DENSU DELTA COMMUNITY-BASED FISHERIES MANAGEMENT PLAN

GREATER ACCRA REGION, GHANA

MINISTRY OF FISHERIES AND AQUACULTURE DEVELOPMENT (MOFAD)
FISHERIES COMMISSION

ACKNOWLEDGEMENTS

Development Action Association (DAA) assisted the Fisheries Commission in facilitating series of community meetings, leading to the drafting of this document. We also acknowledge the various contributions of the Wildlife Division of the Forestry Division, the Ga South Municipal Assembly, Centre for Coastal Management of the University of Cape Coast, Ghana Water Company Limited (Weija Dam), Densu Oyster Pickers Association (DOPA), the Densu Community Based Fisheries Management Committee and the Chiefs and people of Tsokomey, Boartianor, Tetegu towards the development of the management plan. The development of this management plan was made possible with funding from the American People through the United States Agency for International Development under the Sustainable Fisheries Management project (SFMP), implemented by the Coastal Resources Center of the University of Rhode Island.

Citation: Ghana Ministry of Fisheries and Aquaculture Development and Fisheries Commission. (2020). Densu Delta Community-Based Fisheries Management Plan, Greater Accra Region, Ghana. Accra: Ministry of Fisheries and Aquaculture Development, Fisheries Commission. 59 pp.

Cover Photos: Oyster harvesters working in the Densu Estuary.

Photo credit: Development Action Association

LIST OF ACRONYMS

CSOs	Civil Society Organizations
DAA	Development Action Association
DFTC	DAA Fisheries Training Center
DO	Dissolved Oxygen
DOPA	Densu Oyster Pickers Association
FDA	Food and Drugs Authority
GSA	Ghana Standards Authority
GSMA	Ga South Municipal Assembly
GWCL	Ghana Water Company Limited
Hg	Mercury
MOFAD	Ministry of Fisheries and Aquaculture Development
PPT	Parts Per Thousand
PRA	Participatory Rapid Appraisal
RAMSAR	The International Convention *on Wetlands of International Importance especially as Waterfowl Habitat – called the RAMSAR Convention, RAMSAR was the city where it was signed in Iran*
SFMP	Sustainable Fisheries Management Project
UCC	University of Cape Coast
USAID	United States Agency for International Development

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CO-MANAGEMENT AGREEMENT

WHEREAS, the Densu delta, designated as a RAMSAR site by the Government of Ghana and the IUCN, has a significant small-scale artisanal oyster fishery utilized by several communities living adjacent to its shoreline, and provides significant food security and income for fisher folk from these communities, especially women.

WHEREAS, the Fishery Act No. 625 of 2002, Section 2 (a), provides for the Fisheries Commission to prepare and keep under continual review plans for the management and development of fisheries in waters under the jurisdiction of Ghana.

WHEREAS, the Fishery Act No. 625 of 2002, Section 2 (g) promotes cooperation among local fishermen to advance development of artisanal fishing.

WHEREAS, the Fisheries Act No. 625 of 2002, Section 9 (1) authorizes The Commission to appoint committees it considers necessary for the effective implementation of its functions.

WHEREAS, the Fisheries Act No. 625 of 2002, Section 38 provides for application of a portion of the Fisheries Development Fund towards the development of small scale fisheries in the country.

WHEREAS, this fishery plan was prepared by the Commission for the management and development of fisheries, and is consistent with criteria provided in Section 42 (1) of the Fisheries Act No. 625 of 2002.

WHEREAS, the Commission can develop a fishery plan that relates to a specific water area and specified species of fish, consistent with Section 42(2) of the Fisheries Act No. 625 of 2002.

WHEREAS, Section 42 (3) of the Fisheries Act No. 625 of 2002 allows The Commission to collaborate with such State agencies as the Commission considers appropriate for the implementation of each fishery plan and consistent with section 10 (5) of the Local Government Act 462 of 1993 and Section 12 (5) of the Local Government Act 936 of 2016.

WHEREAS, the contents of this management plan are consistent with Section 43 of the Fisheries Act No. 625 of 2002.

WHEREAS, preparation of this fishery management plan was carried out with consultations of appropriate organisations, authorities, and persons affected by the fishery plan as stipulated in Section 44 of the Fisheries Act No. 625 of 2002.

THEREFORE, I HEREBY

Declare the area covered by the RAMSAR declaration for the Densu River delta from the Weija Dam down to the closing line along the mouth of the delta where it opens up into the Atlantic Ocean, and associated mangrove and wetland habitats, with special attention to the fishery of the mangrove oyster, *Crassostrea gasar,* also known as *C.*

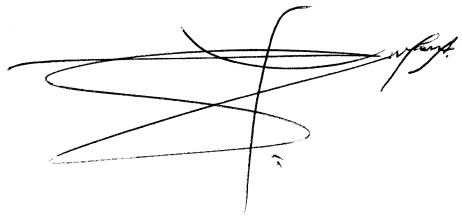
tulipa, as a Fisheries Management Area solely for the purposes of fisheries management.

Delegate to the Densu Oyster Pickers Association, a duly registered association, the authority for the responsible and sustained management and conservation of the oyster fisheries, and are granted exclusive use rights to the oyster fishery resources in this area.

Authorize the Fisheries Commission to make allocations annually from the Fisheries Development Fund and or other budget lines, to support the Co-Management Committee established by the Densu Oyster Pickers Association in the implementation of this plan.

Delegate responsibility for the oversight of this association and its co-management committee to effectively carry out its delegated functions, to the Regional Director, Fisheries Commission, Greater Accra Region.

Approved by:



Date: December 22, 2020

Michael Arthur-Dadzie Esq.
The Executive Director, Fisheries Commission, Ghana

1.0 INTRODUCTION

The open access nature of Ghana's fisheries resources has resulted in severe overfishing and near depletion of many localised small fishery resources such as the oyster fishery found in the Densu Delta. This is due to a number of factors including but not limited to over-exploitation and an increasing number of fishery resource users. However, these current trends must be reversed to ensure sustainability of the fishery into the future. Involving the local community that depend on them for food in their management and granting exclusive use rights is crucial for the survival of such communities. Managed access to fisheries resources will not only ensure food security but also sustain economic and livelihoods of the local users who depend on these resources.

Shellfish and particularly oysters are valuable food for human health and contain about 80% of water, 17.2% of protein, and many vitamins such as A, D, E, B1, B2, B6, B12, C etc., and minerals that satisfy human nutritional needs (South Australian Oyster Research Council, 2010).

This Sustainable Oyster Fishery Management Plan for the Densu River Delta builds on best practices and lessons learned from the 10-day Regional Study Tour on Women's Empowerment and Post-Harvest Improvements to the Gambia and Senegal in 2016 involving 11 members of five women-led civil society organizations (CSOs) and the Fisheries Commission, and supported by the Sustainable Fisheries Management Project (SFMP).

The successes of TRY Oyster Group, a peer woman based organization in the Gambia that developed successful community-based strategies for sustainable oyster and cockle fisheries management and value chain improvements, led to the realization that similar management practices could be implemented for the oyster fishery in the Densu River delta.

The Densu River Delta was designated as a RAMSAR site in 1992, recognizing it as a protected wetland of international importance under the International Convention on Wetlands. A management plan for the Delta was developed in 1999, but did not make reference to oyster harvesting activities.

The objective of this Community-based Management Plan is to ensure sustainable management of the Densu oyster fishery for improved food security and other benefits, especially for women oyster harvesters and other participating estuarine communities who depend on this fishery resource for their livelihood.

This Community-based Management Plan has been developed in consonance with the National Policy Framework on Co-management and provides for exclusive use rights to be granted to the Densu Oyster Pickers Association (DOPA) for the oyster fishery resources in the management area set out in this management plan.

The process for developing this Community-based Management Plan engaged many stakeholders through a series of meetings, workshops and trainings, and a learning-

by-doing approach in managing the oyster fishery resource in the Densu Delta. Initial actions implemented were related to the need to equip community resource users with the capacity to address some of the major oyster fishery resource depletion challenges identified in this co-management plan. These initial actions included training of 150 community oyster harvesters in oyster ecology and biology, training of 30 women and men on scientific water quality data collection (Figure 1), donation of a river boat to ease transport of oyster pickers and facilitate data collection. A study tour to observe traditional management of clams in the Volta River estuary (Figure 2) and mangrove restoration through replanting, and nursery management to improve oyster habitat (Figure 3).

Figure 1: Some members of Densu Oyster Pickers Association who have benefited from training in oyster biology and ecology taking data on water quality monitoring at the Densu Delta

Figure 2: Members of DOPA on a study tour to the Ada clam site to learn how clams are managed by community folks

Figure 3: Members of DOPA implementing some initial ecological management measures by replanting degraded mangrove forest areas at the Densu delta

2.0 THE COMMUNITY BASED MANAGEMENT PLANNING PROCESS

The content of this community based fishery management plan is for the Densu River delta located in the Ga South Municipality of the Greater Accra Region of Ghana. The plan was prepared for the oyster fishery resources found in the Densu River delta for the purpose of harvesting and managing this resource, and was formulated based on the model presented in Figure 4 below.

