Soil Erosion – Its Onsite/Offsite Impacts and Agricultural Education Students Ideas in College of Education Demonstration Farm, Afaha Nsit

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ABSTRACT

Agricultural education in Nigeria has as one of its objectives the acquisition of basic knowledge and practical skills in agriculture by the students. The purpose of the study was to explore soil erosion and examine agricultural education students' ideas about onsite/offsite impacts on the departmental demonstration farm. Three research questions and three null hypotheses were formulated to guide the study. Data was collected using a questionnaire constructed by the researcher tagged Agricultural Education Students Ideas about Erosion Questionnaire (AESIAEQ). Simple percentage was used to answer the research questions and data was analyzed using independent t-test to test the hypotheses at 0.05 level of significance. The results showed that there was no significant difference in NCE I, NCE II and NCE III agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm. Based on the findings, it was recommended amongst others that students should observe onsite/offsite impacts of soil erosion and use locally available materials to prevent its devastating effects on the field.

KEYWORDS: soil erosion, onsite impacts and offsite impacts

INTRODUCTION

Soil Erosion is a form of soil degradation on agricultural land. It is the relatively repaid removal of topsoil by agents such as rain water, wind (air), ice (glaciers), snow, plants, animals and humans. In accordance to these agents, erosion is sometimes divided into water erosion, glacial erosion, snow erosion, wind (aeolean) erosion, zoogenic erosion and anthropogenic erosion (Apollo, Andreychouk & Bhattarai, 2018).

Healthy soil is the foundation of agriculture and an essential resource to ensure human survival on the planet earth. Man food and animal feeds are a function of the soil since humans worldwide obtain more than 99.7% of their food from the land and less than 0.3% from the oceans and aquatic ecosystems (FAO, 2014). Soil erosion is one of the most serious threats facing world food production. Each year about 10 million hectare of cropland is lost due to soil erosion, thus reducing the cropland available for world food production. The loss of cropland is a serious problem because it will lead to malnutrition among the world production (FAO, 2014). The soil is being lost from agricultural land 10-40 times faster than the rate of soil formation; hence endanger human's food security (Montgomery, 2007).

The harmful impacts of accelerated soil erosion processes caused by deforestation, overgrazing, tillage and unsuitable agricultural practices are well known and documented (Walling, 2013). The impact can be severe, not only through land degradation and fertility loss, but through a conspicuous number of one-site and off-site effects. It is important to note here that excessive or accelerated soil erosion causes both "on-site" and "off-site" problems. The on-site impacts include decrease in agricultural productivity and ecological collapse both because of loss of the nutrient rich upper soil layers. This sometimes ends with desertification problems especially in the arid environment where wind erosion is most experienced. The off-site impacts include; sedimentation of water ways, eutrophication of water bodies and siltation (Boardman & Poesen, 2006). The effects of soil erosion of farmer's fields are called onsite effects, while the effects outside agriculture are termed off-site effects.

Water and wind erosion are the two primary causes of land degradation. They are responsible for about 84% of the global extent of degraded land; making excessive erosion one of the most significant environmental problems worldwide (Blanco et al, 2010). Intensive agriculture, deforestation, road construction, anthropogenic climate change and urbanization are amongst the most significant human activities that stimulate soil erosion (Julien, 2010). Soil erosion removes weathered materials (soil rich-nutrient materials) resulting from rock weathering – the process through which the soil is formed. The soil material that is lost through erosion is deposited elsewhere, in place where it is not wanted like roads, streets people's houses, drainage ways, rivers and reservoirs. It can lead to pollution of water courses and reservoirs with agrochemicals (herbicides, pesticides, fungicides and so on) absorbed on soil particles.

Soil erosion by rain occurs when more rain falls than the soil can absorb, either by exceeding the infiltration capacity or the storage capacity of the soil. The excess water runs downslope as over land flow or surface runoff. If the runoff has sufficient flow energy, it will transport loosened soil particles (sediment) down the slope (Prusk & Nearing, 2012). The erosion can take on several forms such as splash erosion, rill erosion, sheet erosion and ephemeral gully erosion or simply gully erosion. Splash erosion creates a smaller crater in the soil, ejecting soil particles (Cheraghi, Jomaa, Sander & Barry, 2016). Rill erosion refers to the development of small ephemeral concentrated flow paths which function as both sediment source and sediment delivery systems for erosion on hill slopes. Generally, where water erosion rates on disturbed upland areas are greatest, rills are active. Sheet erosion is the transport of loosened soil particles by over land flow which is usually unobserved because it does not develop conspicuous channels while Gully erosion occurs when runoff accumulates and rapidly flows in narrow channel during or immediately after heavy rain, removing soils to a considerable depth (Boardman & Poesen, 2006).

