

Cockle and Oyster Fishery Co-Management Plan for the Tanbi Special Management Area The Gambia



January 2012

Ministry of Fisheries, Water Resources and National Assembly Matters



REPUBLIC OF THE GAMBIA

Table of Contents

	<u>Page</u>
Co-Management Agreement	iii
1. Introduction.....	1
2. Background	3
2.1 Description of the Tanbi Wetlands National Park	3
2.2 TRY Association of Cockle and Oyster Harvesters	5
3. Description of the Fishery	8
3.1 Status of the Shellfish Resources and Issues in the Fishery	8
3.2 The biology of the West African mangrove oyster (<i>Crassostrea gasar/tulipa</i>)	10
3.3 The biology of the Blood Ark Cockle (<i>Senilia senilis</i>).....	11
3.4 Harvesting Methods	12
3.4.1 Oyster Harvesting	12
3.4.2 Cockle Harvesting.....	12
3.5 Processing	13
3.5.1 Oyster Processing.....	13
3.5.2 Cockle Processing.....	13
3.6 Marketing.....	14
3.7 Annual Calendar of Activities of Cockle and Oyster Harvesters	15
3.8 Water Quality.....	15
4. Management Objectives	18
5. Management Measures to Achieve Objectives.....	19
5.1 Harvesting of Oysters and Cockles.....	19
5.2 Community Exclusive Use Zones and Open Access Areas.....	19
5.3 Marketing of cockles and oysters	21
5.4 Penalties and Fines.....	21
5.5 Alternative livelihood development.....	22
5.6 Mangrove conservation.....	22
5.7 Development of Oyster Aquaculture	22
5.8 Research and Monitoring	23
6. Institutional Arrangements & Legal Framework for Management	25
6.1 Designation of Tanbi Wetlands National Park as a Special Management Area	25
6.2 Tanbi Cockle and Oyster Fishery Management Committee.....	26
6.3 Community Based Management Committees	27
6.4 Tanbi Advisory Committee.....	28
6.5 Role of the Department of Fisheries	28
6.6 Role of the Department of Parks and Wildlife Management, Department of Forestry and National Environment Agency.....	29
7. Monitoring and Evaluation of Plan Performance.....	30
List of References.....	31

List of Figures

Figure 1. Satellite image of The Tanbi wetland area	3
Figure 2. Perceptions of changes in catch & effort as revealed from PRAs	8
Figure 3. Oyster and cockle harvesting communities of the Tanbi National Park	9
Figure 4. The mangrove oyster <i>Crassostrea tulipa</i> (left) and the blood cockle (right)	9
Figure 5. Life cycle of the oyster	10
Figure 6. Density of oyster spat by month in the Tanbi Wetland National Park	11
Figure 7. Average Coliform Levels in the 15 Sampling Sites, Tanbi Wetland	16
Figure 8. Community exclusive use zones and closed <i>bolongs</i> in the Tanbi Wetlands ...	20
Figure 9. Community exclusive use zone and closed <i>bolong</i> in the Kartong Estuary.....	21
Figure 10. Boundaries of the Tanbi Wetland National Park which also serve as the boundaries for the special management area solely for the purpose of community-based management of the cockle and oyster fisheries.....	26

List of Tables

Table 1. Annual calendar of activities of the oyster and cockle harvesters.....	15
---	----

List of Acronyms

DO	Dissolved Oxygen
GEF	Global Environment Facility
GMD	Gambian Dalasi
ICAM	Integrated Coastal Area Management
IDRC	International Development and Research Center
NSSP	National Shellfish Sanitation Program
PRA	Participatory Rapid Appraisals
TWNP	Tanbi Wetlands National Park
USAID	United States Agency for International Development

Co-Management Agreement

WHEREAS, the Tanbi Wetlands National Park (TWNP) has been declared a RAMSAR site in 2007 and designated as a National Park – due to its significant biodiversity assets of regional and national importance,

WHEREAS, the Tanbi Wetlands National Park provides significant food security and income for hundreds of women cockle and oyster harvesters,

WHEREAS, the Fishery Act of 2007, Section 14 and associated regulations of 2008, provide the authority for the Minister of Fisheries, Water Resources and National Assembly Matters to designate special management areas for the purpose of community-based co-management in the interest of conservation, management and sustainable utilization of fisheries resources,

WHEREAS, the designation of the Tanbi Wetlands National Park as a special management area is fully consistent with The Biodiversity and Wildlife Act, Forestry Act and National Environment Act, as well as the Tanbi Wetlands National Park Management Plan,

WHEREAS, the Fishery act of 2007, Section 11 and associated regulations of 2008 provide the authority for the Minister of Fisheries, Water Resources and National Assembly Matters to allocate property rights over fisheries resources,

WHEREAS, The TRY Association of Cockle and Oyster Harvesters is an official and legally registered Association,

THEREFORE, I HEREBY

Declare the area congruent with the Tanbi Wetlands National Park as a Special Management Area solely for the purposes of fisheries management.

Designate The TRY Association as having exclusive use rights to the cockle and oyster fishery in this area.

1. Introduction

This is the first co-management plan for the Cockle and Oyster Fishery of The Gambia. The plan is specially prepared for the oyster and cockle harvesting areas within the Tanbi Wetlands National Park as a Special Management Area for the purposes of harvesting cockle and oyster resources. The legal basis to designate a Special Management Area is provided for in the Fisheries Act 2007. Section 15 gives power to the Minister of Fisheries, Water Resources and National Assembly Matters to declare Special Management Areas for purposes of community-based management and Section 11 allows for the allocation of property rights and catch share allocations. The cockle and oyster harvesters that operate within the Tanbi Wetlands National Park have already been organized into a community based organization called TRY Association. Through approval of this co-management plan, the TRY Association is allocated the exclusive rights to harvest cockles and oysters from this area and is responsible for the co-management of the cockle and oyster fishery in partnership with other stakeholders including governmental and non-governmental organizations and local authorities.

The purpose of this co-management plan is to ensure the sustainable management and development of the cockle and oyster fishery and enhanced benefits to those involved in the market value chain. An additional aim for this co-management plan for the nine cockle and oyster harvesting communities within the Tanbi Wetlands National Park is to serve as a pilot and if successful, this co-management model can be scaled-up to other cockle and oyster harvesting areas in the country.

The co-management plan was developed through a process that included community meetings, participatory rapid appraisals (PRAs) in cockle and oyster harvesting communities, workshops on co-management, institutional strengthening and capacity building activities, study tour experiences and regional exchanges, collaborative research, and the participation of Government Institutions, Local Government Agencies and Municipalities throughout the process. The co-management plan is divided into six (6) major Sections as follows: Section 1 is the Introduction that briefly outlines the legal basis for co-management of the fishery, the purpose and goal of the co-management plan, and the process of developing the plan and the stakeholders involved. Section 2 gives Background Information on the Tanbi Wetlands National Park and TRY Association. Section 3 provides a description of the fishery and a map of the Tanbi National Park, showing the nine communities where cockles and oysters are harvested, and the area of focus of the co-management plan. This Section also provides a description of the biology of the cockle and oyster species harvested, the harvesting methods, post-harvest processing and marketing methods, and an annual activity calendar of the fishery. It also provides an overview of the status and issues in the fishery including water quality and hygiene. Section 4 outlines the management objectives of the fishery divided into biological, ecological, economic and social objectives. Section 5 addresses the management measures to achieve the objectives of the plan. These measures include community exclusive zones, size limits of harvested species, permanent and closed seasons in open access zones, penalties and fines for violation of rules, aquaculture

development, strengthening of TRY Association as well as research and monitoring needs. Section 6 includes the institutional arrangements and legal framework for co-management.

The co-management plan is designed to be adaptive and is expected to change over time, taking into account changes in harvesting methods and technologies, environmental changes and fluctuations including those that may be caused from climate change, and allows for the efficient and timely introduction of new management measures and strategies warranted by changing circumstances and situations in the fishery.

The development of the co-management plan has been supported by the USAID funded Gambia-Senegal Sustainable Fisheries Project (*Ba Nafaa*). The *Ba Nafaa* project is implemented by the Coastal Resources Center of the University of Rhode Island and the World Wide Fund for Nature - West Africa Marine Ecoregion (WWF-WAMER) in partnership with the Department of Fisheries and the Ministry of Fisheries, Water Resources and National Assembly Matters.

2. Background

2.1 Description of the Tanbi Wetlands National Park

The central coordinates of the Tanbi Wetlands National Park (TWNP) are 13°26' North and 16°38' West. TWNP has an area of 6,304 hectares. TWNP is a mangrove swamp that fronts the Atlantic Ocean to the north and the Gambia River to the east. It is located at the mouth of the River Gambia, occupying the southern portion of the estuary (see Figure 1 below). It has developed through the combination of deposition of fluvial and marine sediments. It is an estuarine and intertidal forested wetland primarily of low mangrove forest, with a complex of vegetation types on its northern boundary and along the mangroves fringing the mainland. The TWNP functions include coastal stabilization, fish breeding and oyster and cockle production, recreation and carbon sequestration.



Figure 1. Satellite image of The Tanbi wetland area

The area is characterized by a network of channels that dissect the mangrove forest and the coastal strip on the northern fringe. The entire complex is essentially estuarine in nature, though it is subjected to full salinities on the northern fringe during flood tides, and there are numerous freshwater flushes around the periphery during the rainy season. Hyper saline conditions can develop in some of the coastal lagoons and in the upper reaches of the *Bolongs* (tributaries or channels in the mangrove system). The fringe of the wetlands is seasonally flooded through rainfall and runoff which affects the salinity regime within the mangrove and lagoon complex. Freshwater is found at approximately 2m depth in this fringe and during the dry season.

