drainage system which curbs, storm servers, and ditches to carry storm water runoff to stream. Or simply in a developed watershed, much more water arrives into a stream, much more quickly resulting in an increased likelihood of more frequent and more severe flooding (Perlman, 2005).

Drainage ditches to carry storm water runoff to storage pond are often built to hold runoff and collect excess sediments in order to keep the runoff off agricultural roads. Runoff from agriculture land even our own yard can carry excess nutrients such as nitrogen and phosphorus into stream, lakes and ground water supplies these excess nutrients have the potential to degrade water supply quality and roads.

As more development and urbanization occur, more of the natural landscape is replaced by impervious surfaces such as roads, parking lots and building that reduces infiltration of water into the ground and accelerate runoff to ditches, stream or roads. In addition to increasing imperviousness, removal of vegetation and soil, grading the land surface and constructing drainage networks increase runoff volume and shorten runoff time into streams form rainfall and snow melt. As a result, the peak discharge, volume and frequency of floods increase in nearby streams (Perlman, 2005).

1.3 Aim

The aim of this study is to analyze the effect of runoff on agricultural roads, the causes of the runoff and its contribution to economy.

1.4 objectives

i. To determine the effect of surface runoff on agricultural roads.

ii. To determine the effects of runoff on the farmers economy and revenue

iii. To determined effects o runoff on agricultural produce transported on the roads.

iv. To correct surface runoff on the agricultural roads

v. To suggest possible ways to keep surface runoff off the agricultural roads in the area consider for the study (Offa) in minimal

1.5 Justification

The study has enormous significance to many communities in the sense that it asses the agricultural quality of their land and roads, and estimate the loss resulting from surface runoff. Consequently this project willing gathering

Information on soil degradation in Offa due to water erosion and

Base line data on erosion in Offa which can be used for the design of erosion or runoff control.

A basis to determine the suitability of land to crop plant cultivation and construction.

CHAPTER TWO

2.0 LITERATURE REVIEW

Several research have been carried out on runoff, but majority has been concentrating on its effect on agricultural farm land.

Bransiek (1959) showed that the selection of runoff data for a year rather than for a calendar year can greatly improve the reliability of results. The data for the beginning of a water year varies with geological location but in general i.e. coincides the season of minimum runoff (Board mar et al 1990).

Runoff is that portion of precipitation that finds its way into streams, channels, lakes and oceans as surface and sub-surface flow. Rain falling on the landscape may flow quickly over soil or rock surface as runoff into stream channels. Alternatively, some water may flow more slowly down slope towards streams within the soil. Some may percolate downward through pores in soil and fractures in rock to reach the top of the saturated zone (water table). Below the saturated zone, it flows much more slowly as groundwater (Wikipedia, 2007).

Runoff occurs after precipitation satisfied the water demand of infiltration, surface detention, channels detention and interception by foliage. Interception by dense cover of forest or shrub common amount to 25 percent of the annual precipitation (Schwab, 1981).

In 1974, U.S army corps of engineering provides one of the earliest computer program to use a basic rainfall runoff mathematical relationship to calculate the program STORM was applied to two basins palm beach gardens and mangnolia ranch in 1975 at cencolocklatche river to evaluate the mathematical relationship

By multiplying runoff rate with time give volume in meter cube (Board mar, 1990).

$$\text{Runoff rate} = \frac{volumeofrunoff}{timetaken} \qquad 2.1$$

$$= \frac{L^2}{t}$$

Where volume is expressed in dimension and time volume of runoff = runoff rat ex time

$$= \frac{L^2}{t} \text{ x t} \qquad 2.2$$

$$= L^3$$

$$= m$$

Where L is dimensional analysis in length and n is in meter cmj and t is time in seconds.

Quantity of runoff discharge is the product of rainfall intensity and yielding area (Board mar, 1990)

$Q = Ai$

Where

Q = runoff rate

A = contributing area (m^2)

L = rain intensity m/hr

$$\text{Runoff coefficient} = \frac{runoffvolume}{rainfallvolume}$$

And contributing are a= Q/I. 2.3

(Boardmar, 1990) reported that, in 1889 kruching concluded that the ratio of Q/L is the rational value that can be used for the design of sewer system an the value of runoff

coefficient is equal to the content of impervious surface divide by total area, assuming no drainage from the pervious surface.

Dao (1993) reported that the runoff volume from heavily grazed permanent grass land is at least double that from lightly grazed area and nearly twelve times grater than that of ungrazed (temporary land). According to duo (1993) this is comparable with the result of mccoll in (1979) who found out that runoff volume was seven time greater from grazed area when compared with ungrazed pasture.

Dao (1993) further reported that pollutant in storm water have strong affinity to suspend solids transported during storm events subsequently the removal of the pollutant and nutrient attached to solid particles and most of the pollutant are associated with the smaller particles fraction less than the micrometers (μm) in diameter. Settling pollutant, saturated particles occur as discret individual particle and cluster of smaller particle fuse into large ones, thus, accelerating their settling rate

Whipple and hunter (1981) concluded that settling rate of pollution in runoff it vary greatly and particle of bigger size cannot be transported and distributed according to settling rate.

Runoff water contains a wide variety of sediment particles that are different with respect to their specific gravity and how they absorb metals and other pollutant (Dao; 1993).

2.1.0 Factor Affecting Runoff

The factor affecting affection runoff may be divided into those associated with the precipitation and watershed. The geological and soil material determined to a large extent that the infiltration water holding capacity, thus on runoff. Vegetation cover and cropping

pattern also influence infiltration and runoff. Vegetation retards overflow and increased surface detention to reduce peak runoff rate (Wikipedia, 2005).

2.1.1 Rainfall duration

A storm of shorter duration may produce no whereas, a storm with the same intensity but longer duration will result into runoff, long duration storm will produce much more runoff than storm of shorter storm. Duration is measured in precipitation per day.

2.1.2 Rain intensity

Rain intensity influences both the rate and the volume of runoff. An intense storm exceeds greater the infiltration capacity by a greater margin than does a gentle rain. Thus the total volume of runoff is grate for the intense storm even though total precipitation for the two is the same. The intense storm actually may decrease the infiltration rate because of it destructive action on the soil structure at the surface (Schwab et al, 1992).

