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SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Developing Capacity In Spatial
Planning For Coastal Fishing
Communities And Ecosystems

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY



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DEVELOPING CAPACITY IN SPATIAL PLANNING FOR COASTAL FISHING COMMUNITIES AND ECOSYSTEMS

Improved disaster preparedness, coastal and land use planning is needed to build resilient fishing communities



Figure 1 Fisher folk in Tsokomey are living in a high risk barrier beach system, and lamenting the loss of fishing canoes and gear from a recent tidal event in September 2016.

It is quite evident that Ghana needs a coastal zone management program that can address critical issues of coastal erosion and frequent flooding events and other coastal development challenges. Over the next several years and decades, the costs of dealing with these issues will soar upwards.

Several recent disasters occurring along the coastline of Ghana have left coastal dwellers, particularly fisher folk, feeling very vulnerable. These disasters resulting from storms and tidal flooding events occur periodically during extremely high tides and also when there are high waves and storm events at sea that make low lying coastal zones hazardous living environments. Much of Ghana's fishing and processing capability is located in low-lying, erosion-prone and highly exposed beaches, barrier spits and shorelines. Thousands of fishers and their families live and work in crowded, vulnerable locations. The shorelines of fish landing sites are littered with remnants of sea walls, riprap, groins and improvised shore protection that also have not provided much relief from ongoing coastal erosion.

Climate change resulting in rising air and water temperatures are leading to rising seas. Increased flooding along riparian zones and estuaries, due to more erratic and stronger rainfall events caused by deforestation and climate change, also put communities living in these areas at greater risk. Unfortunately, these disasters are almost certain to increase in severity and frequency in the upcoming years and over the next several decades as the human population grows and additional development is built in these high-risk zones.



Figure 2 Tidal flooding in Anlo, Ghana
(<http://www.gbcghana.com/1.7864130>)

Recent events in Ghana are the result of a combination of factors triggered by tidal forces. These typically occur during high tides and most frequently during "spring tide" (twice per month) and "king tide" (on average once per year or every 1.5 years) event. These high tide, high wave events are associated with

coastal storms and strong winds. The local expression “tidal waves” does not mean these events are tsunamis caused by earthquakes or volcanic activity.

Why USAID support to these initiatives is essential

In the light of these recurring issues, the United States Agency for International Development, USAID, is committed to supporting initiatives and projects that contribute to effective coastal planning and resiliency building. First, from the standpoint of food security, fishermen and women need to have close access to the shoreline, often in river mouths as well, to conduct their business, so these communities are in part by necessity located in highly vulnerable and disaster prone areas. The SFMP and the Fisheries Commission and Ministry of Fisheries and Aquaculture Development are interested in the well-being of fishing communities and needed access to safe and secure areas for them to conduct their food production activities, fisheries development programs therefore should take an integrated approach and support development of resilient communities that can cope and adapt to living in dynamic coastal zones. In addition, there is a need to maintain areas for local food production to serve as a form of food bank. Many agricultural and fish production areas are being converted to plantation agriculture, industrial and residential development and tourism resorts, resulting in increasing scarcity of places for local coastal communities to live, grow their own food, and sell it locally.

From a climate change and conservation perspective, coastal forests and wetland areas must be preserved as they act as carbon sinks and mitigate against increasing carbon emissions that warm the planet causing rising seas and worsening floods. Mangrove forests in particular serve as the nursery grounds for many important local food fish species. From a disaster management perspective, much of the current property losses can be reduced in the future with better land use planning, and recent deaths are preventable as well as with better disaster preparedness and response measures targeted at easily identified high risk zones.

Already, Ghana is spending millions of Cedis on sea defense walls which cannot be built along the entire shoreline. Sea walls are very expensive and one news article in the past quoted a cost of well over \$1 million per kilometer of coastline to build them. This may be appropriate in some places where high value real estate, human settlements with large populations, and public infrastructure are at risk and where the benefit to cost is positive. However, it is unlikely to be affordable for all communities, so alternative solutions such as relocation must be considered. Such a program should involve the Ghana National Disaster Management Organization (NADMO) in order to link long term planning, disaster preparedness and response capabilities in an integrated approach.

