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CONTENTS

CAUSES AND PREVENTION OF EROSION IN URBAN CENTRES: A CASE OF OKEITUNU/SANNGO AREA OF IBADAN CITY, NIGERIA

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W. O. AJAGBE

ABSTRACT: The causes of erosion in the study area, Okeitunu/ Sanngo, were investigated via the geology and soil properties of the area, the state of the existing road network and the drainage system, and the solid waste management practice in the local government area. It was revealed that both natural and man made activities contributed to the erosion of the area. Topographical nature of Okeitunu and the inadequate stream channel, in addition to bad environmental sanitation practices, unchecked vegetative removal and lack of enlightenment on the part of the inhabitants on erosion problems are the key factors causing the degradation of the Okeitunu environment. Stabilization of the steep slope, rehabilitation of the existing bare roads and damaged drainage will abate the wearing away of the soil. In addition, the populace needs to be enlightened to know what it takes to initiate or aggravate erosion.

INTRODUCTION

Soil erosion is a systematic removal of soil including plant nutrients, from the land surface by the various agents of denudation: running water, wind and waves. It involves the loosening, wearing away, dislodging, transportation and disposition of particulate soil materials from one location to another. All the 36 States of Nigeria including FCT are adversely affected by soil erosion, but the intensity and type vary from region to region. While wind erosion is a menace in the Sudan-Sahel belt where rainfall is low and soils are sandy, coastal erosion afflicts virtually all the states bordering the Atlentic Ocean, that is Ogun, Lagos, Ondo, Delta, Edo, Akwa Ibom, and Rivers States.

Another type of erosion that is rendering havoc to the Nigerian soil is sheet and gully erosion. Examples of areas affected by this type of erosion include the areas of sandy soil and soft rocks in Anambra and Abia states as well exposed land surfaces in many other parts of Nigeria. Gully erosion within settlements deserves separate mention because of the threat that is poses to building and other structures and danger to human lives. One such site is Okeitunnu/Sanngo in Ibadan, Oyo State Capital where erosion had caused the collapse of buildings and worship centres. A lot more buildings

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are parching precariously on the edge of stream channel.

The present situation at Okeitunu despite the Basement Complex rocks formation of Ibadan, deserves attention before attaining the level of gully in places like Abiriba (Abia State), Auchi (Edo State), Efom Alaye (Ekiti State), Nsukka and Ugwuoba areas of Enugu State, Okigwe and Orlu areas of Imo State, and Agulu-Nanka gully sites of Anambra state. (Michael, 1982, NEST, 1991; Okudo, 1996). The problem of erosion, therefore, should not be seen in isolation but likened to a cancerous cell that could become widespread and all pervasive.

EROSION PROBLEM IN OKEITUNU/SANNGO AREA

There are many erosion affected/prone areas in the city of Ibadan but that of Okeitunu/Sanngo area is most pertinent because it exists in the heart of the city where population is dense and houses built close together without drains. Okeitunu/Sanngo is located within Ibadan North of Oyo State. It lies between longitude 3°53' E and latitude 7°25'N and 7°26'N, see Fig. 1. The land use pattern of the study area can be classified into three, namely: the high and the medium density residential areas and the industrial zone. The high density area, Alaro, with a population density of about 2000 per hectare consists of the unplanned area where buildings are randomly set out and the meandering footpaths in – between houses are the only access to most of the houses. The medium density residential area, Okeitunnu is on a generally hilly terrain associated with steep slope undulating landscape. The main industry in the study area is the plank sawmilling.

A notable feature of the area is the railway that separates Okeitunu from Alaro thus putting Alaro in the valley relative to Okeitunu. Consequently, the area is categorized into two zones, Okeitunu that is at the upstream of the railway and Alaro/Sawmill at the downstream. The geology of the study area is not different from the general geology of the city of Ibadan-basement complex rocks. It is classified into major and minor types. The major types are quartzites, banded gneiss, augen gneiss, granite gneiss and migmatites. The minor ones include pegmatite, apilites, quartz veins, dolerite dykes, ampohibolites and xenoliths.

