WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT

Year 2 Annual Report

Milestone #13

September 30, 2022

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Cover image: A woman harvesting oysters from mangrove roots in The Gambia.

Photo Credit: TRY Oyster Women's Association, The Gambia.

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ACRONYMS

CCM	Centre for Coastal Management
CRC	Coastal Resources Center
COVID-19	Coronavirus Disease of 2019
CSIR-FORIG	Council for Scientific and Industrial Research-Forestry Research Institute of Ghana
DAA	Development Action Association
DOPA	Densu Oyster Pickers Association
FANTA	Food and Nutrition Technical Assistance Project
FFQ	Food Frequency Questionnaire
FGD	Focus Group Discussions
FIL	USAID Feed the Future Innovation Lab for Fish
FY	Fiscal Year
GIS	Geographic Information Systems
HFIAS	Household Food Insecurity Access Scale
HH	Household
ICRAF	World Agroforestry
NRM	Natural Resources Management
ODK	Open Data Kit
PPE	Personal Protective Equipment
RDA	Recommended Dietary Allowance
TRY	TRY Oyster Women's Association
UCC	University of Cape Coast
UG	University of Ghana
URI	University of Rhode Island
USAID	United States Agency for International Development
WHO	World Health Organization

1. OBJECTIVE OF THIS DOCUMENT

This report documents project achievements at the end of Year 2, September 15, 2021 – September 14, 2022, of this two-year project that began on September 15, 2020 and is completing its two-year first phase.

2. PROJECT SUMMARY

In September 2020, The United States Agency for International Development (USAID) awarded the University of Rhode Island (URI) the Women Shellfishers and Food Security Activity (project). With USAID, URI co-created the project in partnership with the University of Cape Coast (UCC) in Ghana, the University of Ghana (UG), TRY Oyster Women's Association in The Gambia, and World Agroforestry (ICRAF) based in Nairobi, Kenya.

This project addresses the need for greater attention to food security for women shellfishers and their families while improving biodiversity conservation of the ecosystems on which their livelihoods depend. More robust models, tools, approaches, and processes are needed to enable and promote these sustainable food systems and natural resource management in coastal West Africa. The project aims to strengthen the evidence base, increase awareness, and equip stakeholders to adapt and apply successful approaches in areas of high potential for replication and scale-up in the eleven coastal West African countries from Senegal to Nigeria. It draws on successful cases of a rights-based, ecosystem-based, participatory co-management approach to shellfish management by women in mangrove ecosystems in The Gambia and Ghana developed with USAID assistance. Knowledge and experience generated through the project opens up opportunities for improvement and broader application of these promising approaches in West Africa through three key project components implemented during this first phase:

1) Conduct the first-ever participatory regional assessment of the situation, unmet needs, and promising approaches to shellfish co-management led by women across the eleven countries and the scope and scale of the potential sectoral and cross-sectoral benefits.

2) Elaborate and test elements of models based on existing approaches through site-based research in The Gambia and Ghana to strengthen the evidence base for successful elements of the model. The project will conduct six technical studies covering the field research to document linkages in a Theory of Change and conceptual results chain between women's shellfish co-management and livelihoods, mangrove conservation, and nutrition. It will examine existing elements in the approach that are not well documented, and that could enhance the approach if they are better understood. It will document both sectoral and cross-sectoral findings.

3) Foster a community of practice around the development and dissemination of a toolkit on a rights-based, ecosystem-based, participatory co-management of shellfish by women in mangrove ecosystems in West Africa with and for community, national, and regional level stakeholders. This component consists of two activities: toolkit development and its dissemination. The toolkit will integrate findings from the participatory regional assessment and site-based research. Building on those components,

the toolkit development and dissemination will build a community of practice and provide capacity development support for 37 stakeholder institutions in West Africa. It will provide the first practical guide for the design and implementation of women's shellfish co-management in West Africa, supported by a network of practice, among other elements such as policy briefs and case studies.

2.1 Goal

The project goal is to foster the adoption and scaling-up of an integrated approach to conservation of mangrove and estuarine ecosystems in West Africa that provides cross-sectoral benefits in terms of gender equality and women's empowerment, economic development, household food resiliency and nutritional benefits for women of reproductive age.

2.2 Theory of Change

The theory of change for this project, describes the interrelationship between women's empowerment, sustainable shellfisheries management, and cross-sectoral linkages to community-based mangrove conservation, local food system livelihoods, and nutrition of shellfishing households. The project empirically examines these relationships and tests hypotheses inherent in the following theory of change:

> *IF women's shellfish livelihoods in coastal mangrove and estuarine ecosystems in The Gambia and Ghana are improved through gender and nutrition sensitive co-management and linkages made to community based forest management in the land/seascape, THEN mangrove and estuarine biodiversity will be improved, AND IF approaches for sustainable food producing livelihoods within the coastal mangrove land/seascape contribute to a nutritionally balanced local food supply, THEN household resilience, sustainable food systems, and nutrition will improve*.

The interrelationships and cross-sectoral linkages of the theory of change are depicted in Figure 8 in Annex 1. The model is based on practitioner experiences and qualitative evidence of these interrelationships and stitches together several sector-based models into a broader integrated theory. No in-depth empirical studies have provided a solid evidence base of this theory. While co-management of mangroves and small-scale fisheries have each been shown individually to be effective at improving sustainable management of these resource systems and are well documented in the existing knowledge base, project research activities looked more closely at the connections between fisheries management and resource tenure with mangrove conservation. The research further broadened the basic community-based resource management aspects of the model and examined connections to coastal food systems and nutritional wellbeing of women shellfish harvesters and their families. This component of the model is less well proven and where the evidence base is weak or non-existent. Testing these cross-sectoral linkages empirically was a main focus of the site-based comparative research across six sites, three each in The Gambia and Ghana under project Activity 2.

The theory of change was further broken down into several testable and interlinked hypotheses as illustrated below.

- Hypothesis 1: Gender sensitive governance that promotes co-management and tenure rights and empowered women that manage shellfisheries sustainably improves conservation of mangroves.
- Hypothesis 2: Improved and gender equitable management of shellfisheries and mangroves increases shellfish yields and availability of this nutrient rich food protein, which increases shellfish consumption and contributes to improved household nutrition and income of those engaged in shellfishing.
- Hypothesis 3: High consumption of shellfish contributes to lower prevalence of anemia in women of reproductive age and controlling for other factors affecting anemia such as malaria or hookworms.
- Hypothesis 4: Enriching landscapes around mangrove-shellfish estuaries systems with complementary food and nutrition sources reduces the extractive pressure on the mangroves thereby improving its health which subsequently boosts the productivity of the shellfishery having direct impact on household food security.

3. ACHIEVEMENTS ACTIVITY 1: Conduct the first-ever participatory regional assessment

During the first year of project implementation, the Centre for Coastal Management, University of Cape Coast led the participatory regional assessment of shellfisheries in West Africa covering 11 coastal countries: Senegal, The Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, and Nigeria. The objective was to assess the regional scale and scope of existing shellfisheries and shellfish-based livelihoods occurring in the region's mangrove ecosystems. The assessment covered the shellfisheries in these ecosystems, with particular attention to women's involvement.

As an initial step to identifying the gaps and areas of focus for the assessment, a regional-level literature review on the scale and scope of women-led artisanal shellfisheries, from both natural harvests and aquaculture, across the West Africa region was conducted. The literature review report finalized in February 2021 focused on mangrove and estuarine habitats that support shellfishing activities of women in the 11 West African countries. For each country, basic contextual information on population, percentage population living in/near the coast, gross domestic product, human development index rank, length of coastline, fish consumption (as a percent of animal protein), anemia prevalence, estimated mangrove cover, estimated estuarine/freshwater area for shellfisheries, presence of women shellfishers, number of women shellfishers in mangrove zones, number of coastal systems with mangrove-based shellfishing, and shellfish and mangrove management plans/regulations was considered. The review revealed gap areas that the project's regional assessment should inform.

The regional assessment followed with the support of selected individuals stationed in each of the 11 countries, called In-Country Focal Persons (ICFPs). These individuals collected data in their respective countries on behalf of the University of Cape Coast. The data collection took the form of key informant interviews of individual shellfishers in different shellfishing communities identified in each

country. The data was collected using a questionnaire and was received by UCC digitally through an online submission portal for resource users and for other stakeholders (Government, Academia, NGOs). The responses from respondents were pooled and analyzed to obtain a regional perspective of shellfisheries in the West Africa sub-Region. The results are presented in the report "The Estuarine and Mangrove Ecosystem-Based Shellfisheries of West Africa: Spotlighting Women-Led Fisheries Livelihoods". The report was submitted to USAID on October 13, 2021, finalized, and posted online in English and French in fiscal year (FY) 2022 (see hyperlinked cover images below). Stand-alone reports for each of the 11 countries that formed the basis of the regional synthesis were also completed and posted online in English and French (and in Portuguese for Guinea Bissau) in FY2022 (see Annex 2 for citations and links). The country report for Guinea is only now being finalized, so field data from Guinea is not included in the regional report. Information captured for Guinea was drawn from the literature.

Figure 1: The Estuarine and Mangrove Ecosystem-Based Shellfisheries of West Africa: Spotlighting Women-Led Fisheries Livelihoods report in English and French (the images are hyperlinked).

Key areas of interest elaborated in the regional shellfisheries report include the following:

- The coast and geographical coverage of estuarine and mangrove ecosystem-based shellfisheries in the sub-Region.
- Shellfish exploitation (Estimated number of shellfishers; Insights on gender in shellfish exploitation; Shellfishing as primary occupation; Shellfishers' supplementary livelihoods; The shellfish value chain; Species harvested; Harvesting methods; Harvest volumes and value; Seasonality of harvests).
- Mangrove ecosystems as support for shellfisheries.
- Shellfisheries and Mangrove Ecosystems Governance Regimes.
- Improving Shellfisheries Livelihoods of Women.

Important findings from the study are summarized in the text box and figures below:

Opportunities/Enabling Conditions

Strong vertical integration of the shellfish value chain with women harvesters themselves dominant at every node. This increases the potential for value chain improvements at any node to incentivize sustainable harvest and ecosystem stewardship by women harvesters.

More than 600,000 hectares of coastal ecosystems already prioritized for conservation as Ramsar sites. This Convention on Wetlands is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

More than 30 women shellfisher groups organized at community, ecosystem, and national levels.

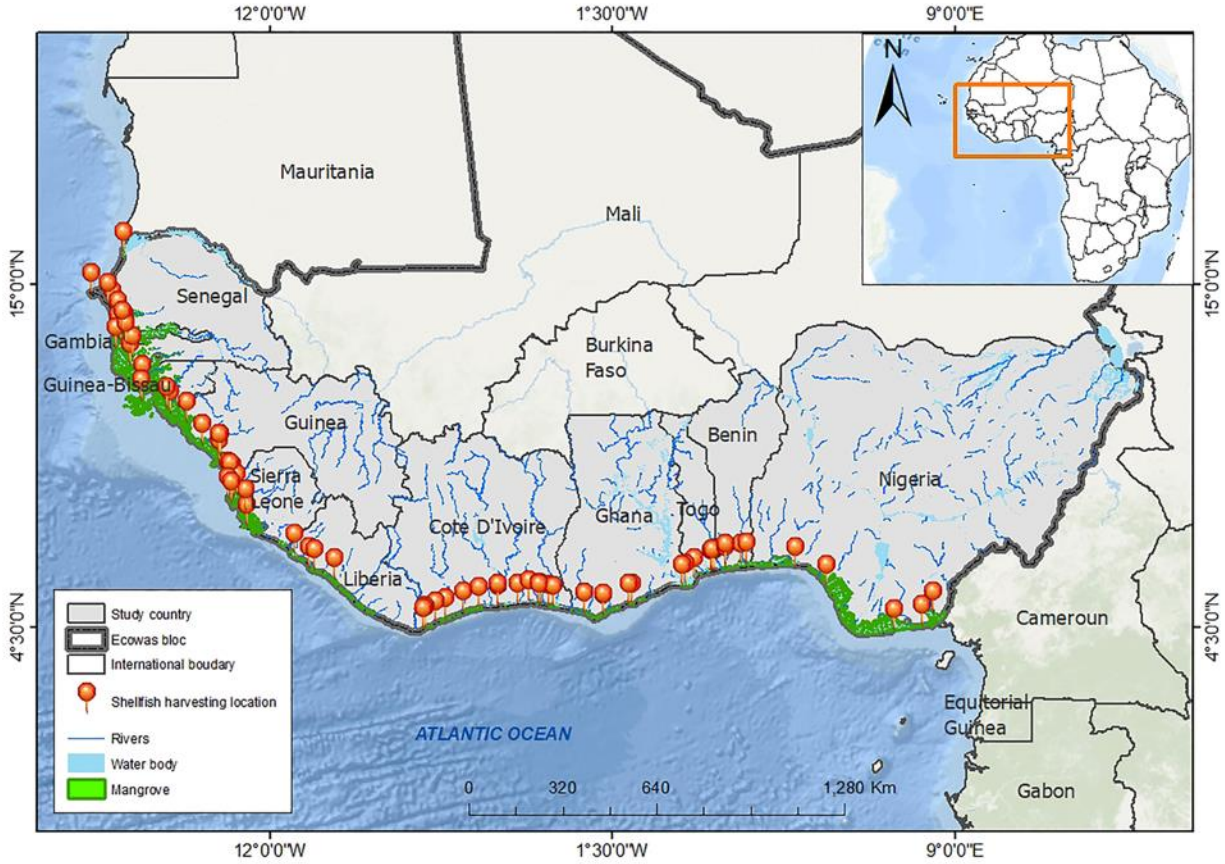

Figure 2: Distribution of shellfish harvesting locations along the coast of West Africa.

