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WACA
West Africa Coastal Areas Management Program

CASE STUDY 06

Fighting Coastal Erosion in Keta Area

"The project has served its humanitarian purpose and is protecting what is left of Keta, but… the sea defense wall has not been able to regenerate Keta and provide livelihood to the people of the area, even though it might have prevented the rapid erosion of what is left of Keta."

A former employee of the Keta Municipal Assembly

The Keta Sea Defence Project

Context

The coastal zone of Ghana is defined as the area below the 30m contour covering 6.5% of the 238,535km2 land area (Armah and Amlalo, 1998). It is home to more than a quarter of the country's population, and contributes as much as 80% of the country's annual capture fish production. The 550km coastline, classified mainly as a high-energy type coast is divided into three geomorphic zones: western, central and the eastern coasts. The coastal area is tied to a number of extractive activities that contribute significantly to the national economy. These include oil and gas production, port operations, thermal electricity generation, coastal agriculture, hydroelectricity generation, fishing (including subsistence traditional fish exploitation in lagoons and the marine environment) and salt production.

However, coastal erosion and flooding resulting from the impacts of human activities, inappropriate systems put in place for managing coastal ecosystems, climate change and sea-level rise remain major threats to coastal dwellers and their livelihoods. Severe erosion rates have been recorded for the eastern coast particularly following the construction of the Akosombo hydroelectric dam (Ly, 1980). Erosion has affected the social and economic life of local populations, threatened cultural heritage and hindered coastal tourism in addition to the destruction of houses and other physical infrastructure. Some of the most affected communities are found in the Keta Municipality, which forms part of the eastern coast (about 149km) stretching from Aflao at the Ghana/Togo border in the East to the Laloi lagoon in Prampram to the west.

Keta Municipal Assembly is one of the 25 administrative districts of the Volta Region of Ghana with its capital Keta. It was carved out of the former Anlo District and was established by Legislative Instrument (L.I. 1868) of 2007. Keta was an important trading post between the 14th and late 20th century via a port and the fort Prinzenstein built by the Dutch in 1784, which is also now partly submerged

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by the sea. The once commercially vibrant littoral town is located at the eastern end of a narrow littoral strip stretching from the east of the Volta Estuary to the mouth of the Keta Lagoon Complex, which is the largest in Ghana and is a designated Ramsar site. The Keta Municipality has a population of 147,618 and a land area of 1,086km2 with 30% covered by water bodies including the Keta Lagoon that is 12km wide and 32km long. Fishing and farming (intensive vegetable farming through irrigation) remain the dominant occupations in the municipality, followed by salt mining, fuel wood harvesting and craft making.

Main Challenges

The generally low-lying lands, unconsolidated ("soft') sediments, shoreline orientation and sediment starvation from the Volta River following the construction of the Akosombo hydroelectric dam put the entire coast of Keta particularly the eastern parts of the coastal strip (Anthony et al., 2016) under intense erosion and flooding from sea level rise and lagoon water rise, especially with high rainfalls. Shortage of littoral sediment created when the Akosombo dam was built on the Volta River in 1961 is a major cause of increased erosion in Keta (Ly, 1980). The erosion process in Keta had been exacerbated by the prevailing wave climate and the submarine topography (Appeaning Addo et al., 2011). Persistent coastal erosion with erosion rates and sand deficit, estimated between 2 and 7 million of cubic meters of sand per year (Baird Official website), led to a number of severe impacts such as the displacement of most coastal communities, destruction of commercial activities (especially as ships no longer docked at Keta), loss of educational, residential, historical, social and cultural edifices and the siltation of the lagoon basin. Major issues facing the area resulting from climate change and its impacts include reduction in land for agriculture (erosion and salinisation), reduction of soil fertility, reduced yields, loss of coconut plantations, reduced fish catch (both lagoon and marine), coastal erosion and the perennial flooding of farms. This situation needed the need for drastic efforts to stop the rapid progression of the sea.

Objective of the Case Study

The Keta Sea Defence wall was constructed in 1999 as a solution to the age-old erosion problem of the ancient coastal town and its neighboring communities. It involved a total of about 12 million cubic metres of sand and 1 million ton of rocks for the entire project which has four design/construct components namely:

a. Sea defence works to prevent erosion. Six groynes of average length of 180m into the sea and a revetment, a beach fill and flood protection beam along the coast from the Keta-Kedzi.

b. Link road. 8.3km bituminous surface road between Keta and Havedzi.

c. Flood control structure. 20 gates of total length 80.5m to maintain the lagoon level below +0.8 NLD to relieve the inhabitants living around the Keta lagoon of extreme flood conditions.

d. Land reclamation. 270 hectares of land was designated for reclamation, however, 30 hectares (Vodza- Adzido area) could not be reclaimed due to the failure of the inhabitants to relocate. Of the remaining 240 hectares, 60% constitutes land for habitation and industry; 23% is unsuitable for reclamation while the rest 15% serves as a zone of tidal influence between the sea and the habitable area. Nine (9) bird islands were also constructed in the lagoon.