Rate and volume of runoff from a given watershed are influences by the distribution of rainfall and rainfall intensity over the watershed. However, an intense storm on one portion of the watershed may result in greater runoff than a moderate storm over the entire watershed (Dandeker, 1982) may be expected to occur

2.1.3 Watershed.

Watershed factors affecting runoff are six, shape, orientation, topography geology and surface contour. Both runoff volume and rate increase and watershed size increase. However, both rate and volume per unit of watershed size may determine the season at which high runoff may be expected to occur (Schwab et al, 1992).

i. First, the increased amount of water flowing into streams during storms causes larger flood and runoff, and they build to peak faster because of them rapid flow of water covers smooth surface

ii. Second, motor vehicles leave oil and exhaust residue on streets, and household and industrial chemical also collect on the pavement surface. These non point source pollutants are readily washed off during storms, contaminating streams into which urban runoff flows. Careless disposal of hazards wastes on street or into storm drain adds to the problem

iii. Third, most precipitation has a chance to percolate downward to groundwater, so the supply of groundwater to well is reduced many steps have been taken to reduce these impact, pavement can be constructed so that water can pass through the recharge ground water and storm runoff can be noted to artificial basin that allow water soak (Lawrence, 1994).

According Board mar et al, (1990), the volume or directed runoff form simple storm can be estimated from the following

$R = P.L.G$

Where

R = direct runoff

P = precipitation

L = basin recharge

G = Groundwater acceleration

2.1.4 Topography.

Topography feature includes slopes, the degree of development and gradient of channels and the extent and number of depressed areas as affected by rate and volume of runoff. Water have extensive flat area with steep, well defend drainage patterns..The geologic or soil materials determined to a large extent, the infiltration rate, and thus affect runoff (Schwab et al, 1992).

2.1.5 Vegetation.

Retards overland flow and increases surface detention to reduce peak runoff rates. Structure such as dam, levees, bridges and culverts all influence runoff rate.

2.1.6 Infilteration rate

Soil characteristic, plant and animal, and slope angle are among the natural factors controlling the proportion of precipitation that are converted runoff in a given landscape, and time it takes for runoff to enter a stream. Human changes to these landscape features can greatly influence runoff. Rain falling on the areas where unfractured bedrock is expose has little opportunity of infiltrate, and instead will runoff the surface. (Wikipedia, 2007)

2.2 Runoff and urban development.

Urban development can greatly increase the amount of precipitation that is converted to runoff in a drainage basin. Most paved surface and rooftop allow no water infiltrated, but instead diverts water directly to storm channel and drain urbanized is serous concern to water resource for several reasons some of these reasons includes

It may be necessary to estimate monthly or annually stream flow from precipitations date. In estimating runoff volume for long periods the destination between direct and groundwater runoff is usually of no concern the must accurate method of estimating long term runoff is probably as a summation of storm amount over the period of a year.

The seasonal distribution of precipitation may be important the runoff. Scattered summer showers usually produce less runoff than general one. Consequently it may be necessary to use monthly or seasonal precipitation dates as separate parameters in an annual rainfall runoff relations.

It is often desirable to predict the total of runoff that may come from water shed during a design of flood. Total volume is of primary interest in the design of flood control reservoir. (Schwab et al, 1992).

2.3 Soil conservation

This method was developed many years by soil conservation service (SCS). The equation to estimate runoff volume is given as:

$$Q = \frac{(1-0.25)^2}{1+0.85^3} \qquad 2.4$$

Where

Q = direct surface runoff depth in mm

I = minimum potential difference between rainfall and runoff in mm, starting at the time the storm begins.

2.4 Design of runoff rate

Method of runoff estimation necessary neglect some factors and make simplifying assumption regarding the influence of other (Schwab et al, 1993).

The capacity of a structure that must carry runoff be termed the design of runoff structure. Channels are planned to carry runoff that occurs within a specified return period. Vegetated control and temporary structure are usually design for a runoff the may be expected to occur once in ten year (10 year). Expensive, permanent structure will be designed for a runoff that is expected to occur only once in 50 to 100 years. Selection of the design return period also called re-occurrence interval depends on the economic balance between the cost of periodic repair or replacement of the facility and the cost of providing additional capacity to damage potentially resulting from failure of the structure may dictate the choice of the design frequency(Schwab et al, 1992).

2.4.1 Rational method

According to Schwab, 1993, the rational method of predicting a design peak runoff rate is expressed in the equation of

$$q = 0.0028CIA \qquad 2.5$$

Where

q = the design peak runoff rate in 3m/s

c = the runoff coefficient

c = rainfall intensity mm/hr for the design period and duration equal to the "time " of concentration of the watershed

A = area of watershed in hectare.

The time of concentration of a watershed is the time required for water to flow from the Most remote point of the area to the outlet once the soil become saturated and fill minor depression. It is assumed that when the duration of storm is equals to the time of concentration, all parts of the watershed are contributing simultaneously to discharge at

outlet. One of the most widely accepted method of computing the time of concentration was developed by Kirpich (1990).

$Tc = 0.0195L^{0.77}$ and $S8^{0.385}$

Where

Tc = time of concentration in minute

L = minimum length in meters

S = the watershed gradient mm/m or different in elevation between the outlet and the most remote divided by the length l

Soil conservation service in 1972, developed a method for computing the time of concentration that consider length of the main channel, topography, vegetation cover, and infiltration rate. Horn and Schwab (1993) found that Soil Conservation Service value of watershed lag time and is called soil conservation service method by SCS (1990)

Where

Tp = time peal (T)

D = duration excess rainfall (T)

TL = time of lag (T)

Tc = time of concentration

2.4.2 Flood frequency analysis method

One method of runoff estimation, called flood analysis depends on the existence of a number of year of record from the basin under study (schwab, 1993). These records constitute a statistical array that defined the probable frequency of recurrence of flood of given magnitudes. The procedure for this method can also applied for rainfall and is given below as

$$i = \frac{KT^{x}}{tn} \qquad 2.6$$

Where

i = rainfall intensity

k, x, and n = constants for a given geographical location

t = duration of storm in minutes

T = return period in years

A complete analysis of rainfall frequency data was prepared by Hershfiedl (1961)

2.3 Erosion

Soil erosion is considered as one of the most serious form of soil degradation in all region of the world. It is a primary source of sediment that pollutes streams and fills reservoir water with sediment, nutrients, and pesticides increasing cost of water treatment soil erosion can however be categorized into (2).

i. **Geological erosion:** - geological erosion includes soil forming and soil eroding process that maintain the soil in a favorable balance suitable for the growth of plants. Geological erosion contributed greatly to the formation of soil and its distribution on the earths surface this long time eroding process cost most of the topographic features such as canyons, stream, channels and valleys (Lawrence, 1994).

ii. **Acceleration erosion:-** this is most difficult and prominent eroding activity facing mankind. It involves breaking down of soil aggregate and sudden removal of organic and mineral particles and construction where alters natural state of the environment.