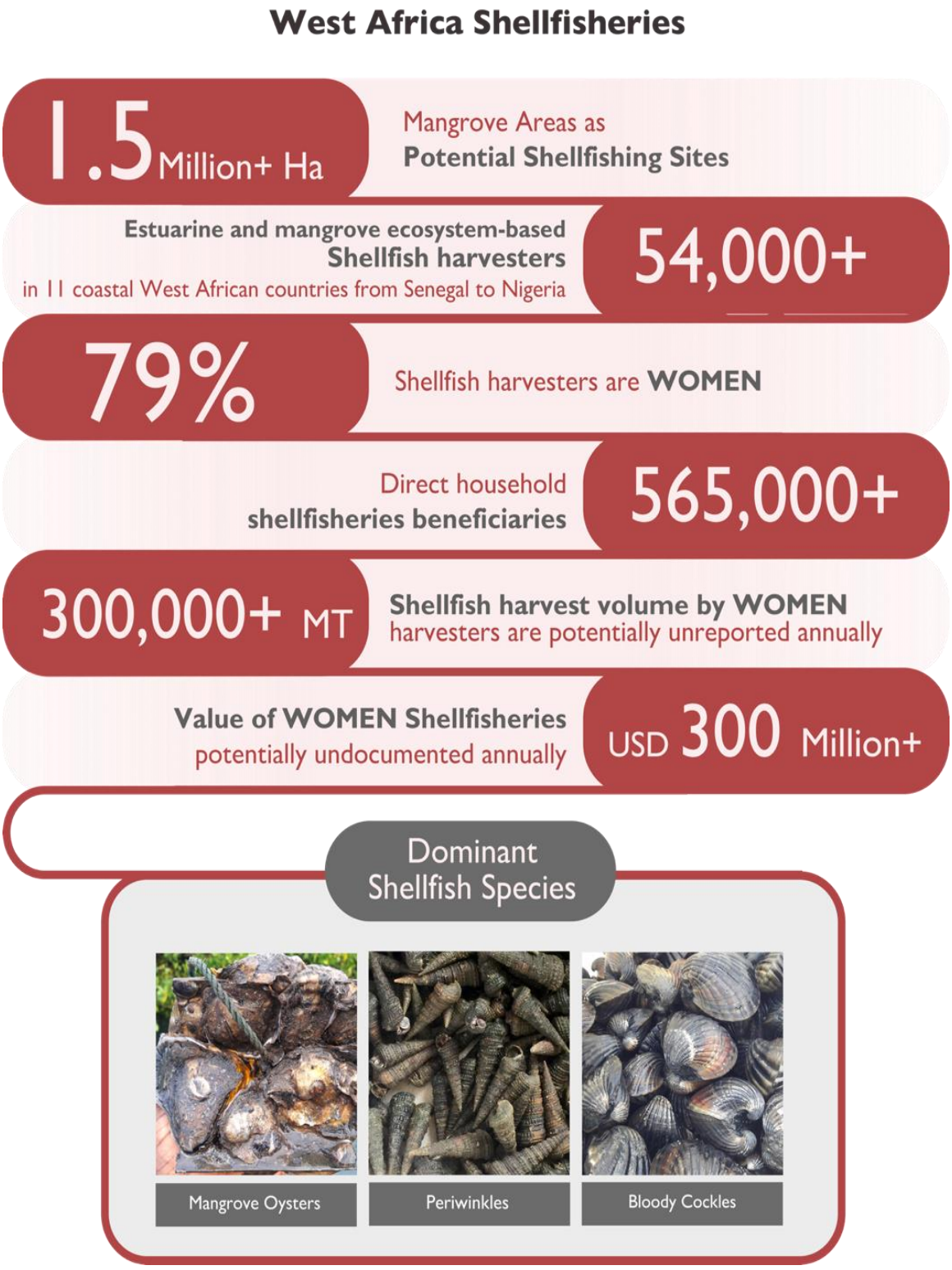

Figure 3: West Africa Shellfisheries.

4. ACHIEVEMENTS ACTIVITY 2: Elaborate and test elements of models based on identified approaches through site-based research in The Gambia and Ghana

Community Entry and Coordination

The TRY Oyster Women's Association played a critical role in facilitating community entry in The Gambia and ensuring that project partners were cognizant of the need to align research schedules and coordination among partners with the needs of women harvesters, especially their time sensitive seasonal harvesting, processing, and marketing activities

4.2 Research Site Selection

In November 2020, selection of Activity 2 research sites in The Gambia and Ghana was documented in the report submitted to USAID in completion of Milestone #2 entitled, "Selection of Locations for Site Based Research." In summary from that report:

Site selection involved the collection of secondary and qualitative field information on criteria for site selection as described in the program design. The criteria included:

1. Existing shellfish activity,
2. Significant involvement of women shellfishers,
3. Existing mangrove systems-based livelihoods,
4. A range of mangrove health conditions (level of degradation) and changes over time.

We used a purposive rather than random sampling approach for selection of sites. This approach was designed to select sites that have significant variation in key outcome variables such as fisheries and mangrove health, nutrition, and anemia and treatment variables such as governance, gender dimensions, and women's empowerment. Purposive sampling was used since the characteristics of the entire population of estuaries regionally are not well known. This approach was also designed to be a rapid assessment utilizing secondary information available and expert opinion and local knowledge to identify candidate sites. Once candidate sites were identified, rapid field assessments were undertaken at candidate sites. World Agroforestry led the field assessment process in The Gambia while the University of Cape Coast led the process in Ghana, with other team members providing information and expert opinion. Once all the information was compiled, the research team held discussions for each country and made a consensus decision of the sites for the field research.

The site selection report summarized the main features of the three sites selected in The Gambia and the three sites selected in Ghana (Tables 1 and 2 below). It is important to note that the estimated area of mangroves was tentative since a comprehensive spatial analysis was not done.

Table 1: Summary attributes of the sites selected for The Gambia.

Site	Shellfishing activity	Average number of women shellfishers per village	Estimated mangrove area in the site	Livelihood connectivity with mangroves	Mangrove condition	Key factors affecting mangroves	Governance aspects
Bullock area	Oyster Crab Cockles	19	3539 ha	Rice farming, vegetable gardening, firewood collection	Less degraded	Harvesting, settlements expansion (land reclamation), die back, pollution	Local regulations of harvesting shellfish are present.
Tanbi Wetland complex	Oyster Crab Cockle	43	2550 ha	Rice farming, vegetable gardening, firewood collection	Moderate (location specific)	Harvesting, settlements expansion (land reclamation), die back, pollution	National Park and Ramsar site, hence, enjoys some degree of management though weak. Women are given exclusive use rights.
Allahein Estuary (Kartong)	Oyster, Crab	~100	424 ha	Vegetable gardening, firewood collection	Highly degraded	Harvesting, settlements expansion (land reclamation), die back	Shellfishing groups exist but no properly functioning governance structure is in place.

Table 2: Summary attributes of the sites selected for Ghana.

Site	Shellfishing activity	Number of women shellfishers for the site	Est. littoral mangrove & water body area	Livelihood connectivity with mangroves	Mangrove condition	Key factors affecting mangroves	Governance aspects	Nutrition Information
Densu Estuary	Oyster	~150	~206 ha	Brush parks - culture-based fishing; firewood collection; salt mining	Highly degraded	Harvesting, settlements expansion (land reclamation	Ramsar protected site with weak enforcement. Co-management policy for oyster harvesting active – yet to be legislated*	Coastwide increase in fishing dependent households of moderate and severe hunger during the artisanal and inshore fishing closure period. Increase in low dietary diversity during artisanal and inshore fishing closure period. Consumption of six food groups in the period during the artisanal and inshore fishing closure low.

Narkwa Lagoon	Oyster Cockle Shrimp	Unknown [60% of 60 people interviewed involved in oyster harvesting and trading (Asare et al., 2019)]	~110 ha	Crop farming (maize, cassava, plantain); salt mining	Moderate (low density of naturally occurring mangrove)	Harvesting, settlements expansion (land reclamation), die back, pollution	Open access fishing; customary law – no-fishing Tuesday (low compliance)	Central region was ranked as a food insecure region in the country. Dietary diversity among children 6-59 months of age is low. Only about 11% of children consumed vitamin A rich foods and 47% of children met the minimum dietary requirements.
Whin Estuary	Oyster Shrimp Periwinkle	~80	~178 ha	Firewood collection; bivalve shell trade	Less degraded	Harvesting, settlements expansion and tourism, pollution from sewage	Open access fishing; customary law – no-fishing Tuesday (low compliance)	Coastwide increase in fishing dependent households of moderate and severe hunger during the artisanal and inshore fishing closure period. Increase in low dietary diversity during artisanal and inshore fishing closure period. Consumption of six food groups in the period during the artisanal and inshore fishing closure low.

*Note: Following the site selection exercise, the Ghana Co-Management Policy for the Fisheries Sector, and the Densu Delta Community-Based Fisheries Management Plan delegating exclusive use rights to the oyster fisheries resources to the Densu Oyster Pickers Association, were approved in December 2020.

4.3 Sub Activity 2a: Participatory assessment of threats and drivers of mangrove ecosystem degradation and preferred restoration options. (ICRAF Lead)

Activity Description:

In the six selected study sites, we identified the main mangrove conversion threats and drivers and other land use practices within the adjacent landscapes through analysis and interpretation of secondary data and with the engagement of local communities. Assessments identified endogenous and exogenous factors (threats and drivers) to the community and the community-managed mangrove area that led to positive or negative outcomes. Then detailed typologies for the factors were developed and presented to communities for prioritization depending on their relative impacts on the ecosystem. After prioritization was done, management interventions that correspond to the factors were developed based on existing knowledge from previous projects and interventions.

To understand the spatial-temporal changes in the state of the mangrove ecosystem, the project collated local ecological knowledge and site-specific changes in land cover and land use types to contextualize the Geographic Information System (GIS) data trends. This complemented the temporal imagery data from Sentinel and Landsat 7 and 8 satellites. Using the results from these processes and data from literature in the region and other regional biomass models, carbon stock estimates for the landscapes were made. Data on trends in mangrove health and existing conditions also fed into the cross-sectoral multivariate analysis.

Summary of Results:

Mangroves are one of the most important vegetation types in coastal areas. They provide numerous ecosystem services, including wood, edible products (fish, oyster, etc.), coastal area stabilization, and many more. However, despite such immense contributions, mangrove forests are being converted into other land uses that seem more attractive economically in Ghana and The Gambia. In other cases, the vegetation is degraded due to the increased extraction and pollution from waste dumping.

According to the Global Mangrove Watch (GMW, 2021), Ghana and The Gambia have experienced losses of their original mangrove forests. Nonetheless, between 1996 and 2016, The Gambia had a net increase in mangrove cover while Ghana experienced a net loss of its mangrove cover despite investments in restoration (Table 3). Ghana has less mangrove area, lower mean height and overall carbon stock than The Gambia.

Table 3: Summary attributes of mangrove conditions in Ghana and The Gambia.

Country	Mangrove area (2016) (km^2)	Mangrove area change (1996-2016) (km^2)*	Mean mangrove height (m)	Mean carbon stock (t/ha)
Ghana	204.18	-23.78 (-12%)	5.89	40.47
The Gambia	597.17	+2.45 (0.4%)	9.30	54.98

Note: * Numbers in the bracket show percentage changes during the reference period.

The Activity 2a technical study led by ICRAF examines the main drivers and pressures that affect the spatial dynamics of this vital resource. Propositions on how to respond to or mitigate these pressures are also provided. This study used the DPSIR (Drivers-Pressures-State-Impacts-Responses) analytical framework and situation modeling proposed by USAID. Four critical drivers and threats were identified: population dynamics, economic activities, natural factors, and sporadic seasonal drivers. For each of these drivers, the main threats they exert on the mangroves are discussed using the community perspectives as the basis. Response options such as policy, practices, governance, and behavioral responses were identified. Practical pathways to implement these responses include developing management plans, 'adopt a mangrove' approach, promoting participatory designed co-management models, devising incentive schemes (e.g., Payment for ecosystem services, etc.), and awareness creation. A sample action plan for restoring and conserving mangroves is provided for practitioners to adapt the plan to their contexts.