The good news is that it is possible to predict with a high level of precision when high spring and king tide events will occur, and days when flooding is most likely. Early warning systems can be put in place to alert the public of such imminent occurrences. Bulletins can inform the coastal public, disaster response and relief agencies as well as district authorities of those periods when risk of flooding is highest. Good weather forecasting and marine weather advisories available online could provide the framework for an early warning system where certain high risk areas could be advised via SMS and mass media, to evacuate, and fishermen advised to move boats to safe harbors or pulled as far up the beach as possible, and engines and gears moved to high ground. Vulnerable areas and risk maps can be produced nowadays with good precision using low cost technologies such as small, unmanned aircraft attached with high resolution cameras.

Improved local scale spatial planning can guide future development in order to reduce the likelihood of such disasters affecting so many people in the future. For settlements and

infrastructure already in hazardous areas, there is a range of mitigation measures that can be taken. All of the suggestions above are good practices being implemented in many countries around the world, and there is no reason that Ghana cannot do the same. To this end, USAID is assisting local, regional and national government to apply these good practices right here in Ghana.

USAID contributions to coastal planning and community resilience since 2009

In June 2016, two Feed the Future sister projects (the USAID/Ghana Sustainable Fisheries Management Project - SFMP and the USAID/Ghana University of Cape Coast Coastal and Fisheries Capacity Strengthening Project) jointly organized a 2-day workshop, in collaboration with the University of Ghana, to highlight the problem of coastal flooding events that occurred along the entire southern shoreline of Ghana earlier in the year. The workshop discussed a range of options for flood prone coastal areas and some suggestions of a way forward. Participants concluded that Ghana needs improved coastal zone and land use management initiatives to deal with these recurring events and their aftermath, and that can help to reduce loss of life, as well as the loss of public and private property in the future.

Another USAID project - the USAID/Ghana Integrated Fisheries and Coastal Governance (ICFG) Initiative, implemented in the Western Region between 2009 and 2014, focused on the coastal and fisheries resources of the region. The ICFG project worked closely with coastal districts in the Western Region toward integrating coastal zone planning, and improving social and livelihood conditions of the coastal population. An important output of the ICFG was the Integrated Coastal Management Toolkit – a first-of-its-kind-in-Ghana; compendia of information products packaged for five of the region’s coastal districts to be used as a tool for district planners as they incorporate ICM issues into district medium- term development plans and spatial plans. ICFG collaborated with the USAID/Ghana Local Governance Decentralization Program (LOGODEP) whose mission was to strengthen local governments' ability to provide services to their citizens and develop more efficient district planning. The ICFG complimented this effort by building information technology capability in the coastal districts, providing GIS data, training and strengthening the Western Region Coordinating Council GIS Lab (also known as the Data Hub). This successful model is being replicated in the Central region by the SFMP.



Figure 3 Flight training with DJI3 Small Unmanned Aircraft



Figure 4 Ahanta West toolkit includes case study of the vulnerable fishing community in Akwidaa

USAID/Ghana SFMP’s role in coastal planning for fishing communities and ecosystems

The Sustainable Fisheries Management Project (SFMP) is a US Government Feed the Future Initiative funded by USAID/Ghana and implemented by the University of Rhode Island that works collaboratively with the Ministry of Fisheries and Aquaculture Development to rebuild targeted marine fisheries stocks through the adoption of sustainable practices. It is one of three complementary programs to emerge from the ICFG, along with the US Forest Service’s Coastal Sustainable Landscapes Project and the University of Cape Coast’s Fisheries and Coastal Management Capacity Building Support Project. As part of an integrated approach to fisheries development, the SFMP is addressing the need for improved coastal planning and land use management along Ghana's coastline. Focusing on building capacity of the Town and Country Planning Departments and coastal districts in the Central and Western Regions.