Fluvial erosion involves flowing water (flood), which can occur within the soil mass (e.g. soil piping) over the land surface (in rills and gullies) or in seasonal or permanent channels (causing seasonal streams and rivers). Flood waters erodes rocks, removing and transporting weathered materials from their source to other location where they are deposited and either stored or transported to other location. Fluvial erosion occurs during rainfall events, from melt-water runoff or ground water percolation.

Wind erosion is a major geomorphological force, especially in arid and semi-arid areas. It is also a major source of land degradation, desertification, harmful airborne dust and crop damage especially after being increased far above natural rates by human activities such as deforestation, urbanization and agriculture (Zheng & Huang, 2009). Wind erosion is of two varieties; deflation and abraision. Deflation occurs when the wind picks up and carries away loose particles and abrasion occurs when surface are worn down as they are struck by airborne particles carried by winds. Deflation are subdivided into three categories; surface creep, where large, heavier particles slide or roll along the ground, saltation, where particles are lifted a short height into the air and bounce and saltate across the surface of the soil and suspension, where very small and light particles are lifted into the air by the wind and are often carried for long distances. Saltation is responsible for the majority (50-70%) of wind erosion, followed by suspension (30-40%) and then surface creep (5-25%) (Blanco & Lal, 2010).

Mass washing/movement is the downward and outward movement of rock and sediments on a slope surface, mainly due to the force of gravity (Van Beek, 2008). Mass washing takes place under the influence of gravity alone (e.g. soil creep, solifluction, mud flow, slumping, landslides and so on). Mass washing is an important part of the erosional process and it is the first stage in the breakdown and transport of weathered materials in mountainous regions (Nichols, 2009). It moves materials from higher elevation to lower elevations where other erodes agents such as streams and glaciers can pick up the materials and move it to even lower elevation. Some mass washing processes act very slowly while others occur very suddenly, often with disastrous results. The rapid form of mass washing are mudflow, landslide and rock falls. Any perceptible downslope movement of rock or sediment is often referred to as landslide. Slumping happens on steep hillside, occurring along distinct fracture zones, often within materials like clay that once released, may move quite rapidly downhill. Surface creep is the slow movement of soil and rock debris by gravity which is usually not perceptible except through extended observation. However, the term can also describe the rolling of dislodged soil particle 0.5-1.0mm in diameter by wind along the soil surface.

Unsustainable agricultural practices are the single greater contributor to the global increase in soil erosion rates (committee on 21st century systems Agriculture, 2011). Tillage of agricultural lands which breaks up soil into finer particles results in tillage erosion. The soil that is displaced by tillage remains on the tilled field and does not cause off-site impact. Conversely, the problem has been exacerbated in recent times due to mechanization which encourages deep ploughing. This increase the amount of soil that is available for transport by water erosion. Others includes, mono-cropping, farming on steep slopes, pesticides and chemical fertilizer usage (which kills organisms that bind soil together), row-cropping and the use of surface irrigation (Lobh, 2009). Heavy grazing reduces vegetative cover and causes severe soil compaction which increases erosion rates (Imeson, 2012). Deforestation causes increased erosion rates due to exposure of mineral soil by removing the humus and litter layer from the soil surface, removing the vegetative cover that binds soil together. Once vegetation have been removed, infiltration rates become high and followed by heavy rainfall, significant erosion transport the soil materials to other locations (Goudie, 2000).

Road construction and urbanization are major contributors to soil erosion. These activities denude the land surface of it vegetative cover, altering drainage pattern and compacting the soil. More still, the asphalt or concrete that is used in construction increases the amount of surface runoff and surface wind speed (Pruski & Nearing, 2002). This increased runoff in addition causes major disruption to surrounding water sheds by altering the volume and rate of water that flows through them and filling them with chemically polluted sediments, leading to serious environmental problems such as eutrophication of lakes and other water bodies. It also causes large increase in bank erosion (James, 1996).