Full report: *Duguma, L., Bah, A., Muthee, K., Carsan, S., McMullin, S., Minang, P. (2022). Drivers and Threats Affecting Mangrove Forest Dynamics in Ghana and The Gambia. Women Shellfishers and Food Security Project. World Agroforestry (ICRAF), Nairobi, Kenya and Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Narragansett, RI, USA 53p.* https://www.crc.uri.edu/download/WSFS2022_01_CRC_FIN508.pdf

4.4 Sub Activity 2b: Developing a sustainable land/seascape collaborative vision (ICRAF Lead)

Activity Description:

Building on Activity 2a, ICRAF identified where there are opportunities in the land/seascape for sustainable resources management. Using a cross-sectional transect (transects that cut across the landscape connecting it to the seascape) through each landscape, the team identified areas of weakness in the landscapes (unsustainable practices) and options for improvement (introduction of sustainable practices). This involved, for example, identifying management interventions that could be adopted or scaled within the landscape based on biophysical, social, and cultural suitability. The visioning also identifies who should do what, when and how. The visioning incorporates issues of shellfishing, coastal resources uses and, in the agricultural areas, the food systems. There are specific areas where women are very prominent, such as in shellfishing, and there are areas where men are more active, such as in agricultural activities in the landscapes. The vision exercise pulls these different activities together to achieve and increase complementarity. Gender equality was addressed by identifying socially and culturally acceptable roles and responsibilities and assigning them to the actors (i.e., men or women) who could best address them. To capture this effectively, selection of participants for the consultation and validation meetings was done recognizing existing social, wealth and ethnic differences in the society to ensure inclusivity beyond gender issues.

The vision development was based on the biophysical characteristics of the landscapes, the capacities of the key stakeholders in the land-seascape, how much return it could potentially generate from a livelihood perspective, and ensuring reduction of pressure on the mangrove ecosystems. This can only

be possible if the social capital among the communities and or stakeholders is strong. The vision development was therefore based on the 4R's principle/ tool (Meyers 2005) capturing the rights, responsibilities, returns, and relationships that exist. This also needs to be built to reduce externalities to the ecosystem and enhance complementarity and synergies among activities of various stakeholders. The inputs required to achieve the perceived 'better state' as described in the vision were examined. As a result of this process, each site has a land-seascape vision that local partners or other government agencies can use to improve the state of the land/seascape.

Activity 2a, 2b and 2c worked together to expand the mangrove management model into a broader land and seascape approach to natural resource management, biodiversity conservation, and food and nutrition security. It provided an opportunity to test tools and apply them in a combined and holistic manner.

Summary of Results:

Ghana is endowed with coastal water bodies that support fishing and fish-related enterprises to support livelihoods. The country has lost a net of 539 square kilometers of mangroves in the past two decades, necessitating an integrated approach to support ecosystems and livelihood functioning. A visioning approach was employed to engage the communities in Densu Estuary, Narkwa Lagoon, and Whin Estuary in Ghana to understand the changes, the current situation, and to identify desired future scenarios in the land-seascape. It involved 115 shellfishers (93 percent and 7 percent females and males respectively). The study suggested that shellfishers are engaged in different secondary livelihood activities, including trade, farming, and livestock keeping, with gender playing a role in activities selection. The general trend in different livelihood activities was degrading and declining productivity over the years and the hope for increased productivity in the future. Natural drivers such as changing temperature and rainfall patterns and human drivers such as crop production, infrastructural development, population growth, overharvesting of fish resources, and pollution, were cited by the communities as being behind degradation patterns. The visioning process identified different activities or practices that the communities want to: 1) stop from happening (e.g., pollution, light fishing, overfishing, etc.), 2) expand or promote (e.g., mangrove restoration), and 3) new activities they want to introduce (e.g., alternative livelihood options and market linkages). Stakeholder organizations and their responsibilities were identified, falling broadly under government, Non-Governmental Organizations (NGO), community, and private sector typologies. Community perceptions on the state of mangrove forests and their relationship to shellfishing activities was documented. Discussion of findings highlight the need for regulatory measures to be implemented in these community land-seascapes and for empowering local resource governance systems through deployment of co-management schemes, contextualized to the local realities.

Full report: *Duguma, L., Darko Obiri, B, Carsan, S., Muthee, K., Tang Guuroh, R., Antwi Oduro, K., Mcmullin, S., Duba, D. (2022). Participatory Land-Seascape Visioning in Densu Estuary, Narkwa Lagoon, and Whin Estuary, Ghana. Women Shellfishers and Food Security Project, World Agroforestry (ICRAF), Nairobi, Kenya. and Coastal Resources Center, Graduate School of*

Oceanography, University of Rhode Island. Narragansett, RI, USA 46p.
https://www.crc.uri.edu/download/WSFS2022_02_CRC_FIN508.pdf

In The Gambia, communities are highly dependent on their natural resources for survival, contributing to their degradation. A holistic approach is required for communities to look back at how these systems have changed, their status, and envisaged future. A participatory visioning process was conducted through 15 focus group discussions in eight communities spread over three sites (Tanbi, Allahein and Bulock). The objective was to build consensus and develop a common land-seascape vision for shellfishing communities towards better ecosystem management. The study established that farming, fishing, and shell fisheries are the main livelihood activities, with men focusing more on labor-intensive and women on less labor-intensive activities. Activities such as farming and fish harvesting varied in different months across the year. Trend analysis revealed that activities are either expanding, not changing or declining in the studied sites based on underlying reasons such as weather conditions, migration trends, harvesting trends, and regulations. Mangroves were perceived to be expanding due to initiatives by different stakeholders to promote shellfisheries. Generally, the communities observed declining production of food, feed and fiber in the past and envisaged an improvement in the future to meet the growing demands by the community. To achieve that, it is necessary to continue promoting current interventions such as mangrove restoration and rehabilitation of degraded sites for sustainable ecosystem services generation in the future. The visioning process identified activities such as deforestation and overharvesting of fish resources that need urgent attention. Activities such as mangrove-replanting, increased regulations enforcement, introduction of sustainable fish harvesting, and rotational cropping were on the other hand highlighted to aid restoration efforts. This study therefore helped identify pathways for addressing deforestation of mangroves and terrestrial forests, overharvesting of fish resources, and challenges related to land management, for instance by working with key enablers such as extension services, and increased partnership and collaboration with product or market actors.

Full report: *Duguma, L., Bah, A., Muthee, K., Carsan, S., Sanneh, E. (2022). Participatory Land-Seascape Visioning in Tanbi, Allahein, and Bulock sites, The Gambia. Women Shellfishers and Food Security Project, World Agroforestry (ICRAF) Nairobi, Kenya and Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Narragansett, RI, USA 37p.*
https://www.crc.uri.edu/download/WSFS2022_03_CRC_FIN508.pdf

4.5 Sub-Activity 2c: Integrated land/seascape food and nutrition complementarity profile using agricultural biodiversity and wild foods and feeds. (ICRAF Lead)

Activity Description:

A participatory screening of agricultural biodiversity and wild food and feed categories in each field site was conducted. For each of the prioritized species, their contribution to food and nutrition security at the landscape level was assessed based on existing production potential, including land availability for planting, and the respective nutrient content. Using production potential and seasonality, a food and nutrition portfolio for the land-seascapes in each country was established. For wild tree

species with high food and nutrition value, a domestication strategy was developed for further piloting by other interested parties. Cross-sectional transects were used to sample the current tree species abundance which contributes to the food and nutritional needs of local communities. Based on this, ICRAF developed; (1) A food and nutritional portfolio for selected landscapes in The Gambia and Ghana; and; (2) domestication strategies for high food and nutritional value wild tree species for each country. For the high value food and nutritional species, appropriate agroforestry interventions were designed as a protocol for integrating the identified wild food and feed species into the landscapes including individual or communal interventions. The underlying premise is if such high value wild food and feed tree species become part of the food systems, the livelihoods and household resilience of local communities improve and pressure on mangrove ecosystems will decrease hence boosting sustainability of shell fishing and household resilience.

The food and nutrition portfolios (or Nutritious Food Portfolios) are context-specific recommendations for producing and consuming a greater diversity of nutrient-rich foods to address seasonal food harvest gaps, and micronutrient gaps in local diets. They consist of a variety of indigenous and exotic trees and crops including fruits, vegetables, pulses, and staples. The portfolios are co-developed with communities taking into consideration socio-ecological dynamics of food production including seasonal availability, food security, and food consumption. They are further informed and validated with communities taking into consideration their needs and priorities for producing food for home consumption and income generation. The portfolios matter in our research because they are an approach to ensuring that agricultural and wild biodiversity are prioritized as part of a solution for promoting greater diversity of nutritious foods in local production systems and diets.

Summary of Results:

Diversified food system strategies can improve food composition and income sources for women oyster harvesting communities dependent on seasonal fishery activities. This study focused on women shellfishers in Densu Estuary, Narkwa Lagoon, and Whin Estuary in Ghana and in Tanbi, Bulock, and Allahein estuaries in The Gambia, and to understand the status and opportunities for increasing the use of biodiversity to meet seasonal food and dietary needs. Research activities included site scoping assessments, 21 focus group discussions in Ghana (5) and The Gambia (16) and 356 random household interviews in Ghana (211) and The Gambia (145). In addition, data validation and feedback discussion meetings were conducted with communities across the six study sites. Overall, assembled data covered household livelihood characteristics, food production, food types, seasonality and expenditure attributes, tree planting, nurseries, species diversity and management, local food portfolios, and oyster and fisheries resource use challenges. Findings revealed key challenges cited as hindrances to meeting environmental and dietary needs by communities. There are food seasonality challenges, narrow food choice options, and inadequate credit facilities, market infrastructure, knowledge, and local capacity limiting fisheries activities. Data analysis revealed that communities are reliant on starchy staple crops, pulses, vegetables, and fruits for nutrition. Immediate nutrition food portfolios developed together with communities showed tree and crop species and their possible contribution for food and nutritional needs from local production systems. April and July were mapped as peak for food insecurity in Ghana, while in The Gambia peak food insecurity was between

June and September. The study therefore recommends establishment of a more diversified food system that includes trees to improve diets and income, and contextualization of the community needs across the sites based on their locally available biodiversity resources.

Full report: *Carsan, S., McMullin, S., Obiri, B., Duguma, L., Guuroh, R., Bah, A., Orero, L., Muthee, K. (2022). Technical Report on Site Based Research in Ghana and The Gambia: Land-seascape food and nutrition profiles. Women Shellfishers and Food Security Project, World Agroforestry (ICRAF), Nairobi, Kenya and Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Narragansett, RI, USA 79p.*
https://www.crc.uri.edu/download/WSFS2022_04_CRC_FIN508.pdf

4.6 Sub-Activity 2d: Analysis of shellfisheries and associated bio-physical parameters of the estuaries. (UCC Lead, UG and URI participation)

Activity Description:

UCC documented the status of the shellfisheries and number of shellfishers (disaggregated by sex). UCC conducted participatory shellfish stock assessments looking at stock sizes and maturity levels (size at maturity) and determined trends of exploitation. UCC assessed water quality parameters, including physicochemical parameters, heavy metal content (mercury), and microbial levels, (i.e., *E coli*). Sites were ranked by high, medium, and low levels of exploitation, pressure, and fishery health. Participatory assessments documented governance and other socio-economic variables to be used in the cross-sectoral multivariate analysis.

Analysis by the University of Ghana and URI also quantified the benefits of oyster consumption. This included an oyster consumption questionnaire that captured what percent of the Recommended Dietary Allowance (RDA) for iron and zinc is met by oyster consumption in these communities on a Food Frequency Questionnaire (FFQ) that captured sources of zinc and iron in the women's diet to determine what percent of their total iron and zinc consumption is coming from oysters. Estimates of economic value were conducted for the shellfish harvested, as well as percent sold for cash income versus household consumption. This was factored into measures of household resilience.

Summary of Results

Monthly data collection on physico-chemical properties of the estuaries (depth, temperature, salinity, dissolved oxygen, pH, and turbidity) were conducted at all six sites. Quarterly data collection on nutrients (phosphates and nitrates), microbial loads (total coliform, fecal coliform, and *E. coli*), and heavy metals (Pb, Hg, As, Cr, and Cd) in both water and oyster flesh, were executed at all sites. Biometric data (shell heights, shell lengths, whole weight, shell weight, meat weight, and dry weight) on oyster samples was collected every month for all six sites. Sex determination by visual observation and histological processes was conducted on oyster specimens from all six sites. In addition to these biological and ecological studies, two separate social surveys, one on the socio-economics of shellfishing households and another on oyster fishery were conducted in the adjoining communities of the six sites. Further studies on the oyster exploitation were also conducted by collecting the catch and effort data at each site.

The results show overall dynamic scenarios at the various sites for all parameters considered in this study. Key results are summarized in the bullet points below.

