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The Sedimentation Effect of Bosso Dam on Bosso water works in Bosso Local Gov't. Area

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Abstract
This study the effects of sedimentation in Bosso Dam. The study reviles as a result of sedimentation the storage capacity of the reservoir reduced to below the theoretical estimated life span of 60 -70 years. Reconnaissance survey was undertaken to the study area were it was observed that the dam had lost over 70 percent of it storage capacity with only 30 to 45 percent left for use. The source of sediment identify during the research includes: The farming activities both around and at upstream of the, erosion animal grazing and sediment transported inform of sediment load as the river flowers. Due to the seasonal nature of the tributaries that feed the dam it was also discovered that the volume of water in the dam fluctuate between season. The research conclude base on the findings that. The water volume of the reservoir has reduced which lead to the inability of dam to meet up with need of Bosso Community.

Introduction

The ability of a dam to store water to meet the purpose for which it was made, depend on a judicious estimation of the design capacity. The design of reservoir capacity is usually base on the area to be served- been it domestic industrial, irrigation, hydroelectric power generation, recreation among others. However, changes in cropping pattern, expansion of town as a result of population growth affect the ability of a dam to serve it need. A dam may be over design as result of uses that where anticipated but which may not materialised. Changes in cropping pattern as well as expansion of town/cities to be served can be eliminated at the design stage, but due to difficulty in estimation of the rate of sediment to be deposited in a reservoir, it become a problem during the design stage of the life span estimation of a reservoir (Segna et al 1987).

In many locations, effective dam management rest upon the control of erosion and sediment. Other important factors such as changes in stream temperature, pollution and nutrient coupled with other factors may be considered. There importance in dam management is often drafted by comparison with effect of erosion and sedimentation.

Erosion and sedimentation refers to two different processes: the process of detaching materials to it deposition. A particulate material is referred to as sediment once transportation began. Erosion can also include dissolution and transport of dissolved substances in some forms i.e. heavy precipitation. Dissolved load are generally low. Through, concentration may be high over a climatic period (Clayton 1981, Swanson 1982).

Rainfall runoff, snowmelt and river channel erosion provide continues supply of sediment that is hydrologically transported and in reservoir. Because of low velocities in reservoir, they tend to be very efficient sediment traps. Reservoir sediment disposal through mechanical methods can be very costly for large volume of sediment. Therefore, the management of reservoir sediment is often an important and controlling issue related to dam removal (ASCE1997). The sediment erosion, transport and deposition are likely to be among the most important effect of dam removal (Heiz centre 2002.)

The sediment related impact associated with dam could occur in reservoir and stream channel both upstream and downstream from the reservoir depending on the local

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conditions and the decommissioned alternative, the large degree of impact can range from very small to very large. If only the power plan of a dam were decommissioned, then sediment related impact would be very small. The top portion of a dam might be removed in such a way that very little of the existing reservoir sediment being release into the downstream river , then the impact of both upstream and downstream channel could be significant.

Resarch Problem

Considering the factor of soil erosion as a major contributing factor to watershed design capacity of a reservoir could be reduce with time as a result of increase in erosion activities. This eroded material are usually transported from the upstream and deposited at the bottom of the dam.

Our inadequate knowledge of estimation during the design stage; about the amount of sediment to be deposited as a result of erosion has been a major contributing factor for the large risk involved in the design of reservoir.

The initiating factor of soil erosion is from agricultural activities such as farming; which involve the tilling the land surface making it soft hence the topmost layer of the soil is easily eroded down the river. The damage attributed to soil erosion processes involved both the direct loss of soil and nutrient in the eroded area and the damage associated with the deposition of eroded material or sediment load at down stream locations. The direct loss can result to low crop production potential, undermine of structure and loss of road ways. Sediment damage on the other hand includes the clogging of stream channel, the silting up of pond/ reservoir and contaminations of down stream water by sediment born pollutant.

