

Socio - Economic Impact of Lake Bosomtwe Shoreline Changes on Catchment Residents in Ghana

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Abstract- People living along lake Bosomtwe basin in Ghana relies largely on fishing in the lake and farming on the marginal lands. The relationship between the land use practices in the catchments, people's livelihood and the lake fishing environment is fascinating, because of the belief that the catchment forests and streams help make the lake basin a rich habitat. However, recent human activities and shoreline changes of the lake are believed to have subjected the catchment areas to undue deforestation from uncoordinated farming practices. The unparalleled degradation of the catchments has disrupted the fish ecology, hence dwindling livelihood opportunities. The local population has had to diversify livelihood strategies. This study examined the impacts of the shoreline changes on the livelihood of the surrounding communities. The study employed the mixed methods approach to undertake the research by triangulating primary and secondary source data. In-depth interview and questionnaire were used to solicit information from eighty seven (87) respondents on their knowledge and perception on Lake Bosomtwe shoreline change and its impacts on their livelihoods. The main findings of the study are that the gradual depletion of the lake is being felt by the population who depend on the lake for their means of livelihood. It is recommended that committees be set up within the three districts to provide environmental education and proper management of the lake as it serves as the highest income generating venture.

Index Terms- Ghana, Livelihood, Shoreline, Lake Bosomtwe, Environmental.

I. INTRODUCTION

Lake Bosomtwe is a natural inland freshwater lake in the Ashanti region of Ghana. It is located about 30 km south-east of Kumasi in the northern tip of the Adansi mountains in the forest zone of Ghana. The lake has a centripetal drainage system; its diameter is 106 km², and is about 11 km at its widest part; it has a maximum depth of 78 meters. The lake covers an area of about 52 km² (Turner, Gardner & Sharp, 1995). Studies by Jones, Bacon, and Hasting, (1981), (cited by Turner *et al*, 1995) confirm that the lake is the result of a meteoritic impact. The rim of the crater has been partly eroded, and is situated in dense rainforest, making it difficult to study and confirm its origin by meteorite impact. It is believed that, it was formed by an explosion of volcanic gases and was gradually filled with rain (Moon & Mason 1965). Shanahan, Overpeck, Sharp, Scholz and Arko, (2007) opined that, periods of heavy rainfall filled the crater with water, causing the lake level to rise above the lowest points of

the rim. Such periods are evidenced from fossils of fish found on hilltops. Water even flowed from the basin through an overflow channel. However, there were also times when the water level was so low that the rainforest probably had it way into the basin rendering the lake only a small pond. Such a period, according to legend and now proved by paleoclimatic records, lasted until about 300 years ago (Shanahan *et al*, 2007). The lake is fed by surface runoff and the 'Aberewa', 'Ebo' and 'Konkoma' Rivers. Fish species found in the lake belong mainly to the family Cichlidae. The main species are tilapia *busumana*, *T. discolor*, *T. zilli*, *Hemidiromis faciatus* and *Sarotherodon galila multifaciatus*. *Clarias species* and *hetero bronchus species* are sometimes caught in the lake (Dontwi, Dontwi, Buabeng, & Ashong, 2002). The major economic activities among the communities surrounding Lake Bosomtwe is fishing in the lake and farming on the steep crater slopes which provide them with their livelihood. To this end reconnaissance survey in some of the communities around the lake reveals substantial evidence of the threats to the fishes and fishery in Lake Bosomtwe. The community leaders and the fisher folk attribute the decline in the fishery to the interferences of the following,

- the natural processes on the lake and by scientific investigations;
- holiday makers and tourist who physically scare fishes to deeper waters; and
- the neglect of custom due to non- performance of rites by the people to the god Bosomtwe.

According to Dontwi *et al*, (2002) there are about 1000 fishermen operating in Lake Bosomtwe. They use 18 metres wooden planks as fishing boat, and employ three types of fishing gears, namely;

- The wire mesh traps
- Efficient gillnet 25m x 2-3m and 4cm stretched mesh; and
- 3.1-2m radius cast net.