A chain of lagoons runs between Cape Creek and Oyster Creek Bridge and a single lagoon occurs on the east of Toll point lagoons, which are subject to limited tidal inundation through narrow channels. This is a dynamic and ever-changing stretch of

coast-line with extensive erosion and deposition occurring. This being so, there is a risk that the lagoons may be breached in several new places in the near future.

Mangrove forest dominates the TWNP south of the Banjul Highway and covers approximately 4,800ha. The numerous *Bolongs*, which dissect the mangroves, form a mosaic of islands up to 800 ha. in size. The mangrove community along the channels reflects slight variation in soil levels, with sections of the fringe forest interspersed with over wash forest. The extent to which these communities extend from the Bolongs is variable and often difficult to determine due to the thicket of branches and prop roots of these low forests. The mean height of the *Rhizophora spp.* forest from soil level is 6-7m. At the head of many *Bolongs* however, individual trees of up to 10m occur, which may be a result of localized freshwater flushes reducing the osmotic pressure of particular trees.

There are extensive areas of tannes (seasonal saline flats) on the periphery of the TWNP that are subjected to seasonal flooding and subsequent drying following the rains. The associated vegetation varies with the degree of salinity. It ranges from the bare tannes to halophytic dominated vegetation including seasonal purslane, beach morning-glory and *Philoxerus vermicularis*, merging into grassland dominated by *Sporobolus spicatus*, *Phragmites australis* and *Paspalum vaginatum*. As the dry season progresses the vegetation of the seasonal saline flats dies back (DPWM 1999).

Humans settled around this area for five centuries. The area is bordered by twelve villages. The Greater Banjul human settlement surrounds TWNP to the south and east. Mandinary, Lamin and Abuko towns are bordering TWNP to the south; to the west, Fajikunda, Talinding, Ebotown and Jeshwang towns limit TWNP. Banjul is at the north-eastern border while Bakau town is to the north-west of TWNP. The area includes some part of the Banjul City area, some parts of Kanifing Municipality and some areas of the Brikama Area Council.

The population has skyrocketed since the mid-1960s. The high national growth rate (4.2%) and migration from upland and neighboring countries are the major reasons of this high increment of the population. The total population of the twelve villages and/or cities surrounding TWNP is 177,285 (2003 census). In 1993, the total population of the twelve settlements was 128,994. That is an annual growth rate of 2.7%. Trends were not the same in all areas; indeed while the population of Banjul and New Jeshwang is decreasing; it doubles everywhere else between 1993 and 2003. The fringe from Jeshwang to Fajikunda is the most populated area. The high growth of the population changed the landscape pattern. The lowland ecosystem of *Borassus aethiopium* and natural waterways are the most impacted landscape features by the large human settlement around TWNP. The settlement is claiming land within the hydrological basin; waterways are blocked-up increasing sedimentation of the mangrove ecosystem.

The communities living around TWNP are diverse; one could notice two types of population: one not dependent on TWNP resources and the other directly or indirectly is relying on the wetland resources. For the later, rice cultivation, vegetable growing, oyster

and cockle collection by women, shrimp fishing and mangrove cutting by the men for fuelwood and construction purposes are the main activities in the buffer zone and within the wetlands. Tourism is developed around Lamin and Denton Bridge where the surrounding communities gain some employment but they receive few other benefits from it.

Climatic events such as the 1962 drought and the droughts of the 1980's and floods of the 1950's are the major natural events that also put stress on the TWNP and the periphery communities.

The Tanbi Wetlands National Park was designated as a RAMSAR site on World Wetlands Day in 2007. The Government of The Gambia decided that the 6,304 hectare mangrove system was important due to its high biodiversity and diverse and rare ecosystems with valuable marine resources. It is important to keep the ecosystem healthy, promote sustainable livelihoods and not use destructive means of harvesting the resources.

There are nine cockle and oyster harvesting communities in Tanbi Wetlands National Park. The collection, processing and marketing of cockles and oysters within the Tanbi Wetlands National Park constitute economic activities by predominantly women operating in individual family units within their respective communities. Prior to 2007, there has been no form of organization and no formal rules legitimized via Government except the annual closure during the rainy season, and there were no formalized committees for managing conflicts or determining rules.

A study by Cham and Touray (2008) highlighted the destruction of mangroves and the harvesting of juveniles as major concerns to be addressed in the oyster and cockle fishery. The study made several recommendations including: adoption of best practices, awareness creation and sensitization of harvesters, introduction of aquaculture, broadcasting of cockles from high density areas to low density areas, and alternative livelihood during the closed season.

The first phase of the ICAM (Integrated Coastal Area Management) project, which started in April 2005, introduced oyster culture (the hanging method) to the nine communities within the Tanbi Wetlands National Park. In 2005, the ICAM project took cockle and oyster harvesters on a study tour to Senegal where they came exposed to oyster culture and improved processing technologies for cockles and oysters. The project also made effort to allocate certain *Bolongs* to the communities that traditionally harvest these areas, and also closed certain areas. Not all the communities were happy or satisfied with the allocations and there are still on-going conflicts between communities that the Department of Parks and Wildlife Management has been trying to resolve.

2.2 TRY Association of Cockle and Oyster Harvesters

In July 2007, the TRY Association of cockle and oyster harvesters in Tanbi Wetlands National Park was established as a community-based non-profit organization. The Association brought together the cockle and oyster harvesters within the Tanbi Wetlands

National Park and periphery communities with the aim to raise their standard of living and become self-sufficient through collective actions and practice of improved and environmentally friendly harvesting techniques, market development and access to credit through microfinance activities. The membership of the Association has grown from 40 members in one community to 500 members in 15 communities. The Association elected its first Executive Committee in 2010, and a Board of Directors was established to advise and guide the Association. TRY Association is planning on eventually expanding its membership further to other areas of the country, and the on-going co-management planning process can be replicated to new areas as TRY membership also grows towards becoming a National Association.

The USAID funded Gambia-Senegal Sustainable Fisheries Project (*Ba Nafaa*) commenced in October 2009 with an objective to developing a co-management framework from management of the oyster and cockle fishery in the Tanbi Wetlands National Park. A key strategy was to build on the work that was being done by the TRY Association. In cooperation with the *Wula Nafaa* project (a sister project in Senegal), a study tour to Senegal (the Sine-Saloum region) was organized for 26 cockle and oyster harvesters and Fisheries Department field staff. The tour exposed the participants to improved production and processing methods for cockles and oysters which can be adapted in their respective communities. Improved oyster products by the TRY Cockle and Oyster Harvesters Association have been developed that allows for some sale of products through the closed harvest season. A value chain assessment was also conducted to identify ways to improve incomes in the post-harvest chain.

The Association was provided a grant by the *Ba Nafaa* project in 2010 to establish microcredit schemes for the women, develop a business plan, and develop a fundraising strategy to raise funds to establish a permanent Headquarter for the Association which can serve as a meeting and training center. The Association has rented a temporary Centre with the support of the *Ba Nafaa* project. Thirty-five young girls (daughters of the women harvesters) are being trained at the TRY Center in sewing, knitting, soap making and home economics, giving them the opportunity to learn how to earn a living to support themselves and their families rather than joining their mothers in the field adding additional pressure on the resources with possible negative impacts on the ecosystem.

The members are now practicing responsible harvesting methods targeting mostly mature oysters and cockles and have agreed to extend the period of closure by an additional three months to nine months to allow the oysters to grow bigger. From a marketing perspective, some progress has been made as some members of the Association now have the ability and know-how to pickle oysters for sale during closed seasons to extend income earning for a longer period throughout the year. The Kanifing Municipal Council has also allocated a special area or market point for oyster and cockles in the central Serekunda market. The Association is operating a successful microfinance scheme involving 250 members. The working conditions are improving: all members have been issued with life jackets, 500 working boots were ordered from Taiwan and issued to members, and members are wearing uniforms during marketing. The Association is also receiving support nationally from Government agencies such as Women's Bureau,

Department of Community Development, Department of Parks and Wildlife Management and Fisheries Department, and from private citizens, and internationally from the Banesto Foundation of Spain and the Friends of Gambia and Senegal in the United States of America. Recently the Association received a US\$ 20,000 grant from the GEF (Global Environment Facility) through the National Environment Agency for mangrove reforestation and aquaculture. The Association raised more than one hundred thousand Dalasis during a local fundraising event in March 2011.

The *Ba Nafaa* Project assistance to TRY Association is supporting the establishment of organizational systems and procedures. The Association will be audited by a local auditor and a consultant will work with the Association to develop a Standard Operating Procedures Manual. *Ba Nafaa's* support will also provide training for programs that benefit members and build their capacity, literacy and numeracy training and microfinance training. TRY Association will begin graduating its strongest microfinance clients out to an established Gambian microfinance institution. This will enable the Association to gradually phase out its microfinance activities over time.

The *Ba Nafaa* Project will also support physical and equipment investments that will enable TRY Association to increase its revenues and reduce its operating costs over the longer term. This includes fees for an architect to design the TRY Center permanent building. TRY Association has already received a response to its request to the Government for land allocation, asking for further information and documentation. It will also cover the purchase of chairs and the installation of a demonstration stove from Tanzania for smoking Oysters.

Under the umbrella of TRY Association, co-management planning processes have been initiated in the oyster and cockle harvesting communities within the Tanbi Wetlands National Park. Management committees have been established in each community and actively participated in the planning processes to develop this management plan. TRY Association is about to be signatory to a groundbreaking Cockle and Oyster Co-Management Plan, entitling its members to exclusive use rights to these natural resources of economic value.