2.3.1 Type of erosion

i. erosion by water

ii. erosion by b wind

The water erosion is the detachment and transportation of soil from the land by running water. Including runoff from melted snow and ice.

Type of water by erosion include interrill, rill, sheet, gully and stream erosion (Schwab, 1999).

2.3.2 Type of water erosion

i. raindrop erosion

ii. sheet erosion

iii. interrill erosion

iv. rill erosion

v. gully erosion

vi. stream channel erosion

i) **Raindrop Erosion :-** this is soil detachment and transport resulting from the impact of water drop directly on soil particles or on the water surface although the rain drop on shallow stream may not splash soil it does increase turbulence providing a grater sediment carrying capacity . According the relationship between rainfall intensity and energy was been found to be $E = 0.119 + 0.0893\log10i$ (Fostal et al, 1981).

Where E = kinetic energy mj/ha-mm

i = rainfall intensity in mm/ha

ii) Sheet erosion: - this is the removal of fairly uniform large portion of soil form land surface by raindrop splash or surface runoff. Sheet erosion always occur on earth surface where water flow as the sheet down any grade interring soil particles of uncropping land where the soil is loosened by tillage.

iii) Interill erosion :- this is the general term combining splash and sheet wash erosion. Laflen, 1986 reported that interil erosion is a function of soil properties, rainfall intensity and slope. the relationship among these parameters is generally expressed as

$$Di = Ki\ L^2\ Sf \qquad 2.7$$

Where

Di = interill erosion rate kg/m-s

Ki = interill erodibility of soil in kg-1/m4

Sf = slope factor = 1.05-0.85 emp (-45sint)

(Liebenow et al)

iv) Rill erosion: - is the detachment and transport of soil by a concentration flow of water. Rill are small enough to be removed by normal tillage operation, rill erosion is the predominant form of erosion under most condition (Schwab et al, 1992) . rill erosion is a formation of the hydraulic shear of the flowing water in the rill and two other properties, the rill erodibility kr and the critical shear te, the shear below which soil detachment is negligence, (lane et al 1987) reported by Schwab, (1992). Detachment rate Dr is the rate of which erosion occurs beneath the submerge area of the rill the relationship among these variables

$Dr = Kr (I - Tc) (I - 0/Tc)$ 2.8

Where

Nr = rill detachment rate kg/m^2-S

Kr = rill erodibility resulting from shear ms/ntt

Tc = critical shear below which no erosion occurs in pa

Qs = rate of sediment flow in rill kg/m-s

T = hydraulic shear of flowing water in pa

Pa = ρgrs

ρ = density of water in kg/m^3

g = acceleration due to gravity m/s^2

r = hydraulic radius of rill in m

s = hydraulic gradient of rill flow

v. gully erosion:- water erosion by gully is the removal of soil by crating channels sufficiently large enough to disturb normal farming operations and the channels are too large to be filled by normal cultivation.

In tropical areas, gully growth following deforestation and cultivation has led to severe problem from soil loss damage to building, roads, ands airports (Dunne et al, 1982). The rate of gully erosion depends primarily on the runoff producing characteristic of the watershed, the drainages, area, soil characteristics, the alignment, size and shape of the fully and the scope in the channel (Bradford et al 1973) narrated by (Schwab et al, 1992) .

2.3.3 The development of gully

The development of gully, may take place either simultaneously or different period of its growth. These processes are

i. Water fall erosion or head cutting at the gully head.

ii. Erosion caused by water flowing through the gulley or by rain drop splash on exposed gully sides

iii. Alternate freezing and the wing of the exposed soil bank and

iv. Slide or mass movement of soil into the gully Schwab, 1992 reporter that from aerial photograph by an topography survey. Beer and Johnson in 1963 developed a prediction equation of the loss region in western Iowa based on watershed runoff characteristic and soil properties. Gully formation was found to depend on soil shear strength, infilteration and depth of water table by broad ford et al. (1973).

2.4 Soil loss

Schertz et al, 1989 reported that much of the reduced yield observed on eroded soil was due to a decrease in the amount of water available to plant on the eroded soil. On the sol , particularly more shallow soils on sloppy terrain, erosion may completely destroy productivity of a appropriate conservation practices are not initiated (USADA, 1989).

Soil loss may be expressed simply as volume lost from or moved on a field (Spear and Frest, 1985). Its however or useful to referred to as an area and a unit of time usually a year. The unit of check during high magnitude rainfall event. This can be difficult to establish.

2.5 Factors affecting erosion

2.5.1 Climate

Climatic factors affecting erosion are:-

i. Temperature:- is the degree of hotness and coldness of climate, it is measure by the use of thermometer.

ii. Wind:- this is the direction and magnitude of prevailing wind. Wind vane the instrument to detect wind direction

iii. Humidity:- this is the amount of water vapor present in the air

iv. Solar radiation:- this is the degree of the sun intensity reaching earth surface . it also a source of sunlight and photosynthesis for plant.

2.5.2 Vegetation

The major effects of vegetation in reducing erosion are

i. Interception of rainfall by absorbing the energy of the raindrop thus, reducing surface sealing and runoff

ii. Retardation of erosion by decreasing surface velocity

iii. Physical restrain of soil movement

iv. Improvement of soil aggregation and porosity of the soil by root and plant residue

v. Increases biological activities in the soil

vi. Transportation which decreases soil water, resulting in increase storage capacity and less runoff

2.6 Control of water erosion

Basically there are two methods of controlling water erosion namely.

i) biological method

the use of vegetation and manipulation of farming practices to reduce runoff and soil loss. Biological method are land use and crop management

land use

land use referred to the actual activity for which a particular piece of land is used for. The direct use of land can be defined as the most intensive use of land without degradation that is to say , a land will be regarded as correctly used if maximum output can be obtained from land without if maximum output can be obtained from without destruction of its structure, texture , and fertility status of the land. Planting of tree crop rather than growing seed in a slope can be considered as correct use of land. Because tree crop grown on strip slope provide adequate cover and reduce runoff and sol loss while cereals while cereals may not be able to withstand the runoff speed, although cereal can be grown slope with terrace (Schwab et al , 1992)

crop management

The use of crop management is essential to minimize splash erosion by providing maximum protective vegetative cover for the soil, this will ensure that plant nutrients in the soil are not depleted

Mechanical method deals with the use of structure to direct runoff water and to help soil loss sedimentation. These structures are mostly used on arable land, this is because arable land are more susceptible to erosion and as there are on permanent vegetative cover and the crop yield which is our main aim does not fall. The manipulation of slop length (L) conservation practice (P) and crop management (C) help to reduce soil loss and runoff (Schwab et al, 1992).