The lake currently has no outlet, although it has apparently overflowed in the recent geologic past (Turner, Gardner, & Sharp, 1996a). The most important controls on the water balance of the lake are rainfall directly onto, and water evaporating directly from, the surface of the lake (Turner *et al*, 1996a). Of lesser importance is the runoff contributed by the lake's surrounding watershed. It is reasonable to assume, when considering the hydro-geological conditions that, little or no groundwater enters or leaves the basin. According to Turner,

Gardner, Sharp and Blood (1996a, 1996b), the lake level is very sensitive to small changes in rainfall and other weather parameters, such as annual mean temperature and evaporation. The lake level has risen more than 6.8m since regular monitoring began in 1932 (Koeberl & Reimold, 2005) and villages had to move several times as the lake transgressed (Turner *et al* 1996). Although the lake level in the past has been both much higher and lower than that at present, studies of the paleoflora of the basin reveal that the climatic factors have not changed drastically. There is, thus, the potential of the lake overflowing its crater rim, inundating all surrounding communities and ecology. Hence, the potential changes in the lake's level and its socio-economic impacts are therefore paramount for investigation. Therefore, the main aim of the study was to examine the impacts of the shoreline changes on the livelihood of the surrounding communities.

II. CONCEPTUAL FRAMEWORK OF THE STUDY

It is difficult, if not impossible, to isolate and quantify the entire specific factors causing shoreline changes. However, in order to evaluate the various factors and their interrelationships, it is necessary to discuss not only major factors but also minor factors. The basis for future prediction comes from this evaluation. To this end various models were evaluated to assess their weaknesses and strength, and afterward the model below was chosen after carefully considering the various variables that it contained with their explanations and relevance to this present study. the framework look at the interplay of factors responsible for the shoreline changes and its socio economic impacts. this is illustrated below in figure 1.

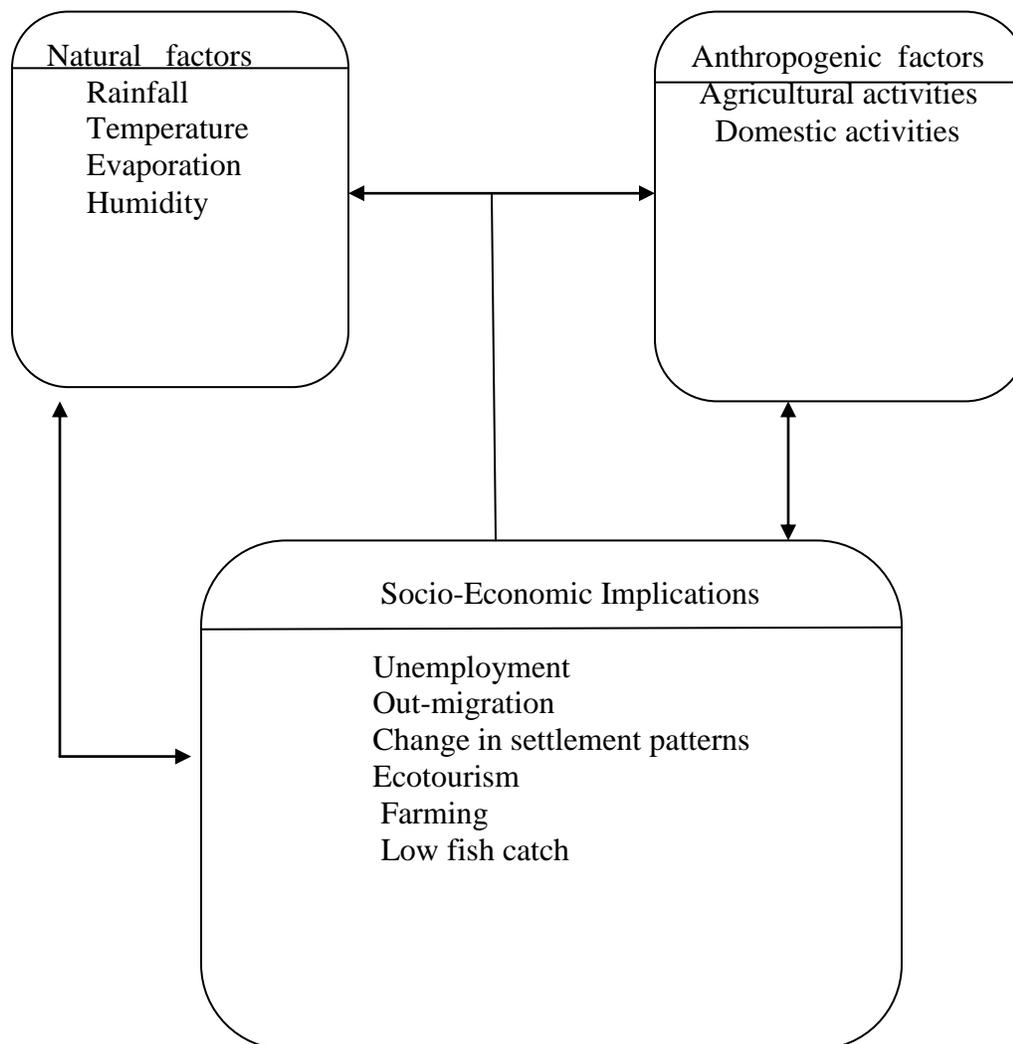


Figure 1: Underlying and proximate factors influencing inland lakes shoreline changes