3. Description of the Fishery

The shellfish fishery of The Gambia is characterized by oyster harvesting and cockle gathering with landing and processing sites dotted along the river estuary, along tributaries (“*Bolongs*”) of the river and lagoons and in wetland areas. The fishery is an important source of livelihood for many people resident in these areas, the majority of whom are women. The development of the fishery became a stated priority for Government since the 1980’s, but little has been done to manage the fishery or to provide technical support to develop it until recently. Information on the fishery is limited. The total number of people involved in the oyster and cockle fishery countrywide is not known. Data on oyster and other shellfish production is unavailable because it has not been part of the countrywide frame survey design and data collection effort of the Fisheries Department.

3.1 Status of the Shellfish Resources and Issues in the Fishery

Participatory Rapid Appraisals (PRAs) conducted in the cockle and oyster harvesting communities have revealed significant concerns about over harvesting as women have to travel longer and farther, take more time to gather cockles and oysters, and they are collecting juveniles (see Figure 2). Conflicts between communities are also emerging as communities start to implement informal and unilateral rules for harvesting (e.g. closed season, exclusive community use zones).

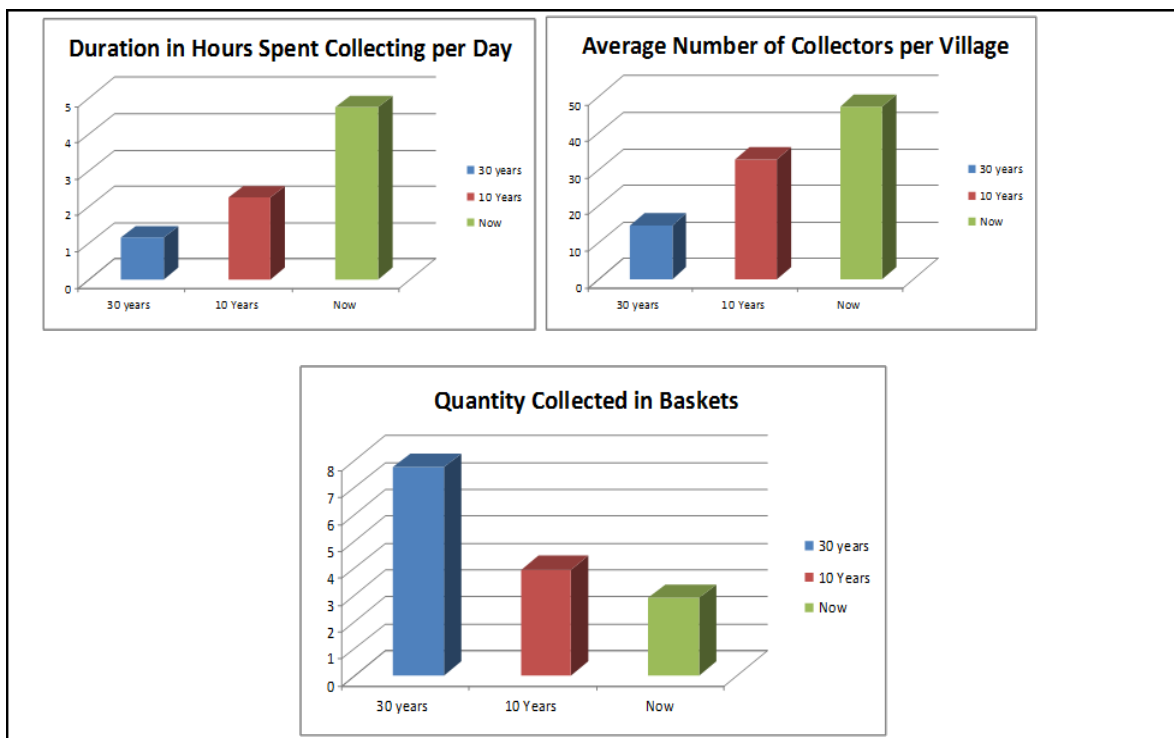


Figure 2. Perceptions of changes in catch & effort as revealed from PRAs

The women from the communities surrounding the Tanbi Wetlands National Park (see Figure 3) harvest the West African mangrove oyster (*Crassostrea gasar/tulipa*) and the blood ark cockle (*Senilia senilis*) as the two primary species of economic importance (Figure 4).



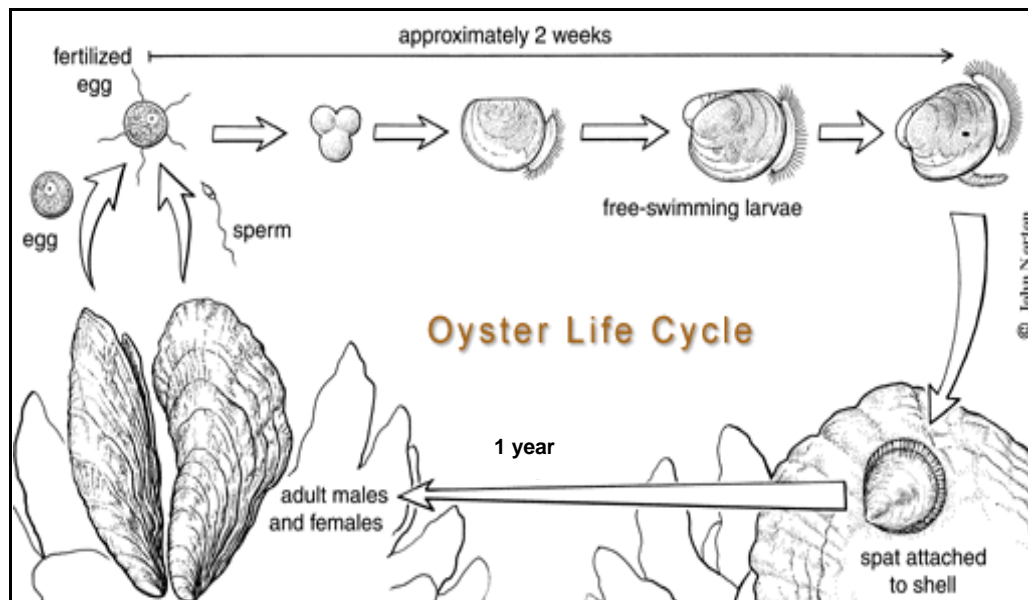
Figure 3. Oyster and cockle harvesting communities of the Tanbi National Park



Figure 4. The mangrove oyster *Crassostrea gasar* (left) and the blood cockle (right)

3.2 The biology of the West African mangrove oyster (*Crassostrea gasar/tulipa*)

The biology of the oyster is amazing (see Figure 5). 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. However, local knowledge gathered from oyster women indicated a black spot on the inside of the lower valve of the female oyster which is not found on the male (Kanyi 2010). Bisexual gonads in the very closely related mangrove oyster *Crassostrea rhizophorae* are formed when the animal reaches the size of 7mm, 45 days after settlement (Nascimento et al. 1980). The *Crassostrea tulipa* mangrove oyster is similar in its development and is so prolific a species that it attains maturity within approximately 120 days after settling when it has a height of less than 20mm. The oysters are usually male when they are less than 20mm and change sex after 30mm to female (Yankson, 1996). These oysters have a reproductive cycle similar to many other marine creatures and invertebrates. Spawning occurs when females release eggs and the males release sperm into the water column where fertilization takes place. The fertilized eggs become larvae which are in a planktonic stage, which means they float longitudinally in the water before settling on hard surfaces such as mangrove prop roots or rocks and sticks or on sea grass. Once they settle on hard substrate, they are called spat – very small sized, baby oysters.



SOURCE: Adapted from Maryland SeaGrant
<<http://www.mdsg.umd.edu>>

Figure 5. Life cycle of the oyster

Monthly data from spat collectors in the Tanbi Estuary system in The Gambia since June 2010 indicate the timing of the settlement of oyster spat (see Figure 6 below). While settlement occurs every month; there is a distinct maximum of spatfall in October and November following the rainy season as salinity in the estuary rises with the onset of the dry season in the country. Interestingly, the post-rainy season maximum for oyster

recruitment is found elsewhere in many other populations of tropical mangrove oysters. This means that the mangrove oysters grow better in high salinity but reproduce better in low salinity. Also, the data seem to suggest that it is possible to develop oyster beds in good growing areas (Lamin and Kubuneh) and transplant the spats to low density areas for grow-out.

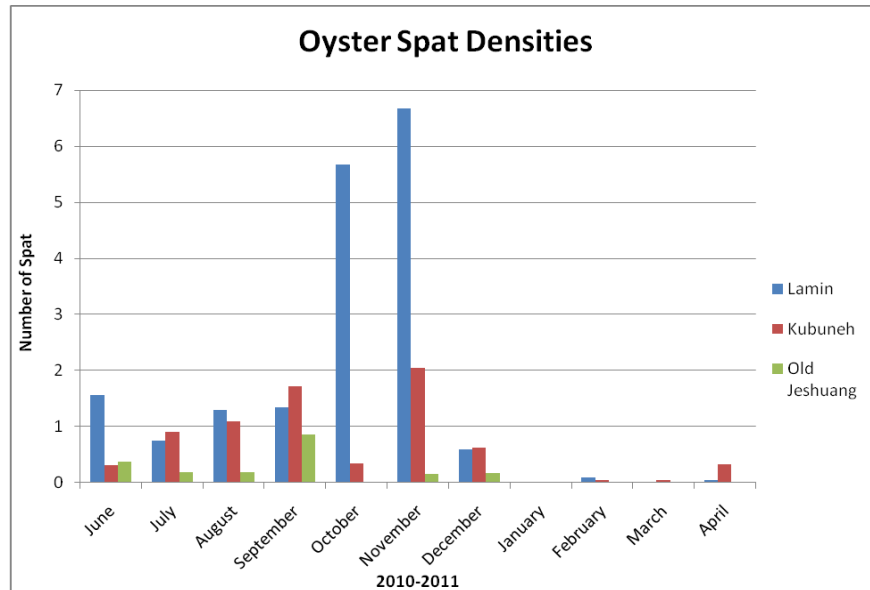


Figure 6. Density of oyster spat by month in the Tanbi Wetland National Park

3.3 The biology of the Blood Ark Cockle (*Senilia senilis*)

Senilia senilis is also referenced as *Anadara senilis*. The species occur naturally in water with salinity over 10 ppt and in which there is little difference between diurnal and seasonal fluctuations. *S. senilis* are found in both coarse sand and black mud environments but absent in channels with strong currents. They reproduce when the gonads are ripe at nearly one year old. According to (Yankson, 1981; Rice, 2011), the size of maturity is at approximately 20mm shell length.