The following crop management practice can be use for the manipulation

1) **grazing pasture:-** the pasture within the area for grazing must be well handled, that is there must be correct animal population and on no account must be land be overgrazed, this leads to compaction resulting in infiltration reduction capacity and increases soil loss and runoff.

2) **Plant population:-** plant population can be defined as the number of plants per unit are of land. Maize which a row crop as often be regarded as soil degrading crop but recent recently studies have shown that maize could be a soil conserving plant it is planted at various population . in an experiment , maize grown at 28 thousand plants /hectare saved loss of 12.3tonnes/hecttres of sol in one year but when the population was increased to 370000 plant hectare the soil loss was reduced to 0.7 tone /ha in one year. Thus maize can be a soil degraded or conserver depending on the population at which it is plated (Schwab, 1992).

Temporary structure

Temporary structure can be recommended on l in situation where cheap labour and material can be used. Increasing mechanization and high labour cost have resulted in the popular temporary structure may be constructed of cressited planks , rocks, logs, woven wire or earth (schwa, 1992).

Smith 1985) reported on the performance of 50 temporarily structure that has been used on the soil conservation service (SCS) experimental field at bater, Missouri only 5 percent of the structure fund to have functioned as included . It has been concluded that vegetal protection was established as easily without temporary structure as with them.

Permanent structure: structure constructed of permanent materials may be required to control the over fall of head of large gulley, to do the discharge form vegetative water way into a drainage ditch , to take up the fall at various parts in any channels to provide for discharge through earth fill

2.7 Channels

Channels are defied as constructed structure which serve as pathway that convey runoff form any point to rivers, oceans dams or the farm land to reduce soil loss due t water erosion and sedimentation on the roads. There two types of channel namely.

Open channel and closed channel: open channels are those that their surfaces ar not exposed to the atmosphere while closed channels are those that their surface are closed and not exposed to atmosphere

Shape of channel: - the cross section shape of the channel as it s constructed may be parabolic, trapezoidal, or triangular. A number of factor influenced the choice of the shape of cross section of the channels but with blade type machine may be trapezoidal, if the bottom width of the channel is greater than minimum width of the cut. The triangular channel may also be readily constructed with blade equipment. Trapezoidal channels having bottom less than that of mower swath are difficult to mow. Flat triangular or parabolic channels with sides of 4:1 (4 horizontal to 1 vertical) or flatter may be easily (Schwab et al 1992).

2.7.1 Roughness coefficient

slope and hydraulic radius are calculated readily form the geometry of the channel, however the roughness coefficient is more difficult to evaluate. Extensive tgests

by Ree, in 1977 and other s have provided techniques and data to determined the roughness of various type f vegetation

2.7.2 Channel capacity

The channel capacity must be proportional to carry the design runoff at average velocity less than equals to the design possible velocity. This is obtained by using the manning formular.

$$V = \frac{R^{2/3} S^{1/2}}{n} \qquad 2.9$$

Where

V = average velocity of flow m/s

n = roughness coefficient of the channel

R = hydraulic radius

S = hydraulic gradient

CHAPTER THREE

3.0 Methodology

This chapter reveals the various method, techniques and steps taken to evaluate the effects of surface runoff on agricultural roads in Offa Local Government area of Kwara State. The method applied in collecting information and data for this study is called Investigation Survey Research Approach (ISRA). This includes questionnaire and oral interview and the information obtained from books, pamphlet and journals are used in the cause of study. This chapter explains in detail the nature of the questionnaire and its administration. In, all, the research study was based on the following agricultural roads in Offa Local Government Area, Erin-Offa road, Oyun –Offa road, Maikka –Offa road, Ojoku-Offa, Wara-Ilorin, and Ogbomosho –Ilorin road.

3.1 Data Collection

The simple random selection method was applied to cover the six agricultural roads in Offa Local Government Area. This involves the administration of questionnaire to the people involved.

This method eliminates discrimination and favoritism of some farmers in the various village visited. For instance, during the visit to Erin –Offa road, the farmers were randomly picked and interviewed interview. This method also applied to the drivers. Using this pattern, four roads were selected in Offa Local Government Area and two roads were selected in Ilorin West Local Government Area given total six roads considered.

Table 3.2 shows number of questionnaires administered, number of returned completed questions, location and the name of the road considered.

Table 3.1 shows distribution of questionnaire among the farmers

/NO	**No of questionnaire administered**	**No of returned completed questionnaire**	**roads**
	20	13	Oyun- Offa
	20	12	Erinle – Offa
	20	11	Ojoku- Offa
	20	14	Maika – Offa
	20	11	Wara-ilorin
	20	13	Ogbomosho-Ilorin

Two questionnaires were designed for this study the first questionnaire went to the farmers while the second questionnaire went to the drivers. Each questionnaire consist two sections A and B. Section A contained research title, introduction of the researcher school while section B contained bio data of correspondent, and question in detail description. The questionnaire are labeled in appendix A and B. .

In each location at least not less than fifteen farmers and not more than twenty farmers were chosen and questioned. In each road not less than 10 driver Table 3.2 shows distribution of questionnaire.

Table 3.2 shows the questionnaire administered, returned completed questionnaire, location and roads

Table 3.2 Showing distribution of questionnaire among the drivers

S/NO	No of questionnaire administered	No of returned completed quesuonnaire	Roads
1	15	10	Oyun-offa
2	15	11	Erinle – offa
3	15	11	Ojoku- offa
4	15	10	Maika – offa
5	15	10	Wara-ilorin
6	15	12	Ogbomósho-ilorin

The questionnaire were collected and interpreted were necessary to collect information such as type of problem encountered on the roads, damaged caused by the roads, ergonomic of the road, maintenance level, method of maintenance, type of the drainage available, blocked damaged, type of farm produce, and location of the farm, name of the roads and farmer bio data.

3.2 Evaluations of Parameters

The questionnaire was carefully distributed throughout the six roads and among the farmers. The total number of one hundred and twenty questionnaires was distributed among the farmers and ninety questionnaires were also administered to the drivers. This gives the breakdown of two hundred and ten questionnaires. The total number of one hundred and thirty four are complete and returned for analysis.

3.3 Data Analysis

After the questionnaire were collected from the field, the data and information gathered from the sixe different location was analysed using regression analysis and analysis of variance (ANOVA) this procedures were carried out using computer. The statistical package used for this analysis was MINITAB 14 APPLICATION SOFTTWARE (2007). The result of regression analyses and analysis of variance are labeled in the appendix.