Source: Adapted from National Research Council (1995)

III. MATERIAL AND METHODS

Study site

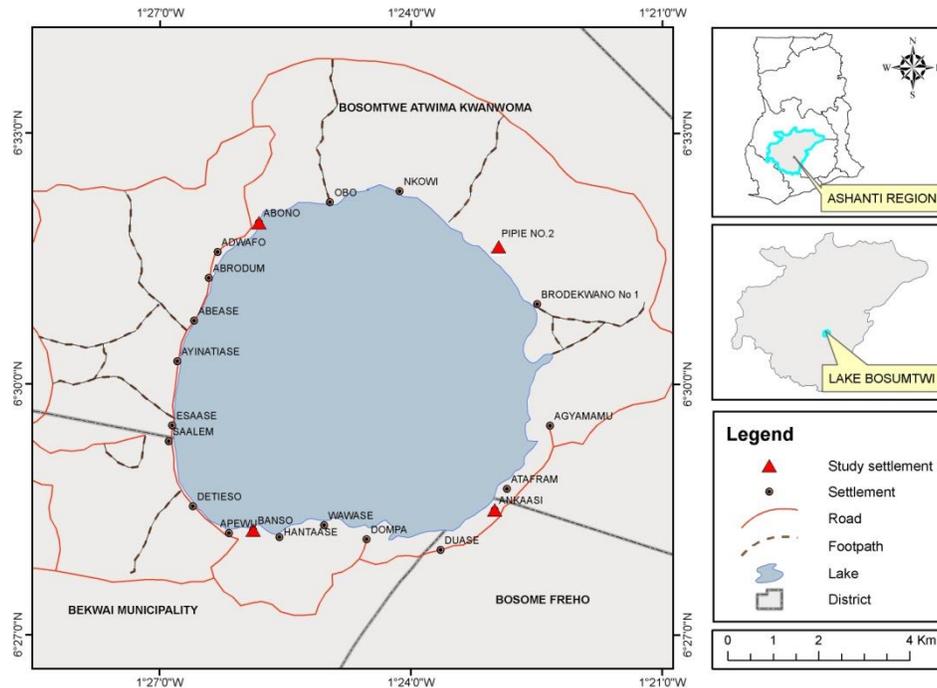


Figure 2: Map of Kumasi showing the study area in the national and regional context.

Source: Fieldwork, 2012

IV. DATA COLLECTION

The data for the study were gathered through in-depth interview as well as the administration of questionnaire to the respondents. The specific subjects examined included the assessment of the knowledge base of inhabitants around the lake; changes in the land use pattern, changes in socio-economic activities, and changes in lake level, as well as the socio economic profile of the residents. The questionnaire were administered in the Asante Twi language and the respondents were purposively selected from four settlement which were Ankaase in the Bosome Freho district Assembly, Abono and Pipie in the Bosomtwe Atwima Kwanwoma district Assembly and Bansa in the Bekwai Municipality. In all (eighty) 80 respondents who were (fifty-five) 55 years and over and seven (7) key informant were consulted.

V. RESULTS AND DISCUSSION

Age distribution of respondents

Attempts were made to purposively select respondents who were old enough to have noted all, or most of the changes in the shoreline of the lake and the effects of the changes on the local folks. As indicated in Table 1 respondents whose ages were 55 years and above were selected for the study. Respondents within

the 55 -70 ages constituted the majority (56.3 %); this was followed by those in the 71 -85 years (37.5%) group. Respondents in the 86 and above age group were (6.2%); these formed the minority. The ability of the old people to give the historical account of the lake makes age an important variable in a research of this nature.