Within the surface layer of the deposit a sandy stratum of reddish brown sandy clay which has low water retention capacity can be found. The existing road network at the Okeitunu zone depicts some having side drains on both sides, some with side drain on only one side and still others with no side drains at all. Most of the side drains are blocked by silt and refuse deposit while some have collapsed due to erosion. Table 1 contains the details of the types and conditions of the roads and drains in the study area. The road and drainage conditions in Alaro/Sawmill are worse. Garbage collection is haphazard. Roadside drains, streets, railway lines and stream courses are the familiar garbage dumps, thus reducing the already inadequate side drains and the carrying capacity of stream channels consequently increasing the risk of flooding.

Okeitunu being on a steep slope, runoff from the area erodes the bare roads and deposit sediment into the existing drains thus leading to the collapse of some drains as early described. Two fully developed gully sites are noticed towards the rail end of the area. Details of the gullies are indicated in Table 2. The runoff with high sediment load from Okeitunu eventually passes through a recently constructed 2m square twin box culvert across the railway and discharges into the Alaro stream the source of which is a spring located close to the sawmill open garbage dump site. Increased runoff moves down the stream at a high speed resulting in the collapse of houses and worship centres and other infrastructural facilities along its path. (Plate 1 & 2). The stream meanders through Alaro, Idito and Odobale areas through Ijokodo High School (School for the Deaf). It finally discharges into Eleyele Lake.

Table 1: Types and Conditions of Road and Drains at Okeitunu Area

Names of Road	Types of Road	Present Condition of Road	Types of Drain	Present Cond. of Drain
Onifade Street	Earth Road	Very poor. Badly eroded. Passable by car with great difficulty	No Drain	Developing gully noted
Okeremi Street	Earth Road	Poor but passable by car	No Drain	Developing gully noted
Church Street	Earth Road	Poor but passable by car	No Drain	Developing gully noted
Amisu Street	Earth Road	Poor, badly eroded and almost impassable by car. Now under construction.	Block wall lined on the outside edge and concrete lined on the inside.	Developing gully noted
Adeola Crescent	Surfaced Dressed	Surfacing in a poor condition with potholes and other surface defects present at various sections of the road.	Block wall lined on the outside edge and concrete lined on the inside	Drains have collapsed on both sides of the road strech and have silted -up in some others.
Jaiyeola-George Street	Earth Road	Poor, badly eroded and almost impassable by car	Block/concrete wall lined drain in front of some houses.	Totally-silted -up
Fatodu Street	Surface Dressed	Serviceable but with few car pot-holes noticed	Block wall lined drain on the outside edge & concrete lined and the inside.	Drain on one side; silted -up with plant growth.

Table 2: Details of Okeitunu Gullies

length (m)	width (m)	depth (m)	Location Description
45.0	6.0	3.5	Started from Amisu street and terminates at a retaining wall constructed to protect railway embankment
100.0	9.3	3.0	Take off from the end of a retaining wall, then runs parallel to the railway and then terminates at a 2m twin box culvert.

CAUSES OF EROSION IN OKEITUNU/SANNGO AREA

According to Ilegbune (1996), soil erosion, whatever the type, may be broadly caused by natural and/or anthropogenic phenomena working singly or jointly in relation to the activities of eroding agents of wind, water and man. From the problem description above the causes of erosion in the area can be categorized into two, thus:

Natural Causes: Natural causative factors include nature of the landscape, the soil, rocks or geologic units, and the surface water and groundwater. For instance hilly, sloppy and sandy areas are readily eroded while clayey or shaley area may be eroded slowly, gradually and continuously until a sandy zone is intersected. Again, predominantly sandy geologic formations, and unconsolidated materials are more amendable to erosion than consolidated ones. Furthermore, sedimentary and metamorphic rocks form stable platforms.