Aim and Objectives

The main aim of this study is to: identify the factors that are responsible for the sedimentation of Bosso Dam and the effects of sedimentation on Bosso water works. This will be achieving through the collection of water volume data from Bosso water works for a period of 10 years (1998-2007). The specific objectives of the study are as follows:

1. To identify the agricultural land use type around the dam
2. To identify the source of sediment generation and deposition
3. To identify the effect of the deposited sediment on Bosso dam.
4. To identify the effect of sediment on Bosso water works.

The Geographical Background Of The Study Area

The study area is Bosso Dam in Bosso Local government Area of Niger State. Niger State is located between latitude 4°00′ and 7°00′ with longitude 8°00′ to 11°00′. The state is within the middle belt of Nigeria. Bosso local government area is located between latitude 9°30′ to 10°00′ and longitude 6°00′ and 6°30′. The study area in particular is Bosso dam north east of Bosso town.

Vegetation

The area of study is found in the guinea savannah belt. The grasses are tall as the area received up to 100mm of rainfall in a year, for a duration of six to seven months. Trees are interspersed with grasses. The trees found in the area include; shear butter, acacias, etc. the trees usually grow under seasonal stress with the stunted grasses. It real extend is diminishing at a faster rate as result of agricultural activities. The heights of the grasses tend to decrease toward the western part of the local governmen boundary.

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Soil
Most part of the study area are under the ferruginous tropical soil, which consist of the single most extensive soil types and it support most of the agricultural food/cash crops production. They have been derived mainly from complex basement sedimentary rocks. Thus in more or humid forest and dried savannah to the south, the soil are deeper, more moist and to the process of laterization. In the savannah where the study area is located rocky hills rise above extensive plains dissected by streams and rivers over these terrain or landscape we have soil variation down slope. However, the soil contains iron which gives the soil high water retention capacity which favoured agricultural activities.

Scope and Limitation
This study focus only on the sedimentation problem of Bosso Dam. Considering source of sediment generation, how the generated sediment had lead to sedimentation of Bosso dam and the effect of the sediment on Bosso water works. The available source of information will be utilized to the fullest to ensure that the primary aim and objective of the study is attained.

Justification
Bosso dam initially had a storage capacity of about 0.681 billion litres which had dropped to about 500 millions litres and subsequent daily supply to Minna municipal had dropped to about 0.4 million litres. To ensure the efficient and continues storage of water in Bosso Dam and supply from Bosso water works, the importance of this study can not be over emphasised

Data and Methodology
The data and material used in this study includes:
Primary data- this are data that was obtain by the student directly from the field. These include photograph (aerial photography) at the study area.
The second source of data is the secondary source which was obtains from text books, journals, previous research work in the study area, encyclopaedia, libraries, magazines and publications.

Methodology
In order to obtain a clear data on the effect of sedimentation of Bosso dam, an intensive and extensive field work survey was embark in order to arrived at a concrete and reasonable conclusion in this study.

Reconnaissance Survey
The rationale behind the use of reconnaissance survey was to ascertain in partial term the real and actual problems peculiar to the study area. Areas of degradation was identify and evidence of it effect on the dam was also observed. In order to appreciate and acknowledge the nature of the problem, a reconnaissance survey of the study area was undertaken. The survey covers the upstream of the dam and the down stream of the dam. Activities at both the upstream and downstream around the dam were taking into cognisance. The field survey presented an opportunity of physically examine and determine the nature and extend of the problem.
A complete ground truthing was carried out to see the evidence of development and potentialities feasibility of the study area. More so, the ground truthing conducted in other to: identify the Agricultural land use type. Data on the agricultural land use type was obtained in both the upstream, and around the dam.
In order to be able to identify the source of sediment generation, the vegetation and soil types in the study area were observed. More also, the data on the evidence of sedimentation as well as it effect on Bosso water works was obtain from the dam.