(Morenikeji, 2006),stated that when variables are more than two, a computer world be needed for the computation, too many variables may lead to what is called multi-co linearity problems. When variables are too many there is tendency for pair wise correlation among them and this will produce spurious result such as ever fitting and making supposedly by significant variables non significant. If there many variables, the step wise option software spss can be employed to identify significant variable (Morenikeji, 2008).

The location selected is dependent variable while the parameters such as damage caused by the road, ergonomic of the road, maintenance of the road maintenance level etc are independent variables of X.

3.4 Regression Analysis

The method of regression analysis used was multiple regression analysis; this is a method of analysis by which estimates are made of the value of dependent variable (location) from the knowledge of the value of one ore more independent variables.

The independent variables Y can be obtained from regression formulae

$Y = \beta o + \beta n \times Xn$ 3.1

Where Y = Location

Bo = y intercept of the line or coefficient of regression

Bn = constant known as the slope of the line

X = independent variable

N = 1, 2.....10

3.5 Regression Analysis Formulae (Multiple).

The multiple regression analysis relates dependent variable y to two or more independent variables

$Y = \beta_0 + \beta_1 X_1 + + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_n X_n$ 3.2

Y = independent variables

Where y in this case of study stands for location and Xi stand for the effects such that

$Y = \beta_0 + \beta_1 X_1 + + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_{10} X_{10}$

3.3

Y = location

B_n = coefficient constant of regress

X_1 = farm product

X_2 = problem encountered on the road

X_3 = maintenance level

X_4 = method of maintenance

X_5 = drainage system

X_6 = blocked drainage

X_7 = effort put into repairing road

X_8 = damaged caused

X_9 = ergonomics

X_{10} = quantity transported

Coefficient of determination (R-square) can be obtained calculating

Total variation = sum of square (total) (SS)

Error variation = sum of square error (SSE regression variation = SSR=SS total –SSE

Therefore

$$R^2 = -\frac{SSR}{SS} \qquad 3.2$$

And standard error can calculated from this

$$SE = \sqrt{\frac{\sum(Y - Y^1)^2}{n - k - 1}} \qquad 3.3$$

N= number of observation

K= number of independent variable

y^1=mean of the y

Mean square error

The mean square for error which measures the sampling variability within the treatment is calculated from the formulae

$$MSE = \frac{SSE}{N-P} \qquad 3.4$$

T – statistic which is used to test the significant or R-square. F is derived from equation

$$T = \frac{SSR}{K} \qquad 3.5$$

$$\frac{SSE}{n-(K-1)} \qquad 3.6$$

T is used to weather to accept or reject hypothesis

if T is $\leq$ 0.05 is significant but if

T $\geq$ critical value 0.05 is insignificant.

The analysis of variance provides a basis for determining whether two or more samples mean differ significantly. A test of significant of multiples sample means is the must difficult for analysis of variance.

ANOVA is used to conduct a formal statistical test of hypothesis. The measurement are carried out in the following step

Sum of squares of treatment (SST) measures

The variation between each treatment mean and it is calculated by squaring the independent between each treatment mean and the over all the treatment. This formulae expresses sum of square treatment

$$SST = \sum_{i=1}^{p} ni(yi - y)^2 \qquad 3.7$$

Where

p = the number of treatment

Y = the overall mean

ni = sample size

Error variation can be calculated from sum of square error formulae represented below as

$$SSE = (Y - Yi)^2 \qquad 3.8$$

Where y_i represent the measurement in sample1 and Y2i is the measurement of sample 2

Mean square for treatments (SST) can be obtained from

$$MST = \frac{SST}{P-1} \qquad 3.9$$

P-I is the degree of freedom = Df

CHAPTER FOUR

4.1 Result and Discussion

After the completed questionnaires were returned, the data obtained for the research study were subjected to statistical analysis to ascertain the effect of surface runoff on agricultural roads. The results obtained using regression analysis and analysis of variance (ANOVA) is shown in table 4.1 and table 4.2 respectively.

Table 4.1 showing the result f regression analysis

Predictor	**Coef. Of regression**	**SE coef.**	**T**	**P**
Constant	-0.2387	0.6364	-0.38	0.709
Farm produce	-0.01625	0.03113	-0.92	0.604
Problem encountered in raining season	2.08611	0.04519	1.91	0.062
Maintenance level	0.7707	0.639	4.90	0.00
Method of maintenance	-0.0697	0.1183	-0.59	0.559
Drainage system	0.6349	0.4771	1.53	0.89
Blocked drainage	0.8782	0.2980	2.95	0.005
Effort put into repairing of the road	-0.1436	0.1960	-0.73	0.005
Damage caused	-0.01761	0.05055	-0.35	0.1769
Quantity of farm produce transported	-0.00716	0.09993	-0.07	0.729
Ergonomics	-0.0970	0.2451	-0.40	0.943
Total	1.77989	2.3616		0.694

Table 4.2 showing the result of analysis of variance (ANOVA)

The result form analysis of variable is shown in the table 4.2

Source	DF	SS	MS	P
Regression	10	150.973	20.00	0.000
Residual eror	55	41.527		
Total	65	192.500		

Table 4.3: showing the ANOVA results

Source	Degree	Seq SS
Farm produce	1	8.979
Problem encounter in rainy season	1	0.449
Maintenance	1	101.180
Method o maintenance	1	0.433
Drainage system	1	16.498
Blocked drainage	1	22.887
Effort (comm../farmer)	1	0.369
Damaged caused	1	0.061
Ergonomics	1	0.114
Quantity transported	1	0.004

Df = degree of freedom

SS = sum of squares

Ms = mean square

B_0 = -0.2387

β_1 = - 0.201623

β_2 = 2.08611

β_3 = 0.7707

β_4 = -0.0697

β_5 = 0.6349

β_6 = 0.8782

β_7 = -0.1436

β_8 = -0.001761

β_9 = -0.00716

β_{10} = -0.0 970

$V = -0.239 - 0.0163X_1 + 0.0861X_2 + 0.771X_3 + 0.070\ X_4 + 0.635X_5 + 0.878X_6 - 0.144X_7 - 0.0176X_8 - 0.097X_9 - 0.0072X_{10}$

4.2 Significant Level

The standard statistical significant level is given as 0.05 ,if any parameter or variable has probability or significant level greater than 0.05 , it implies that the parameter or the variable is un-significant, in or there words the effect of the parameter is not significant . Moreover, in a situation where a parameter or variable has probability or significant value less than or equals to 0.05, it means that the effect of the parameter is significant and viable fore the parameter must b considered important.

