# THE SEDIMENTATION CHALLENGES ON THE LAKE BAM IN BURKINA FASO

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**Abstract**
Lake Bam located in Burkina Faso to the north of the capital Ouagadougou, is the largest natural reservoir of water in the country. In recent years, Lake Bam has experienced a gradual reduction of its storage capacity. During the dry season, it loses well over 70% its wet season capacity. This keeps getting worse each year as it does not recover the full capacity of the previous season. Chief among the major causes of this reduction is the phenomenon of sediment deposition in the bed of the lake. In a quarter century Bam Lake has lost a third of its depth. This paper reviews the sedimentation issues on the Lake Bam using Professional publications, like journal articles, conference symposia, and recent documents related to sedimentation issues of the Lake Bam with the objective to propose solutions that will help restore or increase the storage capacity. Recent advances have aided in understanding and implementing improvement strategies within the basin. However, it was discovered that challenges like erosion, use of fertilizers and pesticides, and climate change effects are prevalent throughout the basin, creating negative environmental impacts for humans, wildlife, and especially aquatic life. Watershed management, catchment rehabilitation and conservation activities such as control of upland erosion, protection of marshes and wetlands as well as tackling climate change impacts are proposed as possible remediation strategies in reversing the rapid sedimentation of Lake Bam in Burkina Faso.

**Key words**: Sedimentation, conservation, erosion, climate change

## 1.0 Introduction

Burkina Faso is a landlocked Sahelian country undergoing significant climate fluctuations exacerbated by the phenomenon of climate change. Over 80% of the population's main activity is agriculture. This agriculture is also highly dependent on rainfall. However, Agriculture is practiced during the dry season in regions close to natural or artificial water reservoirs such as dams, rivers or lakes. These water reservoirs also serve as a source of livelihood to the people.

Lake Bam in Burkina Faso reflects the importance of water reservoirs in the country. It is the Country's largest natural reservoir with a capacity of 41.3 million $m^3$ over an area of 2610 $km^2$. It supplies water to more than 2000ha of farmland operated by ten groups that carry out an annual turnover of more than two (2) million US dollars (Amos, 2004). Nine (9) municipalities in the region are benefiting from the lake. This is a large water reservoir with multiple purposes: water supply for humans, animals, crops under irrigation, large area of migration of wildlife and hydro-agricultural potential.

Despite its enormous potential, the lake, regarded as a Burkinabe national patrimony is facing many difficulties. The lake is losing its water yielding capacity hence a reduced livelihood. A large number of farmers and fishermen have abandoned their farms and nets respectively to do petty trade. Lake Bam is dying and this is due in large part to sedimentation issues. These sedimentation issues are chiefly as a result of anthropogenic activities, climate change effects and environmental actions such as erosion