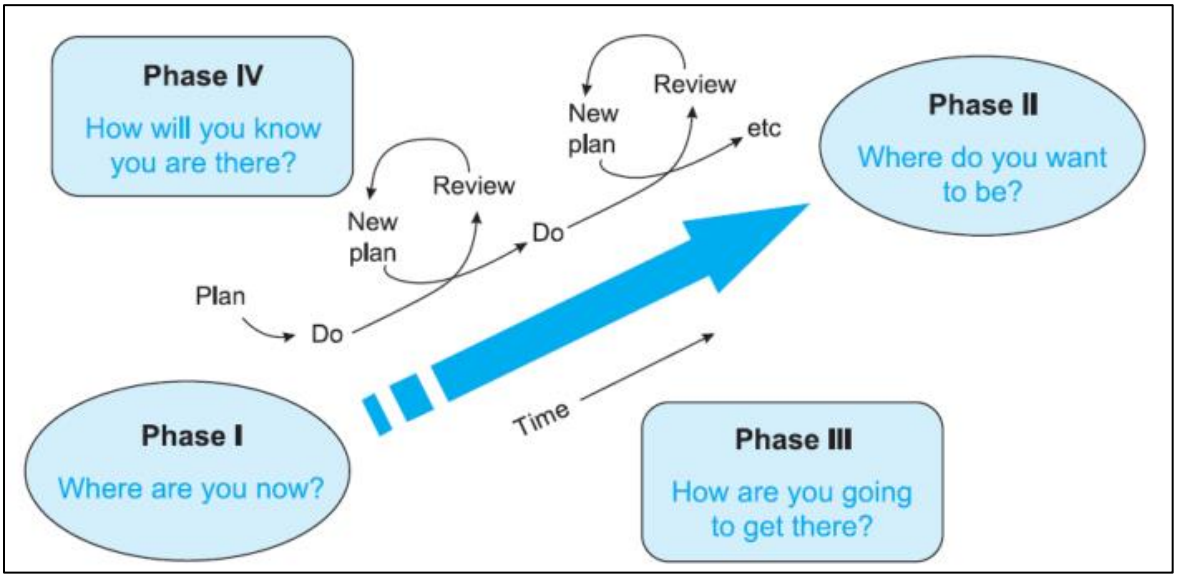


Figure 4: The four main phases in writing a Community Based Management Plan for the Oyster Fishery of the Densu Delta

(SOURCE: Hindson *et al*., 2005).

The planning process was highly participatory with all of the oyster pickers identified in the three communities surrounding the delta engaged in formulating the content of the plan. This co-management plan was developed through a process that included participatory rapid appraisal (PRA), community meetings, with oyster harvesters, stakeholder meetings on co-management, institutional engagement, capacity building of the oyster association, collaborative research, and participation of government institutions (Fisheries Commission, Forestry Commission, etc.). Traditional authorities, specifically the river priests for the Densu River delta (Figure 5) were consulted prior to conducting PRAs and the planning process.

The planning process was facilitated by Development Action Association (DAA) in close cooperation with the Fisheries Commission. A planning committee was set up (Annex 1) that consisted of members of DAA, the Fisheries Commission, other government actors, and traditional authorities that took outputs from community meetings with the oyster pickers and translated them into the written contents of this

plan. Additionally, stakeholder meetings were held with policy makers such as Fisheries Commission, local authorities such as the Ga South Municipal Assembly, Ghana Water Company Limited (GWCL) (Weija Dam), and the Wildlife Division of the Forestry Commission of Ghana. Other stakeholders such as Panbros Salt Industry and Bojo Beach Resort were also consulted in developing the content of this co-management plan.

These consultations led to the formation of an interim co-management planning committee (Annex 2) comprising these stakeholders tasked to compile the initial draft content of the management plan. The plan calls for a permanent Densu River delta co-management committee comprising local resource users (Densu Oyster Pickers Association) who are mandated to implement the co-management plan, and an advisory committee comprising of non-direct resource users mandated to advise the co-management implementation committee.

Table 1 below summarises the four key phases that underpinned the writing of the plan and some of the key actions that have been outlined in the plan.

Table 1: Planning phases and key actions associated with each phase that underpinned the writing of this co-management plan.

Phase	Description	Key Actions
I	Preparation for writing the co-management plan for the oyster fishery	Clear definition of what species of fishery the co-management plan is targeting.
		Key stakeholders needed for the completion and implementation of the co-management plan – stakeholder analyses.
		Current fishery analyses, current challenges and opportunities – situational analyses.
II & III	Co-management development stage	Goals: • Biological goal(s) • Ecological goal(s) • Socio-economic goal(s)
		Objectives: • Biological objective(s) • Ecological objective(s) • Socio-economic objective (s)
		Management Measures – Actions to achieve key objectives.
		Institutional arrangements for implementing the plan – appointment and terms of reference of the co-management committee, role of advisory group, DAA, etc.

Phase	Description	Key Actions
		Resources for implementation of the oyster fishery co-management plan: • Budget
IV	Implementation, Evaluation and Review	Implementation plan – action strategy for rolling out the co-management plan
		Monitoring - Is the plan implementation meeting its set objectives?
		Evaluating – Review of plan

Figure 5: A call on the Wulomo (River Priest) of Bortianor before the PRA was conducted

This management plan has been divided into eight (8) chapters. Chapter 1, the introduction, briefly outlines the importance of the oyster fishery as a means of obtaining critical food nutrients and the general description of the Densu River delta. Chapter 2 focuses on the framework and guiding principles and processes in developing this co-management plan.

Chapter 3, corresponding to Phase 1 in Figure 1, deals with the description of the fishery and the geographical locations where oysters are harvested. It also provides a description of the current oyster stock status, harvesting, processing and marketing patterns, and the area of focus of the co-management plan. It provides an overview of the key management issues for the fishery. The chapter summarizes the characteristics of the oyster fishery in the Densu River delta resulting from the community participatory rural

appraisals (PRA) including the historical harvesting, processing, and oyster resource utilization in the Tsokomey, Bortianor and Tetegu communities. Chapter 4 describes details of the Vision and goal and associated management objectives for the oyster fishery in the near future – *"where we want to be"*

Chapter 5 describes the specific sustainable management measures that have been agreed upon by various community stakeholders through the implementation committee for sustainable exploitation of the oyster resource. It categorises the various management measures into biological, ecological, socio-economic and capacity development thematic areas. Chapter 6 highlights the institutional arrangements and their role in the implementation of the Densu community based fishery management plan. Chapter 7 explains the specific enforcement measures for the management plan, and penalties for violations of the management measures. Lastly, Chapter 8 outlines the monitoring and evaluation scheme for meeting objectives and targets for the management measures set out in this plan.

3.0 CHARACTERIZATION OF THE OYSTER FISHERY IN THE DENSU DELTA

3.1 The Fishery Management Area

The Densu River delta lie in the river valley formed by the Aplaku-Tukuse and Weija-McCarthy Hills, west of Accra, Latitude 5° 31' N and Longitude 0° 20' W (Oteng-Yeboah *et al*., 1999). The lagoons and delta are located to the south of the Winneba-Accra highway and bounded on the south by the Atlantic Ocean coastline between Bortianor and Gbegbeyise (Figure 6, with dotted blue lines). The Aplaku-Bortianor road and the Lofa stream define the western and eastern boundaries respectively. The Densu River delta covers some 34 km^2 of wetlands made up of 21 km^2 of lagoon and freshwater marsh, 11 km2 of salt pans, 2.4 km^2 of scrub and coastal sand dune of 0.25 km^2 (Oteng-Yeboah *et al.*, 1999). The Densu River delta covers a total of 5,892.99 hectares.

Among many fishery and other aquatic resources, the oyster fishery of the Densu River delta of Ghana is characterized by harvesting of the West African mangrove oyster, previously classified as *Crassostrea gasar* and more recently as *C. tulipa* (Marozova *et al*. 1991), at various harvesting sites within the delta. For the purposes of this plan, the total management area for the oyster fishery resources and mangrove habitat restoration covers 1,800 hectares (Figure 6, with red boundary lines). The main oyster landing and processing sites are found in Tsokomey, Tetegu, Faana and Bortianor, all situated in the Densu River delta in the Ga South Municipal Assembly of the Greater Accra Region.

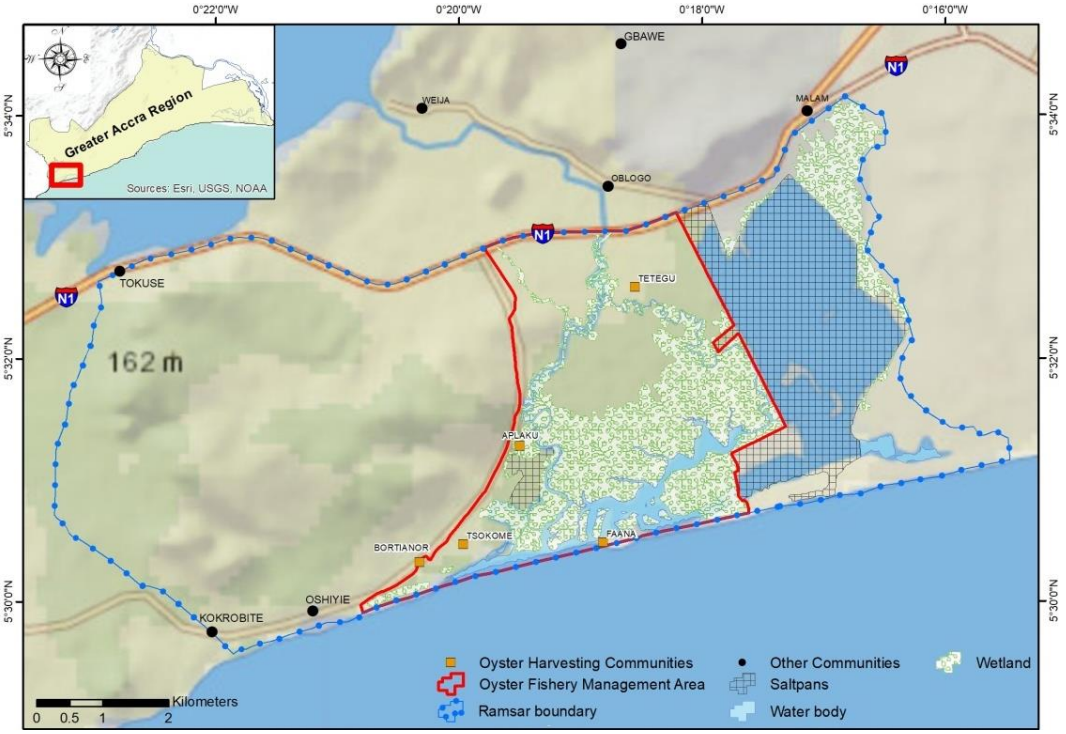


Figure 6: Boundaries of the fishery management plan area and location of oyster harvesting communities around the Densu Delta

This co-management plan focuses on a single species – the West African mangrove oyster (*Crassostrea tulipa*), though there are other fishery resources harvested in the delta such as tilapia, mudfish and crabs. Considerations of other ecological factors such as the mangrove vegetation and water quality have been given attention in this co-management plan. The method of harvesting the oyster is by direct hand picking at low tide (Figure 7), mainly by women oyster pickers and some men, using small motorized and un-motorized artisanal canoes to move to and from harvesting sites to landing areas; although some women will walk along the shoreline and then enter the delta directly from shore with no use of boats. However, some men oyster harvesters and very few women dive in deeper areas to pick the oysters.