STATEMENT OF THE PROBLEM

The onsite impacts of soil erosion especially loss of soil productivity is a long term process that can only be observed by farmers, while the offsite impacts of soil erosion (sedimentation, siltation and eutrophication of lakes and other water shed) need to be given prior attention both by the farmers and others, who live within the ecosystem of the farmstead. Agricultural education student's ideas about the onsite/offsite impacts of soil erosion need to be investigated due to the fact that agricultural education at all level in schools deserves sound and better training in line with the National Policy on Education (2004). In Nigeria one of the objective(s) of the course is to enable students acquire basic knowledge and practical skills in agriculture. It is from this premise that this paper seek to identify ideas that agricultural education students has about the onsite/offsite impacts of soil erosion in the departmental demonstration farm.

OBJECTIVE(S) OF THE STUDY

The general objective of the study was to explore soil erosion and examine agricultural education students' ideas about onsite/offsite impacts on the departmental demonstration farm. The specific objectives of the study are;

(i) To examine NCE I and NCE II agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.
(ii) To identify NCE II and NCE III agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.
(iii) To investigate NCE I and NCE III agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

RESEARCH QUESTIONS

This study seeks to answer the following questions;

(i) To what extent is NCE I agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm?
(ii) To what extent is NCE II agricultural education students' idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm?
(iii) To what extent is NCE III agricultural education students' idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm?

RESEARCH HYPOTHESES

Three hypotheses were formulated in the null form thus;

(i) There is no significant difference in NCE I and NCE II agricultural education students' ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.
(ii) There is no significant difference in NCE II and NCE III agricultural education students' ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.
(iii) There is no significant difference in NCE I and NCE III agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

SIGNIFICANCE OF THE STUDY

The result of this study will be of benefit to the government, the college management, the department and the students as a whole. They will use this finding to make better ways of protecting the college farm environment from soil degradation that may lead to other devastating consequences.

RESEARCH METHODOLOGY

Design: The design adopted for the study was a descriptive survey design. This implies that the concepts are being described, recorded, analyzed and reported using available information. This enabled the researcher assess the situation within the study area at the time of the study and uses same to identify agricultural education students ideas about onsite/offsite impacts of soil erosion.

Population: The population of the study comprised all agricultural education students in the college of education, Afaha Nsit.

Sample/Sampling Technique: The sample for the study consist of sixty (60) agricultural education students out of one hundred and fifteen (115) drawn from NCE classes through a stratified random sampling technique. Twenty students were selected from each of the NCE I, NCE II and NCE III classes by balloting. A total of sixty (60) students were used.

Instrumentation: The instrument used for gathering data for the study was a researcher constructed questionnaire named Agricultural Education Students Ideas about Erosion Questionnaire (AESIAEQ). The researcher developed ten (10) item questions from the literature related to onsite and offsite impacts of soil erosion on the departmental demonstration farm. Content and face validity of the instrument was given by expert in educational test and measurements. Reliability of the instrument was calculated using Kuder Richardson (R-21) formula to yield a value of 0.94.

Data Collection Procedure: The researcher gathered the selected respondents in their respective lecture rooms and a copy of the questionnaire was given to each of them, who responded to each of the ten (10) items completely. This was collected on the spot from all the respondents and was ready for analysis.

RESULT AND DISCUSSION

Table 1: The extent of NCE I agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

	Onsite Impact		Offsite Impact	
S/N	**Students Yes Idea**	**Students No Idea**	**Students Yes Idea**	**Students No Idea**
1	15	5	20	-
2	10	10	15	5
3	20	-	20	-
4	15	5	15	5

5	10	10	20	-
Total	**70**	**30**	**90**	**10**
%	**43.75**		**56.25**	

Table 2: The extent of NCE II agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

	Onsite Impact		Offsite Impact	
S/N	**Students Yes Idea**	**Students No Idea**	**Students Yes Idea**	**Students No Idea**
1	20	-	15	5
2	15	5	20	-
3	15	5	15	5
4	20	-	20	-
5	10	10	15	5
Total	**80**	**20**	**85**	**15**
%	**48.48**		**51.52**	

Table 3: The extent of NCE III agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