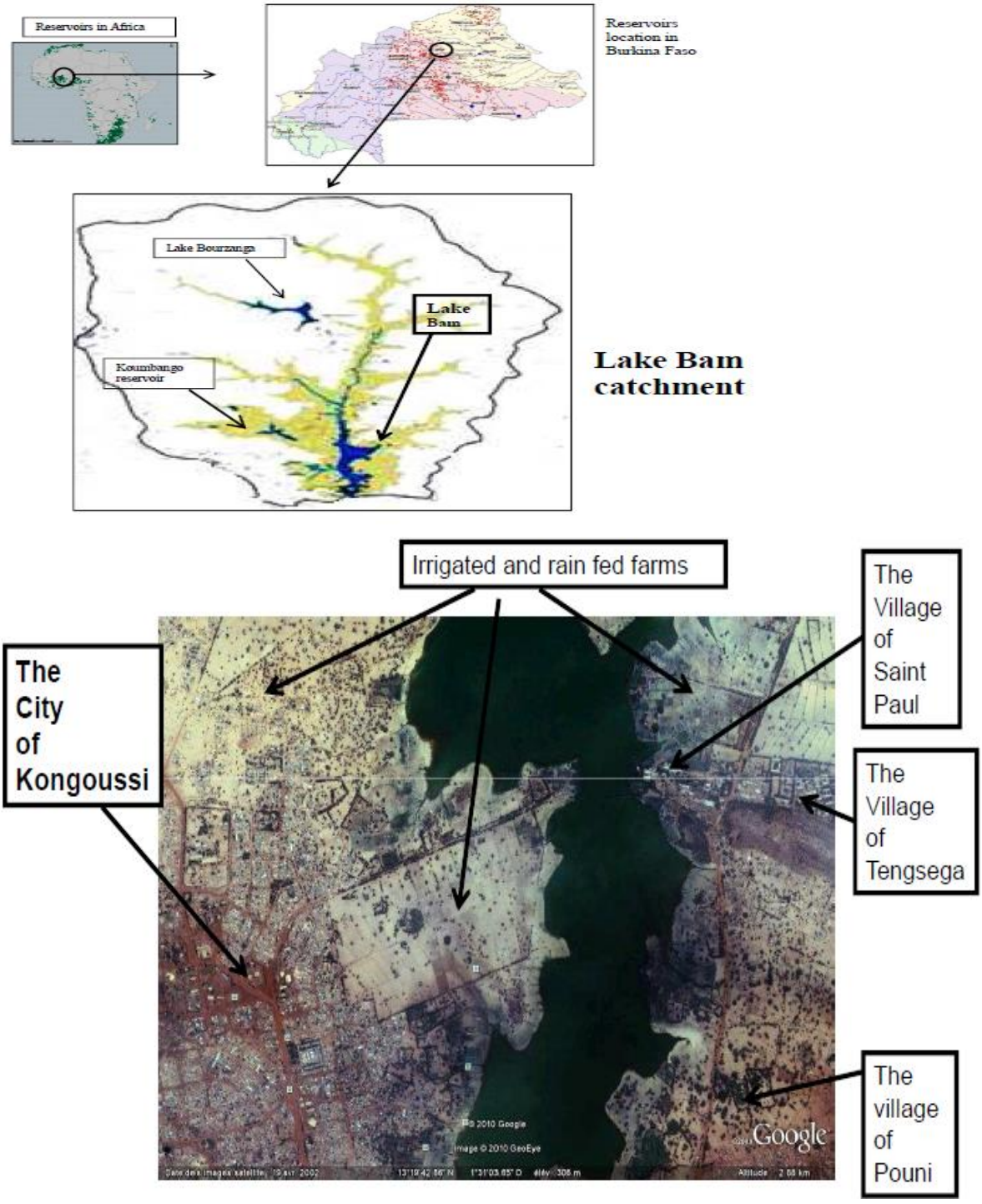


*Figure 1: Lake Bam -Physiography*
*Source: (Ouedraogo, 2010)*

Lake Bam is 115 km north of Ouagadougou, Burkina Faso's capital, in Western Africa. The lake is part of the Nakambe (Volta) river system, which flows through the Central Plateau of Burkina Faso (dry southern-Sahel climate). The catchment's area is about 2,600 km$^2$. The mean annual rainfall is about 600 mm during the wet season (3-4 months). The dry season is very hot (40°C on average), and the annual evaporation is about 1,500 mm during the dry season.

The length of the lake varies according to season between 3-20 km, and the width varies from 4 km and below. The lake is 1.5-3.5 m deep during the wet season and only less than 1 m deep during the dry season; usually forming patches of scattered ponds**.**

In recent years, large parts of the lake dry up during the dry season and the lake breaks into several smaller separate lakes. The volume of the water in the lake varies from 20 to 34 million $m^3$ during the wet season (up to 60 million $m^3$ during floods) and 0-9 million $m^3$ at the end of the dry season. Between 15-20 $m^3$ of water evaporates during the dry season, while another 5-10 million $m^3$ is used directly from the lake for flood irrigation and other human uses. Less than 25% of the total volume remains in the lake at the end of the dry season.

### 1.1 Sedimentation

Sedimentation is the transportation and accumulation of materials such as; sand, silt, gravel, boulders, in water reservoir ( Mama and Okafor, 2011). In other words it is the tendency for suspended particles to settle out of the fluid they are suspended in and come to rest when they encounter a barrier. As highlighted earlier, sedimentation of Lake Bam is due to several phenomena such as:

#### 1.1.1 Human Activities

In the proximity of the lake; a local population, about 60,000 people, recide in a town (Kongoussi) and in 40 villages. The largest source of income in the region is irrigated agriculture (mainly crops), while another important source of income is fishing from the lake. The constantly growing population, together with local impacts of anthropogenic activities, have caused over-exploitation of the area's natural resources. Invariably, some form of Agricultural practices around the lake increases the Lake's sedimentation.