“Data Hubs”: Centers for information generation, sharing and learning

The ICFG initiated a “Data Hub” in the Western Region, which was designed to train regional and district planners on the use of Geographic Information Systems (GIS) to bolster spatial land use planning and its connections to medium term development plans. The GIS training was supplemented with the development of planning toolkits that provide specific technical guidance on planning in the very dynamic and hazardous coastal zones.

A similar Data Hub was established by the SFMP for the Central Region and inaugurated on September 19, 2016. The National Director of Town and Country Planning (TCPD) expressed his view that this USAID investment is not only supporting better planning in coastal areas, but providing support to other agencies in need of spatial planning and mapping services, be it the Lands Commission or Ministry of Agriculture, acting as a spatial mapping and service center for the entire region.



Figure 5 The newly refurbished Central Region data hub outfitted with computers and server

The data hub represents a modest, carefully thought-out investment in computer technology. It includes a number of computer workstations, all equipped with Microsoft Windows 7, Microsoft Office, Kaspersky anti-virus, and freeware QGIS software for GIS analysis and training. The workstations are connected through a network switch to a network attached storage (NAS) device that is configured as a file server. Each workstation has a user level account/password that enables users to access shared file folders on the NAS server during training events. The NAS server is connected to a second Ethernet network which allows for internet access and remote administration of the device by an IT manager. Eventually, this system could enable access of open source GIS data by many professionals and the public at large.

The project recognizes Integrated Coastal Management (ICM) is an important tool for sustainable management of the coastal environment and resource utilization. In view of that the project has developed and tested a training manual with PowerPoint presentations, videos of interactions of the coastal zone and human activities and other materials in ICM which will be used to train stakeholders in the coastal zone such as planners, disaster managers, District, Municipal and Metropolitan Assemblies, environmental officers, fisheries officers, fishermen, fishmongers and community-based natural resource management groups. In collaboration with the Department of Geography and Regional Planning at the University of Cape Coast, the project has developed and tested a curriculum and materials for short-term Geographic Information Systems (GIS) training and a framework for conducting business in GIS for coastal management.



Figure 6 GIS Training for Town and Country Planning Department Personnel in the Western Region

The GIS course is designed to develop the technical and soft skills of participants. It will provide participants with fundamental skills in GIS, remote sensing, teamwork, leadership and communication. It will enhance the intellectual capacity of participants to make systematic analysis of complex dynamic problems using GIS. participants to make systematic analysis of complex dynamic problems using GIS.



Figure 7 Training of Shama district officials and farmers on use of GPS devices for mapping (Photo credit: CSLP)

Contributions of the Coastal Sustainable Landscapes Project.

The CSLP, implemented by the US Forest Service, is strengthening capacity for low emission development through improved coastal forest landscape management. The CSLP is also developing capacity in the use of GIS for conservation and climate change mitigation planning in the Western Region. It works with government technicians and farmers to develop a better understanding and accountability of a district's natural assets, land uses and vulnerable landscapes that will be incorporated into district development plans. The CSLP's emphasis is on basic training in the use of GPS units and their practical use as tools for spatial planning of farms and land use.

Strengthening the role of the University of Cape Coast

The USAID/UCC Fisheries and Coastal Management Capacity Building Support Project is being implemented by the Department of Fisheries and Aquatic Sciences of the University of Cape Coast. The project aims to strengthen capacity in developing and providing quality and relevant education programs, practical research and advisory services that will support the management of fisheries and coastal resources. UCC has already developed curriculum materials and conducted training for local planners on climate change vulnerability assessments and resilience planning among other activities.

UCC is also supporting coastal districts by conducting technical training on climate change adaptation and planning, using a curriculum first developed with the University of Rhode Island during the ICFG Project and recently modified and adapted for subsequent scale up of the pilot training events.