Hydrographic conditions of the systems studied:

- The Gambia systems were observed to be relatively deeper than those of Ghana, Tanbi being the deepest and Whin the shallowest.
- Higher temperatures were recorded in the Ghana systems and lower temperatures in The Gambia systems from December to March 2021. The reverse was observed from June to October, and then switched again in November 2021 to March 2022.
- More stable salinities were recorded, between 20 ppt and 42 ppt, throughout the study period in The Gambia. Wide fluctuations were recorded in Ghana's waters, dropping as low as almost 0 ppt in all the Ghana systems in June during the peak of the rainy season.
- Dissolved oxygen concentrations in the systems studied ranged from an average of about 3 mg/l to 10 mg/l. There were observable hikes in the months of April and May 2021 for The Gambia ecosystems and in December for the Whin estuary and Narkwa lagoon in Ghana.
- Turbidity was low in The Gambia systems and much higher in Ghana systems, generally highest in Whin.

Nutrients, heavy metals, and microbial load:

- Nutrients (phosphates and nitrates) exceeded the optimum limits, but nitrate, which is the limiting nutrient in seawater, did not significantly exceed levels beyond 5 mg/l to drive algal bloom in the systems.
- Coliforms, fecal coliforms, and Escherichia coli occurred in both water and oyster tissue at all sites, with fecal coliform concentration and E. coli showing a general downward trend in the water and oyster tissue, with levels reducing to near 5 CFU/100ml in the water and near 0 CFU/100ml in the oyster flesh in March 2022.
- The levels of Mercury, Arsenic and Chromium were largely within WHO permissible limits in the oyster tissue although some occurred above permissible limits in the water bodies, while Lead and Cadmium were generally above the acceptable limits in the oysters.

Oyster biology and exploitation:

- The largest sizes of oysters were found in Bulock and the smallest in Narkwa. Oysters in The Gambia systems were generally larger in March-May while in Ghana, larger sizes occurred in Sept-October. The modal sizes in The Gambia were about 6 cm while modal sizes in Ghana were about 4 cm (except in the Densu Delta where it is 6 cm).
- Condition Index was generally higher in March for The Gambia, and in August-October for Ghana.
- The oysters from Bulock had the largest maturity size (5.6 cm), followed by Densu (5.4 cm), Allahein (5.3cm), Tanbi (5.2 cm), Whin (4.9 cm), and the smallest in Narkwa (3.6 cm).
- Densu and Tanbi oyster stocks are under exploited, Whin and Allahein are optimally exploited while Narkwa and Bulock stocks are overexploited.

Socioeconomics, oyster fishery, and governance:

- A general trend of better living conditions and an empowered women community of oyster harvesters were identified for the Tanbi in The Gambia among all the communities studied. The women shellfish harvesters of Tanbi are comparatively well-off considering the poverty indicator, wealth measured by household structure, and household income.
- Whin and Narkwa sites in Ghana have no existing structures for governing the oyster fishery. However, the other four sites have varied levels of governance structures and management mechanisms for the fishery, ranging from largely shellfisher and community-led management regimes (Allahein and Bulock) to formalized co-management regimes with exclusive use rights granted to the shellfishers by the government (for Tanbi and Densu).
- With regards to the involvement of shellfishers in decision making, the sites with governance structures and management regimes strongly integrate the women shellfishers in decision making processes.

Recommendations are for steps towards initiation of women-led co-management modalities at the sites without management modalities for the fishery in order to sustainably manage overexploited stocks at Narkwa in Ghana and Bulock in The Gambia, as well as at Whin in Ghana where they are fully exploited. Seasonal patterns of Fecal coliforms and *Escherichia coli,* as well as concentrations of Lead and Cadmium, found in oyster tissue indicate the need to consider seasonal closures to manage human exposure.

Full report: Chuku, E. O., Okyere, I., Adotey, J., Abrokwah, S, Effah, E., Adade, R. and Aheto D. W. 2021. Final Report: Site-Based Assessment of Oyster Shellfisheries and Associated Bio-Physical Conditions in Ghana and The Gambia. Centre for Coastal Management (Africa Centre of Excellence in Coastal Resilience), University of Cape Coast and Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Narragansett, RI, USA. 81p. https://www.crc.uri.edu/download/WSFS2022_05_CRC_FIN508.pdf

4.7 Sub-Activity 2e: Anemia research. (UG/URI Lead)

Activity Description:

The URI Department of Nutrition and Food Science and University of Ghana led the assessment of food security and anemia prevalence across the six field sites. Food security was measured using the Household Food Insecurity Access Scale (HFIAS), a questionnaire developed by the Food and Nutrition Technical Assistance (FANTA) II project that covers nine experiences of food insecurity over the past four weeks. Consumption of animal source foods (including oysters/shellfish) was assessed by using a food frequency questionnaire. Anemia was assessed using portable HemoCue devices to measure the hemoglobin concentration of women on site using one drop of blood obtained by finger prick. This technique is an inexpensive and excellent method for rapidly measuring hemoglobin in a small amount of blood in the field setting. It does not measure other blood indices that may be related to anemia (i.e., malaria). We used questionnaire interview data to investigate what background factors might be related to anemia in our sample (i.e., exposure to indoor smoke and

morbidity). At each of the six sites we planned to collect food insecurity and anemia data from 200 women (1200 total), giving an effect size of 0.3 (given 80 percent power and 0.05 level of significance) for cross site comparisons. Data from these parameters will also feed into the multivariate analysis.

The University of Rhode Island and the University of Ghana received a $114,588 award from the USAID Feed the Future Innovation Lab for Fish (FIL) to strengthen the nutritional research component of the Women Shellfishers and Food Security project. The award funds the following objectives:

- Determine the contribution of oyster consumption to iron and zinc intakes of women shellfishers.
- Determine whether there is any variation in iron and zinc content of oysters across the three study sites in Ghana.
- Investigate whether heavy metal contamination is a concern in the three study sites in Ghana.
- Provide guidance for public health authorities, women's shellfish associations, and other stakeholders.

To achieve those objectives, the award added two 24-hour dietary recall surveys to the three study sites in Ghana to provide a robust analysis of the total iron and zinc dietary intakes to determine what portion is coming from oysters. Conducting two dietary recall surveys is more expensive than the previously planned food frequency questionnaire, but it is the most accurate method in a community setting to measure total micronutrient intake. Additionally, the award funded collection and analysis of 305 oysters from each study site in Ghana for analysis of heavy metal contamination. While there is some preliminary data on heavy metal contamination in oyster tissue from a small sample of oysters collected in the study sites by UCC, this research will fund a well-powered analysis and deliver a strong dataset on the status of heavy metal contamination in oysters. The FIL data collection ran parallel with that of the Women Shellfishers and Food Security Activity. We collected oyster samples during the time of data collection and kept them in a -86 degree Celsius freezer at the Department of Nutrition and Food Science until laboratory analysis at the University of Ghana ECO Lab.

Summary of Results:

Oyster shellfishing offers a rich source of iron and other nutrients for women shellfishers in Ghana and The Gambia, where anemia prevalence among women remains high. Success at oyster shellfishing depends on appropriate management of local shellfisheries resources. In estuarine communities where the local shellfisheries resources are poorly managed, decreased oyster yields and availability could deny women shellfishers of a potentially vital resource for income and the prevention of household food insecurity, low dietary diversity, and anemia. We aimed to compare nutritional outcomes among women shellfishers 15-49 years of age living at three estuary sites in Ghana and The Gambia. We hypothesized that within each country, lower household poverty and higher oyster consumption (potentially resulting from increased oyster yields due to improved management of shellfisheries resources) would be associated with: (a) lower household food insecurity, (b) greater likelihood of achieving minimum dietary diversity for women (MDD-W), and (c) lower prevalence of anemia. In addition, we aimed to determine the mineral and heavy metal concentrations of oysters collected from three estuarine sites in Ghana and evaluate whether heavy metal contamination is of concern to the health of women shellfishers at these sites.

Figure 4 Phlebotomist measuring blood hemoglobin concentration in The Gambia (UG).

We conducted two cross-sectional surveys, one in Ghana and one in The Gambia. Within each country, the study participants were women shellfishers 15-49 years of age living at three oyster estuary sites selected according to three levels of mangrove ecosystem degradation and fisheries "health status". We collected information on the women's demographic and socioeconomic characteristics, household food insecurity, and consumption of food from different food groups by using a questionnaire. We estimated oyster consumption and nutrient intakes per day as the mean of the consumption or intakes from repeat 24-hour dietary recalls and determined blood hemoglobin (Hb) concentration using a Hemocue photometer. Women's poverty level was estimated using the wealth-poverty score (WPS), which was calculated by assigning a value of 1 (yes) or 0 (no) to each of 10 items (household ownership of a: 1) canoe, 2) phone, 3) TV, 4) fan, 5) refrigerator, 6) LPG stove; 7) main fuel used for cooking is liquified petroleum gas, 8) walls of house mainly made of cement, 9) consumption in the last month of corned beef, 10) purchase of eggs in the last month; total score range 0-10.) WPS values were classified as high (richer household) if ≥ the site median value or low (poorer household) if < the site median value. We defined "any oyster consumption" as oyster consumption > 0 g in the repeat 24-hour dietary recalls, and any anemia as Hb < 12 g/dl. Across estuary sites within each country, we compared mean oyster consumption and nutrient intakes (including iron intake from oysters) per day, household food insecurity, percent of women achieving the MDD-W, and anemia prevalence using ANOVA (SAS PROC GLM) for continuous variables and logistic regression (SAS PROC LOGISTIC) for binary variables. Within country, we used Poisson regression models (SAS PROC GENMOD) to determine whether WPS level (high/low) and any oyster consumption were associated with each of the following outcomes: (a) household food insecurity, (b) MDD-W, and (c) anemia. In each Poisson regression model, we controlled for estuarine site and additional covariates that were significantly associated with the outcome at 0.2 alpha in correlation analysis. Finally, we compared the mean mineral concentrations of oysters collected from

each of the three estuary sites in Ghana (total n = 915) by ANOVA and evaluated the potential health risks of exposure to heavy metals (cadmium, lead, and mercury) through oyster consumption among the women shellfishers. For all statistical analyses, the level of significance (α) was set at 0.05.

In Ghana, 504 women were recruited from the Densu (*highly degraded* mangrove ecosystem and *underexploited* fisheries health status, n = 200), Narkwa (*moderately degraded* mangrove ecosystem and *overexploited* fisheries health status, n = 166), and Whin (*less degraded* mangrove ecosystem and *fully exploited* fisheries health status, n=138) estuary sites from June 8, 2021 to July 16, 2021. Mean ± SD age (32 ± 9 y) did not differ by site (P = 0.30). Mean ± SD WPS was higher among the Densu (5 ± 3) and Whin (5 ± 2) women than the Narkwa (3 ± 2) women (P < 0.001) and the percentage of households with high WPS (≥ 4) was greater for the Densu (63%) and Whin (65%) sites than the Narkwa (37%) site (P <0.001). Only 13% of the women in Ghana consumed any oyster (> 0 g) in the repeat 24-hr recalls. Mean ± SD oyster consumption (g/d) was significantly higher among the Densu (9.6 ± 26.0) and Narkwa (6.7 ± 25.7) women than the Whin (0.3 ± 2.2) women, (P = 0.001); iron intake from oyster (mg/d) was significantly higher among the Densu women (0.4 ± 1.3) than the Whin women (0.02 ± 0.20), with that for the Narkwa women (0.3 ± 1.7) not significantly different from the other sites, (P = 0.009). Percentage of women with any household food insecurity did not differ by site (92% overall, P = 0.09), but the percentage with severe food insecurity was greater for the Narkwa site (85%) than the Densu site (72%), with the Whin site (79%) in between, (P = 0.012). Anemia prevalence (20% overall; P = 0.08) and the percentage of women who achieved the MDD-W (21% overall; P = 0.65) did not differ by site.

The multivariate Poisson regression models controlling for estuarine site and additional background factors associated with the outcome at 0.2 alpha level showed that WPS (high/low) related significantly (P = 0.021) in the opposite direction to household food insecurity, with 96% (95% CI: 93, 100) of women from richer households experiencing household food insecurity compared with 86% (95% CI: 79, 93) of women from poorer households. Apart from this, WPS (high/low) and any oyster consumption were not associated with household food insecurity, achievement of MDD-W, or anemia status.

The oysters collected from the three estuary sites in Ghana differed significantly in the mean concentrations of all the minerals and heavy metals measured, except cadmium. Mean ± SD (mg/kg wet weight) iron concentration was highest in the oysters from Narkwa (147 ± 142) followed by those from Densu (125 ± 91) and Whin (103 ± 87), P < 0.001. Nearly all of the oysters exceeded the EU/FAO regulatory maximum limit for the 3 heavy metals measured, cadmium, lead, and mercury. The combined impact of these three heavy metals ranged from 26 times the allowable Hazard Index (HI) value for oysters from the Whin site to 78 times the allowable HI value for oysters from the Narkwa site, with oysters from the Densu site in between at 32 times the allowable HI. Mercury contamination was the primary heavy metal responsible for the excessive HI values. Collection of samples in the June/July period of peak seasonal rains may also be a factor.