Figure 7: Women harvesting oysters by direct hand picking at low tide

3.2 Status of the Shellfish Resources and Issues in the Fishery

The oyster fishery, which has been a traditional resource in these communities, serves as an important source of both individual and family livelihoods for many people, especially women residents. Many generations of settlers have depended on it; hence the social and historical importance of this resource cannot be underestimated. Over the years, little has been done to manage this important fishery resource for the communities surrounding the delta.

Participatory Rapid Appraisal (Janha *et al*. 2017) has shown that prospects exist to develop a community-based management plan for sustainable oyster harvesting as a livelihood diversification strategy for the women of Tsokomey/Bortianor. Although scientific data and information on the oyster fishery at the Densu delta is limited, recent membership of the Densu Oyster Pickers Association (DOPA) revealed an estimated number of 300 people. Majority of these people are women who are directly involved in this oyster fishery. Data on oyster production and stock assessment are not available and currently being researched by the University of Cape Coast. A recent study estimated the value of the oysters harvested from the Densu River estuary annually to be between GHC 1.0m and GHC 2.3m (Bilecki, D. B., Crawford, B., Hardi-Nyari, B., 2018) demonstrating that the estuary provides a valuable source of food and income for women harvesters, processors and marketers.

The PRA showed that the oyster fishery was in decline due to over-exploitation and loss of mangrove habitat. The PRA results revealed disturbing trends of increased harvesting time, increased travelling distances to oyster picking sites (due to dwindling oyster stocks), decreased volumes of catch per trip, and reduced density of harvested oysters at present compared to thirty years ago (Figure 8). There is a critical need to protect and improve habitat and sustainably manage the oyster fishery in order to reverse the declining trends. Opportunities exist for value chain improvements in post-harvest processing and marketing. Market awareness of the economic and nutritional value of oysters is low.

Occasionally conflicts occur between oyster pickers and fisher folk who set up their brush parks ("*atidza*") close to oyster harvesting sites. However, any tension that arise is usually resolved before it escalates. Nevertheless, water use zoning is required within the management plan to accommodate the brush park fishery dominated by men.

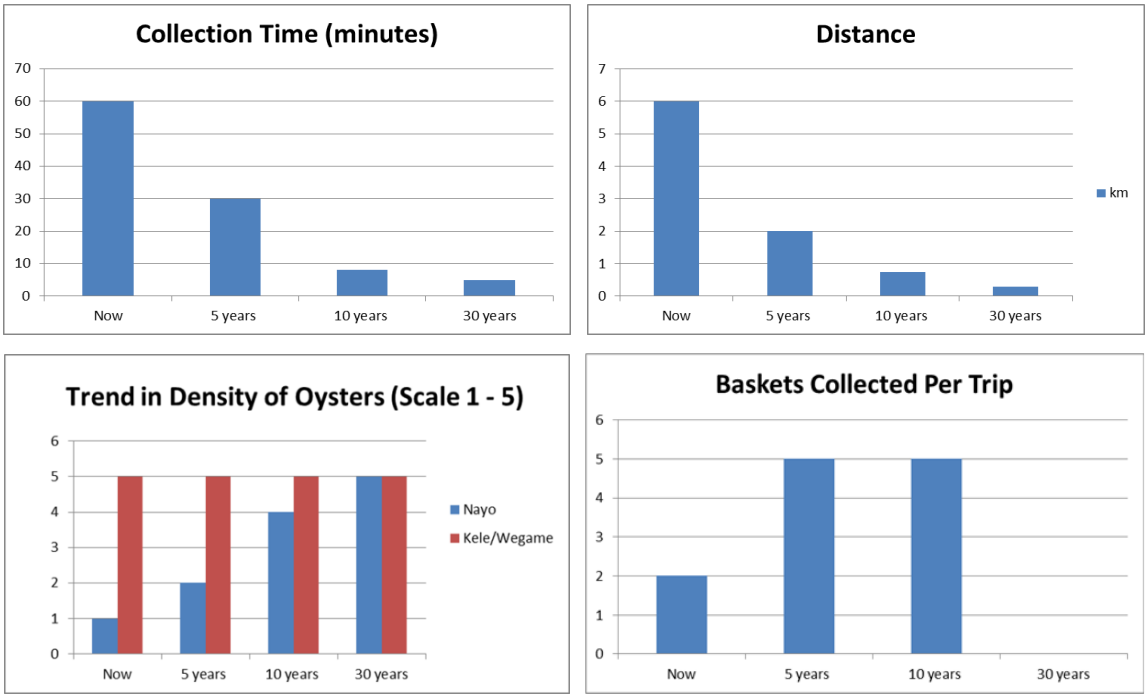


Figure 8: Perceptions of trends of changes in catch and effort as revealed during the PRAs

The predominantly women harvesters from the Tsokomey, Bortianor and Tetegu communities harvest the oysters (*Crasssostrea tulipa*) from seven sites (Bojo, Nayo Bibio, Nayo Agbo, Kpevuduogbor, Faana, Wegame and Kele) (Figure 9).

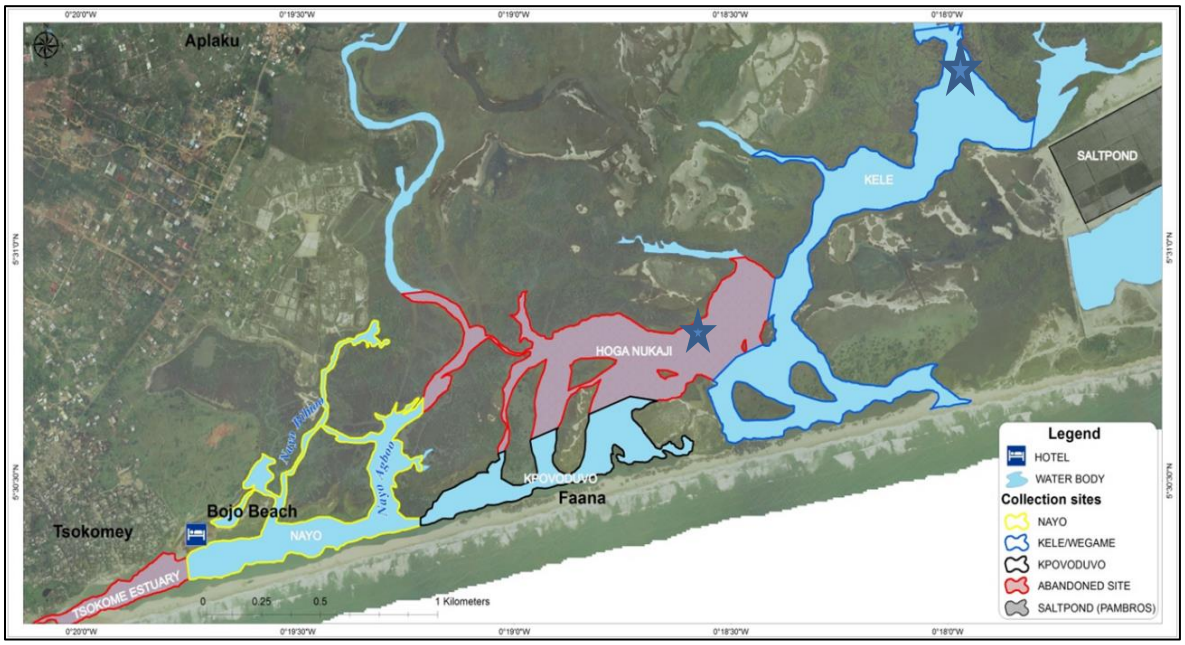


Figure 9: Sites for harvesting oysters at the Densu delta - Bojo, Nayo Bibio, Nayo agbo, Kpevuduogbor, Faana, Wegame and Kele

3.3 The Biology of the West African Mangrove Oyster (*Crassostrea tulipa*)

Crassostrea tulipa, commonly known as the mangrove oyster is widespread in the tropical regions of Africa. Oysters are bivalves, meaning they have two shells and live in marine or brackish (salty) water. The shells are thick and irregular (Figure 10).

Figure 10: The mangrove oyster (*Crassostrea tulipa)*

When oysters reach sexual maturity, they start as males, but as they get older they become females. The male oyster cannot be determined from the female by just looking at the live oyster. The *Crassostrea tulipa* mangrove oyster is a prolific species that attains maturity in 120 days after settling on substrates and can attain a size of 20mm. The oysters are usually male when they are less than 20mm and change sex after 30mm (Yankson, 1996).

The oysters have a reproductive cycle similar to many other marine invertebrates (Figure 11). Spawning occurs when females release eggs and the males release sperm into the water column where fertilization takes place. The fertilized eggs become veliger larvae in a planktonic stage. This means that they float longitudinally in the water column before settling on hard surfaces such as mangrove prop roots, rocks, sticks or on sea grass. Once they settle, referred to as settling or spat-fall, they are called spat – very small sized, baby oysters.