The sex of the species is protandric. The eggs are released by the female and the male releases the sperm which fuse together and lead to fertilization. The larvae float in water for a few days and sink to settle on the bottom where it embeds in the substrate for growth. From observations of cockle sea beds in the Kartong estuary in The Gambia, it was clear that the *Senilia senilis* can set in very high abundance in localized seed beds to the point that although the cockles are known to grow up to 6cm in shell length, the seed cockles are prone to die before they reach 0.5cm. The phenomenon of seed dying out due to competition for food resources is known to occur in Thailand in the population of the related species *Anadara granosa* (Tookwinas, 1983). The collection of seed from local seed beds of high density and seeding the cockles on to specially prepared aquaculture

ploys in sand flats in the low intertidal and shallow subtidal zone is possible (Broom, 1982; 1985).

3.4 Harvesting Methods

Harvesting of cockles and oysters is predominantly done by women in the Tanbi Wetlands National Park and the periphery oyster communities belonging to the Jola, Balanto and Manjago ethnic groups, although other ethnic groups are also involved (Cham and Touray 2008). The majority of the harvesters are Gambians but some are migrants from Southern Senegal (Cassamance). The harvesting and collection of oysters and cockles respectively is organized during the six hours of diurnal low tide; therefore the time of departure to the collection/harvesting sites is variable and coincides with the last half of the mid-tidal period. The women walk to and from work every day, walking distance from home to landing site vary from community to community depending on distance from home to the landing site.

3.4.1 Oyster Harvesting

Different methods of harvesting are employed by the women. Presently, there are two distinct tools used for oyster harvesting. These are the cutlass and a small axe. The axe is used to extract the oyster from the prop roots of the mangrove. The axe is more selective than the cutlass. The axe selects the oyster one by one, removing the mature oysters and leaving the small ones to grow. The cutlass on the other hand peels the oyster from the roots of the mangrove scraping the bark of the roots and usually leaving a scar on the roots.

The women use un-motorized canoes and paddle from their bases to the harvesting sites. The canoes are simple dug-outs that are mostly 3-4 metres in length and can carry only one or two people. The harvesting tools, water and food are placed onboard the canoe on departure to the harvesting sites. They set out to the harvesting sites at low tide when the oysters are exposed for harvesting and return to the landing sites when the tide is high. During high tide, the oysters are submerged and cannot be harvested.

The vast majority of the women do not have their own canoes and there are a few canoes in each community, not enough for all to use at one time. As was the case before the introduction of the canoe, some of the women are still walking on foot to the oyster harvesting sites at low tide. The women walk considerable distances on foot in the mangroves to harvest oysters. They remove the oysters from the mangrove prop roots while standing in water at low tide. They carry either a bag or basket for loading the oysters after harvesting and return to their landing sites before high tide sets in, with their head loads of oyster in bags or baskets.

3.4.2 Cockle Harvesting

The cockles are also harvested by the same women either using canoes to the harvesting sites or walking on foot at low tide. Unlike oyster harvesting by canoe, the women anchor the boat and disembark. When they reach the sand bank where cockles are embedded, they stoop to start collecting cockles by scraping the sand with their fingers to get to the

cockles. Sometimes the women put their forefingers in holes where cockles inhabit and pluck out single cockles one at a time. These holes are only noticeable when the tide ebbs completely from the banks. Sometimes spoons are used to pluck out cockles but superstitious beliefs of cockles disappearing from high yield places due to use of spoons, stop the women from using spoons. Similar to the oyster harvesters, as soon as high tide starts to set in, the cockle gatherers return to the landing sites.

3.5 Processing

Processing of oysters and cockles is performed by the same women who harvest them from the wild.

3.5.1 Oyster Processing

Until recently the processing of oysters involved cooking in water or roasting and smoking. However, steaming or boiling is more common nowadays because it is more effective and consumes fewer resources (firewood, water and time). The process begins with removal of foreign matter from the harvested oyster. The live oysters are then steamed in pans/drums for 30 minutes to one hour during which the shells open up or the muscles soften up to ease opening of the shells and extraction of the meat.

If oysters are to be smoked, (which is now a rare practice), they are placed directly onto the burning fire or on metal grill over the fire. In either case, the oysters are then split open with knives to extract the meat which is collected in woven baskets and marketed often after they are washed clean or even reheated in some sites. In some other places in the country, the meat is preserved by salting and sun drying to very low moisture content before they are marketed.

Meanwhile the oyster shells are gathered in heaps and sold out for cash to users in the production of white lime, for brick making, the preparation of chicken feed and fertilizer.

3.5.2 Cockle Processing

Cockles are normally processed by boiling/steaming in pots, pans or drums for about 30 minutes to one hour during which the shells open up and the cockle meat loosens up or fall out of the shell. After steaming, the cockle meat is usually sieved with perforated trays or they are shaken and separated by gravity when the meat falls to the bottom and shells gently scooped out from the top.

Following separation, individual cockle meat pieces are picked out from the separated shells and returned to the sieved out meat, and small shell particles that remain are also removed/ picked by hand. The meat is then placed in baskets and washed many times in sea water. Water is allowed to drip and the product re-cooked before marketing. In some instances the product is salted and sun dried to very low moisture content before storage and subsequent marketing, similar to oysters.

3.6 Marketing

The selling of cockles and oyster is also done by the same women who harvest and process them. However, it is not uncommon to find younger women (daughters or family members of harvesters) selling processed cockles and oysters along the highway to and from the city of Banjul.

Processed oysters and cockles are marketed in diverse places including the processing site during processing. The main marketing points are in urban market places and along roadsides while some producers carry the products on their head and sell from one home to another in the neighborhoods. Dried oysters and cockles are sold at the weekly market days in rural communities locally referred to as “*loumos*”; which move from village to village on a daily basis.

Selling is by a measure of an empty milk tin that contains about 150 grams of oyster or cockle meat. The price of this measure is generally the same in all places. The current price of oysters (in 2011) is GMD15 (approximately 50 US cents). However the large, handpicked grade of processed oysters is currently sold at GMD20.00 for the measure, while the smallest grade is sold at GMD10.00.

Cockles are also marketed in market places either fresh or dried, or carried around on head and sold from home to home and from one village or town to another. The price of fresh cockles is GMD5.00 and dried cockles are also sold at GMD10.00.

Buyers and consumers include individual consumers who buy the product for home consumption, street food vendors, restaurant operators and exporters. Information obtained during the conduct of the value chain assessment show high profitability in oyster food vending but vendors complained about the high cost of oysters.

Currently, limited quantities of oysters enter the international trade. The oyster is exported by individuals who normally carry with them few kilograms as gifts to relatives or are informally sold to close-circuit customers in niche markets. The main export destinations of these small quantities are mainly the USA and UK, where buyers or recipients are mainly Gambians and others from the diaspora, who have occasional preference for traditional foods. The product may also be taken for special ceremonial occasions of Gambians living abroad. Hence exports are classified as traditional ethnic foods of value (Njie and Drammeh, 2011).

Stringent sanitary requirements are constraints to be overcome if raw or fresh product is to be exported in the future. Sanitary requirements and control systems must be adequately met if oysters are to be legally exported, particularly to the European and American markets, including those relating to risk assessment and implementation of sanitation plans, to control food safety risks. There are no medical records specifically linking any food-borne illness to consumption of oysters in The Gambia.

3.7 Annual Calendar of Activities of Cockle and Oyster Harvesters

The oyster collection used to be carried-out from December to June until recently (2011) when, by consensus, the oyster harvesters agreed to reduce the harvesting season from March through June. When the women are not engaged in oyster harvesting or cockle gathering, they engage in other activities to earn a living such as petty trading, firewood collection, working as house maids, rice farming, small-scale fish trading (selling fresh and smoked fish), as shown in the calendar below (Table 1).

Table 1. Annual calendar of activities of the oyster and cockle harvesters.

ACTION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Oyster harvesting			X	X	X	X						X
Cockle harvesting							X	X	X	X	X	
Petty trading							X	X	X	X	X	
Firewood collection	X	X	X	X	X	X	X	X	X	X	X	X
House maid							X	X	X	X	X	
Rice farming							X	X	X	X	X	
Fish trading							X	X	X	X	X	

3.8 Water Quality

Water quality studies were undertaken by the *Ba Nafaa* Project in order to determine whether there are public health risks from contamination of the harvesting areas (e.g. contamination from *E. coli* bacteria in the water where oysters and cockles are grown). Initial data was collected (see Figure 7 below) for one year to assess any seasonal variations in potential health risks. Water samples were collected from the 15 oyster harvesting communities within Tanbi Wetlands National Park and Western Region on a fortnightly basis and analyzed at the Water Quality Monitoring and Control Laboratory of the Department of Water Resources in Abuko. Total and fecal coliforms were determined by use of the membrane filtration method, using standard TC and FC media. Coliform counts were done using 25 mL of filtrate and reported as colony counts per 100mL of sample as is routinely reported in shellfish sanitary water quality literature (e.g. Graybow et al. 1981).