Also, surface water in form of floods, streams, rivers, raindrops, and groundwater flows are also major causative agents of erosion. Topographical nature of Okeitunu area is the major factor responsible for the erosion of the area. At Okeitunu, being a built-up area, high coefficient of runoff and short time of concentration explain why large amount of water gathers quickly and moves at a very high speed thus limiting the rate of infiltration into the soil and subjecting the unpaved road to erosion. At Alaro Sawmill area, the inadequate stream channel to carry the high volume of runoff makes the surrounding bare soil prone to erosion.

Man-Made: Human activities have contributed immensely to Nigeria's soil erosion problems, translating what would have been a benign process under a natural cover of vegetation into a serious problem in some areas and a calamity in others. The situation is not different in Okeitunu and some of the causes of erosion in the area that are due to human actions are explained below: (a) bad land management and unheeded town planning regulations readily explain the construction of buildings in natural water paths and the construction of unplanned drainage. This alters significantly both the shape of the land and (as a consequence) the extent of flood and erosion, (b) bad environmental

sanitation practices such as indiscriminate disposal or dumping of refuse which block artificial and natural flow channels, (c) lack of vegetative cover that could act favourably against both wind and water erosion. As urbanization intensifies, natural surfaces are replaced by buildings, pave road, and concrete surface, which do not allow water to percolate readily into the ground. Consequently, a large proportion of the rainfall which should normally infiltrate into the soil, or be intercepted by vegetation and thus delayed for some time before running off, is immediately available for denuding the unprotected land and (d) lack of enlightenment on the part of the inhabitants of the area. Most f the people living in the area are ignorant of the actions of man and the resultant environmental hazards on settled area.

CONCLUSION AND RECOMMENDATIONS

Feasibility studies and final engineering design need to be carried out to effect a permanent solution to the erosion problem in the study area. The physiographic nature of the area makes it mandatory that the solution plan that may emerge be executed in one phase in order not to aggravate the erosion problem of the area. The inhabitants of the area should be involved at all stages of the project for the prevention and control of erosion. This is to let the dwellers have a sense of ownership that will promote dedicated surveillance. The economic losses, in addition to loss of lives, due to erosion menace are enormous and the amount spent on the control of it by the affected communities and government is alarming. Therefore, erosion in cities should not be condoned and every possible effort should be made to control the existing gullies, put a stop to developing ones, and create awareness such that actions that initiate erosion are not fermented.

From the foregoing discussion, it is obvious that the problem of erosion both at Okeitunu and Alaro/Sawmill areas need be attended to almost simultaneously. The solutions to the problems are categorized into two parts.

Okeitunu Area: (a) the whole area is on a steep slope which is practically bare and erosion is in varying stages across the area as mentioned earlier. In order to prevent further worsening of the erosion, there is the need to stabilize the slope by paving the existing roads, (b) adequate drainage should be provided for the roads that have none and the rehabilitation of the existing ones in order to safely and adequately convey the floodwater away from the area and (c) the existing gullies need to be filled-up, stabilized and replaced with adequate concrete channel.

Alaro/Isopako Area: This is the area where destructive effect of the flood is most felt. The immediate solution is the channelization of Alaro stream to carry a design flood safely from the railway to Ona River at Eleyele. This may involve the demolition of some encroaching buildings on the riverbank.

Various structural measures such as weir construction, bunds, catchpits, ditches etc, when used alone could lead to sub-optimal development of the flood plain and may even invite greater losses when storms occur which exceed the design limits of the structures. Therefore, there is the need to prevent erosion with the adoption of non-structural measures. The possible alleviative measures or non-structural methods for the prevention of the development of gullies in the case of erosion, and flood mitigation are discussed below:

Development of Control Laws: The enactment of environmental laws where none is in existence by the government and the provision of adequate enforcement machinery for their implementation will prevent to some extent the occurrence of flood and erosion. Such measures will: (i) check the current haphazard encroachment of buildings along the stream channel by prohibiting the development of land which is subject to flood damage; (ii) prevent the use of water path, drains and railway lines as refuse dump site.