Spatial information and planning for fishing communities through the SFMP

Integrated fisheries management and resilience plans are being developed for two important locations where major rivers discharge into mangrove-dominated estuaries, supporting local fisheries that are candidates for local co-management. The coastlines at the mouths of the Ankobra and Pra rivers are also dynamic, hazardous locations occupied by small fishing communities constantly facing erosion and flooding hazards. Civil society organization Hen Mpoano is leading efforts to conserve the ecosystems, bolster livelihoods and address vulnerabilities in the Ankobra, while Friends of the Nation is guiding similar efforts in the Pra, both with the assistance of Spatial Solutions, and help in each location respectively from Daasgift Quality Foundation and the Central and Western Region Fishmongers Improvement Association.

A base map of the 10,000 ha planning area in the lower Ankobra shows the isolation of the communities along the river and the low level of urban development, the encroaching agricultural uses into the dominant, still intact forest and wetland land cover. It is important to note that this is among the first times community and environmental planning is taking place for an ecological landscape shared by two districts — Ellembelle and Nzema East, guided by a joint planning committee. District planners visited these remote areas for the first time. Using the best available imagery, the base map is still affected by one of the great challenges in spatial planning, which is obtaining cloud free imagery at a high resolution to clearly define landscape change including the vulnerability of settlements along the coast and riparian areas. This map has several blank areas representing cloud cover. In addition the land cover mapping does not discriminate mangroves from the other wetland vegetation, which is a critical distinction for understanding threats to fisheries habitat.

To overcome the limitations of available information sources, SFMP experimented with acquiring high resolution imagery using a small unmanned aircraft (SUA), first in vulnerable coastal areas including Sanwoma and nearby Axim. Hundreds of small images were stitched

together, and combined with elevation data captured by the SUA, to produce both a clear land cover image of the mouth of the Ankobra, but to reveal the dramatic exposure to flooding and coastal erosion facing the community.