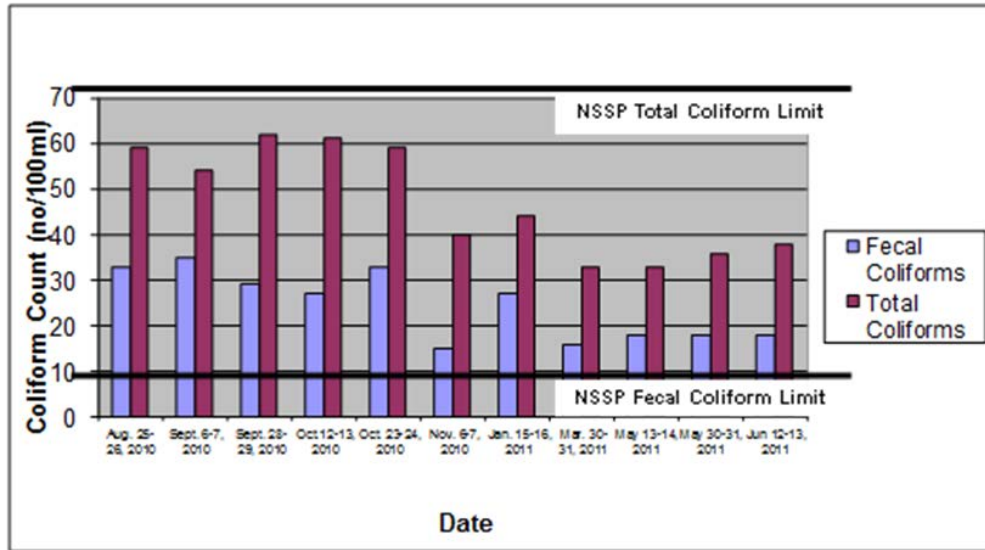


Figure 7. Average Coliform Levels in the 15 Sampling Sites, Tanbi Wetland

The results of the study, so far, show that both total coliform and fecal coliform counts were relatively low in all sample sites. However, a seasonal elevation of coliforms during the rainy season is suggested by the data and slightly elevated coliform counts were found at two locations in the estuary system at Old Jeshwang at a location at which pigs are being raised in pens within the tidal zone, and at Lamin Lodge, the site of a hotel, boat marina, and fishing boat landing. The results are among the lowest counts in many tropical oyster growing grounds and suggest that a shellfish sanitation program could allow for safe harvest of live oysters for a raw oyster market to tourist hotels or eventual export may be feasible. The data from the Tanbi sites appears to be reasonably clean in comparison to US NSSP (U.S. National Shellfish Sanitation Program) Coliform water sanitation standards (70 MPN/100mL Total Coliform and 14 MPN/100mL Fecal Coliform). However, it is important to closely monitor the Old Jeshwang and Lamin Lodge sites to see if coliform and fecal coliform counts are on the increase and to consider closure of these sites if increases beyond acceptable levels are confirmed.

First-level regulations of shellfish growing water might include the simple closure of areas with obvious potential for fecal contamination. These regulatory closures might include prohibition of shellfish harvesting in areas in which animal husbandry is being carried out close to the shore such as within about 200 meters of the Old Jeshwang site or at boat harbors or marinas such as those at Denton Bridge or Lamin Lodge. Shell fishing closures solely based upon risk assessment from shoreline surveys is consistent with the 2007 protocols of the NSSP. This is a simple first step that Gambian officials can undertake to assure public health.

Since the initial results indicate potentially favorable conditions for marketing raw shellfish, Government staff from the quality control laboratories of the Department of Water Resources, Department of Fisheries and the National Environment Agency underwent training in water quality assessment and enforcement at the central water

quality control laboratory in Providence, Rhode Island in June 2011. Water quality data needs to be collected and analyzed for at least three consecutive years, until July 2013, in order to have greater certainty concerning seasonal variations and long term trends.

Towards a Shellfish Sanitation Plan

A draft National Shellfish Sanitation Plan for The Gambia was jointly presented at an interagency meeting at the Ministry of Fisheries, Water Resources and National Assembly Matters in 2011 by individuals who underwent training in the US. The meeting included three representatives of the Agriculture Committee of the House of Representatives of The Gambia. The aim was to start laying the foundation for a shellfish sanitation program including traceability standards that would be appropriate in The Gambia. Such a program would need to involve multiple agencies, so the institutionalization of interagency cooperation and commitment of human resources and funding would be essential to make such a program work. Although initial water quality results are encouraging, the marketing of raw oysters to be eaten raw by the consumer is not a realistic goal for 2011/2012. Initial priorities are to establish a Gambian shellfish sanitation program that could provide local markets with a safe raw or fresh product, especially for hotels and restaurants catering to European tourists. Obtaining export certification for an export product is a longer-term priority. In the near term, the *Ba Nafaa* Project will support improvements in water and sanitation at one or two oyster landing sites in 2012/13.

Shoreline Sanitation Survey

In addition to in situ water quality testing, shoreline sanitation survey techniques enable decision makers to identify areas of critical threat to shellfish sanitation. In June 2011 a Shoreline Sanitation survey of the Bund Road in Banjul was conducted as a pilot activity and training but a full shoreline sanitation survey of the Tanbi Wetlands National Park is needed as another element to establishing a shellfish sanitation program. In conjunction with water quality data, the results of this survey will provide the Cockle and Oyster Management Committee with critical information for ensuring the quality and safety of harvested shellfish.

4. Management Objectives

Several stakeholder meetings and workshops have been organized with the financial and technical support of the *Ba Nafaa* project, involving representatives from each of the communities harvesting cockles and oysters in Tanbi Wetlands National Park as well as other communities in the Western Region that are affiliated to TRY Association as members. These meetings and workshops have also included local leaders (Alkalos), legislative representatives, municipalities, and key Government agencies including Department of Fisheries, Department of Parks and Wildlife Management, Department of Forestry, and National Environment Agency. The meetings and workshops have built an understanding of the management issues and need for a new management approach. The meetings have also helped to outline an institutional framework for management that includes community-based committees for each harvesting village as well as a Tanbi ecosystem-wide management committee. Training workshops to discuss co-management concepts were also implemented to prepare the women with basic knowledge to start the co-management planning process. Importantly, all the stakeholders are supportive of the contents of this co-management plan including the main objectives for management and measures to achieve these objectives. Key objectives developed by the stakeholders are provided below. The management objectives are based on biological, ecological, social and economic issues:

Biological Objective:

- Sustainable harvesting of the cockle and oyster resources that prevents small sized juveniles from being harvested and allows larger more valuable oysters and cockles to be harvested.

Ecological Objective:

- Maintain the health and functioning of the mangrove ecology, thereby protecting important habitats of oysters and other shellfish, finfish, and marine mammals including the West African manatee, as well as mitigating Climate Change through carbon sequestration.

Social Objective:

- Strengthen Community Participation in planning, implementation and decision making in the rational and sustainable use and management of the oyster and cockle resources.

Economic Objective:

- Access to improved markets, financing, poverty reduction and food security among oyster harvesters.

5. Management Measures to Achieve Objectives

The Management measures have been adopted following an elaborate process involving PRAs at each community, a PRA validation workshop attended by participants representing all the cockle and oyster harvesting communities in Tanbi Wetlands National Park and surrounding communities in the estuary such as Kubuneh, Bafuloto, Kembujeh, Mandinaba, Kuloro and Kartong. The participants deliberated on management measures that will govern the fishery to ensure sustainability of the resources and conserve the ecosystem as well. This was followed by a consolidation workshop to which village heads (Alkalos), Municipalities, elected Councilors and concerned Government agencies/institutions participated. The following management and conservation measures are accepted by all communities:

5.1 Harvesting of Oysters and Cockles

- No harvesting of small sized cockles (approximately 25mm in length) and oysters (approximately 6cm in length)
- A closed season for harvesting Oysters for 8 months (July to February) and open season for 4 months (March to June) for all areas including exclusive community use zones
- There is no closed season for cockles.
- Axe must be used to remove oyster from prop roots of mangrove to avoid harvesting small-size oysters and at same time preserve the mangrove
- Professional I.D. cards for all collectors/harvesters
- No oyster harvester shall operate for more than two days at harvesting sites, but should adopt a shift system.

5.2 Community Exclusive Use Zones and Open Access Areas

The management measures include designation of certain Bolongs in Tanbi Wetlands National Park as exclusive zones for individual oyster communities (see figures 8 & 9). The following Bolongs are designated as exclusive community use zones:

1. Kugijach Bolong for Wencho
2. Oubakau Bolong for Karmalloh
3. Kirinkiring Bolong in Jeshwang
4. Sismai Bolong in Ibotown
5. Kalan Bolong in Fajikunda
6. Ogenbenu Bolong in Abuko
7. Simat Bolong in Lamin
8. Kajuwes Bolong in Kembujeh for Kembujeh, Kubuneh, Galoya and Bafuloto Cluster.
9. Allahein Bolong in Kartong
10. Yomba Bolong for Mandinary, Kerewan and Daranka Cluster

Within the exclusive use zones, communities can restrict access by individuals from outside the community and establish additional rules for management of the oyster and

cockle resources in these areas as they deem necessary (e.g. closures longer than 8 months for all or part of these *bolongs*, daily harvest quotas, etc.)

Areas outside the community exclusive zones are open to harvesting by all members of TRY Association. The Association may restrict access to non-members or allow access under certain conditions such as after paying a user fee. TRY Association, through its Tanbi Cockle and Oyster management committee, can establish rules and penalties within these open areas that apply to all harvesters and as detailed in the section on Institutional Arrangements.