4.3 R – square

The r- square is an indicator o how well the model fits. The data form the result of regression analysis , r-square is 78..40%, this implies that we have explained 78.40%of

F = sum of the degree of freedom

P = significance probability level (significance)

The two results show that surface runoff has greater effects on agricultural roads, also showed that there is significant level between the surface runoff and agricultural roads, farm produce as well as farmers incomes or revenue.

The regression equation is given as

$$Y = \beta o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10}$$

Where

Y = location

Bo to B_{10} = regression coefficients

x_1 = farm produce

x_2= problem encountered in raining season

x_2= maintenance level

x_4= method of maintenance

x_5= blocked drainage

x_6= blocked drainage

x_7= effort put into repairing of the road

x_8= damaged coursed by the road

x_9= quantity of farm produce transported

x_{10}= ergonomic

effects surface of runoff on agricultural roads, also implies that 78.40% of to the variation in dependent variable Y (location) are accounted for by independent variable x (such as farm produce, quantity transported ----------ergonomics) while the remaining 21.60% which is known as residual value accounted other factors such as temperature, humidity, infiltration rate, soil porosity , evaporation ate, rain intensity , prevailing wind intensity , which are not consider in this cause of study.

At this point on can observed that residual value is small enough to say that we have better prediction so of effects of surface runoff on the agricultural lands. Because, the smaller the residual value the better the production of variable give x variable (ww.nigeria state. Gov. ng)

4.4 Correlation Coefficient R

customarily, the degree to which two or more predictors (independent or X variable) are related to the dependent (Y) variable in expressed in the correlation coefficient R, which is the square root of R-square . in multiple regression , R can assume values between O and 1 (www.nigeria stat. gov.ng 2007) the correlation coefficient r is 0.8854)

to interpret the relationship between variables one looks at the sing before regression coefficient either negative or positive. If a regression coefficient (βn) is negative then, the relationship is negative and when regression coefficient is zero then ther is no relationship between the both dependent variables and independent variables (www.nigeria stat.gov. ng(2007. the above statement established thaw the minus or positive sign of regression coefficient give how strong the relationship between both dependent variables and independent variables is

4.5 Standard Errors (s)

Standard error is estimated to know either the model fits the data or not. The smaller the standard error the perfect the model fits the data (Morenikeji, 2005). The standard error value obtained is 0.86927 or 86.8927%. the standard error I accurate because the value falls within the range of 0 an d100%.

4.6 discussions relating to independent variable

4.7 The farm produce

The newest concern of farmers is not about the weather that can destroy their crops, it sin not about the farm labour shortage, nor I it about whether the market price is good for the farm produce instead it is about the harmful impact of moving farm produce form one location to the another has caused the produce (Shaaffer, 2008). The result on the table 4.1 shows the probability of farm produce is greater than 0.05 value of significant level which implies that surface runoff has no direct effect no the farm produce. Considering the sign (minus) in the front of regression coefficients that is establishes that the relationship between independent variable x1 (farm produce and dependent variably x (location) is negative. It can be concluded that the relationship is not strong enough

4.8 Problem encountered during the raining season

The continuous rain during the peak period of rainy season in Offa is enough to drive one around the bend and literally into potholes. That is because tar road are particular vulnerable to the erosive effect of water, causing a number of potholes. Forming each day to rise by 70% in heavy or continuous down pours. Table 4.2 show that rainfall contributes immensely to surface runoff consequently damaging the agricultural

roads the probability value of problem encountered during the raining season is 0.062 while that of significant level is 0.05 indicating that rainfall affects surface runoff. Due to this effect, surface runoff thereby reacting potholes on the agricultural road.

4.9 Maintenance Level

Man mad infrastructure need to be maintained periodically, to thi effect roads are not exceptional. Maintenance of road is an imperative for al road users as it is also improves economy and agricultural production of the area. The result of regression analysis on the table 4.1 shows thaw maintenance level is significant in controlling the bad effect of surface runoff on the agricultural roads. Probability of maintenance level is 0.00 which is greatly less than that of significant value 0.05 recall that if the significant level is less than equals to 0.05,meaning that the maintenance level and surface runoff are correlated. The positive sign before regression coefficient (β_3) also justified the relationship between maintenance level and roads

4.1.0 Method of maintenance.

The method of maintenance also important in restoring and to proper condition there are different methods of maintenance such filing the potholes, grading, tarring among other. According to the regression analysis result on table 4.1 the probability of method of maintenance is 0.559 and the significant level 0.05. it is stated earlier that any parameter that has significant value greater standard statistical significant value (0.05) is considered un-significant, therefore method of maintenance is un-significant. The negative sign before its coefficient of regression (-0.0697) show the there is negative relationship between the method of maintenance and the location, therefore there is on correlation between maintenance method and surface runoff.

4.1.1 Drainage system

Drainage system is used to carry water off the motorways, loosened soil particle are carried from the road bed and into the roadway drainage system. Particles most often settle out where thy diminish the carrying capacity of the ditch and in turn cause roadway flooding which leads to surface runoff, consequently to roadway erosion. Most of the erode soil, however=, ultimately end up in streams and river where it diminishes channel capacity, causing more frequent flooding and severe flooding and has adverse effects on the agricultural roads (environmental protection agent. 2008). There is no drainage system in wara-oja-ilorin road an the drainage along Maika of road also blocks. These two roads are seen subjected to erosive effects of flood by surface water runoff and some time waterlog occurred. When the drain age are blocked with by manmade materials or non source materials the water flowing is unable to find it sways to rivers, streams or dams consequently causing flood in te adjacent road. If adequate measure before any is observed such intensive maintenance of the drain age and regular cleaning of the drains system are put in place, the problems of drainage blockage might have not been encountered. Environment protection agency , 2008 reported that drainage is for carrying water to rivers streams or dams but loosened soil particles are carried form road into roadways loosened soil particles are carried form road into roadways loosened soil particles are carried form road into roadways drainage system which can lead to drainage system blockage

The result of the research study consider the drainage system insignificant , showing the a the type of drainage system doe not affect surface runoff the regression

analysis result on table 4.2 shows that the probability of drainage system is 0.01189 while the standard significant level is 0.05, therefore, the hypothesis is null,

4.1.2 Blocked drainage system

It s deduced form environmental protection agency that surface flow carried loosened soil particles from the road and into roadway drainage system human dumping refuse into drainage can also cause drainage blockage. This deduction made it clear that the type of drainage sister doe not contribute to road degradation but blocked drainage systems have impact in the bad effect f surface runoff on the roads.

The result obtained for regression analysis emphasize on the blocked drainage system that, the probability of blocked drainage sister is 0.005 and standard statistical significant level is 0.05 meaning that the blocked drainage system is significant in surface runoff control measures.