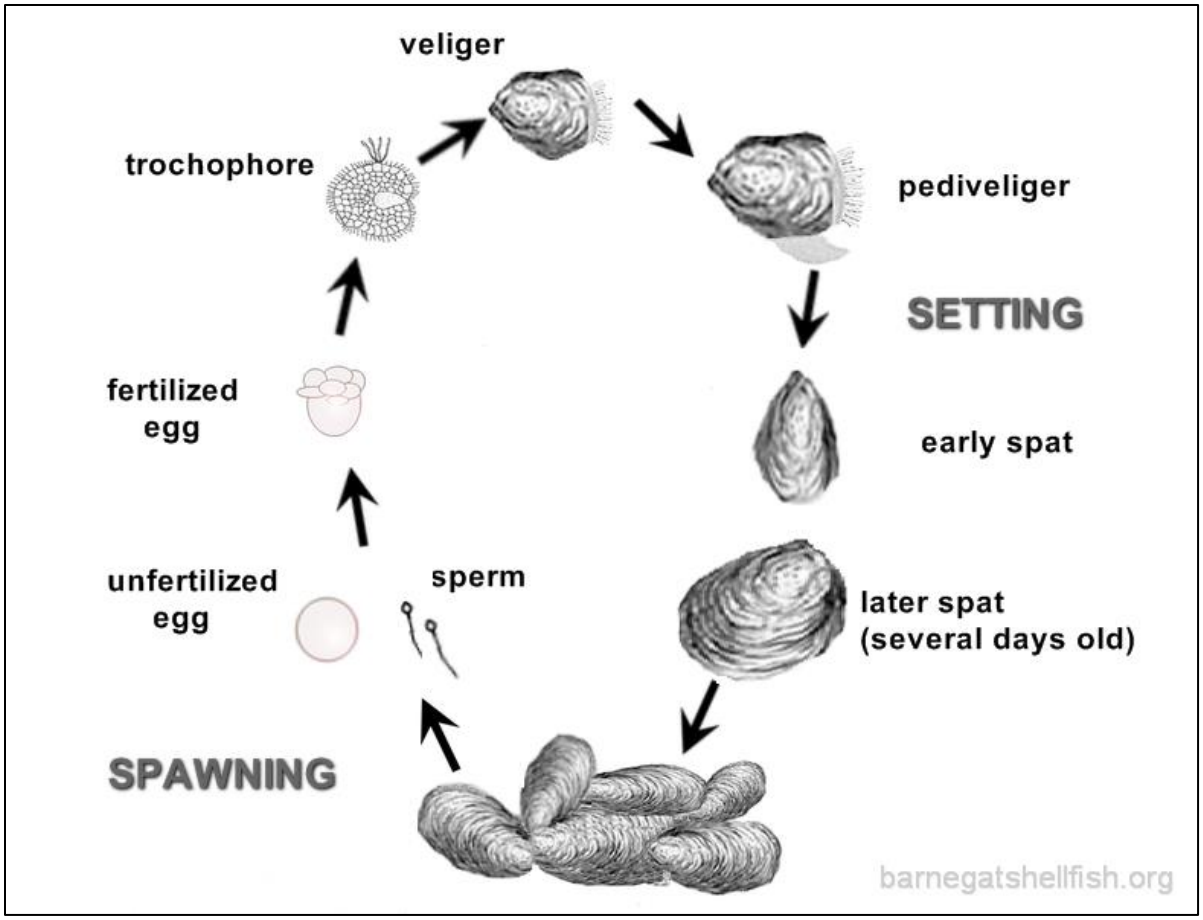


Figure 11: Life cycle of the mangrove oyster (*Crassostrea tulipa)*

Data on the timing of reproduction and spat-fall in the Densu River delta does not exist, however, scientific research to establish specific spat-fall periods for the Densu delta oysters is being pursued. Local knowledge and data collected during the PRA from the oyster pickers at the Densu delta indicated that the peak of a "cream-like" fluid observed in harvested oysters normally occurs in the months of January through to February, indicating probability of peak spawning periods. The small spats or "baby oysters" settle on old shells seen in the months of March to May. Based on this local ecological knowledge, a closed season has been proposed in this management plan to be observed from November to mid-April to coincide with this biologically significant period as a biological management measure to ensure oyster spawning and maturity to desirable sizes.

3.4 Chain of Activities in Oyster Harvesting and Processing

In Tsokomey, oysters are picked from the river bed in mostly shallow water and the entire chain of activities from picking to marketing and selling, are carried out on the same day. This is in sharp contrast to The Gambia and Senegal where similar activities last three to five days as oysters grow on the aerial roots of mangroves where they are harvested by removing them with an axe that does not destroy the roots.

The time spent on interrelated activities associated with the entire oyster value chain is as depicted in Figure 12.

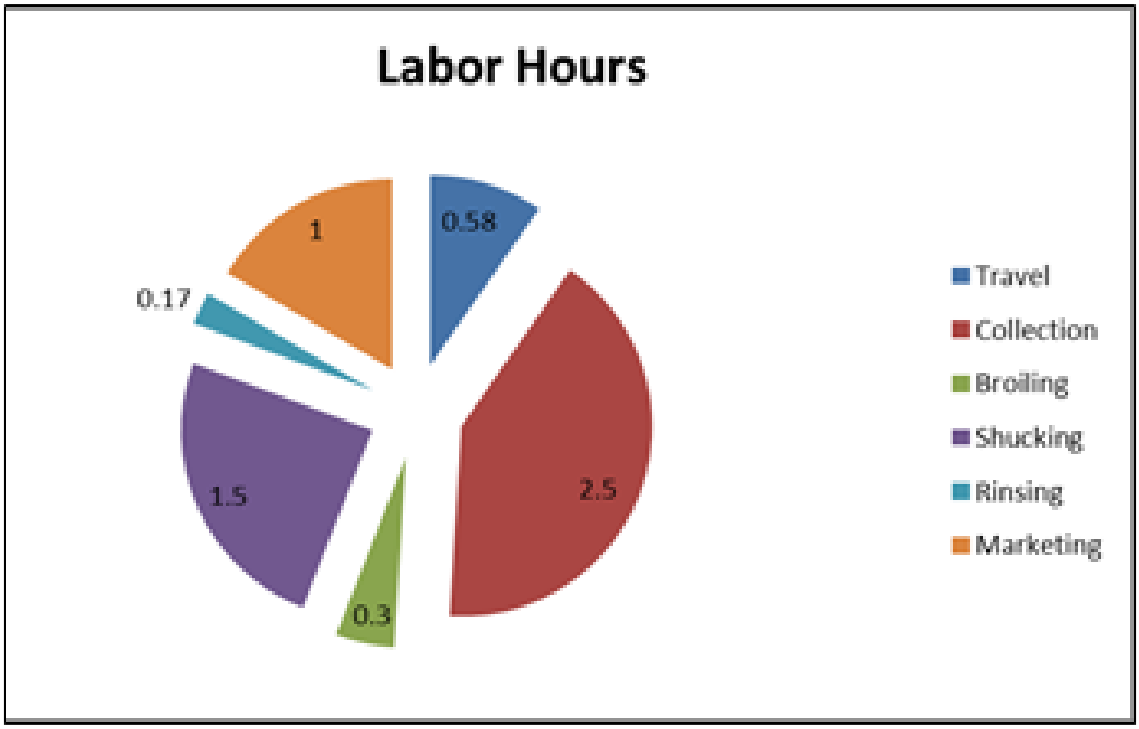


Figure 12: Labour hours on various oyster processing activities by oyster harvesters in Tsokomey

Access to Harvesting Sites and Picking Oysters: Most of the women walk along the river's edge to get to harvesting sites, taking about 30 minutes from the landing site. They indicated that access to the harvesting sites used to be a shorter walking distance before the Bojo Beach Resort was built and an electric fence installed around its perimeter, thus blocking access to the tributary where the women pick oysters. Canoe transport to the harvesting sites is a faster option but cost constraints limit its use to transporting harvested oysters and sometimes women share the cost involved. The canoes are also used for harvesting at sites further upstream, such as "*Wegame*".

The women pick the oysters as individuals and spend 2 to 3 hours. They stand in the water about knee- deep. They wear improvised socks and gloves made from old clothing to protect themselves from cuts. They use metal bowls to collect the oysters. Figure 13 shows how some oyster pickers use locally made baskets attached to used drinking water bottles which serve as floats for the basket.

Transporting harvested oysters to the landing site: The women rent a canoe at 5 Cedis (1.10 US Dollars) per trip. Paddling the canoe takes between 15 to 20 minutes from the harvesting site to the landing site.

Washing oysters: Oysters are washed at homes using clean water and bare hands to remove the black sand covering them. Washing is done with bare hands. However, this is not thorough enough to completely remove the sand particles.

Boiling oysters: The oysters are boiled in their shell in a cooking pot for 15 to 20 minutes. Fuelwood for processing the oysters is normally purchased at 1 Ghana cedi (0.23 US Dollars) per bundle.

Figure 13: Oyster harvesters demonstrating harvesting oysters during the PRA. Normally they would have individual basins

Brush parks (*Acadjas* in Ga or *Atidza* in Ewe) are in the background (left).

Shucking: The women use knives to shuck the oysters (taking the meat out of the shell). This takes 1 to 2 hours for a day's collection. Some women use gloves to protect their hands during this activity.

Rinsing: The shucked oyster meat is rinsed in clean water with salt and left to drip in a basket. This takes 10 minutes.

Marketing/selling: Oysters are arranged in heaps and placed on a tray to be sold. The oysters sell out as soon as the community is aware they are available. They are a cheap source of food in the community, selling at 1 Ghana cedi (0.23 US Dollars) for 40 average-sized pieces.

3.5 Annual Calendar of Activities of Cockle and Oyster Harvesters

Data collected during the PRA indicates oyster picking is done almost throughout the year. Harvesting at shallow areas of the delta is done from March to August while deep water areas such as "*Wegame*" are done throughout the year. When the women are not engaged in oyster harvesting, they occupy themselves with other activities to earn a living. They engage in activities such as river fishing, petty trading, marine fish cleaning at landing sites, fish porters, etc. as shown in the calendar below (Table 2).

Table 2: Calendar of economic activities of oyster harvesters.

Activity	Month of the Year											
	J	F	M	A	M	J	J	A	S	O	N	D
River fishing*	X	X	X	X	X	X	X	X	X		X	X
Basket fishing	X	X	X	X	X	X	X	X	X		X	X
Shallow water oyster harvesting			X	X	X	X	X	X				
Fish processing	X	X	X	X	X	X	X	X	X	X	X	X
Fresh fish sale	X	X	X	X	X	X	X	X	X	X	X	X
Sale of food (fried fish, porridge, corn dough)	X	X	X	X	X	X	X	X	X	X	X	X
Deep river oyster harvesting*	X	X	X	X	X	X	X	X	X	X	X	X
Fish cleaning at landing site	X	X	X	X	X	X	X	X	X	X	X	X
Fish porter	X	X	X	X	X	X	X	X	X	X	X	X
Paid labour for coastal and community cleaning	X	X	X	X	X	X	X	X	X	X	X	X
River transport (paddle canoe)*	X	X	X	X	X	X	X	X	X	X	X	X

** These activities are often carried out by men*

X- Active months for oyster harvesting, fishing and non-fishing activities

3.6 Water Quality for Oyster Growth

Most of the activities which influence water quality occur outside the Delta because of the larger population living outside but close to it (Biney, 1995). There is high organic contamination at Bortianor and Tsokomey which are areas of high human activity. However the whole Densu River delta may be characterised as slight to moderately contaminated with organic matter mainly from domestic sources (Oteng-Yeboah, 1999).