#### 1.1.2 Erosion

Erosion is the process of degradation and transformation of relief or soil by factors such as wind or surface water runoff (Ongwenyi et el, 1993) . The sedimentation in the lake Bam is mainly due to the erosion. It should be noted that increased erosion also results directly in an increase in sedimentation**.** This erosion is aggravated by lack of trees and grasses around the lake; the wind or surface water runoff transport of solid materials and particles from to the lake.

#### 1.1.3 Climate Change

Human activity is the first cause of climate change and may be cancelled or at least mitigated with sustainable strategies (Musa, 2008). The increased intensity of rainfall due to climate change in regions close to Lake Bam led to higher rates of erosion. In addition, the increase in temperature during dry seasons, and increased erosion during wet season, results, for example, in negative impacts on water quality in the lake. Other indirect impacts of climate change are associated with changes in soil and vegetation and the precarious measures adopted by the populations.

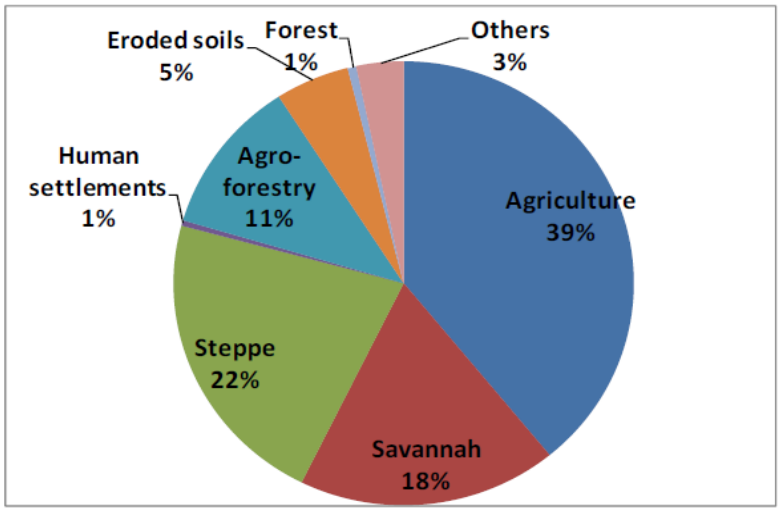


*Figure 2: Occupation of space around the Lake*
*Source: (Ouedraogo, 2010)*

## 2.0 Materials and Methods

Professional publications, like journal articles, conference symposia, and recent documents related to sedimentation issues of the Lake Bam are used as resource materials.

The method was to categorize the causes of sedimentation's into three phenomena which are:

(i). human activity
(ii). erosion
(iii). climate change

These different phenomena have been assessed through by the materials in order to discuss and propose some solutions.

## 3.0 Results and Discussion

It has been discovered that the main causes of sedimentation in Lake Bam are Unsustainable Agricultural practices around the lake, erosion of fields, loss of vegetation that could provide some cover due to over-grazing, lack of proper management and inefficient monitoring (Amos, 2004)

In the past feasibility studies were done to ascertain the extent of sedimentation of the Lake. The reports were put together and presented to the Ministry of Agriculture and Hydrology of Burkina-Faso. This dates as far back as 2004. the recommendations made can be classified under two broad classes; Remedial physical Activities and Management recommendations.

The physical recommendations include raising the level of the dam at the lake's outlet, construction of water control system at the lake's outlet, making of terraces on the edges of the lake and raising the levels of the fields behind those terraces to avoid flooding (Amos, 2004). Other recommendations are; excavation of the sediments in the lake while using the excavated soil for raising the fields behind the lake. Sediment traps and hydrological measurement stations could also be constructed on tributaries (Amos, 2004).

The management recommendations include the establishment of a restoration administration for the lake, setting regulations on the use, organising workshops for the locals, management of the buffer zones, managing the discharge and use of pesticides and herbicides. zoning of grazing and management of livestock, tree protection, ongoing monitoring and sewage management. (Amos, 2004)

Not many of these recommendations have seen full implementation due largely to a lack of proactive move by the government. These Recommendations need to go beyond the level of discussion and talks to the level of taking actions. Hence, the sedimentation challenges persisted and got worse as the years went by. Currently, the lake

which may be as wide as 2000 ha in the raining season shrinks to less than 600ha in the dry season. Also, depth as high as 3m in the raining season reduces to less than 1m in the dry season(Ouedraogo, 2010).
The physical rehabilitation like built a dam, biological/ecological rehabilitation, institutions that will govern the lake , integrate republican and indigenous institution and improve people capacities in institution by education are also some recommendations which can save the lake (Ouedraogo, 2010).