4.1.3 Effort put into repairing the roads

The result of table 4.1 show that farmer effort are quit low, not significant, therefore, causing more potential for surface runoff to cause further deterioration of the rod. The probability of the effort to put in place is 0.457 which is higher than the significant level meaning that the road users lack maintenance culture and the effort put in place is insignificant.

4.1.4 Damage cause by the road.

Surface runoff has tremendously damaged our road by creating potholes, causing vibration and inhibits vehicles movement. definite surface runoff does not have direct impact on the farm produce carried but on the vehicle that passé through the road. The damage of the farm produce is due to the vibration experienced on the roads by the plying

vehicles and when the drive tends to avoid pothole on the road. Damage caused y the road includes rapid wearing of engine, weakening the vehicles body, un necessary loosen of bolt and nt. Hazard to the driver death , pelling and breaking of tuber crops. In large quantity experienced

For instance, in Maika area where farmers produce tube crop such as sweet potatoes, yam and cassava in large quantity experiences damage of tubers by the road. The result on the table 4.1 shows that damage caused by the road has probability value 0.729 but significant level is 0.05.

That is to say damage cause by the road is not occur due to any other things but lack of adequate maintenance and inadequate monitoring of the roads by authority in charge

4.1.5 Ergonomics

Working method can be usually be improved by Redding fatigue and improving control through a better interaction between human machine and his environment the result obtained shows that the ergonomic is not significant it s probability is 0.694 while significant level is 0.05 the ergonomics probability is higher than the significant legel which made ergonomics insignificant

4.1.5 Quantity of farm produce transported

For a farmer to transport a large quantity of farm produce, his increase his income and at the same time give potentialities to expand or cultivate more land consequently providing more dishes for consumers and more access for agro allied industries to access sufficient enough raw materials for their productions. In situation which farmer cannot transport enough quantity of farm produce from his farm to the market place, it

hinders the expansion of his farming and income will be drastically reduced which will further reduce the farming activities and mechanization due to lack of fund. A very bad road like that of Ojoku Offa road that deters ability of farmer to move enough farm produce from their farms to the market tends to make quantity of produce transported irrelevant in significant. The result obtained from statistical analysis shows that the probability value of quantity of farm produce is 0.943 infact, this is largely higher in significant level therefore it is considered insignificant.

4.1.7 discussion of analysis of variance (ANOVA) result

4.1.8 using the analysis of variance , the amount of variation in the data that cannot be accounted for this method of prediction is the total sum of squares which equal to 192.500 which is uncertain

4.1.9 Mean square

The mean square is the sum of squares divided by the corresponding degree for freedom. The mean square is 15.097

4.2.0 the significant level

The F value is the test to decide whether the sample means are within sampling variability of each other that it tit test the hypothesis Ho :Ni N10 this is the same as asking whether the model is as a whole has statistically significant predictive capability in the regression analysis Gerard Dalai, 2007). The regression fro the established that all parameters are significant because the probability value is 0.00 is greatly les than the significant value 0.05 therefore one can conclude that all the parameter are significant in result obtain from analysis of variance.

CHAPTER FIVE

5.1 Conclusion

It can be concluded that effects of surface runoff on agricultural roads are hazardous to both farmers and drives. Besides, more attentions need to be dedicated to surface runoff, erosion and flood control

Conclusively, farmers, drivers and authority in charge of the road should work together to improve maintenance level and provide water free flow road side drainages to minimize problems encountered on the road during raining season or peak rain period.

5.1 Recommendations

From the various studies carried out and statistical analysis result, three parameters are emphasized. These three parameters are problems encountered on the road during raining season, maintenance level and blocked drainages therefore the following recommendations are made:

i. Collaborative efforts should be put in place by the farmers, drivers, community and the authority in change of the road to intensify the road maintenance level. This can be realized by the flowing:

   a) regular payment of tax by farmers, drivers and the community
   b) Timely report of roads condition to appropriate body
   c) voluntary involvement of community in the maintenance of the road
   d) Timely response to farmers, drivers, community plights concerning by the road by the authority in charge of the road.

ii. Drainage system blockage should be avoided, this is practically vested on the farmers and the community, the community head should inform the entire community their responsibilities in clearing drainage systems and the farmers head should tell his counterpart their responsibilities to keep drainage system clean. Also awareness should be initiated by government to sensitize people to disembark on dumping refuse into drainages, canals rivers streams ands water ways.

iii. Reconstructing the existing dilapidated road side drainages systems and increase the depth of the existing drainage system

iv. Government should enact or promulgate laws that will mandate people to clean their environment and drainage system then enforce the promulgated laws.

REFERENCES

Aneke, D.O (1985) "The Effects of Change in Catchments Characteristics on Soil Erosion developing Countries (Nigeria)" agri Eng 66, 131-135

Beer, C.E. and H .P. Johnson "Factors in Gully Growth in the Deep Losses Area Of Western Lowa, pp 237-240

Boardmar, J .M., Foster I. D .L , and Deenin. J.A (19900)"Soil Erosion on Agricultural land " Johnson and sons, Raffins lane, Chi Chester West and Sussex p 019 England pp (70-1077).

Bradford, J.M., D.A.T Farrell and W.E. Larson (1973). "Mathematical evaluation of Factors Affecting Gully Stability "Soil soc. Am Proc. 37; 103-107

Bransicken, D.L (1959) "Selecting the Water Year for Small Agricultural Watershed" Am. Soce. Agr. Eng. Trans. 2(1) pp 5-8, 10

Chow, Vente (1962) "Hydrologic determination of water way areas of the design of drainage structure in small drainage basin "Am Geophs. Union. Trans. 32, 231 231-237, April.

Dao T. H (1993) "Tillage and Winter Weather Residue Management Effects on Water Infiltration and Storage. Soil Science Society. Am. Jst, pp 1586-1595.

Foster G.R (1983) User Requirement . USDA water erosion prediction project (WEPP) USDA- ARS national soil erosion Lab., West Lafayette, in.