Mean values of various properties of water in the wetland are given in Annex 3. With the exception of parameters like pH, Hg (Mercury) and DO (dissolved oxygen), large variations occur in the physical and chemical characteristics of the surface waters in the wetland between dry and wet seasons (Oteng-Yeboah, 1999).

Frequent water spillage from the Weija Dam upstream change water salinity levels which affect oyster growth. The fresh water intrusion leads to oyster die-offs in the brackish water areas of the estuary which constitute the habitat for oysters.

Water Quality data and analyses are on-going. Thirty-five (35) community oyster harvesters have received specialized training on water quality data collection and are collecting scientific data on water temperature, turbidity, salinity and pH during low and high tides in collaboration with the University of Cape Coast.

3.7 Key Issues

Overharvesting and increasing numbers of pickers: There were fewer oyster pickers 30 years ago compared to today, according to data collected during the PRA. This increase in the number of oyster pickers can be ascribed to increasing population around the delta. As a result of the increase in number of harvesters, smaller sized oysters are now being harvested compared to 10 and 30 years ago.

Mangrove loss which is essential habitat for oysters*:* The two main mangrove species in the delta are *Avicennia africana* and *Rhizophora racemosa* (Oteng-Yeboah, *et al*., 1998) which have been over exploited for use as fuelwood and also for brush parks (locally called "*atidza*") for fishing. This has led to change in the micro habitat conditions conducive for oysters and also loss of potential substrate on which oyster spats settle and grow.

Freshwater spillage from the dam*:* The periodic spilling of water from the Weija Dam upstream allows for strong fresh water flow into the estuary. This affects salinity which drops to completely fresh water (0 PPT salinity) for several days within the year, and reportedly results in oyster die-off. This normally coincides with the major and minor rainy seasons (May to July and September to November) in Ghana. Data collected during the PRA revealed that, some deep harvesting sites of the estuary such as "*Wegame*" still maintain appropriate levels of water salinity and larger long-lived oysters survive even during the spill from the dam. The *Wegame* area thus provides for a spawning stock and refugia that allows for re-growing of oysters in the delta.

The Densu River splits into two main tributaries as it enters the delta. The western tributary has the greatest flow of fresh water and is closer to where the oyster die-off occurs. The eastern tributary is smaller with less flow. This is where the larger oysters are found. It is not clear whether fresh water spillage from the dam can be controlled to minimize oyster die-off in the area and this needs to be investigated further.

4.0 MANAGEMENT APPROACH

The management approach adopted in this plan is ecosystem-based adaptive management that attempts to reduce uncertainties over time in a structured process of "learning-by-doing". The initial management actions served as experiments to learn more about the resources while at the same time attempts were made to manage the resource with limited existing information and understanding of the decline in the oyster fishery. This process generated new ways of doing things instead of maintaining the existing ineffective approaches.

4.1 Purpose

The purpose of this community-based co-management plan for the Densu River delta is to:

"***Establish an ecologically and economically sustainable oyster fishery."***

4.2 Goals

The goal for the Densu estuary oyster fishery is formulated based on four main principles related to sustainable management:

Biological – Maintain oyster stocks well above exploitative levels to ensure sustained harvesting.

Ecological – Rehabilitate mangrove habitat to levels that preserve the micro habitat conditions to ensure sustained harvesting.

Socio-Economic – Improve the standards of living for local oyster harvesters through improvement in oyster value chain activities and creation of supplemental employment opportunities leading to improved income levels of resource users.

Capacity Development – Strengthen the organizational capacity of the Densu Oyster Pickers Association and the co-management committee.

4.3 Objectives

The corresponding objectives for the above goals are summarised in Table 3 below.

Table 3: Summary of biological, ecological, socio-economic and capacity development goals and their corresponding objective co-management plan.

Purpose	Goals	Objectives
Establish an ecologically and economically sustainable oyster fishery.	**Biological** - maintain oyster stocks well above exploitation levels to ensure sustained harvesting	Establish sustainable harvesting of oyster resources that avoids juveniles from being picked and allows larger more valuable oysters to be harvested.
	Ecological – rehabilitate mangrove habitat to levels that can ensure sustained harvesting	Maintain the health and functioning of the mangrove ecology, thereby protecting important habitats of oysters and other fish species.
	Socio-economic - Improve the standards of living for local oyster harvesters through improvement in oyster value chain activities and creation of supplemental employment opportunities leading to improved income levels of resource users.	Improve post-harvest value chain activities for oysters thereby reducing poverty and improving food security among both women and men oyster harvesters
	Capacity Development - Association strengthening	Strengthen local community involvement in planning, implementation and decision making in the sustainable use of oyster resources. Strengthen capacity of membership and leadership of the Densu Oyster Pickers Association to participate in key community decision making.

5.0 MANAGEMENT MEASURES FOR ACHIEVING KEY OBJECTIVES

Table 4 below summarises key management actions which take into consideration measures that can be taken quickly to restore biological and ecological balance while the full management actions are implemented. For instance, the interim planning committee recommended the immediate start of mangrove restoration whilst the process of drafting the co-management plan for approval was still underway.

The Densu River delta co-management planning committee (see Annex 2 for a list of members) led the engagement of the finalization of the proposed management measures by the community. Thus the following management and conservation actions have been proposed by the co-management committee.

The management measures took into account initial actions by the communities to restore ecological balance. More than 9,000 mangrove seedlings covering 5 hectares of degraded mangrove site along the delta has been restored. Other initial actions undertaken include scientific data collection by women oyster pickers on water quality, among other things (see Annex 4 for more information on initial actions).

Table 4. Summary of management actions per goal and objective.

Management Goal	Objective	Management Action Description
Biological	Oyster Harvesting	An oyster harvesting size limit of approximately 7cm is hereby established. Since oysters are gregarious in nature, this size limit applies to only the main oyster picked.
		A closed season for harvesting oysters is hereby established: • 5 months (November - mid-April) for all areas (to coincide with spat fall periods) • 1 month (starting late July to end of August) to coincide with the traditional *Homowo* celebration
		Move the management regime from open to restricted access: • Provide registration cards for all oyster pickers with the Densu Oyster Pickers Association to ensure easy recognition of any oyster harvester but also regulate harvesting of oysters by non-members or non-conforming people. Establish rules for new entrants and consider capping the total number of authorized pickers.
		Set limits on volumes and number of days allowed for continuous oyster harvesting during the harvesting season.
		Establish closed areas to serve as refugia and regeneration areas for stock rebuilding following freshwater spillage from Weija Dam which affects salinity resulting in die offs in some areas of the delta.
Ecological	Mangrove restoration	Establish a mangrove nursery for replanting degraded mangrove areas.

Management Goal	Objective	Management Action Description
Ecological		Replant degraded mangrove areas with 15,000 seedlings covering approximately 5 acres of the estuarine area. Establish exclusive zones for non-harvesting of mangroves for the first 3 years of restoration. Erect clearly marked sign posts designating restored mangrove sites to increase deterrence and reduce illegal cutting.
	Oyster reef restoration/ enhancement	• Designate areas appropriate for oyster reef restoration and enhancement. • Return at least twice annually three boatloads of shucked oyster shells to the designated restoration areas. This should coincide with the "spat-fall" period thought to be from November to mid-April. • Set up two (2) oyster shells dumping sites in each of the three (3) harvesting communities to be used for semi-annual oyster reef restoration activities.
	Manage fresh water pulsing and pollution to reduce impact on oyster and minimize die offs	• Coordinate with the Water Management Authority responsible for Weija Dam releases so they are aware of the issues. • Conduct collaborative research with university investigators on modelling of freshwater flows and the pulsing that can inform decision makers on best means to minimize oyster die offs.
Socio-Economic	Alternative/ diversified livelihood development	• Promote alternative livelihoods for the Densu Oyster Pickers Association (DOPA) members to ease harvesting pressure on the mangroves and oyster resources, with the DAA Fisheries Training Center (DFTC) taking the lead in such activities.
		• Development of Oyster culture: The Densu Oyster Pickers Association (DOPA) will work with the Zonal Fisheries Commission, Forestry Commission and University of Cape Coast on the continued development of environmentally friendly oyster culture approaches in the Densu Delta fishery management area.
	Marketing of oysters and other value additions	• Limit child labour in oyster fishery in consonance with the laws of Ghana. • Undertake post-harvest value chain activities associated with oysters including; handling, processing. packaging and marketing under hygienic and sanitary conditions.
		• The DAA Training Center to liaise and train DOPA members on adding value to their products and assist them in packaging and marketing of processed oysters.
Capacity Develop-ment	Association strengthening	• Develop the organizational capacity of DOPA to self-govern their members and the oyster fishery. • Train oyster pickers in the Densu Delta in mangrove nursery establishment and management.

6.0 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTING THE PLAN

6.1 The Densu Delta Co-Management Committee

Following recommendations from the interim planning committee, a permanent co-management committee was formed at a validation workshop consisting of all stakeholders (see Annex 5). In accordance with Ghana's Fishery Co-Management Policy, membership was selected from direct resource users, represented by the Densu Oyster Pickers Association and from each of the local communities where the association members reside. It consisted of a 15-member committee with 11 being women and four men, providing equitable gender representation among the oyster pickers. The committee has been duly registered with the District Assembly (see Annex 6). The following are the terms of reference for the Densu Delta Co-Management Committee.

- Have a one-year term of office and not serving more than a four-year tenure on the committee.
- Initiate the processes leading to the approval of this management plan or amendments by the Fisheries Commission.
- Oversight responsibility of running and implementing the day-to-day management and conservation measures as agreed upon in this co-management plan.
- Restrict access to the oyster growing areas for harvesting by any person who is not a member of the Association, or who does not conform to the management restrictions set out in this management plan.
- Communicate to the Regional Director of the Fisheries Commission for regulatory consistency review with plan objectives, and any additional management and conservation measures deemed fit and agreed upon by the committee in conjunction with the Association and traditional authorities for the achievement of planned objectives.
- Institute additional or new penalties and sanctions as they deem fit in consultation with the Association members, traditional authorities and the entire community.
- Communicate any additional rules, management and conservation measures adopted by the co-management committee, to the entire Densu Oyster Picker Association membership and other resource users either in writing or orally prior to the measures coming into effect.