	Onsite Impact		Offsite Impact	
S/N	**Students Yes Idea**	**Students No Idea**	**Students Yes Idea**	**Students No Idea**
1	20	-	20	-
2	20	-	20	-
3	15	5	15	5
4	20	-	20	-
5	15	5	20	-
Total	**90**	**10**	**95**	**5**
%	**48.64**		**51.35**	

Table 4: t-test analysis of difference in the NCE I and NCE II agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

Source of variance	N	$\overline{X}$	SD	df	t-cal	t-crit	Decision

NCE I Students Idea	20	16.0	2.83				
				38	2.04	4.35	NS
NCE II Students Idea	20	16.5	2.26				

Significant at P<0.05, NS = Not Significant

Table 5: t-test analysis of difference in the NCE II and NCE III agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

Source of variance	N	$\bar{X}$	SD	df	t-cal	t-crit	Decision
NCE II Students Idea	20	16.5	2.26				
				38	2.46	4.35	NS
NCE III Students Idea	20	18.5	1.62				

Significant at P<0.05, NS = Not Significant

Table 6: t-test analysis of difference in the NCE I and NCE III agricultural education students idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

Source of variance	N	$\bar{X}$	SD	df	t-cal	t-crit	Decision
NCE I Students Idea	20	16.0	2.65				
				38	3.78	4.35	NS
NCE III Students Idea	20	18.5	1.62				

Significant at P<0.05, NS = Not Significant

DISCUSSION

Agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm shown in tables 1-3 which answers the research questions indicated that 43.75% and 56.25% of NCE I students has ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm respectively . 48.48% and 51.52% of NCE II students has ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm respectively. 48.64% and 51.35% of NCE III students has ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm respectively. This implies that agricultural education students have a common idea about onsite/offsite impacts of soil erosion on the departmental demonstration farm. It is worth at this juncture to maintain that agricultural education students observed that excessive soil erosion in the departmental demonstration farm cause both onsite and offsite problems.

The result of the analysis showed that there was no significant difference in the agricultural education students' idea about onsite/offsite impacts of soil erosion on the departmental demonstrations farm. This was shown in table 4, where the null hypothesis I was tested at P <

0.05 level of significance to reveal a calculated t-value of 2.04 and critical t-value of 4.35, thus the null hypothesis was accepted. Result in table 5 showed no significance, where the null hypothesis II was tested at $P < 0.05$ level of significance to reveal a calculated t-value of 2.45 and critical t-value 0f 4.35, thus the null hypothesis was accepted. The result in table 6 also showed no significance, where the null hypothesis III was tested at $P < 0.05$ level of significance to yield a calculated t-value of 3.78 and a critical t-value of 4.35, hence the null hypothesis was accepted.

This result is in line with the findings of Walling, 2013, Boardman & Poesen, 2006, Blanco et al, 2010 and Julien, 2010, who in their different opinion stated that the harmful impacts of accelerated soil erosion are well known and identified the onsite and offsite impacts on farmers' field and outside agriculture. They mentioned contributors to water and wind erosion to include, unsuitable agricultural practices, deforestation, road construction, anthropogenic factors and urbanization. They concluded that these factors are responsible for about 84% of global extent of land degradation. It was seen at this point that most significant environmental problems such as land pollution (by agrochemicals), water pollution (eutrophication), sedimentation and siltation were made known as the offsite impact of soil erosion being observed outside the field. Conversely the onsite impacts were those that affect productivity and take a long time to manifest or noticed by the farmers.

CONCLUSION

It was therefore concluded that there is no significant difference in the NCE I, NCE II and NCE III agricultural education students ideas about onsite/offsite impacts of soil erosion on the departmental demonstration farm.

RECOMMENDATION

Based on the study, the following recommendations were proffered;

1. The government should make and use legislation that prohibits unsuitable agricultural practices like bush burning, indiscriminate use of agrochemical and so on, thereby saving our soils from degradation.
2. Stakeholders in the business of agriculture should create awareness on the dangers of soil erosion and make better planning to prevent it in the field.
3. Timeless of farm operations should be adopted in the department whenever farmstead is to be established.
4. Prompt attention should be given by the government in making any devastating field better again after the episode of soil erosion.
5. Students should be able to observe the onsite and offsite impacts in the field and use locally available materials to prevent it, thereby protecting the farm ecosystem.

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