Table 1: Age category of respondents

Age (years)	Frequency	Percent
55 – 70	45	56.3
71 – 85	30	37.5
86 and above	5	6.2
Total	80	100

Source: Fieldwork, 2012

Sex of respondents

The research shows that men on the field were more observant than women. The men were able to show the specific locations of the former shorelines than their female counterparts. Eighty (80) respondents comprising those who were 55 years and over were purposively selected to explore their knowledge on the changing shoreline of Lake Bosomtwe and its implications on the socio-economic activities of the surrounding communities.

Table 2 shows that 56.2 percent of the respondents were males while 43.8 percent were females.

Table 2: Sex distribution of respondents

Sex	Frequency	Percent
Male	45	56.2
Female	35	43.8
Total	80	100

Source: Fieldwork, (2012)

Level of education of respondents

It was assumed that education will enhance one’s knowledge and perceptions on the shoreline changes of Lake Bosomtwe. Education brings enlightenment. Hence, the higher one’s education the deeper the person’s knowledge. As illustrated in Figure 3 the educational attainments of the entire respondents were as follows; twenty two percent of the respondents had no formal education; 10 percent had primary education, 60 percent middle, 5 percent secondary and 3 percent tertiary education. Literacy within the basin can thus be described as low, since only 8 percent of the respondents could be associated with higher education. Though the level of education is low, the respondents had knowledge about Lake Bosomtwe shoreline changes.

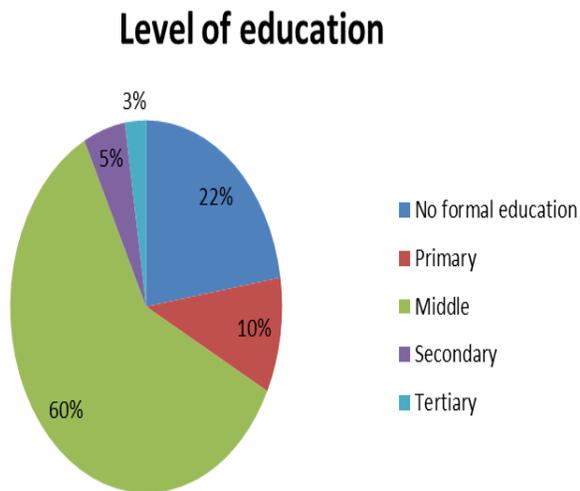


Figure 3: Highest level of education of respondents

Source: Fieldwork, (2012)

Occupation of respondents

Table 3 illustrates the data on respondents’ occupation. Farming and fishing were the main occupations of the respondents. Whereas fishing constituted 31.2 percent of the population, another 20 percent of the respondents were involved in fish mongering and farming. Those in fishing and farming constituted 8.8 percent, while almost 18 (017.5%) percent farming only. The fish mongers constituted the minority group (12.5%). These show that fishing rather farming is the major occupation of the respondents in the lake Bosomtwe catchment area (Table 3). With the shoreline changes of the lake, fishermen

are the most affected group in the area and this has resulted in the fishermen being laid off. This was brought about by the reduction in fish catch and fish composition from Lake Bosomtwe.

Table 3: Types of occupation of respondents

Occupation	Frequency	Percent
Fishing	25	31.2
Farming	14	17.5
Fishing and Farming	15	18.8
Fish mongering	10	12.5
Fish mongering and Farming	16	20.0
Total	80	100

Source: Fieldwork, (2012)

Income level of respondents

In the case of financial standing, respondents whose income was GH ¢ 20 a month were in the majority (47.5%), this was followed by those earning between GH ¢ 30 – 40 (31.1%). Those earning GH ¢ 50 – 60 (12.5%) were the next group, whilst those who earned GH ¢ 50 -70 (8.7%) were the lowest (Table 4). The relatively small size of the farms, lack of farming equipment (comprising rudimentary instruments such as cutlass, hoe, and axe) and limited access to funds for purchasing fertilisers and pesticides were some of the difficulties mentioned by the people. There is also seasonal character of many of the crops and fish. All these factors had resulted in limited income for the people surrounding the lake and often only at the subsistence level. It was indicated that fish catch was declining in amount and size, and attributed the decline in fish catch to recent scientific activities by certain Austrians. In their view, the removal of mud sediment from the lake has affected the shoreline of Lake Bosomtwe and its area extent. The significance of the income in this regard is that, as a result of the decrease in the area of the lake, and hence the fish population. Emphasis is now shifted to farming which is not as lucrative as fishing.