The committee does not have the mandate to;

- Establish new or review downwards or upwards, management and conservation measures, fines, penalties and other recommendations made in this management plan, without wider consultation with Association members, the Zonal Officer of the Fisheries Commission, advisory committee, and

traditional authorities, and without the review and concurrence of the Regional Director of the Fisheries Commission.

6.2 Densu Delta Oyster Management Advisory Committee

This committee will consist mainly of stakeholders that are not oyster resource users, such as policy makers, the Fisheries Commission, District Assembly, industry players, etc. and their key mandate is to serve as an advisory body to the Densu Oyster Co-management Committee (see Annex 7 for current members). The role of the advisory committee shall include;

- Advise the Densu Delta Co-management Committee on management plan implementation and provide practical recommendations and technical support services on plan implementation.
- Make recommendations to the Regional Fisheries Director, District Assembly and other governmental agencies on implementation status and any needed actions on their part.
- Bring to the notice of the co-management committee any changes in national policy that might necessitate a review of the management plan or modification of some content of the plan.
- Assist the co-management committee in reviewing the performance of this plan at least once every year.

6.3 The Role of MOFAD and the Fisheries Commission

The expected roles of the Ministry of Fisheries and Aquaculture Development (MOFAD) and Fisheries Commission under this management plan are to;

- Lend support through its district, zonal and regional offices during stakeholder engagement processes.
- Approve and adopt the overall co-management plan.
- Review performance of the implementation of the management plan through its annual monitoring and audits in order to assess whether management objectives are being achieved.
- Assist in the enforcement of community co-management rules and regulations through its district and regional representatives in cases where the co-management committee experiences difficulty with sanctioning offenders.
- Review and concur with any new proposed management actions or changes in objectives.
- Ensure proposed changes in management actions do not contradict existing fisheries laws and regulations and are consistent with national fisheries policies and plans.
- Motivate, facilitate, validate and capacitate the Association and co-management committee.
- Convene periodic meetings of the advisory committee.

- Attend periodic co-management committee meetings as requested.

6.4 The Role of Local Government Units

Local government unit for the purpose of this plan is defined as the Municipal Assembly, more specifically, the Ga South Municipal Assembly. It is expected to:

- Coordinate fisheries co-management activities and incorporate needs of fisherfolk into short and medium-term development plans such as maintenance of sanitary conditions and removal of solid waste at Densu Delta landing sites, enforcing restrictions of dumping of refuse and other pollutants into the Delta and its tributaries.
- Support capacity building of the co-management committee and the Densu Oyster Pickers Association by facilitating their registration with the Municipal Assembly.
- Support inclusion of the Densu Delta co-management committee voice in the municipal decision making and planning processes.
- Support and assist in enforcement of fisheries regulations and rules in the co-management plan by authorized officers of the Fisheries Commission.
- Allocate funds to support the co-management committee and implementation of the management plan.
- Assist in the establishment of communication channels for awareness creation and educate the fisher folk and community members on the content of the co-management plan.
- Help arrange for a meeting place and other logistical support for the co-management committee as needed.
- Encourage education of the children of fisher folk and advocate against child labor and trafficking practices in fishing communities.

6.5 The Role of the Weija Dam Authority

- Provide up-to-date water spillage information to members of DOPA.
- Undertake controlled water spillage to the extent practical, to maintain normal water salinity downstream at the delta in order to reduce incidences of oyster die-off due to excessive discharge of fresh water.

6.6 The Role of the Wildlife Division (Forestry Commission)

- Prohibit construction of permanent structures within the RAMSAR core management area.
- Ensure sanitation (no dumping including solid and liquid waste).
- Prevent removal of vegetation (mangroves and trees).
- Assist in mangrove restoration activities.
- Assist in by-law enforcement.
- Serve as a member of the advisory committee.

- Train, educate and sensitize the surrounding communities on the importance of mangroves and other vegetation to oyster restoration.
- Support livelihood diversification programmes.

6.7 The Role of Universities and Research Institutions Especially University of Cape Coast, Department of Fisheries and Aquatic Sciences and Centre for Coastal Management

- Conduct research to determine spat fall periods for the Densu River delta.
- Assist in the collection and interpretation of research data on water quality, harvesting volumes and rate of decline or increases of the oyster resource.
- Conduct action research with DOPA members on the potential of oyster culture in the Densu delta.

6.8 The Role of Civil Society and Private Sector Organizations (e.g. DAA)

- Support on-going training and capacity building of the co-management committee and DOPA members.
- Facilitate stakeholder engagement and planning activities associated with implementation of this plan.
- Provide additional logistics, human and financial resources and services in support of implementation of this plan.
- Develop the means for post-harvest improvements of oysters that can provide value-added economic improvements for processors and harvesters, as well as a safe and healthy product for consumers.

7.0 ENFORCEMENT OF MANAGEMENT MEASURES AND SANCTIONS

7.1 Sanctions, Penalties and Fines

These sanctions and penalties govern the oyster resource and violators of these management measures shall be sanctioned and fined according to these rules.

Members of DOPA or non-members have the primary responsibility for monitoring member and non-member actions with regards to management rules and prohibitions in this plan.

When a person who is a member or non-member of the Association violates harvesting rules and restrictions, he/she should be referred to the co-management committee by the individuals who observed the infractions, so they can caution the person for first time offence and make the individual render an apology to the entire Association.

When the person violates rules for the second time, the catch would be taken from the person, sold and the proceeds deposited in the bank account of the co-management committee, The person will be required to render an apology to the members of the Association and also made to pay a fine not exceeding Gh₵50.00.

When the person violates rules for the third time, a fine of two hundred Ghana Cedis (GHS 200) must apply. The violator pays the full fines stated in this management plan and if the violator fails to pay within two weeks of stipulating the fine, he/she forfeits rights to the use of the resource and can be banned from harvesting oysters for a period of time prescribed by the co-management committee.

If a non-member is found harvesting oysters without permission of the co-management committee, the committee should refer this to the traditional authorities for resolution and then to the Fisheries Commission and Police where traditional authorities are unable to enforce compliance. The same penalties apply to all offenders whether members or non-members of the association.

- Pickers who are found harvesting more than the stipulated volume and cumulative number of days should be fined an amount of GHS 50 (Fifty Ghana Cedis).
- A fine amounting to GHS 100 (One Hundred Ghana Cedis) for harvesting small sized oysters (less than 7cm).
- A fine of GHS 100 (One Hundred Ghana Cedis) for persons found cutting down mangroves without the proper authorization.
- A fine of GHS 150 (One Hundred and Fifty Ghana Cedis) if found harvesting from closed areas or closed harvesting sites.
- A fine of GHS 200 (Two Hundred Ghana Cedis) for harvesting oysters during the stipulated closed season.

Any accused offender who wishes to appeal a sanctioning decision by the co-management committee can appeal to the local traditional authorities or Fisheries Commission.

8.0 MONITORING AND EVALUATION FOR MEETING PLAN GOALS AND OBJECTIVES

The Densu Oyster Fishery Co-Management Committee with the support of the entire membership of the Densu Oyster Pickers Association shall monitor and review the progress of agreed management measures. The advisory committee in conjunction with the Fisheries Commission, and Wildlife Division of Forestry Commission will play a supervisory role in performance monitoring for implementation success. The implementation plan contained in Annex 8 contains a number of indicators to assess progress in implementing management action and performance.

The following specific procedures and actions shall be followed as part of the monitoring and evaluation of the management measures and key performance indicators;

- Each and every member of DOPA has a responsibility to participate in monitoring and evaluation of the implementation of management measures stated in this plan and progress towards achieving the plan objectives.
- Continual monitoring of the water quality through a semi-annual data collection and analyses from DOPA members with support from UCC.
- Co-Management Committee members will solicit feedback from DOPA membership during harvesting periods as part of the evaluation processes.
- The advisory committee members will convene an annual meeting with the entire members of DOPA and the co-management committee to assist in facilitating review of implementation progress with respect to the key performance indicators as the basis. The meeting will evaluate and review areas such as;
    - Difficulties, if any, in implementing enforcement actions, sanctions and penalties.
    - Status of funds obtained from fines – amount collected and appropriation or use of such funds.
    - Degree to which biological, ecological, social and economic management objectives outlined in the plan are being met including impacts of mangrove replanting and other forest conservation activities.

REFERENCES

Biney, C. A. (1995). Environmental Baseline Studies - Limnology Densu Delta. Ghana Coastal Wetlands Management Project. Ghana Wildlife Department. Ghana. GW/A.285/SF2/29, 39 pp.

Cockle and Oyster Fishery Co-Management Plan for the Tanbi Special Management Area. The Gambia, (2012) Ministry of Fisheries, Water Resources and National Assembly Matters, The Gambia. 37 pp.

Bilecki, D. B. Crawford, B, Hardi-Nyari. (2018). The Value and Volume of Oysters Harvested from the Densu Estuary: A Rapid Assessment. The USAID/Ghana Sustainable Fisheries Management Project (SFMP). Narragansett, RI: Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. GH2014_ACT224_CRC. 12 pp. https://www.crc.uri.edu/download/GH2014_ACT224_CRC_FIN508.pdf

Janha, F. M. Ashcroft and J. Mensah (2017). Participatory Rural Appraisal (PRA) of the Densu Delta Oyster Harvesting, Bortianor/Tsokomey, Greater Accra Region, Ghana. TRY Oyster Women's Association, Development Action Association, Hen Mpoano and Coastal Resources Center, University of Rhode Island. 27 pp. http://www.crc.uri.edu/download/Gh2014_ACT148_DAA_FIN508.pdf

Hindson J., D. D. Hoggarth, M. Krishna , C.C. Mees and C. O'Neill (2005). How to manage a fishery: a simple guide to writing a fishery management plan. Marine Resources Assessment Group, London, Centre for Environmental Education, Ahmedabad, Scales Consulting Ltd. London. 86 pp.