In The Gambia, 214 women were recruited from the Allahein (*highly degraded* mangrove ecosystem and *fully exploited* fisheries health status n = 35), Tanbi (*moderately degraded* mangrove ecosystem

and *underexploited* fisheries health status, n = 109), and Bulock (*less degraded* mangrove ecosystem and *overexploited* fisheries health status, n = 70) estuary sites from July 2-23, 2021. Mean ± SD age (31 ± 9 y, P = 0.06) and wealth-poverty score (overall: 5 ± 2; P = 0.35) did not differ by site and the percentage of households with high WPS (≥ 5) (overall: 62%; P = 0.46) was similar across sites. Only 7% of women in The Gambia reportedly consumed any oyster (> 0 g) in the repeat 24-hr recalls. Mean ± SD oyster consumption (1.9 ± 8.1 g/d, P = 0.74) and iron intake from oyster (0.06 ± 0.26 mg/d, P = 0.73) did not differ by site. The percentage of women with any food insecurity was greater for the Tanbi site (87%) than the Allahein site (66%), with the Bulock site (84%) in between and not significantly different from the other two sites (P = 0.018); the percentages of women with severe household insecurity (43%, P = 0.06), adequate dietary diversity (61%, P = 0.25), and anemia (41%; P = 0.55) were similar across sites.

The multivariate Poisson regression models controlling for estuarine site and additional background factors showed that the WPS level (high/low) related significantly (P = 0.001) in opposite direction to the achievement of MDD-W, with 43% (95% CI: 37, 51) of women from richer households achieving MDD-W compared with 62% (95% CI: 53, 73) of women from poorer households. Apart from this, WPS (high/low) and any oyster consumption were not associated with household food insecurity, achievement of MDD-W, or anemia status.

The conclusion is that household poverty and oyster consumption were not associated with food insecurity, dietary diversity, or anemia among women shellfishers in Ghana and The Gambia. The low oyster consumption among the women shellfishers in both countries may have led to the lack of any substantial impact on these outcomes. The women shellfishers likely sell a much greater proportion of the oysters they harvest than they consume and have a diet that depends more on other aquatic animal source foods (e.g., small pelagic fishes). Yet, in both countries, the women shellfishers mostly remain poor, so there is also no association of the women's household poverty level with their household food security, dietary diversity, or anemia. Recommendations include that further research is needed to: (a) explore how the women shellfishers in Ghana and The Gambia might use their shellfishery resources more effectively to prevent anemia, (b) assess selenium and heavy metal exposure among women shellfishers in Ghana using biomarkers, and (c) evaluate relationships between fish and shellfish intake, heavy metal, and selenium exposure, and health risk among women shellfishers in Ghana. Oysters offer a rich source of iron and other nutrients for women shellfishers in Ghana and The Gambia and currently appear to be underutilized in the diet, but efforts to promote oyster consumption in Ghana must be accompanied by appropriate steps to reduce heavy metal contamination (especially mercury) in the country's estuary waters.

Full report: *Adu-Afarwuah, S., Kyei-Arthur, F., Ali, Z., Oaks, B. (2022). Dietary Intakes, Food Security, and Anemia Prevalence among Women Shellfishers in Selected Estuary Sites in Ghana and The Gambia. Technical Report of Findings on Activity 2e and contributions to Activity 2d. University of Ghana Department of Nutrition, University of Rhode Island Department of Nutrition and Food Science and Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Narragansett, RI, USA. 53 pp.*
https://www.crc.uri.edu/download/WSFS2022_06_CRC_FIN508.pdf

4.8 Sub -Activity 2f: Coordinate theory of change review, data gathering, and multivariate analysis. (UCC/URI Lead: ICRAF, TRY, UG participation)

Activity Description:

URI, ICRAF, University of Ghana and UCC coordinated a multivariate and qualitative analysis of the dataset from the six sites to test the hypotheses stated in the award document. Data collection on all variables used Kobotoolbox or the ODK platform. Data was analyzed using statistical packages such as SPSS and using a variety of tests depending on data type. Survey data was supplemented with qualitative information based on local knowledge and secondary information. The write up of the findings includes discussion of potential confounding variables behind statistical correlations and qualitative relationships or acknowledges if no confounding variables are found. As part of documentation of the evidence base, we summarized knowledge and cross-sectoral connections relative to the various parts of the theory of change as to whether that evidence is weak, moderate, or strong, and extent to which our research findings have improved it or not, or if findings are counter to hypothesized assertions. The analysis is summarized in a report. Results of the study have been disseminated to the network of stakeholders involved in the regional assessment and the in-depth field work. For results related to nutrition and health, results will be shared with local health authorities who were engaged from the beginning of the process for guidance on the best method for sharing information with the community members. This will include potential benefits of shellfish consumption for a healthy diet and any identified risk due to heavy metal contamination or high levels of E. coli as an indicator of potential human pathogens.

Summary of Results:

The multivariate analysis report is a summary of a multivariate analysis of the theory of change model of the USAID Women Shellfishers and Food Security Project,

The theory of change model put forth by the project was:

> *IF women's shellfish livelihoods in coastal mangrove and estuarine ecosystems in The Gambia and Ghana are improved through gender and nutrition sensitive co-management and linkages made to community based forest management in the land/seascape, THEN mangrove and estuarine biodiversity will be improved, AND IF approaches for sustainable food producing livelihoods within the coastal mangrove land/seascape contribute to a nutritionally balanced local food supply, THEN household resilience, sustainable food systems, and nutrition will improve.*

We refined this model and developed four major hypotheses statements to be assessed through site-based research. These were:

- Hypothesis 1. Improved and gender equitable management of shellfisheries increases shellfish yields, which increases shellfish consumption and income of those engaged in shellfishing.
- Hypothesis 2. Shellfisher mangrove management actions improve mangrove habitat which in turn improves the health of shellfish stocks.

- Hypothesis 3. High consumption of shellfish and increased income from shellfishing contributes to lower prevalence of anemia in women of reproductive age and improves other nutrition variables. Shellfish consumption is a main contributor to reduced anemia compared to other factors such as geographic factors or household and individual characteristics.
- Hypothesis 4. Enriching landscapes around mangrove-shellfish estuaries systems with complementary food and nutrition sources reduces the extractive pressure on the mangroves thereby improving mangrove health and improves shellfisher household income and household food security.

There is existing evidence that co-management of mangroves and fisheries are effective good practices as well as evidence that improved mangrove habitat can increase fisheries yields. In West Africa, women play an important role in estuarine fisheries management through substantial harvesting of bivalves where women dominate all aspects of the value chain (Chuku et al., 2022a). There are two examples in West Africa where women shellfishers are successfully managing shellfisheries through a rights based, co-management approach which is also providing benefits for mangrove conservation (MOFAD, 2020; MFWR, 2012). This has good potential for scale up within the region. Less evidence exists on the impacts of improving proximate landscape food systems on food security and bio-diversity conservation, and nutritional benefits from shellfish consumption for women shellfishers. If demonstrated through this research, it would provide stronger empirical evidence for scaling up of and integrated approach of women-led shellfisheries management, mangrove management, and diversified food portfolios of shellfishing households in the proximate landscape.

Six sites in two West African countries were purposively selected for the study. These were the Densu, Narkwa, and Whin estuaries in Ghana, and the Tanbi, Allahein, and Bulock estuaries in The Gambia. Regional project partners collected field data including ICRAF, University of Ghana, TRY, and University of Cape Coast. We collected data on eight theme areas of the model:

1. Mangrove ecosystems
2. Shell fisheries
3. Estuarine water quality
4. Landscape level and household food systems
5. Governance of shellfisheries and mangroves
6. Empowerment of women shellfishers
7. Socio-economics of the shellfishery and of shellfishers:
8. Nutrition of women of reproductive age and household food security

Data was aggregated and used to empirically assess the hypothesized casual relationships in each of the four major hypotheses asserted above. We conducted statistical analysis for both case level analysis and site level analysis across the two countries and six sites combined.

The following is a summary the main findings from the analysis:

Hypothesis 1

- Sites with a higher governance score have a lower exploitation ratio and fishing mortality, and higher fishery health rank compared to sites with a lower governance score.
- Shellfish height - a shellfisheries health indicator - is greater in sites with a higher governance score.
- Fisheries health rank and mean shell height is higher and exploitation ratio and fishing mortality lower where women's empowerment scores are higher.
- Ghana sites have a higher mean temperature, pH, turbidity and a lower mean depth and salinity, as well as a shorter mean shell height than sites in The Gambia, but none of these differences were statistically significant.
- Underexploited sites have a greater mean shell height, a higher mean salinity and a greater mean depth compared to the fully and over-exploited sites but none of these differences were statistically significant.
- Underexploited sites have lower natural mortality rates as well as a higher mean salinity and a greater mean depth than fully and over-exploited sites.
- There were no statistically significant differences between the fishery health indicators and shellfish consumption or per capita food expenditures.
- Household income, shellfish livelihood dependency, and shellfish income are all higher in the underexploited sites. The poverty/wealth index shows higher poverty in the over and fully exploited sites. Livelihood diversity is lower in underexploited sites. However, only livelihood diversity and the poverty index showed statistical significance.
- There was no significant relationship between household income, livelihood dependence, shellfishing income or the poverty/wealth index and livelihood diversity.

Hypothesis 2

- There seems to be no relationship between shellfisher protections for mangroves and mangrove health for any of the measures used.
- There were no positive relationships between higher women's empowerment scores and higher mangrove health on any of any of the mangrove health parameters used.
- Total pressure scores were lower where mangrove health scores were higher, but not statistically correlated.
- There is no evidence to support the hypothesis that improved mangrove health leads to improved shellfisheries health.

Hypothesis 3

- Per capita food expenditure and shellfish income dependence were not related to any of the nutrition variables.
- Hb and anemia prevalence had significant correlations with income and wealth predictor variables that were opposite our expected direction.
- Dietary diversity score and dietary diversity adequate were positively correlated with the wealth-poverty score.

- The HFIAS score (a higher score means higher food insecurity) was negatively correlated with the household income rank and the wealth-poverty score.
- A food secure household was positively correlated with household income rank and the wealth-poverty score.

Hypothesis 4

- The mean household diverse food system score was higher where mangroves show the least improvement or show decline, and where median per capita food expenditure was lower which were opposite expectations.
- Sites with higher mean diverse food system scores have higher mean MDD-W scores, higher prevalence of households with adequate diets, higher mean income ranks and lower per capita food expenditures.
- Mean MDD-W and MDD-W adequate was higher where the mean years farmed was higher and where the number of visits to a local market weekly was higher, and lower where the mean distance to a local market and percent of female headed households were greater.
- Results suggest that households that are more experienced at farming and have more adults rely less on buying food and depend more on what they grow. In addition, results suggest higher household income in male headed households, households with more adults, where households are closer to local markets, and with more years of farming experience.
- There is weak evidence to support the hypothesis that reduced pressure and threats improves mangrove health.
- There is no evidence to support the hypothesis that increased shellfisher income or per capita food expenditure in shellfishing households will improve nutrition in shellfishing households.

Main conclusions form these findings for each hypothesis are below.

Hypothesis 1: There was evidence in this study that co-management and women's empowerment leads to improved shellfish stocks. There was little evidence that heathier shellfisheries result in higher shellfish consumption among women shellfishers, improved income, or lower poverty. There is no evidence that improved livelihood diversity improves shellfisher household income (see Table 4). Concerning the later conclusions, the cross sectional rather than time series research design, data collection methods, indicators used, and the small number of sites sampled in this study may have led to these negative findings. We recommend that those hypotheses not confirmed, regarding income and poverty, be further examined in subsequent studies. Other exogenous or local factors also may play a more important role.

Table 4: Summary of hypotheses and conclusions for hypothesis 1.

Hypothesis	Conclusion	Comments
Improved governance will improve the health of the shellfish resource.		A statistically significant trend of higher governance scores were observed with higher fisheries health rank and mean shell height. Lower fishing mortality and exploitation ratios had a higher governance score.
Women's empowerment will improve the health of the shellfishery.		Sites with a higher fisheries health rank and higher mean shell height had higher women's empowerment scores. Sites with higher fishing mortality and exploitation ratios had lower women's empowerment scores. These relationships showed statistical significance using either linear regression or spearman rho.
Physico-chemical parameters of the waterbody influences shellfishery health.		Qualitatively, underexploited sites have greater shell height, higher salinity and greater depth compared to the over and fully exploited sites. The Gambia sites have a lower mean natural mortality and greater mean shell height than Ghana sites, suggesting Ghana waterbodies environmental conditions may be less conducive for oyster growth and survival. However, trends were not statistically significant when comparing site level means.
Improved shellfishery health increases shellfish consumption.		No evidence to support this. However, we had no data on shellfish yields per harvester so while shellfisheries health was used as an indicator, yields per harvester may be a better approach to this question in the future.
In sites with healthier shellfisheries, women shellfishers have higher shellfishing income, overall household income, and lower poverty rates.		Little evidence to support this. Only when underexploited sites were compared to over and fully exploited sites was there a statsitically significant relationship with the poverty indicator.
Greater livelihood diversity is related to higher household income.		There was no significant relationship between household income, livelihood dependence, shellfishing income, or the poverty/wealth index and livelihood diversity.