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7.5 megapixel camera was use to capture various imagery during the field work survey

Personal Interview

Personal interview inform of interactive forum was done having in mind that the quest will revile some of the effect of the effect of sedimentation in Bosso Dam on the study area. Questions were asked in order to find out more relevant information. Some of the respondent provides great opportunity of knowing some key fact about the research.

Other Sources of Data

Journals, text books, previous research on the study area, and other relevant materials were consulted in other to obtain and acquire more information.

Analysis of Results

Sedimentation can be said to be a process of washing away of the topmost layer of the earth surface by rain which is entrapped, transported, deposited, and compaction in the water reservoir.

When a dam is built across a sediment laden river, the storage reservoir behind the dam often traps much of the load. Such dams store most of the stream flow reaching them, so that over 90 percent of the sediment load is being retained in the reservoir over a long period of time.

Abubakar (1997) in a study of pattern of and source of suspended sediment discharge into kubanni reservoir, stress that most of the modern reservoirs trapped as much as 50 percent of the sediment transported.

The relationship between erosion and sedimentation clearly illustrates the active role of water as well as land use and river response, is a particular transforming anthropogenic activities into environmental factors leading to sedimentation of dam.

Identification of Areas of Sediment Generation and Deposition

Bosso dam is located in the hill valley with outcrop on each side serving as a boundary. The topography of the study area is very sloppy. The highest altitude is estimated to be about 1200m above sea level and the lowest is 950m above sea level, as shown by contours on map. The river itself lies in low relief areas, where water collected sediment are generated from the hill outcrop surrounding the dam.

The dam is not located along any major river channel but depends on surface runoff from rainfall through the collection drainage. There are about seven of these water channels that feed the dam. A minor river Kalako, which represent the major river channel in the area flow down toward s federal university of Technology Minna, Bosso campus and collect in the drainage system and run through the campus to Suleja. The river runs from North to South. It is believe that River Kolako is likely to be a tributary of River Kaduna. The river and it channel depends on climate and seasons. It's Dam near the hill with lower contour, where the water runs. This water body flow along with sediment load which are subsequently deposited in the dam.

Identification of Agricultural Land Use Type

Observation during the reconnaissance survey indicates that some portions around the dam were used for farming. The farms are mainly of subsistence type, it's sustained by irrigation during the dry season. The trees that bear fruits are harvested and sold or eaten by the local inhabitant of the area.

When the inhabitant who are farmers by profession and farming as their source of livelihood tilled the land, rear animals which grazed on the land, etc. leaving most of the to be directly exposed to erosion as a result of being loosen up. As rain fall, the loosed

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soil is easily washed away into river channels into the dam as sediment.

As the water flows down the slope, the overland slope washes the finest materials and as it flows, it pickup progressively silts and then sand. The soil of the area is made-up of about 35 percent of clay hence more susceptible to water erosion compared to soil that have higher clay content. The usually have a steep slope as it source, therefore it's usually of high speed leading to runoff rather than soaking the soil. The action of rain drop on the loose soils further break down the soil aggregates hence decrease surface structure and decrease rate of water percolation into the soil.

Most of the farmland around 100m within the Bosso River is wrongly tilled along the path of the running water. These farming activities greatly increase the risk of erosion on the slope. ASCE (1997) state that any material which slows down water movement or increase the rate of percolation reduces the risk of erosion. The situation around Bosso dam aggravates the risk of erosion by providing already made channels for water to rundown. In order to minimise erosion on the steep slope, it should be on wood or grass land.

Effects of Sidementation On Bosso Water Works

Sedimentation was responsible for the rise in level of the beds of the water reservoir increasing the danger of inundation of adjourning area, the rise in water level and consequent of water logging of the whole area.

The initial depth of the dam is about 17.06m is now about less than 8.05m. Leading to a decrease in the storage capacity from about 0.681 billion litres to less than 500 million litres. And subsequent daily supply to Minna municipal dropped to about .5million litres. Therefore, resulting to the inability of the dam to meet up with the domestic water need of Minna and environs. This lead to water scarcity. Niger states have to find alternative water supply from Chanchaga and Tagwai dam to meet the demand of the people.