Marozova, A. L., K. D. Leung-Tack, V. I. Kholodov, V. V. Trousevich, S. Camara, V. K. Maskevski, F. X. Ibrahimov and P. D. Lamakin (1991). L'ostrdiculture en milieux de mangroves (Etude de cas en Guinee et au Senegal), I.E. Timchenko and S. Konate, eds. Sene documentaire 7, COMAR, France, 148 pp.

Oteng-Yeboah, A. A. (1999). Development of management plan for the Densu Delta Ramsar Site, Wildlife Division of Forestry Commission. Ghana. 100 pp.

South Australian Oyster Research Council (2010). The best oysters are pure: Nutritional facts, vitamins and mineral. (http://www.coffinbayoysters.com.au)

Yankson, R. (1996). Sexual differentiation of *Crassostrea tulipa* in two contrasting brackish water environments. *Journal of Molluscan Studies* 62:135-137.

ANNEX 1: STAKEHOLDER ANALYSES OF COLLABORATORS ENGAGED DURING THE COMMUNITY CO-MANAGEMENT DEVELOPMENT PROCESS

Stakeholder Category	Name of Stakeholder	Type of Engagement	Level of Influence	Level of Importance	Expected Role
Local Government	Ga South Municipal Assembly	Has participated in meetings held in March and April 2017.	Very High	Very Important	Facilitate validation of the final co-management plan into the Assembly's short to medium term plan.
Policy Makers	Fisheries Commission	Has participated in meetings held in March and April 2017 Has representative at the zonal level on the Co-management planning committee	High	Very Important	To make crucial inputs into the content of the draft and final co-management plan. To assist in aligning co-management plan to any existing fisheries policies, laws or by-laws.
	Forestry Commission	Has participated in meetings held in March and April 2017 Has representative at the zonal level on the Co-management planning committee Representative is the chairman of the committee	High	Very Important	To make critical inputs to the draft and final co-management plan. Continue to promote mangrove replanting and restoration efforts along the catchment areas covered by the co-management plan.
	EPA	Yet to engage	Normal	Important	Should assist in ensuring that no encroaching of protected mangrove cover is depleted.

Stakeholder Category	Name of Stakeholder	Type of Engagement	Level of Influence	Level of Importance	Expected Role
	Ghana Water Company (Weija Dam)	Has participated in meetings held in March and April 2017. Has representative at the zonal level on the Co-management planning committee.	Normal	Important	Provide assistance on education of the public on the need to reduce pollution to the delta. Also to provide timely information on the opening and closure of the Dam overflow.
Traditional Authorities and Community Opinion Leaders	Wolo Solemo	Has participated in meetings held in March and April 2017 Has representative on the Co-management planning committee	Very High	Very Important	Long release of lands under its control for mangrove restoration. Enact traditional and cultural taboos that protect delta and mangrove as part of the co-management plan.
	Sakumono	Has participated in meetings held in March and April 2017 Has representative on the Co-management planning committee	Very High	Very Important	Long release of lands under its control for mangrove restoration. Enact traditional and cultural taboos that protect delta and mangrove as part of the co-management plan.
	Community Assembly Members	Lend support	Normal	Normal	Support and give backing to key management measures in the co-management plan. Help ascertain perception of the current situation.
Local Focus Resource Users	DAA Oyster Pickers Association	Has participated in meetings held in March and April 2017.	Low	Very Important	Lead the formulation of a co-management plan and

Stakeholder Category	Name of Stakeholder	Type of Engagement	Level of Influence	Level of Importance	Expected Role
		Has two representatives on the Co-management planning committee			implementation, monitoring and evaluation. Allocate resource use right to members
Other Resource Users	River fishermen ("*Atidza*" fishermen)	Has participated in meetings held in March and April 2017. Has representative on the Co-management planning committee.	Low	Important	Lend support to the implementation of the management plan and minimise "conflicts"
	River Canoe Owners	Lend support	Low	Important	Lend support to the implementation of the management plan
Other Organizations (NGO, Educational, Research, etc.)	University of Cape Coast	Has participated in meetings held in March and April 2017. Has engage and assigned a PhD student to assist in data collection for the co-management key decisions.	Normal	Important	Assist in training of local oyster harvesters and also provide key scientific data on ecology, biology, stock assessment, water quality etc.
	DAA	Coordinate and facilitate activities of the oyster co-management committee.	Normal	Important	Coordinate and facilitate activities of co-management committee and also assist in capacity building of key local resource users.
	Hen Mpoano	Assist DAA in Coordination and facilitation activities of the oyster co-management committee.	Normal	Normal	Support coordination efforts and facilitation activities of DAA.
Other coastal resource	Bojo Beach Resort	Assist DAA in Coordination and facilitation activities of the	Normal	Normal	Support coordination efforts by DAA and provide

Stakeholder Category	Name of Stakeholder	Type of Engagement	Level of Influence	Level of Importance	Expected Role
stakeholders		oyster co-management committee.			accessibility through their property for data collection and other research work
	Panbros Salt Company	No Engagement	Important	Less influential	Participate in monitoring and ensuring implementation of management measures with line boundaries of the Densu Delta

ANNEX 2: CO-MANAGEMENT PLANNING COMMITTEE MEMBERS

No	Name	Sex	Community/Organization	Position
1	Ayitey Armah	Male	Bortiano – Assembly member	Assembly member
2	Arnold Avile	Male	Tsokomey – River Fisherman	Member - Tsokomey Youth Leader
3	Fidelia Soglo	Female	Tetegu - DAA Oyster group Association	Member
4	Beatrice Kukekpor	Female	Tsokomey - DAA Oyster Group Association	Association President
5	Nii Ampofo	Male	Tsokomey - Traditional leader	Sakumo Wulomo
6	Peter Amui	Male	Bortiano - Traditional leader	Bortiano - Traditional leader
7	Andrew Agyekumhene	Male	Forestry Commission and Chairperson of Committee	Municipal Director
8	Daniel Atobrah	Male	Tsokomey – Bojo Beach Resort	Manager
9	Olivia Horvey	Female	Ga South Municipal – Fisheries Commission	Municipal and Zonal Officer
10	Comfort Addo	Female	Kokrobite - DAA	Former DAA Board President
11	Ashley Aikins	Male	Ghana Water Company – Weija Dam	Weija Dam Representative
12	Abraham Asare	Male	DAA -Office	M&E Officer
13	Samuel Manu	Male	Head Office – Fisheries Commission	Head of the Post-Harvest Unit

ANNEX 3: MEAN VALUES OF WATER QUALITY PARAMETERS IN THE DENSU DELTA: DRY (APRIL) AND WET (JULY) SEASONS IN 1994

Parameter	Dry Season	Wet Season
Temperature (^{0}C)	33	28.4
pH	7.7	7.9
Salinity (ppt – ^{0}/00)	32.0	10.5
TDS (mgl^{-1})	37,543	14,325
Na (mgl^{-1})	22,865	10,770
K (mgl^{-1})	651	399
DO (mgl^{-1})	7.2	7.0
Nh3- (mgl^{-1})	0.01	0.01
P04 (mgl^{-1})	0.05	0.02
Biochemical Oxygen Demand (mgl^{-1})	6.1	5.6
Chemical Oxygen Demand (mgl^{-1})	1.031	1.329
Pb (mgl^{-1})	0.34	0.58
Hg (mgl^{-1})	<0.001	<0.00
Total coliform (counts/100ml) *	32,000	30
Faecal coliform (counts/100ml) *	2,000	20'

* Measured at the South-eastern part of the wetland

SOURCE: Oteng-Yeboah. A. A. (1999). Development of management plan for the Densu Delta Ramsar Site, Wildlife Division of the Forestry Commission. Ghana. 100 pp.

ANNEX 4: PICTURES FROM EARLY MANAGEMENT ACTIONS

Figure 14: Community oyster pickers from Bortianor, Tsokomey and Tetegu in the Ga South Municipal Assembly embarked on a community street walk as part of the awareness creation before the start of a scheduled five and a half month "closed season"

Figure 15: A community durbar to mark the implementation of the first a scheduled five and half "closed season" at the Densu Delta in the Ga South Municipal Assembly

Figure 16: Traditional leaders and other stakeholders signed a compact pledging their public support for the implementation of a scheduled five and half month "closed season" of the Densu Delta for oyster harvesting

Figure 17: Performing the "traditional rites" signalling the close of the Densu Delta for a scheduled five and half month "closed season”

Figure 18: Boost in Oyster production (low tide) after the implementation of a scheduled five and half month "closed season" at the Densu Delta

Figure 19: Boost in oyster production (density and volumes harvested) after the observance of a scheduled five and half month "closed season" as management actions to revamp oyster production in the Densu Delta in the Ga South Municipal Assembly in the Greater Accra

ANNEX 5: PICTURE OF MEMBERS OF THE PERMANENT DENSU OYSTER PICKERS CO-MANAGEMENT COMMITTEE

Figure 20: Members of Densu Delta Co-Management Committee

Table 5: Name and designation of members of the Densu Delta Co-Management Committee

No.	Name	Sex	Community	Position
1	Beatrice Kukekpor	Female	Tsokomey	Member
2	Bernice Agorogo	Female	Tsokomey	Member
3	Forgive Akakpo	Male	Tsokomey	Member
4	Bernice Bebli	Female	Tsokomey	Member
5	Hortor Godwin	Male	Tsokomey	Member
6	Franscis Agbeshie	Male	Bortiano	Organizer
7	Promise Hunya	Male	Tsokomey	Member
8	Mercy Kugbe	Female	Tsokomey	Member
9	Patience Amudzi	Female	Bortianor	Secretary
10	Ruth Hiamanya	Female	Tsokomey	Member
11	Cecilia Senu	Female	Tetegu	Member
12	Grace Agbeve	Female	Tetegu	Member
13	Fidelia Soglo	Female	Tetegu	Chair Person
14	Yaw Agbeshie	Male	Tsokomey	Member
15	Millicent Agorogo	Female	Tetegu	Member

ANNEX 6: REGISTRATION CERTIFICATE OF DOPA

GA SOUTH MUNICIPAL ASSEMBLY
(GSMA)
WEIJA JUNCTION

REPUBLIC OF GHANA

Certificate of Registration

This is to certify that

DENSU OYSTER PICKERS ASS.
has been registered as a C.B.O.
with the GA SOUTH MUNICIPAL ASSEMBLY

Business Type: C.B.O.