Table 5: Monthly income distribution of respondents

Amount (GH ¢)	Frequency	Percent
Up to 20	38	47.5
30 – 40	25	31.3
50 – 60	10	12.5
50 -70	7	8.7
Total	80	100

Source: Fieldwork, (2012)

Social impacts of Lake Bosomtwe shoreline changes

One of the research objectives was to explore from the residents’ point of view the impacts of the lake Bosomtwe shoreline changes on their socio-economic activities. This subsection presents a number of the impacts of the shoreline changes. The factors to be considered include unemployment, change settlement pattern, low income level, out-migration.

Unemployment

The main economic activities of the communities surrounding the lake are farming and fishing. The people depend more on the fishing industry than farming. Young and old, men and women are employed in the fishing sector. The reduction in the fish stock has laid off many of the fishermen, and this has affected their employment status as well as their livelihoods. The increasing lake temperature has reduced the total fish catch; hence, the income level of those in the fishing sector has reduced considerably.

One fisherman had this to say:

Due to the reduction in the fish catch, I cannot even pay for my children's school fees; and they are most of the time driven from school for not having good school uniform and for non payment of extra classes.

To further explain the effects of the shoreline changes on the lives of the people, the indigenes had resorted to farming on the receded shoreline to compensate for the reduction in fish catch.

One fishmonger also commented that:

I have seven (7) children and I took care of them, educated them to the university level, through the money I had from selling fish, but now, I do not even get some of the fish to buy and this has made life very unbearable and the cost of living very high. We have now shifted our attention to salmon as the substitute for fish in our diet.

Out – migration

Lake Bosomtwe shoreline changes have had an impact on the surrounding communities. The research discovered that the activities of the subsistence-based economy (fishing and farming) are closely integrated and depends on the lake for their survival. Due to the absence of employment opportunities in the basin, the area has observed massive out-migration. There has been an increase in out migration of the youth in the region. People are constantly moving out of the communities and a chunk of them are the able bodied youth who are migrating to seek greener pastures elsewhere, thus leaving the communities for the aged who are inactive. Prakash *et al*, (2005) made a similar observation that most of the youth in the area moved out of the basin and more were expected to move as the lake kept on shrinking in size and depth affecting job opportunities as well as education.

Changes in fish landings and nature of sales

Fishing activities near-shore has proved futile as there has been a reduction in fish catch. Whereas some men try fishing in deep waters, others now travel up to the less degraded coast of neighbouring villages. The temperature of the lake has changed and this probably has forced the fishes to move to deep waters, hence both fishing styles and fishnets are changing. Temperature changes have affected the volume and the area extent of the lake, hence, the shoreline of the lake has changed significantly. Due to this, the small net is replacing the old style and tradition, and the government has prohibited the use of small nets to conserve biodiversity in the lake. With regard to the nature of sales of fish, there has been an increase in women's involvement in the fish trading, even though volumes of fish catch have reduced; women

no longer wait for fish at home but interact with men who buy fish at the coast. This participation of women confirms Nindi's (2007) observation of the women participation in fishing as result of the reduction in the fish catch among the men who work on Lake Nyasa.

Settlement changes

One of the implications of the Lake Bosomtwe shoreline changes is the changes that occurred in the settlements in some villages. The fear of been flooded and the possibility of losing property and human beings as well as animal lives culminated in the resettlement of some of the communities. The people of Konkoma abandoned their original settlement and established a new town away from the lake in order to protect themselves against the incidence of flooding. This same phenomenon made the people of Pipie (Plate. 1) move to higher and safer grounds where they established new settlements. These communities now use the old settlement as farms. This has shifted their economic activity from fishing to intensification of farming and petty trading.



Plate 1: An old cooking utensil showing an abandoned settlement

Source: Fieldwork, (2012)

Economic impacts of Lake Bosomtwe shoreline changes

Low level income

Fishing has remained an important source of income for the residents of the Lake Bosomtwe basin. There are indications of falling productivity based on the respondents' recollections of what fishing conditions were like some decades ago. Examination of fish catch shows a significant reduction in the number and the size of the fishes the fishermen bring home. The subsistence nature of the activities of the inhabitants coupled with poor road network has contributed to low income within the area. The seasonal character of many of the crops results in an uneven income for the surrounding communities. Respondents mentioned that the fish catch is declining in amount and size. The reduction in fish stock by the fishermen has exacerbated the impact of poverty which is the hallmark of the Lake Bosomtwe basin. Though there is no specific per capita indicator for the basin, it can be estimated that about 95 per cent of the population live below the poverty line, which is, living on less than US \$1 per day (Government of Ghana, 2004). The study shows that the

growing need for outside finances in this impoverished region has led many communities to sell or lease a number of plots of land to foreign investors who are interested in tourism around the lake for building guest houses. Inadequate compensation to farmers who lose their agricultural plots to foreign investors has led to political squabbles around the lake.