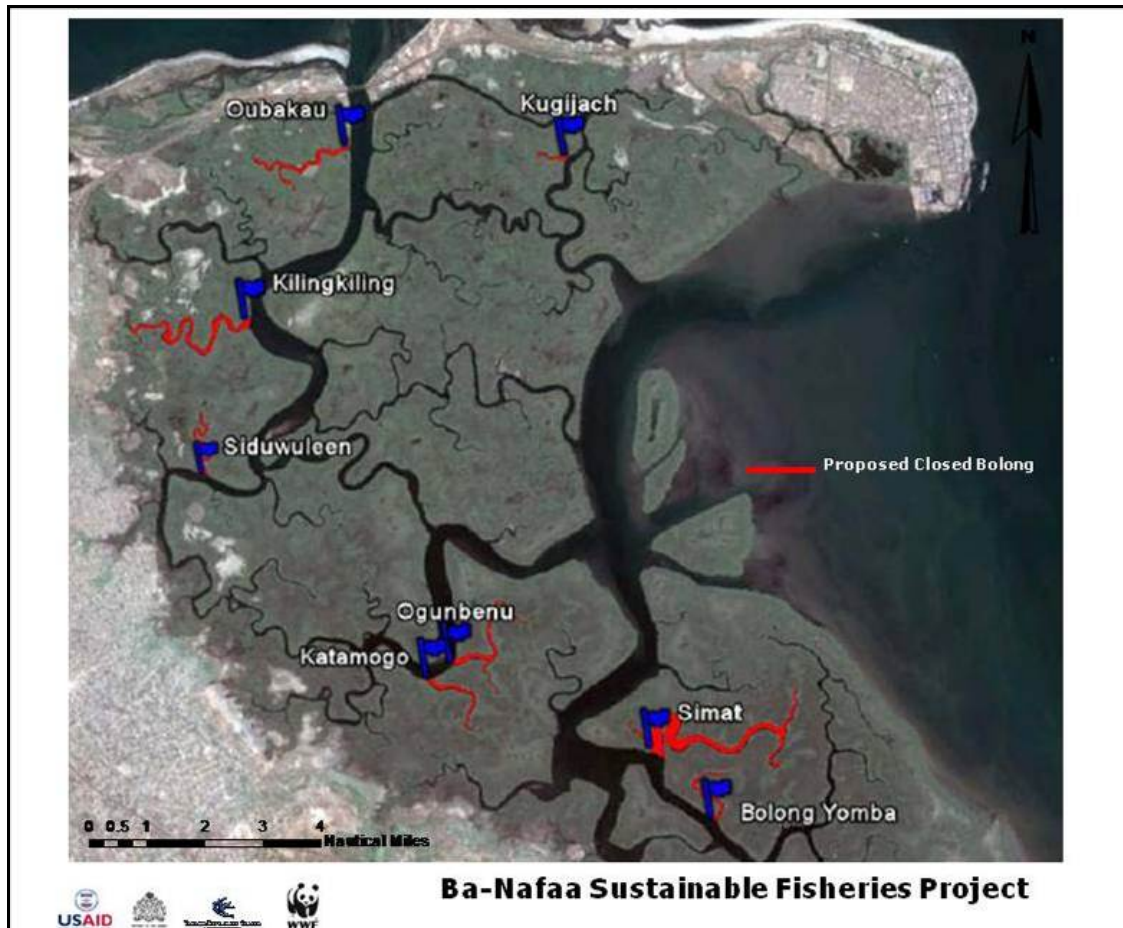


Figure 8. Community exclusive use zones and closed *bolongs* in the Tanbi Wetlands



Figure 9. Community exclusive use zone and closed *bolong* in the Kartong Estuary

5.3 Marketing of cockles and oysters

The communities agree to the following rules on marketing of cockles and oysters:

- School children should not be engaged in the marketing of cockles and oysters and banned from selling at markets and roadsides as well as hawking in town.
- The handling, processing and marketing of cockles and oysters shall be performed under hygienic and sanitary conditions.

5.4 Penalties and Fines

The communities agree on the following penalties/fines for violation of rules established in this plan:

- A fine amounting to GMD 1,000 (One Thousand Dalasis) for harvesting small sized cockles/oysters.
- A fine of GMD 2,000 (Two Thousand Dalasis) if found harvesting in other community's Bolongs
- Oyster harvesters found harvesting on a daily basis shall pay a fine of GMD200.
- A fine of GMD 2,000 (Two Thousand Dalasis) for harvesting oysters during the closed season.
- A fine of GMD 2,000 (Two Thousand Dalasis) for persons found cutting down mangroves.
- Failure to pay fines shall result to seizure and sale of canoe.

It is the responsibility of TRY Association to enforce rules and collect fines from Association members and non-members violating the rules. A receipt must be provided to anyone who pays a fine and TRY Association should keep an accounting record of amount of fines collected and expenses from fine revenues. TRY Association can decide on how fine revenues will be used with the main intent to contribute to the objectives of this co-management plan. Non-members that do not agree to pay a fine or have their canoe seized will be reported to the community's Alkalo and the Department of Fisheries, and their assistance sought in helping to sanction violators as per this plan.

5.5 Alternative livelihood development

Alternative livelihood activities will be promoted by TRY Association for young generations to ease harvesting pressure on the mangroves and shellfish resources.

5.6 Mangrove conservation

For the conservation of the mangroves, the communities agree to undertake joint monitoring, control and surveillance activities within the Tanbi Wetland National Park with the Department of Parks and Wildlife Management and engage in mangrove reforestation activities in communities where mangroves are being depleted.

5.7 Development of Oyster Aquaculture

The Government of The Gambia has long since realized the importance of aquaculture and its potential to increase national fish production while at the same time reducing the country's total dependence on capture fisheries for fish food supply. The development of subsistence, small-scale and commercial aquaculture is a stated Government policy although emphasis and focus has remained the development of capture fisheries.

In the late 1980's, the Department of Fisheries conducted research studies on the culture of the mangrove oyster of West Africa (*Crassostrea tulipa*) under a project funded by the Canadian International Development and Research Cooperation (IDRC). Results of the studies identified great commercial potential for the products but the market was not adequately developed. The rack system of culture employed by the research project proved a more efficient method for the exploitation of oysters and a more sustainable alternative than other existing harvest methods which used mangrove poles and was destructive to the mangrove ecology. Recommendations from this research were to encourage less destructive aquaculture methods, increase oyster production via aquaculture as well as improve access to credit facilities for the producers.

Mr. Daniel Theisen of the University of Maryland provided professional volunteer services via the *Ba Nafaa* project to conduct training and renewed trials on oyster culture in 2009. The nine communities within Tanbi Wetlands National Park were clustered into 6 groups for training on the construction of lattice racks using bamboo poles ranging from 5-9 cm in diameter, arranged in the form of an inverted "V" and tied together with galvanized wire and rope, stringing and hanging of oyster shells onto the bamboo poles. Following the end of the training, a demonstration aquaculture rack was constructed in each community. These racks also served the purpose of action research on spatfall to

determine the best time to hang spat collectors for the purpose of oyster farming. These activities also indicated that oyster culture can be developed for several reasons: to protect the wild mature oysters as a source of spat, to protect the mangroves from damage during harvest, and the culture of oysters has the potential to improve the food security and the social welfare of the oyster harvesters.

Communities agreed to work with the Department of Fisheries on the continued development of environmentally friendly oyster aquaculture in the Tanbi Wetlands National Park. TRY Association via this co-management plan will have exclusive rights to oyster farming in the Tanbi Wetlands National Park and can establish rules if necessary concerning designation of individual or group farming plots. Community committees will establish rules concerning aquaculture plots within the community exclusive use zones.

Cockles are also harvested in the Tanbi Wetlands National Park and as well as in other estuarine areas in The Gambia, such as the small estuary in Kartong. As previously mentioned, cockle ranching to enhance yields is common in Malaysia whereby beds of dense cockle spat are harvested, transplanted and broadcast to grow-out areas. These grow out areas can be allocated or leased to individual or community groups as grow out plots. The *Ba Nafaa* Project is conducting action research with TRY members in Kartong to determine if this ranching method is viable in The Gambia. If successful, then a cockle ranching plan will be developed for Kartong and could also be applied in the Tanbi area as well.

5.8 Research and Monitoring

The Department of Fisheries and The TRY Association will encourage research into improved practices of management and aquaculture of oysters and cockles. These include oyster aquaculture research, market surveys, water quality studies and oyster spawning studies, and the research on transplant of oysters and cockles from high spat density areas to low density areas (such as the trial being conducted in Kartong), among others. Cooperation with donor projects, universities and NGOs to assist in conducting relevant research and monitoring is encouraged. Research related to Climate Change will also be encouraged. Relevant areas of research include both:

- Measures for adaptation to the potential impacts of Climate Change on the Oyster and Cockle fisheries.
- The potential for oyster and cockle management practices in The Gambia to contribute to Climate Change mitigation.

Potential themes related to Adaptation Measures:

Ocean Acidity: Excessive mortalities of larval oysters in hatchery tanks due to acid conditions brought on by excessive carbon dioxide dissolved in the seawater supply have recently been documented in the United States (Grossman, 2011). This is parallel to some recent laboratory studies that have shown that tiny juvenile shellfish such as oysters and clams may experience shell erosion or even mortality if exposed to acidic sediments

(Talmage, 2009; Watson, 2009). Availability of carbonate for shell formation is strongly influenced by pH, with lesser carbonate available as carbon dioxide dissolves in seawater and pH levels decrease. Climate models predicting carbonate availability in ocean waters in the year 2070 if current trends in world carbon dioxide production continue at the present rate suggest that carbonate availability for shell formation would be reduced to marginal levels in tropical and subtropical waters, including Gambia and Senegal (Watson, 2009; Mucci, 1983). In this context, the oyster and cockle fisheries of Senegal and Gambia may be enhanced by management of shellfish beds and aquaculture development that takes increasing ocean acidity into account. Various aquaculture strategies such as returning shucked shells to the water can act to buffer sediments and bottom water against the effects of carbon dioxide acidification, thereby enhancing bivalve larval sets and juvenile survival (Green, 2004; MacKenzie, 1983). Even before the relationship between sediment pH and the effect on shells of developing shellfish was known, the use of oyster shells as an effective setting cultch for tropical mangrove oysters, aiding in spat survival was demonstrated (Devakie, 1993). In some cases, public policy aimed at maximizing oyster production has included laws requiring return of shucked oyster to harvest grounds to promote sustainability of oyster fisheries (Rice, 2008). A number of studies suggest that aquaculture of seaweeds and filter-feeding bivalve mollusks in the world's oceans may be a means for combating ocean acidification by serving to take up and sequester nutrients and carbon, and allow for their removal upon harvest (Smith, 2011; Rice, 1999).