Hershfied, D.N (1961) " Rainfall frequency atlas of the united states of America " U.S whether bureau technology paper 40, may

horn D.L and G.O. Schwab (1963) " Evaluation of Rational Runoff Coefficient for Small Agricultural Watershed "Am. Sol. Agri eng. Trans 6 (No3), 195-198

Hershfied, D.N (1961) " Rainfall frequency atlas of the united states of America " U.S whether bureau technology paper 40, may

http //www.en. wikipedial. Org//wiki/surface runoff (2007)

http// ga.water. usgs. Gov//edu//water cycle runoff (2007)

http//www.jerry dalai.com /lttsp/gov/out. Htm

http//www.joburg. org (2007)

http//www.epa.gov (2008)

http//www.nigeria state. Gov. ng (2007)

http//www.pfb.com (2008)

http//www.statsoft.com (2008)

http//www.water encyclopedia.com(2007)

horn D.L and G.O. Schwab (1963) " Evaluation of Rational Runoff Coefficient for Small Agricultural Watershed " Am. Sol. Agri eng. Trans 6 (No3), 195-198

Hunter A.G.M and Oven G.M (1998) "Tractor Turnover Turning Accident on Slope " a Journal of Occupational Accidents " Elsivier Science Published by Amserda, 5 (190-212).

Krpich P.Z (1940) " Time of Conservation of Small Agricultural Watershed " civil eng. 103, 362 pp 10-18

Lane L.J, G.R. Foster, and A.D. Nicks (1987) " Use of Fundamental Erosion Mechanic in Erosion Prediction " paper no. 87-2540. ASAC, St Joseph, MI

Liebenon A.M, Eliot,J.W., J.M. Laflen, and K.D . Koll (1990) " Interrill Erodibility : Collection and Analysis of Data From Crop land Soil " ASAE. Trans. 33, 1882-1886.

Mecoll D.K, Foster G.R, Renard K.G and Moldenlaver W.C (1981) " Conservation of the Universal soil loss equation to S I Metric Unit " J. Soil Water Cms. 36, 355-359

M.M Dandeker and K.N Sherma (1988) " Water Power Engineering pp 46-80

Mavis, F.T et al (19750 "The Transportation of Detritus By Flowing Water " State University , Lowa, Studies Ni Engieerign Bulletin 5

Schwab G.O., D.D. Frangemerer, W.J. Elliot, R.K. Frevert (1992) " Soil and Water Conservation Engineering " Printed in United States of America by the Hamilton Printing Company

Sherman L.K (1987) "Stream Flow From Rain fall by Unit Graph Method pp 108, 581-505

Smith D.D and W.H. Wishchmere (1962) "rainfall erosion.

Schertz D.L., W.C. Modenhaver, S.J. Living, G.A. Wiesies, and E.A Hinz (1989) " Effects of Past Soil Erosion on Crop Productivity in India " J. Soil water RCMS. Sue. 44, 604-608

US. Department of Agriculture (USDA) (1975) " Control Of Water Form Cropland " vol 1, US Gpo. Washington D.C

US Soil Conservation Service Conservation Service (1973) " a Method for estimating Volume And Rage of Runoff In Small Watershed. Se.s tp 149/ washing ton dc

Wole Morenikeji (2006) " Research and Analysis Method" Published by university of Jos press limited, Jos.

APPENDIX A

SECTION A

SRESEARCH TITLE: EFFECTS SURFACE RUNOFF ON AGRICULTERAL ROAD(S) IN OFFALOCAL GOVERNMENT AREA OF KWARA STATE

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DEPARTMENT OF AGRICULTURAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

Dear Correspondent,

Agriculture is the bed rock of any nation which has contributed immensely to the development the nation as well as human life In the are of food and shelter creating employment opportunity, providing raw materials for agro- allied industries, source of exportation, and income for both the country and the farmers Due to all the aforementioned advantages of agriculture, it was observed tha agriculture is viable in the economy of developing country like ours.

One the problem embattling farmers is the inability to transport their farm produce either from farm either to the market, to the processing centre, or to their residences due to un- motor-able roads caused by runoff , his further complicates the farmer's problem of transporting satisfied quantity of farm produce.

This questionnaire was designed to check the effects of runoff on agricultural roads as it has contributed to the degradation of farm roads.

Sir/Ma, if this questionnaire is properly filled, it may profer solution(s) to the problem of road(s) degradation by run off and the problems encountered by both farmers and drivers on the damaged agricultural road(s).

SECTION B

BIO DATA:

Name ----------

Age----------

Level of education

Occupation ------

Date----------

FARMERS

1. Name of your farm

2. Location of your farm

3. Size of your farm (Ha)

4. Type of your farming system (a) Subsistence farming

   (b) Commercial farming

5. Types of crop you grow

   ----

6. Are they perishable crops?

7. The name of the road(s) ------

8. Type of the road(s)

a. Truck A road

b. Truck B road

c. Truck C road

9. During the raining season, what are the problems encountered on the road(s)? ----------

10. During Dry season, what is the problems encounter on the road? ----------

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11. Who takes care of the road(s)?

a. Federal Government b. State Government

c. Local Government d. Individual

e. Community f. None

12. What is the level of maintenance carried out?

a. Intensive b. Moderate c. None

13. How often do you pay your tax? ----------

14. How much do your pay as tax? ----------

15. Do you compain about the situation of the road(s)? YES or NO

16. Who do you complain to? ----------

17. What is the level of response?

a. Immediately b. 7 days 3 months later

c. 4-months 1 year later c. Never

18. What efforts have you or your community put into repairing the road(S)?

a. Joint efforts b. Individual efforts

c. Community efforts

19. How do you carry out the maintenance? By

a. Grading b. Tarring

c. Filling the pot holes on the road(s) d. Others (pls. specify)

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20. What is the type of drainage system is available on the road?

a. open drainage b. Hedge drainage

21. Is the drainage blocked? Yes or No

22. What is the nature of the blockage?

a. Dumping of waste materials by man b. Materials carried by runoff

23. What type of damage does the road cause your well being and its effect on the farm produce?

24. Are you able to transport satisfied quantity of farm produce through or on the road(s)?

APPENDIX B

SECTION A

SRESEARCH TITLE: EFFECTS SURFACE RUNOFF ON AGRICULTURAL ROAD(S) IN OFFALOCAL GOVERNMENT AREA OF KWARA STATE

THE RESEACHER; UTHMAN ABDULWAHEED

DEPARTMENT OF AGRICULTURAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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SECTION B

BIO DATA:

Name ----------

Age----------

Level of education ----------

Occupation ----------

Date----------

DRIVERS

1. Vehicle Type ----------
2. Vehicle capacity ----------
3. Is the vehicle for goods? YES OR NO
4. Is it commercial vehicle ----------?
5. How often do you ply the road(s)? ----------
6. Are you able to load to full capacity of the vehicle? YES OR NO
7. What is the effect of the damaged road(s) on your well being and your vehicle ----------?
8. DI you enjoy driving on the road(s)? YES OR NO
9. What is your contribution towards the maintenance of the roads you ply

i. Individual ii joint efforts iii union efforts iv. Others (pls. specity)