The Keta Sea Defence Project thus aimed to control the release of periodic floodwaters from the areas surrounding the lagoon to the ocean, to protect life and properties from being destroyed and to avert the increasing loss of land as a result of erosion.

Major Activities

Following feasibility studies which commenced in 1997, as part of efforts to adapt to the severe erosion and to protect the built-up environment in particular, an US$85 million Keta Sea Defence Project (KSDP) was undertaken between 1999 and 2004. The project was funded by the Exim Bank of the United States of America, with the Great Lakes Dredge and Dock Company of the United States of America as the Contractor and Baird & Associates, and Messrs Conterra Limited providing design and consultancy services respectively (Baird Official website). The choice of the design-build format allowed for the testing of assumptions from the design phase allowing the design to be modified and optimised during construction. The project activities centred around:

- Stabilizing the shoreline
- Preventing inundation of inhabited areas by the sea
- Preventing flooding from the lagoon

- Enabling land reclamation from the lagoon for habitation and industrial purposes

Through the Keta Sea Defence Project, several activities were undertaken. For example:

- The project developed a system that allows sand to be retained, but also pass around to reach down-drift beaches. Beach nourishment and groin construction allowed sand to begin to bypass the groin field system.
- The project developed and validated the posterior previsions of waves to describe the site conditions.
- Protection was extended far enough to protect erodible lagoon sediments.
- The project developed a flood control structure to address this issue and minimize erosion.
- A link road was constructed to re-establish road lost to erosion. The 8.3km road makes travelling easy for people as well as a reduction in transport fare between Keta and Aflao.
- Bird islands destroyed during the reclamation were constructed.

Results and Impact

With the completion of the project, erosion has greatly reduced and the shoreline between Keta and Kedzi has been stabilized. The reconstruction of the 10 km road between Keta and Kedzi has restored some level of economic activity, while a number of people threatened by erosion have returned to live in their original communities. Land was reclaimed to provide new areas for homes, businesses and communities. In the process, life, properties and farm lands have being protected.

In addition, since the completion of the project, the groynes have been trapping sediment and building the beach at Keta. This has resulted in the stabilisation and securing of a 7.5 km coastal space for the establishment of physical structures such as social amenities for previously vulnerable communities. The opening of the flood control gates of the sea defense allows saline water into the lagoon area thus creating a conducive environment for the breeding of brackish species including shrimps and a boost in fishing activities. The sea defence has also saved lands otherwise threatened by erosion and salinity for farming activities. The incidence of flooding has reduced drastically as the periodic floodwaters from the areas surrounding the lagoon to the ocean are controlled.

Although the defence structures appear to have facilitated effective management of erosion in Keta (especially the Keta-Kedzi stretch), its impact on the down-drift coast (Kedzi and Havedzi) is negative as it does not ensure sediment deposition hence provoking a significant increase in mean erosion in the down-drift coast. Erosion after the defense works increased from 3.2 m/year prior to construction to about 17 m/year after construction. This means that the groins are trapping all sediments from up drift coast leaving the downdrift coast with little or no sediment at all. This explains the erosion situation between Kedzi and Hlorve. The defense project is therefore a major contributory factor to accretion in the west and erosion in the eastern side. The groynes trapping sediment to build the beach at Keta have starved the shoreline between Kedzi and Hlorve of the needed volume of sediment (Angnuureng, et al., 2013). The increased erosion was only realised years after the intervention. This could be due to the unavailability of baseline information of the site, which meant that the projections were based on a hindcast of conditions which may not be entirely reliable or may have changed after the intervention.

Lessons Learned

1. Identifying the best method for coastal management measure

The construction of the Keta Sea Defence using a combination of groynes and revetments has led to increased coastal erosion on the down-drift coast towards the Ghana–Togo border by over 50%. This points that the shore-hardening technique using groynes may not always be the best method of shore protection (Angnuureng et al., 2013). Structural coastal protection measures may sometimes have negative impact on surrounding areas although initial purpose is well achieved. The project also highlighted that in dealing with coastal erosion and addressing climate-smart coastal management in the West African region there is the need for long term and holistic strategies and plans informed by scientific and empirical evidence.