Sea level rise: Current information on predicted sea level rise due to climate change indicates at least 2 key issues:

1. That inundation of coastal fishing communities, including vulnerability of infrastructure at shellfish landing sites needs to be understood and considered in decision making. The Bund Road levee system in Banjul on the border of the Tanbi Wetland is also particularly vulnerable.
2. That mangrove ecosystems may migrate inland as sea level rise occurs. For systems such as the Tanbi Wetlands, where inland zones are fully developed and mangroves cannot migrate, sea level rise may mean a reduced wetlands area. In this case, intensified aquaculture efforts may be an important adaptive measure to make up for lost natural oyster habitat. For other mangrove systems, management planning might include specification of buffer zones restricted to development along the inland edges of the wetland.

Potential themes related to mitigation measures:

Recent research indicates that the tons of carbon dioxide equivalent per hectare contained in Oceanic and Estuarine Mangrove ecosystems are two to three times that of tropical forests and that the majority of this is held in soil organic carbon rather than in the living biomass. Documenting the extent to which sustainable, ecosystem-based co-management of oyster and cockle fisheries contributes to the maintenance and even the expansion of these ecosystems will be increasingly important. Climate Change Mitigation services

provided by these ecosystems and those who manage them have international economic value and markets to compensate for this value are expanding (Murray et al., 2011).

6. Institutional Arrangements & Legal Framework for Management

The area of coverage for this co-management plan includes all of the marine and intertidal waters within The Tanbi Wetlands National Park. The Park was designated as a Ramsar site on World Wetlands Day in 2007. The Government of The Gambia decided that the 6,304 hectare mangrove system was important because of high biodiversity, and diverse and rare ecosystems with valuable marine resources, and the desire to keep this important ecosystem healthy, promote sustainable livelihoods and not use destructive means of harvesting. Under Section 14 of the Fisheries Act 2007, the Tanbi Wetlands National Park, which is a marine protected area, can also be designated as a special management area for the purpose of community-based co-management in the interest of conservation, management and sustainable utilization of fisheries resources. The Wildlife Act, the Forest Act and the National Environment Management Act are all relevant to the management of the Tanbi Wetlands National Park, and are therefore to be harmonized with the Fisheries Act. The Tanbi Wetlands National Park is under the responsibility of the Department of Parks and Wildlife Management; the Department of Forestry has responsibility over the mangroves; the Department of Fisheries has responsibility over the fisheries resources including oysters and cockles; and the National Environment Agency is the umbrella agency for all environmental management matters which includes the management of national parks and all other areas of the country. The activities of the stakeholders within the coastal zone (which includes the Tanbi Wetland National Park) will be coordinated through the Coastal and Marine Working Group. The Working Group includes, among other stakeholders, the Department of Parks and Wildlife Management, Department of Fisheries, Department of Forestry and the National Environment Agency as Chair.

6.1 Designation of the Tanbi Wetlands National Park as a Special Management Area

As per Section 14 of the 2007 Fishery Act and Regulations of 2008, the area congruent with the boundaries of the Tanbi Wetlands National Park is hereby declared a special management area solely for the purpose of community-based management of the cockle and oyster fisheries. TRY Association is hereby authorized as having exclusive use rights to the oyster and cockle resources within the Park. Associated with the allocation of these use rights comes the responsibility for TRY Association to manage these resources in a responsible manner that prevents their overexploitation and use good harvest practices that help conserve associated habitats, flora and fauna.

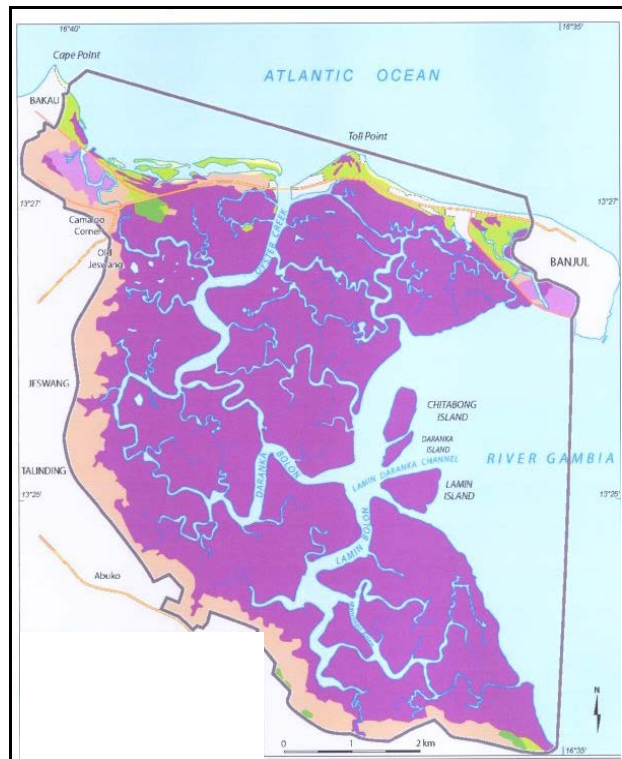


Figure 10. Boundaries of the Tanbi Wetland National Park which also serve as the boundaries for the special management area solely for the purpose of community-based management of the cockle and oyster fisheries.

6.2 Tanbi Cockle and Oyster Fishery Management Committee

TRY Association is hereby authorized to establish a Management Committee for the purposes of managing the cockle and oyster resources in the Tanbi Wetlands National Park. The TRY Association shall decide on the make-up, duration of membership, and how committee members shall be appointed. This committee shall have the authority to set and change management measures applicable throughout the Tanbi special management area, to designate exclusive community use zones, and is authorized to enforce rules, assess fines and seize gear and equipment of violators. Specific authorities include the following:

- Set length of seasonal closures of oysters and cockles and timing of openings for each
- Establish minimum size limits
- Designate community exclusive use zones
- Restrict the number of harvesters collecting in "open" areas - outside of community exclusive use zones
- Charge user fees or license harvesters in "open" areas - outside community exclusive use zones
- Restrict harvesting only to Tanbi Wetlands National Park community residents or open to non-community members under certain conditions (e.g. charge an access fee)

- Establish permanent closures or closed areas for periods longer than the annual Tanbi-wide closure in "open" areas - outside community exclusive use zones
- Require traceability of product from harvest areas to end consumers for any product sales intended for raw consumption
- Establish closed areas anywhere in Tanbi special management area for reasons of seafood safety due to water quality contamination or risks
- Establish penalties including fines not to exceed Dalais5000 for violations of rules, and for repeat offenders, can confiscate harvest gear or ban individuals from further harvesting for a period up to one year
- Rules need to be approved by the majority of the TRY management committee in a meeting where a quorum (majority) of committee members are present and noted in written minutes. Rules must be communicated to all TRY members via TRY community committees verbally or in writing within 14 days and transmitted for information purposes only (not approval) to the Department of Fisheries, Department of Parks and Wildlife Management and Department of Forestry for assistance in enforcement and as a basis of annual audits and to ensure consistency with existing national laws and regulations.
- Communities shall be trained on cockle and oyster safety and quality assurance.

6.3 Community Based Management Committees

Under the Tanbi Cockle and Oyster Management Committee, community-based committees will be established for the purposes of managing the cockle and oyster resources in the Tanbi special management area. The Tanbi Cockle and Oyster Management Committee shall decide on the make-up, duration of membership, and how community-based committee members shall be appointed. These community-based committees shall have the authority to set and change management measures applicable only within designated exclusive community use zones established in this co-management plan or in other areas designated by the Tanbi Cockle and Oyster Management Committee. Community-based management committees can establish the following type of measures within their zones:

- Set daily quotas on harvests of individuals from community zones during open seasons
- Establish daily closures on harvests from community zones during open seasons (e.g. no harvesting on Monday, Wednesdays and Fridays. or on Tuesday and Thursday, etc. or alternate who can harvest on which days)
- Restrict number of harvesters collecting in exclusive use areas
- Charge user fees or license harvesters
- Restrict harvesting only to local community (exclude non-community members) or open to non-community members under certain conditions (e.g. charge an access fee)
- Establish permanent closures or close areas for periods longer than the annual Tanbi-wide closure.
- Establish penalties including fines not to exceed GMD 5000 for violations of rules, and for repeat offenders, can confiscate harvest gear or banned from further harvesting for a period up to one year

Community-based committees cannot:

- Set a size limit smaller than Tanbi wide size limit (if established), but can be larger.
- Set a seasonal/annual closure less than the Tanbi wide closure, but can be longer.

Rules established for community exclusive use zones need to be approved by the majority of the TRY community-based management committee members. These must be endorsed by the Alkalo either verbally in a TRY community meeting or via a letter. Rules take effect once they are announced in a TRY community wide meeting and verbally explained. Rules should be transmitted verbally or in writing to TRY Tanbi-wide management committee for information purposes and review to ensure they do not contradict Tanbi-wide rules.

6.4 Tanbi Advisory Committee

- Membership: One member who is a local representative to a Municipal council who serves a chair, Department of Fisheries, Department of Parks and Wildlife Management, Department of Forestry, National Environment Agency, National Nutrition Agency and the National Consumer Group.
- Advises the Tanbi-wide management committee on management plan performance and provides technical services on status of stocks and other ecosystem issues relevant to management of the cockles and oysters.
- Makes recommendations to the Director of Fisheries and Minister of Fisheries, Water Resources and National Assembly Matters on status of plan implementation and performance and if interventions to correct deficiencies are required.