Hypothesis 2: There was no evidence in this study that shellfisher protections or legal site protections (RAMSAR sites in these cases) improve mangrove health. (see Table 5). This suggests potential weak or non-existent implementation of RAMSAR plans and that shellfisher efforts at protection are not sufficient to see changes in mangrove heath at the site level. Qualitatively, there was weak evidence that where pressures and threats were lower, mangrove health was higher. This aspect of the theory of change deserves further investigation. We recommend more detailed analysis and weighting for measuring severity of threats. The USAID guidelines for rating direct threats may provide a useful approach (USAID, 2017). We found no relationship between mangrove health and shellfish health even though the existing scientific literature suggests a relationship between mangroves and fish yields (Aburto-Oropeza, 2008; Hutchison et al., 2014; Anneboina and Kumar, 2017). Again, future studies can improve the measures used in our study by factoring in overall mangrove area in relation to the number of shellfishers per unit of mangrove area and harvests per shellfisher, measures not used in

this study. In addition, while mangroves may play a role, fishing effort, exploitation levels, and shellfish governance factors may be the overwhelmingly main drivers regardless of mangrove health. For example, Densu has few mangroves but a healthy and well-managed shellfishery. Tanbi has an abundance of mangroves and a healthy and well-managed shellfishery as well. Extent of mangrove habitat in an estuary may be more related to the overall potential total of shellfish yields at the site rather than have any impact on exploitation levels. We did not assess this relationship in our study, but it has evidence in the scientific literature (Anneboina and Kumar, 2017).

Table 5: Summary of hypotheses and conclusions for hypothesis 2.

Hypothesis	Conclusion	Comments
Shellfisher protection and or legal site protection of mangroves will strengthen mangrove health.		There seems to be no relationship between shellfisher protections or legal site protection for mangroves and mangrove health. Therefore, it is likely that other factors are influencing mangrove health.
Women's empowerment will improve mangrove health.		There were no positive relationships between higher women's empowerment scores and increased mangrove health for any parameters used in this study.
A reduction in total pressures/threats will improve mangrove health.		Weak evidence of a relationship where total pressure scores were lower where mangrove health scores were higher, but not statistically correlated.
Improved mangrove health improves shellfish health.		There is no evidence to support the hypothesis that improved mangrove health leads to improved shellfisheries health even when examining only The Gambia sites.

Hypothesis 3: There was no evidence in our study that increased shellfish consumption decreases anemia levels (see Table 6). Low consumption levels of oysters by women shellfishers being the main reason. While oysters are a good source of iron and zinc, consumption levels would have to increase by a large amount to have any real impact. However, Adu-Afarwuah et al. (2022) advised not to promote increased consumption due to substantial health risks from heavy metal contamination in oyster tissues in Ghana sites, most notably of mercury. Government agencies should identify local sources of contamination and work to reduce heavy metal loading into the estuaries. This study did suggest that increased household income and greater wealth improves food security and having adequate dietary diversity, but unrelated to shellfish income. However, Adu-Afarwuah et al. (2022), using a different approach (Poisson regression and assessing each country separately), showed opposite results not supporting this hypothesis. Given the conflicting evidence depending on approach used, this hypothesis is worthy of further study.

Table 6: Summary of hypotheses and conclusions for hypothesis 3.

Hypothesis	Conclusion	Comments
Increased shellfish consumption decreases anemia and increases Hb in the blood.		No evidence. Consumption levels are low.

Hypothesis	Conclusion	Comments
Increased shellfish consumption improves nutrition.		No evidence. Consumption levels are low.
Increased shellfish income and household wealth improves nutrition.		Statistical evidence that household income and wealth improve food security and dietary diversity but no evidence they reduce anemia or increase Hb levels in the blood.

Hypothesis 4: There was no evidence from our study that improving proximate landscape livelihoods reduces pressure and threats to mangroves or improves mangrove health (see Table 7). Our study suggests that increasing proximate landscape livelihoods increases household income but decreases per capita food expenditures due to more reliance on locally grown food and reducing the need to purchase food. Household characteristics can also influence nutrition, household income, and food expenditures. There was no evidence that higher household income or per capita food expenditure in shellfishing households improves MAHFP or dietary diversity. This is confusing with findings in hypothesis 3 which showed household income and wealth influenced other nutrition measures - the HFIAS score and being food secure. While the wealth measure was related to dietary diversity, household income and shellfisher income were not. Hence, while there were mostly negative findings on dietary diversity measures (except when using the wealth-poverty score) in the hypothesis 4 analysis, there was supporting evidence for the food security measures in the hypothesis 3 analysis. Chegini et al. (2021) have shown that food security in rural areas of Iran has complex associations with income, household welfare, and other household characteristics that are similar to our findings. Given the mixed results and complexity of relationships, more in-depth research is needed with respect to shellfishing household income, wealth, various nutrition measures, and other potential factors, with some factors having more influence than others.

Table 7: Summary of hypotheses and conclusions for hypothesis 4.

Hypothesis	Conclusion	Comments
Improvements in proximate landscape livelihoods reduce pressure and threats to mangroves.		No evidence to support this.
Improvements in proximate landscape livelihoods improve mangrove health.		Most of the mangrove indicators were not related to the proximate food systems score except a weak correlation with mangrove health rank.
Improvements in proximate landscape livelihoods improve nutrition of shellfishing households		Weak correlations with the dietary diversity variables but not with the minimum adequacy of household food provisioning score.

Hypothesis	Conclusion	Comments
Improvements in proximate landscape livelihoods increases income and food expenditures from proximate livelihood and food systems.		Weak statistical evidence that improvements in proximate landscapes increase household income but reduce per capita food expenditures. The relationship between improved landscape livelihoods and food expenditure was opposite expectations but suggests as households grow more diverse food themselves, they seem to rely less on food purchases, most likely by consuming more of what they grow.
Other explanatory variables may improve nutrition of shellfishing households, as well as increased income or food expenditures from proximate livelihood and food systems.		Statistical evidence that several explanatory variables - years farmed, number of visits to a local markets weekly, distance to a local market, and female headed household seem related to dietary diversity measures.
Increased shellfisher income, household income or per capita food expenditure in shellfishing households will improve nutrition in shellfishing households.		No evidence to support this.

Full report: *Crawford, B., Adu-Afarwuah, S., Oaks, B., Kyei-Arthur, F., Chuku, E. O., Okyere, I., Duguma, L., Carsan, S., McMullin, S., Muthee, K., Bah, A., Orero, L., Janha, F., Arnold, C. D., Kent, K. (2022). The women shellfishers and food security project: multivariate analysis of the theory of change model. Centre for Coastal Management, University of Cape Coast; World Agroforestry; Department of Nutrition and Food Science, University of Ghana; Department of Nutrition and Food Science and Coastal Resources Center, University of Rhode Island. Narragansett, RI, USA. 105 pp.* https://www.crc.uri.edu/download/WSFS2022_10_CRC_FIN508.pdf

4.9 COVID-19 Mitigation and Adaptation Measures.

The project partners and their field teams have been applying the mitigation measures for implementation of Activity 2 and sub-activities 2a to 2f in accordance with safety standards to prevent the spread of COVID-19 described in the project's COVID-19 Implementation Plan and have been using and distributing personal protective supplies as included in the project budget. International travel was undertaken on the project between Ghana and The Gambia and from Kenya to Ghana and The Gambia in mid-FY 2021 and in FY 2022. Anecdotal information from field visits in The Gambia and reported by TRY are that project visits have helped to raise the awareness of the women harvesters that COVID-19 is real, that they are at risk, and to educate them about and model the risk reduction measures they should be taking. An October 2021 series of photo essays by the Associated Press on Covid-19 and The Gambia's women oyster harvesters highlights their attitudes about vaccines and the gender gap on vaccines in Africa.

Anecdotal information from TRY Oyster Women's Association in The Gambia and Development Action Association in Ghana that supports the Densu Oyster Picker's Association indicate that there were significant impacts of the COVID-19 pandemic directly on women's shellfish livelihoods in 2020 and 2021 as markets closed cutting off revenue and as alternative sources of revenue upon which

women shellfishers traditionally depend also dried up, in The Gambia due to COVID-19 and in Ghana due to the longstanding decline and recent collapse of the small pelagic fishery due to overfishing. TRY reports that in The Gambia there was even more extreme pressure on shellfish resources in these years, even if they are easing somewhat in 2022. Due to the widespread economic hardship caused by COVID-19, many additional people, most of whom are not trained in best practices, harvested oysters in 2021 as the season opened. As a result of the influx, the usual practice of rotating harvesting days to extend the harvest over four-months was not being applied and the harvest ended after less than 3 months. These types of impacts will need to be considered in the analysis of research findings.

5. ACHIEVEMENTS ACTIVITY 3: Foster a community of practice around the development of a toolkit

Building on the participatory regional assessment of shellfisheries in West Africa, and site-based research in Ghana and The Gambia, project partners and stakeholders from the 11 coastal West African countries from Senegal to Nigeria contributed to the development and finalization of the Women Shellfishers and Food Security Toolkit on women's shellfisheries co-management. In addition to project partners, the University of Rhode Island, the World Agroforestry Center (ICRAF), the University of Cape Coast, the University of Ghana, and TRY Oyster Women's Association in The Gambia, this included the network of in-country focal persons (ICFPs) engaged by UCC from the 11 countries, Senegal, The Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, and Nigeria. The 11 ICFPs led stakeholder outreach in their countries and are connected to UCC and with one another on a WhatsApp group. They have maintained relationships with country level stakeholders in the sector over the two years of the project to date.

UCC as the lead on this component has generated a significant stakeholder list with representation from all of the project's target countries, and more importantly from the key groups, i.e., women resource users, government departments, and academia, as well as NGOs and regional organizations. UCC's Center for Coastal Management (UCC/CCM) is at the heart of this network as envisaged at the conception of the project (see Figure 5).

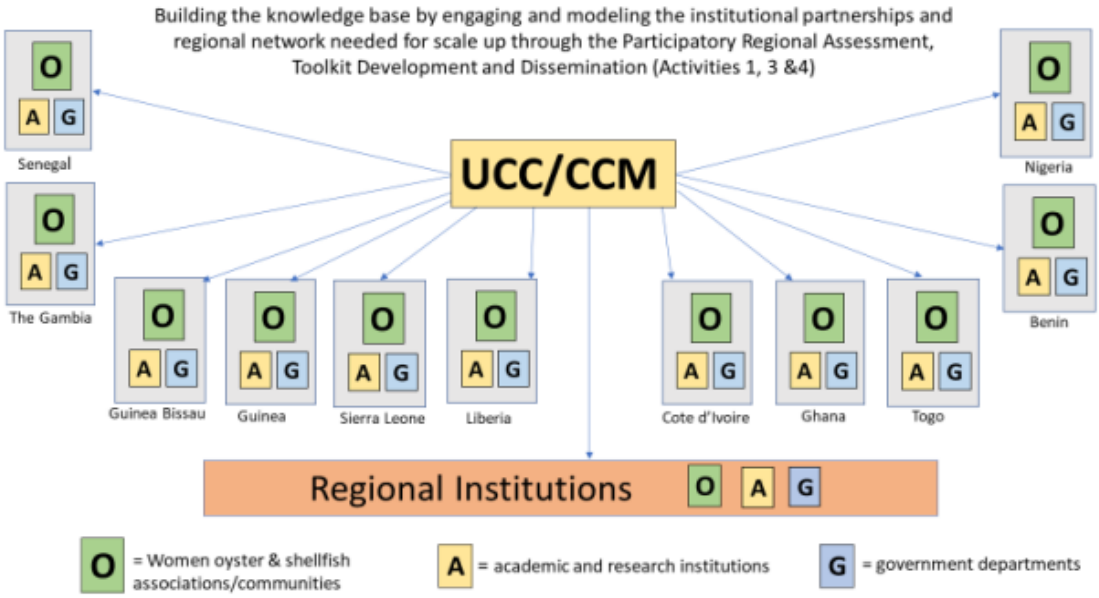

Figure 5: Graphic depiction of the stakeholder network and community of practice envisaged at the project planning stage.

Consequently, for the first time ever in West Africa, stakeholders with interest in women-led shellfisheries were brought together on one platform to discuss women shellfisheries virtually. The Women Shellfishers and Food Security project organized and hosted a day-long virtual West Africa workshop on March 21, 2022 where the findings of the regional assessment were presented. A draft of the toolkit was also presented and stakeholders provided input on its development. More than 84 stakeholders from 11 countries in West Africa participated in this workshop. These included 20 females and 5 males from resource user groups, and 13 participants from government (including departments of fisheries and environment), and an additional 46 from academia, NGOs, regional institutions, and projects. Project partners also met separately in March and September 2022 with the FAO FISH4ACP project that is focusing on shellfish value chains in The Gambia and Senegal to identify synergies. FISH4ACP presented their project at the March 21, 2022 workshop. Communication and sharing of documents have continued between the Women Shellfishers and Food Security project and FISH4ACP to date as FISH4ACP works towards identifying its interventions.