Category: "C"

Dated this: 5th day of FEB. 2018

Registration No.: GSMA/0001/18

GA SOUTH MUNICIPAL ASSEMBLY (GSMA)

Municipal Co-ordinating Director

Municipal Chief Executive

Figure 21: Registration Certificate of DOPA by the Ga South Municipal Assembly

ANNEX 7: PICTURE OF MEMBERS OF THE ADVISORY COMMITTEE

Figure 22: Members of the Advisory Committee to the Densu Delta Co-Management Committee

Table 6: Names and designation of Advisory Committee members for the Densu Delta Co-Management Plan

No	Name	Sex	Community/Organization	Position
1	Charles Ayitey Armah	Male	Bortianor – Assembly member	Assembly member
2	Arnold Avile	Male	Tsokomey – River Fisherman	Member - Tsokomey Youth Leader
3	Dr. Margaret Ottah Atikpo	Female	Sustainable Fisheries Management Project (SFMP)	Post-Harvest and Gender Specialist - SFMP
4	Daniel Boye	Male	Panbros Salt Ltd.	Representative Panbros Salt
5	Nii Ampofo	Male	Tsokomey - Traditional leader	Sakumo Wulormor
6	Andrew Agyekumhene	Male	Forestry Commission	Efutu Municipal Officer
7	Daniel Atobrah	Male	Tsokomey – Bojo Beach Resort	Manager
8	Olivia Horvey	Female	Ga South Municipal – Fisheries Commission	Municipal and Zonal Officer
9	Comfort Addo	Female	Kokrobite - DAA	Former DAA Board President
10	Ashley Aikins	Male	Ghana Water Company – Weija Dam	Weija Dam Representative
12	Shirley Baghoh	Female	Ga South Municipal Assembly	G.S.M.A Representative
13	Abraham Asare	Male	DAA -Office	M&E Officer
14	Edna Dadeboe	Female	Ghana Education Service	Ghana Education Service – G.S.M.A Representative
15	Scot Apawudza	Male	Fisheries Commission	Greater Accra Regional Fisheries Director

ANNEX 8: IMPLEMENTATION PLAN FOR THE DENSU OYSTER FISHERY MANAGEMENT PLAN

Manage-ment Object-ive	Manage-ment Action(s)	Measur-able Indica-tors	Means of Verification	Base Line	Target	Frequen-cy	Critical Assumption	Responsi-bility	Duration		Budget (GHS) *Indicative
									From	To	
Oyster Harvest-ing	Closed areas as oyster Refugia for Oyster Restoration and Growth	Number of "closed areas" established measured in acres	Total number of acres closed	0	2 *(measured in acres of total area)*	Annual	Water monitoring data collected supports the establishment of refugia sites	Densu Delta Management plan Committee & DOPA	2021	2024	10,000
	Closed season for oyster stock replenish-ing	Number of days oyster resource is banned from harvesting	Total Effective days counted for banned oyster harvesting, Photos from Closed Season durbar ceremony.	0	150	Annual	Stakeholder consultations completed and common understanding established	Densu Delta Co-Management Committee	2021	2024	10,000
	Pilot Oyster Culture	Number of individual oyster culture established *(measured in total acres)*	Photo evidences of oyster culture sites and progress report	4	5	Annual	Members of DOPA receives adequate training and capacity building on oyster culture	DOPA	2021	2022	10,000
	Establishme nt of "Size limit for harvesting oysters" (Minimum Size of 4cm)	Percentage of harvested oysters returned to river because of minimum size limit *(measured in total kilogram)*	Photo and progress report	0	30% of all total annual catch	Annual	Early biological management measures have been successfully implemented	Densu Delta Co-Management Committee/ DOPA	2021	2024	5,000

Manage-ment Object-ive	Manage-ment Action(s)	Measur-able Indica-tors	Means of Verification	Base Line	Target	Frequen-cy	Critical Assumption	Responsi-bility	Duration		Budget (GHS) *Indicative
									From	To	
	Establishment of oyster shell collection site for replanting as oyster reefs	Number of oyster collection sites established	Photo of collection sites	0	3	Annual	DOPA Membership are willing to participate in collection site and low level demand for oyster shells in the community	DOPA	2021	2024	2,000
	Re-deposits *(replanting)* of used shells	Percentage of harvested processed oyster shells re-deposited into Densu Delta	Photo/video evidence of deposited shells into Densu Delta and Progress report	1	4 (50% of total annual harvested oysters)	Annual	Other management measures are successful and annual oyster yield is sustained	Densu Delta Co-Management Committee/ DOPA	2021	2024	5,000
	Set catch limits and effort controls	Number of harvesting days per individual oyster harvesters	Progress report of efforts of individual DOPA members	0	20% reduction in harvesting days	Number of efforts per each DOPA member recorded	DOPA members are willing to share information on harvesting efforts	DOPA	2020	2024	5,000
	Provide registration cards for all oyster pickers with the Densu Oysters Pickers association to ensure easy recognition of any oyster harvester but also regulate harvesting of	Number of oyster pickers with identification cards	Progress report/Photo ID	0	200	once	DOPA members are willing to share the cost of printing the identification cards	DOPA	2020	2021	

Manage-ment Object-ive	Manage-ment Action(s)	Measur-able Indica-tors	Means of Verification	Base Line	Target	Frequen-cy	Critical Assumption	Responsi-bility	Duration		Budget (GHS) *Indicative
									From	To	
	oysters by non-members non - conforming people										
	Hygienic oyster handling and processing retraining to improve value chain	Number of Oyster harvesters trained *(Segregated by sex)*	Progress report Signed participant roaster and Group photo of trainees	0	99% of total DOPA membership	Annual	DOPA members willing to offer themselves for training and the availability if training funds	DOPA/ DFTC	2021	2024	20,000
	Oyster value addition retraining on packaging and marketing for improved income	Number of Oyster harvesters trained *(Segregated by sex)*	Progress report Signed participant roaster and Group photo of trainees	0	99% of total DOPA membership	Annual	DOPA members willing to offer themselves for training and the availability if training funds	DOPA/ DFTC	2021	2024	20,000
Mangrove Restoratio n	Establish exclusive zones of non-harvesting mangrove area for the first three years	No of hectares of areas established as exclusive zone for non-mangroves	Map	0	3 hectares	Annual	DOPA members willing to comply by the rule for	Co-management committee	2021	2024	
	Erect clearly marked sign posts designating restored mangrove sites to increase	No of sign post erected showing restored mangrove sites	Photo of evidence	0	4	Annual	DOPA members willing to comply by the rule	DOPA	2021	2022	

Manage-ment Object-ive	Manage-ment Action(s)	Measur-able Indica-tors	Means of Verification	Base Line	Target	Frequen-cy	Critical Assumption	Responsi-bility	Duration		Budget (GHS) *Indicative
									From	To	
	deterrence and reduce illegal cutting										
	Secure land for Mangrove restoration planting	Number of acres of land secured	Photo evidence	0	1,500 acres	Annual	Traditional Authorities of "SakumoWe" willing to release land for plantation	Nii Ampofo & DOPA	2017	2017	2,000
	First Pilot Mangrove Seedlings plantation	Number of mangrove seedling planted	Area Picture of planted red mangrove seedlings	12,500	20,000	Annual	Site for mangrove plantation will be secured	DOPA	2021	2024	6,000
	Mangrove seedling nursery established.	Number of mangroves seedlings nursed	Progress Report, photo or nursed mangroves	0	3 sites (10,000 seedling)	Annual	Family head of proposed and willing to release land for nursery	DOPA, Forestry Commission *(Wild Life Division)*	2021	2024	10,000
Capacity Building	Capacity Developmen t to facilitate the creation of Association to own "use right" of the oyster resource in the Densu Delta	Number of active associations members *(segregated by sex)*	Registration data base for membership	1	1	Annual	Communities harvesting Oyster willingness to form association	DAA	2021	2022	10,000
	Peer to peer review and exchange & knowledge sharing study tour Visits.	Number of exchange study tours embarked *(segregated by local and*	Study tour reports and signed participant list	0	5	Annual	Availability of needed fund for study tour	DOPA /DAA	2021	2024	20,000

Manage-ment Object-ive	Manage-ment Action(s)	Measur-able Indica-tors	Means of Verification	Base Line	Target	Frequen-cy	Critical Assumption	Responsi-bility	Duration		Budget (GHS) *Indicative
									From	To	
		international study tour)									
	Capacity Building of DOPA Association in leadership training	Number of DOPA members trained *(Segregated by sex)*	Progress report, pictures and participant list from training	1	3 Trainings *(200 people trained of which 90% are females)*	Annual	DOPA members willing to offer themselves for training and the availability if training funds	DFTC/ DOPA	2021	2024	30,000
Diversified livelihood developm ent	Promote alternative livelihoods for the Densu Oyster Pickers Association (DOPA) members to ease harvesting pressure on the mangroves and oyster resources, with the DAA Fisheries Training Center (DFTC) taking the lead in such activities.	Number of DOPA members involved in alternative livelihood activities	Progress report	0	50	Annual	DOPA members are willing to participate in the alternative livelihood activities	DFTC /DOPA	2021	2024	
		Number of alternative livelihood activities introduced	Progress report	0	3	Once	DOPA members are willing to participate in the alternative livelihood activities	DOPA	2021	2024	

ANNEX 9: PICTURE GALLERY - GENERAL


Figure 23: Left: Mr Godwin Hortor, using a bottom sampler to check for bottom water salinity; Right: Madam Bernice Bebli using secchi disk to check for water turbidity


Figure 24: Left: Madam Grace Agbeve measuring water temperature; Right: Some members of the trained water data collectors


Figure 25: Left: Madam Jackline Kunaki measuring water salinity using a salinometer; Right: Madam Patience Amudzi recording the data collected

Figure 26: Members of DOPA embarking on mangrove restoration exercise at the Densu Delta

Figure 27: Members of DOPA participate in practical sessions during the two-day training on mangrove nursery establishment

Figure 28: Consultative meetings with Oyster Pickers

DENSU DELTA COMMUNITY BASED FISHERIES MANAGEMENT PLAN

DECEMBER 2020

This publication was printed with support from the American People, USAID Ghana Sustainable Fisheries Management Project

(Cooperative Agreement No. AID-641-A-15-00001)