2. Addressing upfront the views and concerns of local communities

Whilst the Keta Sea Defence Project has served the purpose of fighting erosion in Keta, it has failed to restore economic activities in Keta and its environs. A fishing harbour component which the community members advocated for would have provided a livelihood to the people of Keta and its surrounding who are mostly

fishermen and farmers. Many residents complained that community engagement was poor. The role of community consultation before, during and after project completion is key to avert challenges associated with similar projects. Communities like Blekusu in the Ketu South District are now bearing the brunt of the defense wall at Keta. The community has a population of 4000 people and community members believe some of these issues could have been averted if community members had been more engaged in the development and implementation of the project.

3. Timely and proactive interventions

Interventions in erosion hotspots must be proactive and not reactive. Rather than wait until life and property are lost and communities ask for sea defence walls, long term planning and strategies such as environmental education, policy reforms in inter-sectoral land use planning and coastal zone management, coastal sand mining prevention should be encouraged. Dynamics of sand transport and interaction along the coast must be well considered during planning and designing of structural measures. This requires a scientific approach and long-term perspective.

4. Addressing sustainability issues

The high cost of the sea defence wall has made it unsustainable for a developing country like Ghana to replicate the project in other coastal communities facing similar problems. It is estimated that an amount of $1.14 billion will be needed to build sea defense walls to protect the shorelines in communities most at risk across Ghana. However, deciding on the best option also depends on feasibility studies including cost benefit analyses. Focused investment of critical infrastructure within integrated coastal area management must take into consideration long term effects. For example, Fuveme, also in the Keta Municipality has "lost more than 150 homes to the sea". The level of destruction in Fuveme is staggering. Whilst the residents are advocating for a sea defense wall, the likelihood of having one built for them is slim. Issues of affordability and sustainability must be addressed in deciding on the best option for addressing erosion in Ghana.

5. Political pressures vs. realism

The building of the coastal defense structures was also done in response to pressures by local residents and political parties vis-a-vis the government in place

at that time. The local populations had become frustrated with the lack or insufficient action from the side of the government to address the protracted situation and their strong opposition to relocate. In retrospect, adequate consultations with the local residents and addressing the complex land tenure aspects may have led to another outcome.

6. Potential for scale up and replication

The sea defence structures appeared to have improved the management of coastal erosion in the Keta area. However, the wall came at a great financial cost to the country and also to some of the surrounding communities. The project has shown that 'hard' engineering approaches and structural measures including "green" solutions, which may succeed in controlling shoreline retreat, may influence changes in geomorphic features along the adjoining shoreline thus shifting the problem to other parts. Among one of the most appropriate options is the adoption of an Integrated Shoreline Management Plan (ISMP) with the use of 'soft' engineering approaches such as beach nourishment and an effective land use planning including the creation of buffers. An ISMP (a sub-set of Integrated Coastal Zone Management) moves beyond the use of site-specific methodologies to address coastal protection with a long-term perspective. Decision to scale up or replicate similar interventions must consider the critical issues of transfer of impacts to neighbouring communities, costs as well as impacts on socio-economic activities and biodiversity conservation.

REFERENCES

- Angnuureng, B. D., Appeaning, A.K., and Wiafe G (2013). *Impact of sea defense structures on downdrift coasts: The case of Keta in Ghana*. Acad. J. Environ. Sci. 1(6): 104-121.
- Anthony, E., Almar, R., Aagaard, T., 2016. *Recent shoreline changes in the Volta River delta, West Africa: the roles of natural processes and human impacts*. African Journal of Aquatic Science 41, 81–87.
- Armah, A. K., & Amlalo, D. S. (1998). *Coastal zone profile of Ghana: Accra, Gulf of Guinea large marine ecosystem project*. Accra: Ministry of Environment, Science and Technology
- Baird Official website: http://www.baird.com/what-we-do/project/keta-coastal-defence
- Boateng I. K. (2009). *Development of Integrated Shoreline Management Planning: A Case Study of Keta, Ghana*. Proceedings of the FIG Working Week 2009. Eilat, Israel, 3-8 May 2009
- Dagbui, M. P. (2013). *A presentation on climate change in Keta Municipality.* Keta Municipal Assembly
- Ly, C. K. (1980). *The role of the Akosombo Dam on the Volta River in Causing Erosion in Central and Eastern Ghana (West Africa)*. Marine Geology 37:323–332