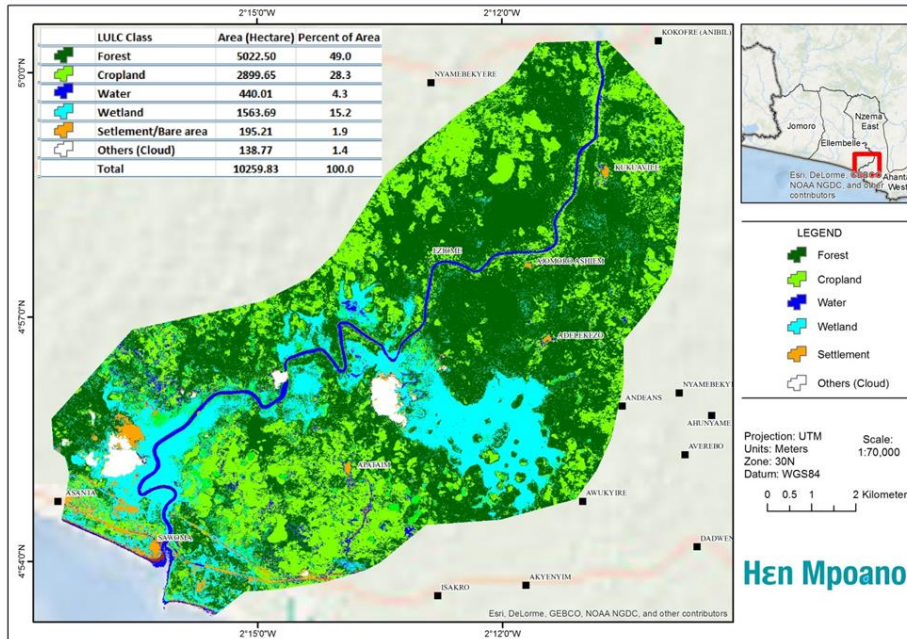


Figure 8 Land cover in the lower Ankobra River

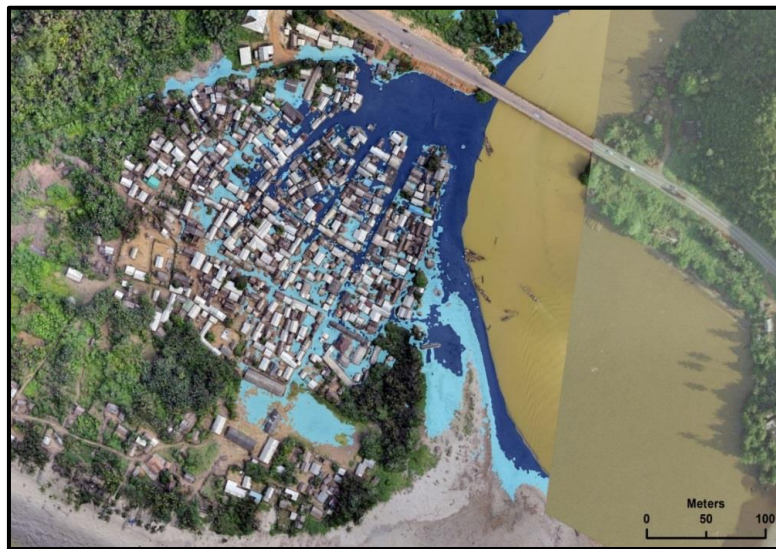
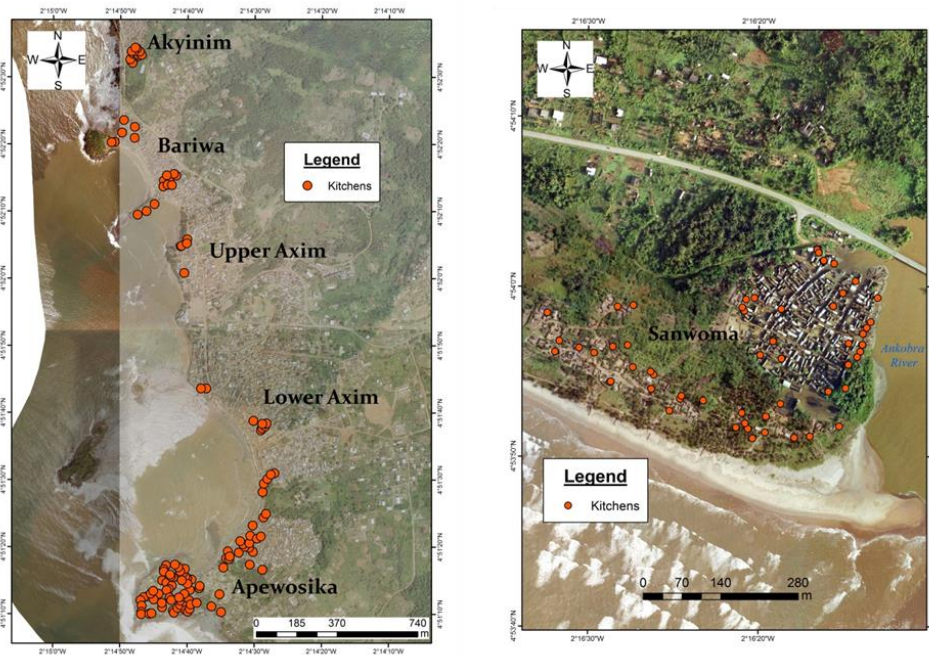


Figure 9 UAV imagery showing flooding inundation areas of Sanwoma Village located at the mouth of the Ankobra Estuary

Figure 10 Location of fish processing facilities in vulnerable areas



The imagery from the flights of the SUA also made it possible to combine information about the location of facilities used a key coastal livelihood, the processing and smoking of fish. As the figure illustrates, most fish smokers are in locations highly vulnerable to erosion, flooding and wave events. The SFMP is involved in developing and fostering the adoption of new, more energy efficient and healthier smoker designs, and wants to insure that these investments are not located in highly exposed locations.

Friends of the Nation documented the substantial amount of work that has already been done in the Pra River, including the work of the ICFG from 2009 to 2014 including a profile of the Shama Old Town fish landing site, shore classification of coast of Shama District, land use mapping of the District, mangrove and adoption of byelaws including designation of desired coastal zone uses and protection of wetlands. These were compiled into the Shama District Integrated Coastal Management Toolkit. Other information had prepared by FoN in 2014 through a project supported by IUCN funding, which included a socio-ecological and economic data including a flora and fauna survey, development of management plans, creation of local institutions for conservation and replanting of about 42,000 mangrove seedlings in degraded areas.