## 4.0 Recommendations

### 4.1 Watershed Management

The Watershed management plays a role in the flow of pollutants to the lake. A layout consisting of natural vegetation, for example, will experience less impact of pollutant runoff into the water than that consisting asphalt and concrete surface. Plants such as: Herbaceous, shrubs, trees are recommended for the installation of a lake bank (Roberge, 2004) . Other recommendations are as follows:

- Carry out recovery activities for lost vegetation- such as planting of trees, preventing the cutting of the few available trees
- avoid or reduce the use of chemical fertilizers and pesticides around the lake;
- maintain or create a riparian vegetation, especially in the first 10-15 meters of the lake by planting, preferably indigenous species;
- diversify (species, size) plantations (grasses, shrubs and trees adapted to banks);
- Facilitate environmental considerations in construction works near and around the lake through carrying out proper Environmental Impact Assessment on projects before construction

### 4.2 Catchment Rehabilitation

The solutions envisioned are threefold:

(i). Enhancement: Scientifically, this is the most optimal solution. It consists of an increase in the height of the dike road in question. This causes a saving in water of 30 to 40 million cubic meters. The disadvantage here is the risk of flooding.

(ii). Scrubbing: each year, 112 000 cubic meters of mud settles in the lake bed. The scouring is to remove the mud. But this option is quite complicated, delicate and expensive. This is a risky operation, because it is possible in this operation to pierce the impermeable layer (Bedrock).

(iii). Finally, there are accompanying measures such as environmental protection, planting of species adapted to stabilize erosion.

### 4.3 Fight against Erosion

Afforestation of the land, shorelines, fords, are needed The conservation of forests and wetlands throughout the watershed, while allowing logging that meet the standards as well as the excavation and proper maintenance of road ditches are essential to limit erosion. Several techniques are recommended in the document (Abrinord, 2008) concerning erosion control and management of ditches. Barrier sediments: Establishment type sediment barrier: straw bale or geotextile.

### 4.4 Climate Change Consideration

Like Musa et al (2008) the following recommendations are also made;

*Table 1: Key Adaptive Strategies to Climate Change*

| Adaptive strategy | Brief description of Requirements and Solution |
|---|---|
| **Rain water harvesting and small storage** | Legal framework for rainwater management<br>Knowledge transfer<br>Cloud seeding<br>Development of eco-roof technologies |
| **Aquifer recharge and aquifer storage and** | Conjunctive water management |

| | |
|---|---|
| **recovery(ASR)** | ASR system ; and utilising the capacity of floodplains |
| **Soil Moisture Management especially in rained area** | conservation agriculture to reduce the impacts of dry spells and improve water use efficiency practices and technologies |
| **Agriculture and other insurance policy** | Facilitate risk management and mitigate negative consequences of adverse effects of climate change |
| **Improved observation network to facilitate better production** | To improve .. water conservation and reduce loses and negative effects arising from extreme events |

**5.0 Conclusion**

The aging of the lake due to sediment accumulation is linked to human activities. Residents and owners of the lake borders, and government have an important role to play in the restoration of the aquatic ecosystem of the lake Bam. Climate change and erosion both contribute mainly to lake Bam sedimentation issues. In view of the review of the materials, we acknowledge that sedimentation is a major cause of the death of lake. The watershed management and catchment rehabilitation recommendations given could help save the lake if well implemented. Some of them have their risks and are expensive. However, concerted and prompt steps need to be taken to resuscitate the lake.

The four priority actions recommended for the maintenance of the lake consists; proper watershed management , Catchment rehabilitation , Fight against erosion, and Climate change consideration. Full participation of all stakeholders are required for the effective implementation of these recommendations.

As the years go by, the progressive decline of the lake has become alarming. As a result, the source of income for thousands of people are under serious treat.

**Acknowledgements**

Firstly, I like to acknowledge the management of my institute PAU-Institute for Basic Sciences Technology and Innovations. I appreciate my mentor Prof Patrick Home. He played a massive role in the form of encouragements, expert advices and guidance. I like to also thank my colleague Idowu Ezekiel for his support and encouragement. Finally I, appreciate the committee behind this conference, for making it possible for this conference to take place.

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