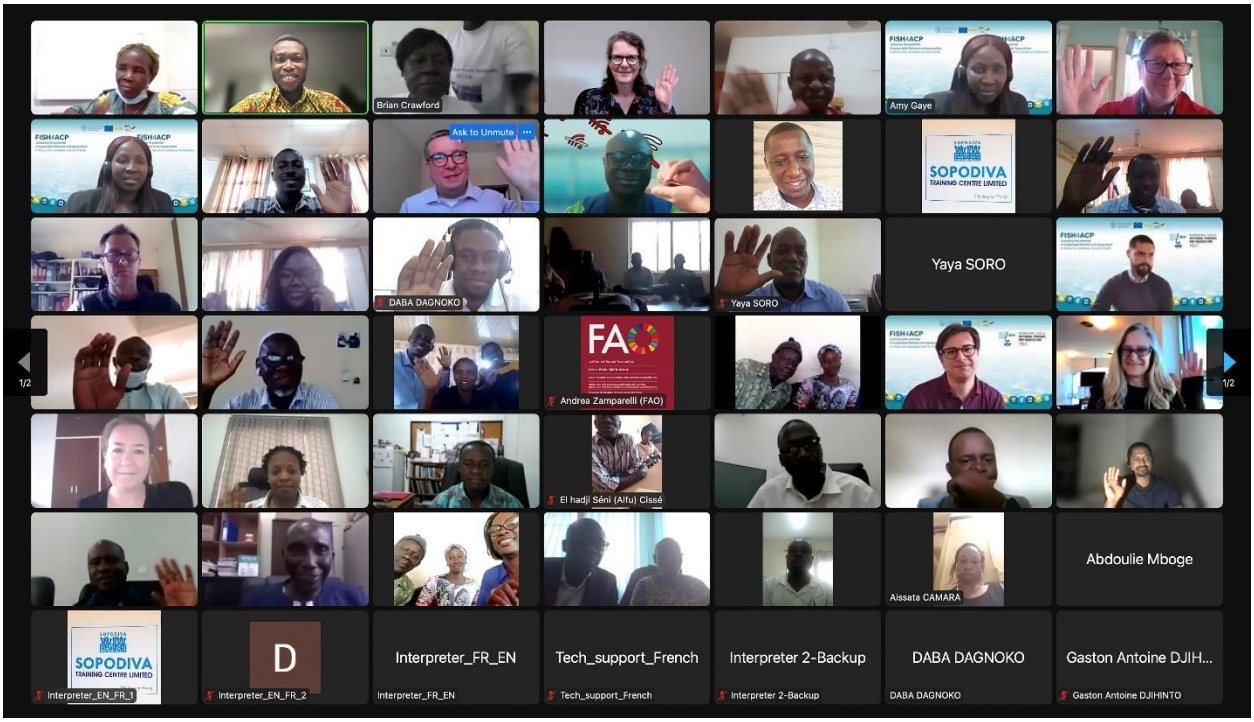

Figure 6: Screenshot of some of the participants in the March 21, 2022 West Africa regional workshop.

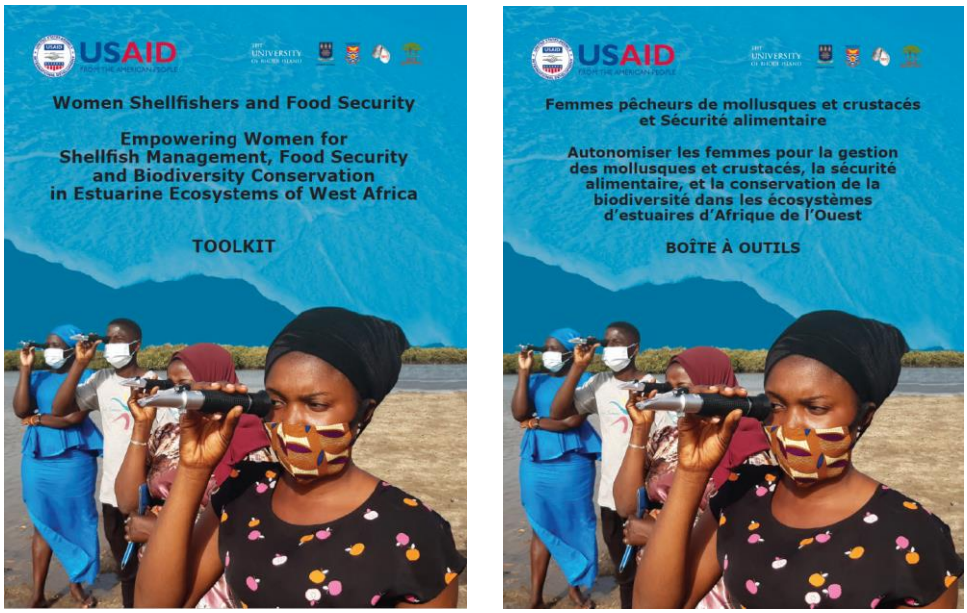

Figure 7: Toolkit Cover images in English (left) and French (right) (hyperlinked).

The Empowering Women for Shellfish Management, Food Security and Biodiversity Conservation in Estuarine Ecosystems of West Africa Toolkit is available online in English and French.

The toolkit presents a participatory, gender-equitable, rights-based, ecosystem-based, co-management approach to managing shellfisheries and associated mangrove ecosystems in West Africa. It aims to equip diverse groups of local, national, and regional level stakeholders to apply successful approaches. It covers: Basics on the biology and ecology of the major shellfish species harvested by women in West Africa; Key principles and best practices; A thirteen step co-management planning process; Management measures, including consideration of associated mangrove ecosystems and land/seascape food production systems; and annexes that show stakeholders how the approach aligns with the United Nations Sustainable Development Goals (SDGs) and the FAO Voluntary Guidelines for Securing Sustainable Small Scale Fisheries.

Annex J of the Toolkit contains hyperlinks to all of the Women Shellfisher and Food Security project studies, including the West Africa regional shellfisheries assessment synthesis report, 11 country reports, and 8 technical reports. These are also cited and hyperlinked in Annex 2 of this report.

Two project researchers pursue graduate degrees on West Africa shellfisheries topics

Site-based research activities presented an excellent avenue to engage graduate students at the University of Cape Coast and the University of Ghana as part of the capacity building and community of practice objectives of the project.

At UCC, Ms. Aisha Abdallah, a second-year Master of Philosophy in Fisheries Science candidate who had keen interest in oyster fisheries was selected for the opportunity to work with the project on her Master's thesis. Aisha is an exceptional student who studied under the World Bank Africa Centre of Excellence in Coastal Resilience program at UCC. She had her Bachelor's degree from the University of Ghana in Fisheries Science and served teaching assistant at the Department of Marine and Fisheries Sciences during her mandatory national service. Aisha has an avid interest in the assessment and modelling of fisheries resources and hopes to model oyster stocks towards its sustainable use and management.

UG, engaged Francis Z. Taabia in project work for his Ph.D. research training. Francis is working on a research topic "Nutritional status and food security of women shellfishers and the potential role of oysters as a source of dietary minerals and trace elements in three estuarine sites in Ghana". He coordinated and managed the field data collection among the women shellfishers (including the women's background socioeconomic characteristics, household food insecurity, and a repeat 24-hour dietary intake) and led the oyster sample collection at the three estuarine sites in Ghana. Subsequently, he assisted with the mineral concentrations analysis of the oyster samples at the University of Ghana Ecological Laboratory, including learning the technical procedures involved in those analyses. Francis has started writing up his dissertation and is expected to complete his Ph.D. training in August 2024.


Aisha Abdallah, UCC


Francis Z. Taabia, UG

6. ACHIEVEMENTS ACTIVITY 4: Toolkit and Participatory Regional Assessment Dissemination

The engagement of stakeholders to champion dissemination of both the Regional Assessment and the Toolkit began in Year 1 with the participation of ICFPs and other stakeholders in the participatory regional assessment. It continued in Year 2 at the March 21, 2022 workshop as described above. Engagement of these stakeholders in Toolkit development created a strong foundation for dissemination/Training of Trainers on the final Toolkit at a second virtual regional workshop on July 12, 2022. The results of the multivariate analysis of site-based research were also presented at this workshop.

A total of 120 participants from 64 institutions across the 11 coastal West Africa countries participated in the July workshop, including more than 29 percent of participants (at least 24 females and 11 males) from resource user groups. As a result of this and the March 2022 workshop, 168 people were trained in sustainable natural resources management and/or biodiversity conservation as a result of USG assistance, and 64 organizations, including 10 resource user organizations, 19 government entities, 23 academic and research organizations, and 12 NGO's and others received technical capacity development support in women's shellfisheries co-management in West Africa. Of these, a total of 14 host country higher education institutions received capacity development support with USG assistance.

The dissemination to date of project results and products is detailed in Table 8. A total of 24 dissemination activities have been undertaken, including 2 virtual regional workshops, 8 conference or session presentations (6 done, 2 prepared and submitted), 3 peer reviewed journal papers (1 published, 2 submitted), 10 on-line platforms, and 1 set of 170 professionally printed Toolkit hard copies in English and French for distribution.

Table 8: Dissemination activities and platforms.

No.	Activity	Date	Project Products	Audience
1	Conference session at Cultivating Equality: Advancing Gender Research in Agriculture and Food Systems organized by the CGIAR Gender Platform. https://gender.cgiar.org/conferences/cultivating-equality-2021-conference/women-shellfishers-and-food-security-west-africa	Oct. 12-15, 2021	Regional Assessment and Preliminary findings of site-based research in Ghana and The Gambia	Development practitioners, academia, global.
2	Side event panel presentation under the USAID Fish Innovation Lab at the 2021 Borlaug Dialogue on Nutrition https://www.worldfoodprize.org/index.cfm/96455/98430/tel:+1515-245-3783	Oct. 19, 2021	Activity 2e	Policymakers and other government officials, representatives of the private sector, officials of international organizations, academics, farmers, scientists, students and educators. Global.
3	Presentation to ATLAFCO Blue Economy Conference https://www.comhafat.org/en/files/agenda/doc_agenda_408101108.pdf	Dec. 1-3, 2021	Regional Assessment	Ministerial Conference on Fisheries Cooperation among African States bordering the Atlantic Ocean.
4	Project Virtual Regional Workshop 1 (English and French interpretation). Workshop recording: https://youtu.be/MD-IJJ5Useg	Mar. 21, 2022	Regional Assessment Draft Toolkit	84 participants from WA including resource users, government, academia, NGOs, and regional organizations (more than 25 were resource users from 11 WA countries of which 80% were female; 13 were government representatives with at least one from each of the 11 countries.).
5	Presentation for Ghana Study Tour to URI	May 8-22, 2022	Regional Assessment	Ghana Ministry of Fisheries and Aquaculture Development, Parliamentarians, Ghana Industrial Trawlers Association (GITA).
6	Project Virtual Regional Workshop 2 (English and French interpretation) Final Toolkit - Workshop recording: https://youtu.be/57JUcX67qGQ	July 12, 2022	Multivariate Analysis Report Final Toolkit	120 participants from WA including resource users, government, academia, NGOs, and regional organizations (more than 35 were resource users from 11 WA countries of which 69% were female; 22 were government representatives from each of the 11 countries with two or more from every country except Sierra Leone).
7	Centre for Coastal Management, University of Cape Coast (YouTube): https://www.youtube.com/channel/UC5aYtBTV9YP_YECkrvQBcJw	Mar. 22 and July	Virtual Regional Workshops 1 and 2 Recordings on Regional Assessment	38 subscribers. 30 and 22 views respectively since posting (as of 9/22/2022).

No.	Activity	Date	Project Products	Audience
		16, 2022	Multivariate Analysis Report Final Toolkit	
8	Chuku EO, Effah E, Adotey J, Abrokwah S, Adade R, Okyere I, Aheto DW, Kent K, Osei IK, Omogbemi ED, Adité A, Ahoedo K, Sankoh SK, Soro Y, Wélé M, Saine DF and Crawford B (2022) Spotlighting Women-Led Fisheries Livelihoods Toward Sustainable Coastal Governance: The Estuarine and Mangrove Ecosystem Shellfisheries of West Africa. Front. Mar. Sci. 9:884715. doi: 10.3389/fmars.2022.884715	July 18, 2022	Regional Assessment	1,450 views as of 9/29/2022.
9	News on IMBeR Platform: https://imber.info/news/fisher-women-champion-sustainable-ocean-governance/	Sept. 8, 2022	Regional Assessment	Interdisciplinary marine research community. Global.
10	USAID DEC website: https://dec.usaid.gov/dec/home/Default.aspx	2021-2022	All English and French products (see links in Bibliography)	Development practitioners, global. The largest online resource for USAID funded technical and project materials for international development.
11	URI/CRC website https://www.crc.uri.edu/projects_page/	2021-2022	All English and French products (see links in Bibliography)	Coastal communities and stakeholders, development practitioners, policymakers, and academia, U.S. and international.
12	UCC/CCM website https://ccm.ucc.edu.gh/project/women-shellfishers-and-food-security-project-ucc-subgrant	2021-2022	All English and some French products (see links in Bibliography)	Coastal communities and stakeholders, development practitioners, policymakers, and academia Africa-wide.
13	Centre for Coastal Management, University of Cape Coast (Twitter): https://twitter.com/ccm_ucc	Sept. 8, 2022	Regional Assessment	245 followers.
14	Research Gate: https://www.researchgate.net/project/Women-Shellfishers-and-Food-Security-Project-West-Africa	Aug. 29, 2022	Regional Assessment	10 reads as of 9/22/2022.
15	4th World Small-Scale Fisheries Congress (4WSFC) Africa https://www.4wsfcongress.com/africa-november-2022 participation in an accepted panel session on women/gender in small-scale fisheries.	Nov. 21-23, 2022	Regional Assessment	150 'in-person' participants plus virtual (Africa-wide).
16	Toolkit hard copies printed for distribution	Sept. 2022	Toolkit	Project stakeholders. English 100 copies. French 70 copies.