Figure 11 Documenting rapid shoreline change and vulnerability in Old Shama fish landing site and Pra River

New information for the Pra estuary developed by the SFMP adds considerable detail to understanding natural hazards. For example, the current shoreline derived from a SUA flight was superimposed on an image of the configuration of the shoreline in 2005. The resulting analysis reveals the dramatic shift in the location of the barrier spit Anlo Beach in the past ten years, and the extensive scouring and loss of beach and associated structures in the Old Shama fish landing site. Spatial Solutions found that a sea level rise of about 1m would lead to the inundation of the entire beach and houses within 100m distance from the current shoreline of Old Shama. The mapped area indicates an area of approximately 7000 m² will be inundated. Landing areas for fishing boats will be completely inundated along with sections of the road network running along the shoreline. The shore protection efforts will also be compromised. Fish processing facilities will also be lost.

Valuable spatial information also can be developed by drawing on Local Ecological Knowledge (LEK) Mapping. Hen Mpoano recently carried out a survey in Moree and Half Assini under the guidance of Dr. Kathy Castro from the University of Rhode Island. The group used nautical charts to map out fishing grounds, spawning areas and breeding grounds of sardinella, drawing upon the insights provided through focus group discussions. Information was elicited on the biology of small pelagic species (Sardinella, Mackerel and Anchovy). The focus groups consisted of Chief Fishermen, Fishmongers, Fishing crew members, and Captains. The outcome of the local ecological knowledge will be used to fill existing knowledge gap within the fisheries to compliment the available scientific information on life history parameters.

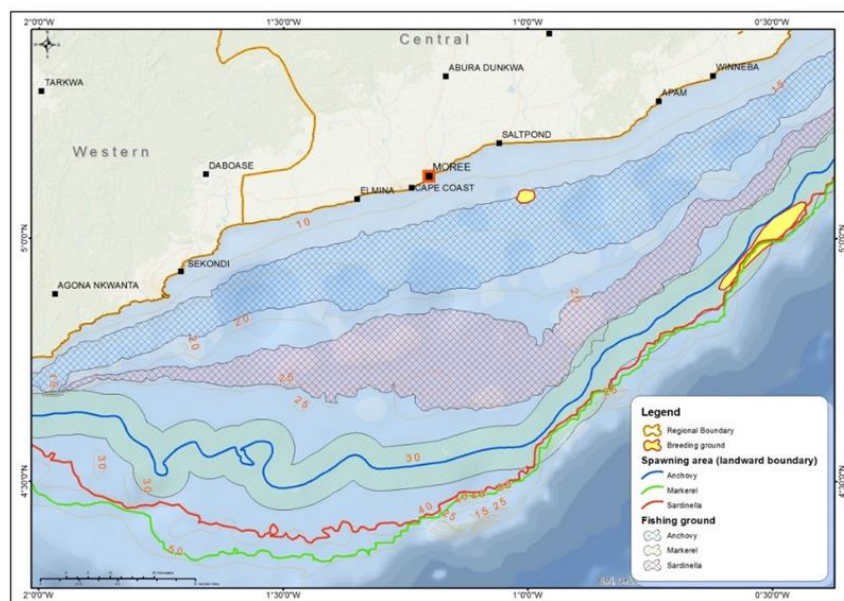


Figure 12 Mapping Local Ecological Knowledge

Extending and scaling innovative spatial planning approaches

Planned for the upcoming year are greater investments in the use of small unmanned aircraft (UAVs) for developing high resolutions images of coastal areas for a range of planning purposes, including mapping and monitoring of flood and erosion prone areas, wetland monitoring, identification of deforestation hotspots, and production better resolution maps associated with street naming which can help in better property tax revenue generation of the districts, and even in conducting disaster assessments after storm and flooding events. The UAVs can fly below cloud cover and also provide imagery that is not available, or to replace poor quality imagery from cloud impacted satellite data.