Low fish- catch

The residents of the lake basin reported noticeable declines in catches during the past seven years and raised concerns about the possibility of over fishing in the lake. But the most commonly given reason for the declining fish catch was the scientific activities conducted by some researchers about over a decade ago. The residents also see the intensification of tourism activities on the lake as enhancing the movement of the fish deep into the lake. Again, the respondents associated the decline to the Lake Bosomtwe shoreline changes and its associated temperature changes to the intensification of tourism in the area. Previously, a study by Whyte (1975) found that Lake Bosomtwe was inhabited by a number of fish species in the mouth of the tributaries. A recent food web study by Poste, Hecky and Muir (2008) found that many fish species were destroyed and one species of Tilapia was now restricted to only the Aberewa River.

Impact on ecotourism

The results showed that ecotourism development in the Lake Bosomtwe basin undoubtedly depends to a large extent on the lake. However, a parabolic view of the lake shows the absence of tourism facilities in the basin. The reduction in the area extent has created a place for the construction of tourism facilities in the catchment area. However, tourism developers should be careful of the kind of structures that they put up as the lake has the possibility of increasing and decreasing its area extent and if permanent structures are built they may be affected. Again, Pollution of the lake water has affected ecotourism development in the basin as tourist report of the plastic materials that float on the lake; all these have affected the aesthetic beauty of the lake as result of dirty water and dead aquatic life. This will perhaps reduce the recreational and tourism value of the lake. Thus, ecotourists are not enjoying nature as they want to. For instance, swimming, in the lake has become unfavourable. Moreover, polluted waters provide a very favourable habitat for waterborne and insect disease vectors such as diarrhoea, bilharzias, typhoid, cholera, and dysentery. With the declining shoreline of the lake, tourist arrival to the basin would be affected and scientific research and studies would also be hampered. Scheren (2003) observed that there has been an outbreak of water related diseases in the catchment area.

Impact on farming

The Lake Bosomtwe shoreline changes have affected the livelihood opportunities of the communities. The local population has had to diversify livelihood strategies to ensure survival. The major economic activities of the people surrounding the lake are fishing and farming. Among the crops grown on the outer rim of the lake, that is, on the steep slopes include cocoyam, plantain, cassava, yam, cocoa, banana, and vegetables such as okro, tomato, and onion. Most of the men are farmers as well as fishermen, and the women sell fish and farm

on the land. The farmers have now intensified farming and grow more crops to consume and to sell at the nearby markets in Kumasi and Bekwai. The implications of shoreline changes on the communities is that, the farmers have to grow crops which take a short time to mature as the lake has the possibility of changing its position.

VI. CONCLUSION

The people living along the lake have limited income to acquire most of their needs. Their endogenous development depends on the relationship among humans (social organisation, knowledge, skills, and insights), nature (water, land, and ecosystem), and the spiritual realm (rituals, religion, beliefs, norms, and values). However, there is a need to improve their local knowledge systems, livelihood capitals and a practice to enhance in situ development built out of people's needs and locally controlled development alternatives. Shoreline changes have had an impact on the local communities and there is also every possibility of the lake to change its position in the near future. These suggestions if carried out can contribute to the sustainability of Lake Bosomtwe and also improve upon the livelihood of the surrounding communities. The range of the lake shoreline change problems is so wide that a restricted research strategy is not feasible for the time being. Again, non structural strategic options which are simplest, cheapest, and most effective means and involve re-planting native vegetation within the accreted area to create shades as well as prevent people from farming on the accreted land and also serve as barrier to the sediment entering the lake, are needed. There should be the provision of employment avenues by the state and other Non Governmental Organisations in the catchment area to absorb the people living in the lake Bosomtwe basin. This will ensure the improvement in the livelihood of the people. It will further reduce the incidence of migration within the area. Furthermore, there should be the establishment of committees within the three districts to provide environmental education, and proper management of the lake as it serves as the highest income generating venture for the Bosomtwe Atwima Kwanwoma District, to borrow the words of the planning officer of the District. Finally eco-tourism should be encouraged to protect the lake from losing its vegetation cover.

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