6.5 Role of the Department of Fisheries

- Endorses approval of the overall co-management plan to the Minister of Fisheries, Water Resources and National Assembly Matters.
- Approval by the Director of Fisheries of substantive changes in plan goal or objectives, in consultation with Director of the Department of Parks and Wildlife Management.
- Conduct annual audits of plan implementation in collaboration with the Department of Parks and Wildlife Management to assess whether management objectives are being met or progress towards objectives is satisfactory.
- Require the TRY management committee to revise management plan rules if not making progress towards sustainability objectives and goal.
- Review all rule changes annually in collaboration with the Department of Parks and Wildlife Management, Department of Forestry and National Environment Agency and advise TRY management committee on technical soundness to prevent overexploitation of cockles and oysters and to meet other management objectives.
- Establish a shellfish sanitation program for oysters and cockles that may include:
 - Establishing closed areas for reasons of seafood safety due to water quality contamination or risks
 - Requiring and setting as needed, traceability requirements and procedures for harvest, sale and distribution of product intended for raw consumption

- Establishing fines for any harvester or seller in the value chain of the product intended for raw consumption that does not have traceability labels
- Establishing sanitary standards and criteria for harvest and distribution of product intended for raw consumption
- Establishing fines for any harvesters taking product intended for raw consumption in violation of traceability rules, or sanitary requirements or harvest prohibitions
- Establishing water quality monitoring protocols to ensure harvest of safe shellfish
- Conducting water quality monitoring (directly or via interagency agreements w/ other agencies laboratories) and implement other shellfish sanitation plan actions as may be required
- Promoting sustainable aquaculture and ranching of oysters and shellfish among TRY members.
- Assist TRY in developing value added products and expanding marketing opportunities locally, regionally and internationally.
- Approves overall co-management plan.
- Assist TRY in enforcement of management rules.
- Promote research and monitoring that aide in management, including adaptation measures for climate change impacts.
- Assist with implementation of management measures as requested by the Tanbi Cockle and Oyster Management Committee.

6.6 Role of the Department of Parks and Wildlife Management, Department of Forestry and National Environment Agency.

- Recommend the approval of the overall co-management plan to the Minister of Forestry and Environment.
- Assist TRY Association in enforcement of management rules.
- Promote research and monitoring that aide in management.
- Assist with implementation of management measures as requested by the Tanbi Cockle and Oyster Management Committee.
- Substantive changes in plan goal or objectives require approval by the Director of Fisheries in consultation with Director of the Department of Parks and Wildlife Management, Department of Forestry and National Environment Agency.
- Cooperate with the Department of Fisheries on annual audits of plan implementation and changes in rules to ensure consistency with national forestry, biodiversity and wildlife laws, regulations and policies and with the TWNP management plan.
- In collaboration with the Department of Fisheries conduct annual audits of plan implementation to assess whether management objectives are being met.
- Monitor essential habitat quality (status of mangrove ecosystem).
- Conduct research on Vulnerability Assessment and impacts of Climate Change.
- Coordinate the activities of the stakeholders within the coastal zone through the Coastal and Marine Working Group.

7. Monitoring and Evaluation of Plan Performance

The Tanbi Cockle and Oyster Fishery Management Committee of TRY will periodically review progress on meeting the objectives of this co-management plan, at least annually. The review should be conducted with advisory committee members, or discussed in a meeting with the advisory committee after the committee's deliberations and review. Such periodic reviews should specially look at:

- Issues concerning degree of compliance with management measures and rules, including closed seasons, closed *bolongs* and minimum sizes and marketing restrictions
- Difficulties, if any, in implementing enforcement actions and penalties
- Status of funds obtained from fines – amount collected and if any disbursed or expensed
- Issues, if any, concerning operations of the Tanbi-wide committee and the community-based committees
- Degree to which biological, ecological, social and economic management objectives outlined in the plan are being met including:
 - Review of the length of the closed season for oysters and cockles in relation to allowing them to grow to mature and more marketable sizes.
 - Status of oyster and cockle stocks and harvesting pressure: Are sizes getting smaller? Is it taking longer to collect the same amount? Are more people harvesting? What additional management measures may be needed to better control total harvest and catch rates?
 - Group marketing issues if any
 - Impacts of alternative livelihood activities, mangrove conservation, and aquaculture activities?
- Priority actions the management committee must take in the near term for managing the oyster and cockle fishery

List of References

- Broom, M.J. 1982. Analysis of the Growth of *Anadara granosa* (Bivalvia: Arcidae) in Natural, Artificially Seeded and Experimental Populations. *Mar. Ecol. Prog. Ser.* 9:69-79.
- Broom, M.J. 1985. The biology and culture of marine bivalve molluscs of the Genus *Anadara*. ICLARM studies and reviews No. 12. International Center for Living Aquatic Resources Management. Manila, Philippines. 37p.
- Cham, A.M. and O. Touray. 2008. Oysters and Cockles Study in The Gambia. Unpublished report, November 2008
- Devakie et al. (1993). Small scale oyster culture on the west coast of Peninsular Malaysia. BOBP/REP/63. GCP/RAS/118/MUL. BOBP, Madras, India.
- Graybow, W.O.K., C.A. Hilner, and P. Coubrough. 1981. Evaluation of standard and modified M-FC, MacConkey, and Teepol media for membrane filtration counting of fecal coliforms in water. *Applied and Environmental Microbiology* 42(2):192–199.
- Green, M.A. et al. (2004). Dissolution mortality of juvenile bivalves in coastal marine sediments. *Limnology and Oceanography* 49(3):727-734.
- Grossman, E. (2011). Northwest oyster die-offs show ocean acidification has arrived. *Yale: Environment* 360. (http://e360.yale.edu/feature/northwest_oyster_die-offs_show_ocean_acidification_has_arrived/2466/#.Ts0p5cPP1g0.email).
- Kanyi, B. 2010. pers. comm.
- MacKenzie, Jr., C.L. (1983) How to increase oyster production. *Marine Fisheries Review*, 45(3):1-22.
- Mucci, A. (1983). The solubility of calcite and aragonite in seawater at various salinities, temperatures and one atmosphere of pressure. *American Journal of Science* 283:780-799.
- Murray, Brian, Linwood Pendleton, W. Aaron Jenkins and Samantha Sifleet. 2011. Green Payents for Blue Carbon: Economic Incentives for Protecting Coastal Habitats. Nicholas Institute Report. NI R 11-04.
- Nascimento I.A., M.I.A.S. Ramos, and A.E. Dos Santos. 1980. Sex-ratio e ocorrencia de hermafroditismo em *Crassostrea rhizophorae*. *Simposio de Brasil Aquicultura Academia do Brasil Ciencias* 5:395–396.
- Njie M. and O. Drammeh. 2011. Value Chain of the Artisanal Oyster Harvesting Fishery of The Gambia, Coastal Resources Center, University of Rhode Island, pp.74.
http://www.crc.uri.edu/download/Value_Chain_of_the_Artisanal_Oyster_2011.pdf

- Rice, M.A. (1999). Control of eutrophication by bivalves: Filtration of particulates and removal of nitrogen through harvest of rapidly growing stocks. *Journal of Shellfish Research* 18:275.
- Rice, M.A. (2008) A history of oyster Aquaculture in Rhode Island. *41oNorth* 4(2):28-31. http://seagrant.gso.uri.edu/41N/vol4no2/12_rice.pdf
- Rice, M.A. 2011. Status Report on Bivalve Aquaculture and Water Quality Activities. Gambia-Senegal Sustainable Fisheries Project, Coastal Resources Center, University of Rhode Island. 12p.
http://www.crc.uri.edu/download/Rice_Gambia_Report.pdf
- Smith, B. (2011). The coming green wave: ocean farming to fight climate change. *The Atlantic* 29 Nov 2011. http://www.theatlantic.com/life/archive/2011/11/the-coming-green-wave-ocean-farming-to-fight-climate-change/248750/?single_page=true
- Talmage, S.C. and C.J. Gobler. (2009). The effects of elevated carbon dioxide concentrations on the metamorphosis, size, and survival of larval hard clams (*Mercenaria mercenaria*), bay scallops (*Argopecten irradians*), and Eastern oysters (*Crassostrea virginica*). *Limnology & Oceanography* 54(6):2072-2080.
<ftp://oceane.obs-vlfr.fr/pub/gazeau/Nicolas/Larvae%20papers/Talmage%20and%20Gobler%202009.pdf>
- The Fisheries Act of 2007. Supplement "C" to The Gambia Gazette No. 20 of 19th October, 2007. ISSN 0796 – 0298.
- Tookwinas, S. 1983. Commercial cockle farming in southern Thailand. ICLARM Translations 7, 13 p. Translated by E.W. McCoy. International Center for Living Aquatic Resources Management. Manila, Philippines. ISSN 0115-4141, ISBN 971-1022-20-6.
- Watson, S.A. et al. (2009). Early larval development of the Sydney rock oyster, *Saccostrea glomerata*, under near-future predictions of ocean acidification. *Journal of Shellfish Research* 28(3):431-437. <ftp://oceane.obs-vlfr.fr/pub/gazeau/Nicolas/Larvae%20papers/Watson%20et%20al.%202009.pdf>
- Yankson, K., 1982. Gonad maturation and sexuality in the West African bloody cockle, *Anadara senilis* (L.). *Journal of Molluscan Studies* 48: 294-301.
- Yankson, R. 1996. Sexual differentiation of *Crassostrea tulipa* in two contrasting brackishwater environments. *Journal of Molluscan Studies* 62:135-137.