The research had shown that: the reduction in the storage capacity of Bosso dam is as a result of sediment deposition in the dam. The sediment deposit which covered an area of about 2.15km^2 in 1983 now occupied about 5.02 km^2

The number of crocodiles that where carried from river Kaduna during the rain has reduced as a result of drying up of the drainage pattern which makes it difficult for the crocodiles to migrate.

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Fig 4.5: one of the tributaries of Bosso Dam
Source: field work 2008

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Conclussion and Recommendation

Summary

The research work was set to identify the effect of sedimentation in Bosso dam in view of the important role water play in our daily activities. The research was set with the objectives of identifying the agricultural land use type, source of sediment generation and deposition, the effect of deposited sediment on Bosso water works

Data were obtained from both primary secondary sources, and reconnaissance survey. The research revile that as a result of sedimentation, the storage capacity of the dam had reduced below the theoretical value of 60 to 70years. Also as a result of sedimentation, the dam has lost about 70 percent of it storage capacity; this had lead to reduction in the daily water supply to less than 500million liters per day. Though, this may varies with season.

Conclusion.

Considerable effort has been made towards achieving the aim and objectives set at the beginning of this study. The ground truthing of the study area has enabled the delineation of various land cover and land use; and necessary information as related to the sediment generation and deposition around the dam was obtained.

Erosion has been linked with such factors as human activities, rainfall, biological activities of organism within the soil as well as impact of land cover in erosion intensity determination and inherent inability of soil to resist erosion.

The analysis had shown that the major cause of sedimentation in Bosso dam was due to erosion of the land surface, as well as anthropogenic activities of man at the upstream. The sedimentation had lead to the drastic decrease in the volume of water hence resulting to low water supply by Bosso water works to the environs.

It's important to note that Bosso dam is one means out of many for dealing with water resources demand of the area. However, erosion and sediment problem, land conservation would provide long term solution to the problem at hand. In many cases, problem of water quality may be solved by end-use conservation, planning, engineering works and combination of both. Soil conservation practices greatly reduce erosion from the land surface, channel bank cutting and gully head cutting. The contribution of sediment to reservoir can be reduced by over 85 percent through intensive conservation.

The problems associated with sediment transport have been addressed by measures such as being transported downstream from check dams, dams, rivers, and coasts (constructing a permeable check dam, bypass tunnel, dredging, sand bypass, etc.). However, as seen in coastal erosion, the need for cooperation among authorities in individual areas may be augmented in many cases.

Recommendation

Bosso Dam had build to last indefinitely in order to protect the dam from such effects of sedimentation, the following measure need to be taking:

a. Erosion can be limited by prohibiting construction and other forms of urban land use activities outside prescribed limits.
b. Agricultural activities outside the prescribed area can be check to reduce erosion.
c. Erosion is a natural phenomenon that can not be completely stopped but can be controlled therefore; it should not be over looked.
d. Its recommended that the fresh water zones should receive equal attention as the land use zone, since they have direct effect on each other and

sediment from land use should be studied hand in hand with water systems, because it has a pronounce impacts on the availability of quality water.

e. Comparison should be made between erosion likely to result from floods as a result of man activities. This will go a long way to ensure long life span of the dam.
f. Prepare and adhere to a schedule of regular maintenance for temporary erosion and runoff control. Two critical maintenance operations that must be performed regularly are cleaning out accumulated sediment and replacing worn-out or deteriorated materials, such as silt fence fabrics, so that the effectiveness of the controls is maintained. Maintenance can include dredging and reshaping sediment basins and re-vegetating the slopes of grassed swales.
g. The government should dredge the dam as well as expand the dam to enhance it storage capacity.
h. For feature monitoring activities adequate socio- economic data of the reservoir should be collected and also data on sediment volumes as well as numerical data on daily water supply of the reservoir should be correlated so that; exact value of the sediment effect can be obtain.

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