Public Enlightenment Campaign: The enlightenment of people, at all levels, to be aware of their responsibility for nurturing and wisely utilizing the environment and taking urgent steps towards restoring environment balance where such balance has been upset will also reduce the menace of erosion. People should be educated on; (a) identification (that is, symptoms) of erosion, (b) Usage of erosion protection structures; and (c) town planning laws, regulation and codes particularly as regards building, farming and deposit of solid waste in drains and water paths, and indiscriminate opening of ground for mud house buildings.

Acquisition of Data: Control of erosion requires sufficient data obtained through continuous measurement of precipitation, wind direction, rainfall intensity and river flow. To do this effectively calls for the procurement and installation of modern flow measurement devices in various locations.

Desk Studies: Studies such as local geology, topography and soil characteristics; geomorphology of stream and river channels within urban centre, should be conducted on continuous basis.

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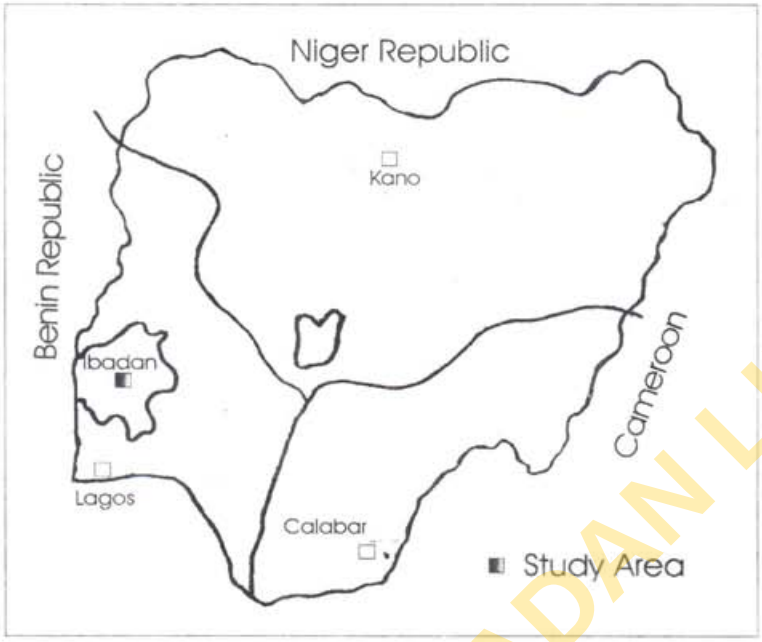

Fig. 1: Map of Nigeria Showing the Study Area

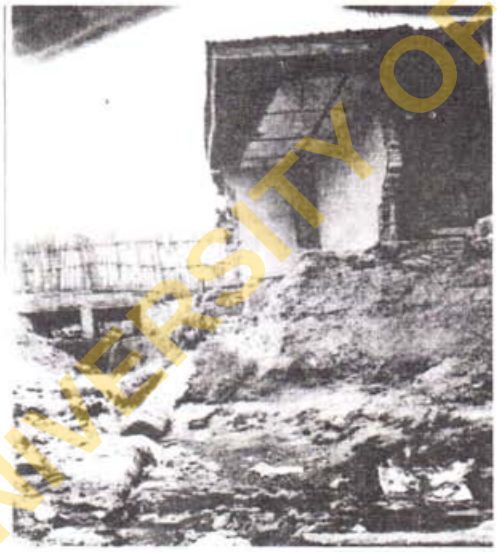

Plate 1: Collapsed Part of a Building Lying in the Flood Plain at Alaro Area.

Plate 2: A Building under Threat along Water Channel at Alaro Area.