Figure 13 Discovering and documenting shoreline modifications in Coconut Beach area, Elmina

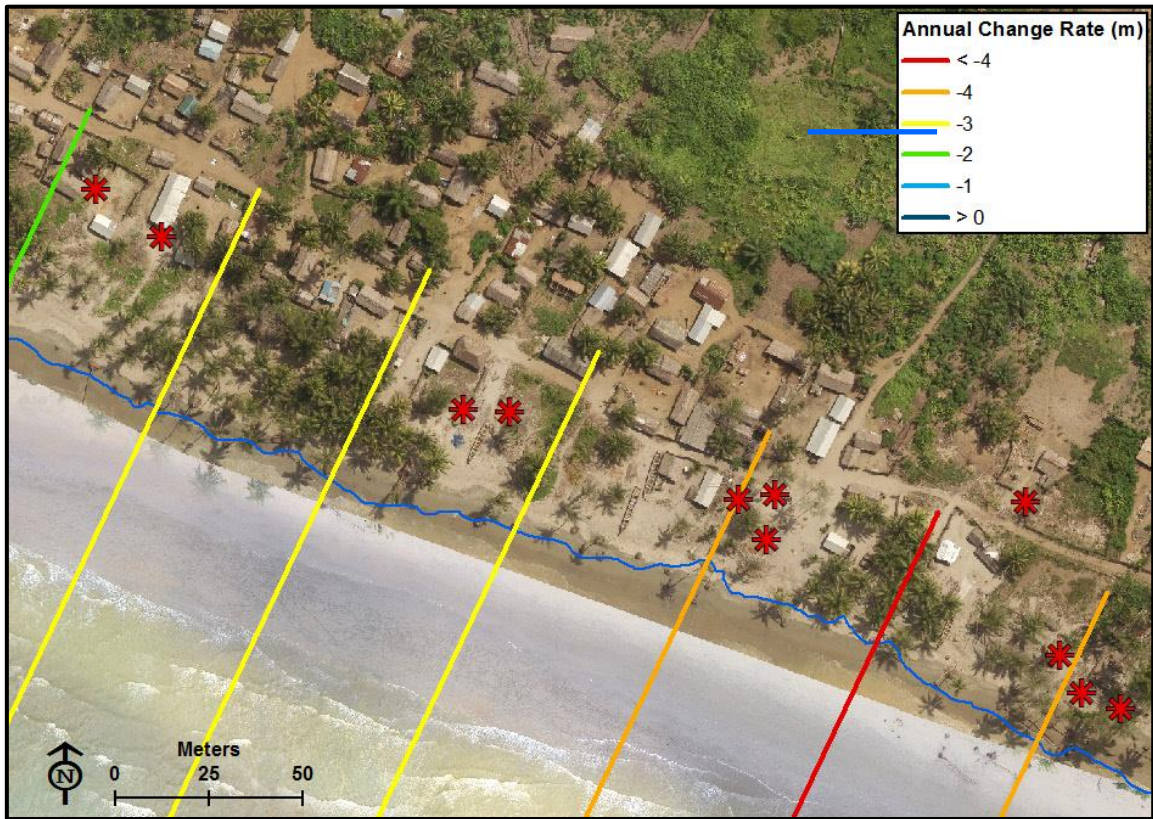


Figure 14 Measuring shoreline change and impacts of high wave events in Sanwoma

Initial testing and demonstrations of this technology via the SFMP in Ghana have demonstrated a high degree in versatility in how the imagery can be used and that it is very cost effective. SFMP, UCC and CSLP are already collaborating in this regard with long term UAV capability being planned and developed at UCC, including equipment and instrumentation acquisition, flight training and UAV image processing. This will provide capabilities for long-term periodic monitoring that compliments on-the-ground) data collection in wetland and mangrove areas.



Figure 15 Training in UAV operations and piloting at the University of Cape Coast

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