No.	Activity	Date	Project Products	Audience
17	Toolkit links in English and French redistributed by email to more than 120 stakeholders	Aug. 2022	Toolkit English and French	More than 120 stakeholders in 11 countries and regional.
18	ICRAF website https://worldagroforestry.org/publication/women-shellfishers-and-food-security-project	Aug. 2022	Toolkit	Development practitioners, policymakers, researchers, and communities.
19	ICRAF Blog https://www.worldagroforestry.org/blog/2022/09/06/how-women-shellfishers-can-be-empowered-conserve-coastal-biodiversity	Sept. 6, 2022	Toolkit	Development practitioners, policymakers, researchers, and communities.
20	Presentation of Activity 2e findings at the Feed the Future Innovation Lab for Fish Annual Meeting	Aug. 9-11, 2022	Technical Report Activity 2e	Principal Investigators, Co-Principal Investigators, Management Entity Partners, and External Advisory Board.
21	Issoufou Liman (2021) The state of mangrove vegetation in Ghana based on historical Landsat observation USAID Women shell fishers and Food security project. Internal ICRAF Seminar. (ref. Activity 2a).	Sept. 23, 2021.	Technical Report Activity 2a	Project partners and affiliated subject area experts.
22	Issoufou Liman Harou, Inyele Inyele, Peter Akong Minang and Lalisa Duguma (2022). The state of mangrove forests of The Gambia based on harmonic modelling of Landsat and MODIS time series. Journal: Frontiers in Forests and Global Change, section Tropical Forests (Submitted). (Ref. Activity 2a).	2022	Technical Report Activity 2a	Scientists, policy makers and the public to advance our understanding of how forests 'work.
23	Issoufou Liman Harou et al. (2022). Estimating the dynamics of Ghanaian mangrove cover using phenological metrics derived from synoptic Landsat observations. International Journal of Applied Earth Observation and Geoinformation (Submitted) (Ref. Activity 2a) https://track.authorhub.elsevier.com/?uuid=81ca3c1a-7780-44b7-aed6-db683149b3e2	April 22, 2022	Technical Report Activity 2a	Researchers.
24	Submission of abstract panel presentation at the American Public Health Association (APHA) Conference in Boston. " *The potential nutritional benefits and health risks of oysters in Ghana: results from the Women Shellfishers and Food Security (WSFS) Project*" (https://www.apha.org/events-and-meetings/annual). (Ref. Activity 2e)	Nov. 6-9, 2022	Technical Report Activity 2e	Public health experts.

7. LEARNING QUESTIONS

In the Program Description and the Monitoring, Evaluation and Learning Plan, the project identifies some key questions and challenges to be addressed by the theory of change that have been tested in the site-based research and discussed in depth in the multivariate analysis presented in Section 4.8 above (sub-Activity 2f). These constitute the project's focus for Learning Questions as follows:

The project addresses the challenge identified in the AFR BAA under **Area of Interest #2: Regional dimensions of the nexus of sustainable Natural Resources Management (NRM) and food systems** concerning the need for tools, approaches, and processes to enable and promote regional sustainable food systems and NRM. The project will also address **Area of Interest #1: Sustainable NRM and Food Systems** concerning cross-sectoral integration and synergies between food production systems and the environment.

Key Question 1: What is the extent of socio-ecological benefits provided by empowering women shellfish harvesters to co-manage estuarine shellfisheries as a means to conserve mangrove ecosystems in coastal West Africa? By co-management, we mean the sharing of decision making between resource users and government authorities over the goals of management, choice of management actions as to how resources will be managed sustainably, who can harvest and defining the resources and areas where user rights are provided.

Key Question 2: Can the basic and well proven model linking shellfish management and mangrove conservation be expanded into a more integrated approach that provides cross sectoral benefits within the coastal mangrove seascape and adjacent landscape for sustainable food production and a nutritionally balanced food supply that contributes to improved nutritional wellbeing of this marginalized group?

Key Question 3: What is the potential for women's shellfish co-management to provide an entry point for integration with community-based forestry management approaches demonstrated in the region to better address some of the key threats of mangrove degradation and the gender dynamics of those threats?

The project's comprehensive approach to addressing these questions integrates concerns over the differential levels of access to, and utilization of natural resources (shellfisheries and mangroves) by vulnerable groups (marginalized women shellfish harvesters) and has, within the limitations of the project's site-based research to date, articulated the implications of these dynamics for promoting cross-sectoral programming towards USAID goals of sustainable NRM and broad-based economic growth in coastal communities. Learning question results were shared, discussed, and disseminated in the form of a presentation on the multivariate analysis findings as part of the Activity 4: Dissemination activities at the Project Virtual Regional Workshop 2 attended by 120 stakeholders.

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8. EXPECTED OUTCOMES AND INDICATORS OF ACHIEVEMENT

The expected project results and output and outcome indicators for FY22 have been achieved as detailed in Table 9 below and the accompanying explanation of indicators..

Table 9: Performance Indicator Tracking Table.

Indicator	Base -line	Year 1 (FY 21)			Year 2 (FY22)			Phase I Total/Original LOP			Comments
		Target	Actual	% target v. actual	Target	Actual	% target v. actual	Target	Actual	% target v. actual	
Number of research results documented and available (AFR/SD Custom Indicator STIR-1-UAF: Special Studies (Resources for Missions)	0	1	0	0%	6	18	300%	7	18	257%	1 Participatory Regional Assessment of Shellfisheries (submitted to USAID in October 2021 (Year 2) 10 Shellfisheries Country Assessment Reports 6 Technical Reports (Activity 2a, 2b Ghana, 2b The Gambia, 2c, 2d, 2e) 1 Consolidated Multivariate TOC Report (Activity 2f)
Research hypotheses or alternative findings are validated by research results.	0	0			Tracked	Done	100%	Tracked	Done	100%	100% tracked: 7 of the 19 relationships tested were validated 1 of the 19 relationships tested had limited validation 11 of the 19 relationships tested were not validated
Number of shellfish and mangrove stakeholders that: ● Have increased awareness of the basic concepts embodied in the theory of change,	0	0			74	67	91%	74	67	91%	40% of 168 workshop participants from 11 countries including resource users, government, academia, NGOs and regional/actors meeting at least one criterion.

Indicator	Base-line	Year 1 (FY 21)			Year 2 (FY22)			Phase I Total/Original LOP			Comments
		Target	Actual	% target v. actual	Target	Actual	% target v. actual	Target	Actual	% target v. actual	
• Have tools to design interventions to achieve TOC intended outcomes, • Are networked regionally, • Some identify plans or resources to pursue opportunities for scale up.											
Number of people trained in sustainable natural resources management and/or biodiversity conservation as a result of USG assistance (USAID Standard Indicator EG.10.2-4)	0	0	22 20 F 2 M		74	168 77 F 91 M	227%	74	190 97 F 93 M	257%	In FY 22, 168 participants trained included more than 60 resource users (of which 44 (73%) were female), government, academia, NGOs, and regional stakeholders from each of the 11 countries. 46% of all participants were female.
Number of Toolkits produced	0				1	1	100%	1	1	100%	https://pdf.usaid.gov/pdf_docs/PA00ZHT6.pdf
Number of Dissemination Activities	0	0			17+	24	141%	17+	24	141%	See Table 8 above. -2 Virtual Regional workshops -8 conference or session presentations (6 done, 2 prepared and submitted) -3 peer reviewed journal papers (1 published, 2 submitted). -10 on-line platforms. -1 set of 170 Toolkit hard copies for distribution.
Number of institutions receiving capacity development support	0	0			37	64	173%	37	4	173%	Organizations include: 10 Resource user

Indicator	Base-line	Year 1 (FY 21)			Year 2 (FY22)			Phase I Total/Original LOP			Comments
		Target	Actual	% target v. actual	Target	Actual	% target v. actual	Target	Actual	% target v. actual	
(AFR/SD Custom Indicator CBLD-9-UAF).											19 Government 23 Academic/research 12 NGO/other
Number of host country higher education institutions receiving capacity development support with USG assistance (AFR/SD Custom Indicator ES.2-1)	0	0			11	14	127%	11	14	127%	One or more higher education institutions from 9 of the 11 West Africa countries (except Guinea, Guinea-Bissau, and Liberia).

Explanation of Indicators

Number of research results documented and available (AFR/SD Custom Indicator STIR-1-UAF: Special Studies (Resources for Missions)).

The 18 research results documented and available that are reported for FY 22 representing a 300% achievement of the FY 22 target include:

- 1 Participatory Regional Assessment of Shellfisheries (submitted to USAID in October 2021). The production of this synthesis report began with a Literature Review that is also available but was not reported as a separate research result.
- 10 Shellfisheries Country Assessment Reports, including Senegal, The Gambia, Guinea Bissau, Sierra Leone, Liberia Cote d'Ivoire, Ghana, Togo, Benin, and Nigeria. The Guinea country report is in process, but not yet final and available. The country assessments were originally envisioned as chapters of the regional assessment report but were finalized as stand-alone reports/research results to facilitate accessibility for audiences with a national focus and to provide research results in a format that is more accessible in length. Reporting of these as individual research results accounts for the high percentage of overachievement on this indicator.
- 6 Technical Reports (Activity 2a, 2b Ghana, 2b The Gambia, 2c, 2d, 2e). Five 5 Technical Reports on site-based research in The Gambia and Ghana on 5 theory of change topics were originally planned. These became six reports as the Activity 2b research was reported in separate documents for Ghana and The Gambia. A site selection report was also produced as an initial step of the site-based research. That report is available but was not reported as a separate research result.
- 1 Consolidated Multivariate Theory of Change Analysis Report (Activity 2f).

Citations for each of these reports and links to their on-line locations are provided in the Bibliography (see Annex 2).

Research hypotheses or alternative findings are validated by research results (Project Custom Indicator).

Research hypotheses were tracked for validation (or not) representing 100% achievement of this indicator in FY22. The status of validation of the theory of change linkages analyzed are documented in the report on the multivariate analysis of the theory of change model and summarized in Tables 4-7 of this report. The status of validation is as follows:

- 7 of the 19 relationships tested were validated.
- 1 of the 19 relationships tested had limited validation.
- 11 of the 19 relationships tested were not validated.

Number of shellfish and mangrove stakeholders that: Have increased awareness of the basic concepts embodied in the theory of change; Have tools to design interventions to achieve TOC intended outcomes; Are networked regionally; Some identify plans or resources to pursue opportunities for scale up (Project Custom Indicator).

An estimated 67 (40 percent) of a total of 168 shellfish and mangrove stakeholders meet at least one of the indicator criteria, representing 91 percent achievement of the FY22 indicator target. These are resource users, government, academia, NGOs, and regional/international stakeholders who participated in one (132 stakeholders) or both (36 stakeholders) of the Women Shellfishers and Food Security Workshops in FY22 (see Table 10).

Table 10: Summary of virtual regional workshop participants.

Total participants Workshop 1	84
Total participants Workshop 2	120
- repeat	36
- new	84
Total unique participants	168

To measure this outcome indicator, a survey of participants before the first virtual regional workshop in March 2022 and following the second virtual regional workshop in July 2022 provided the following findings on the criteria for this indicator:

- Have increased awareness of the basic concepts embodied in the theory of change: Before the first workshop, 67 percent of survey respondents provided an opinion on whether they believe three specific Theory of Change linkages are valid compared to a 73 percent providing an opinion following the second workshop. Those not responding to these questions or saying they don't know decreased from 33 percent to 27 percent, indicating 6 percent more participants expressing awareness. However, these differences were not statistically significant.
- Have tools to design interventions to achieve Theory of Change intended outcomes: Before the first workshop, 19 percent of survey respondents said yes. After the second workshop 40 percent said yes (a statistically significant difference between the two time periods). This indicates that the project toolkit and outreach interventions may have caused this change.
- Are networked regionally: Before the first workshop, 24 percent of survey respondents said yes compared to 25 percent after the second workshop. At the same time, the percent replying no, increased from 52 percent to 55 percent, indicating a need to continue to strengthen stakeholder engagement in regional networks. However the change between time periods is not statistically significant.
- Some identify plans or resources to pursue opportunities for scale up: Before the first workshop, 29 percent of survey respondents said that they had plans. After the second workshop, 40 percent said they had plans. This difference was statistically significant.

To estimate a result based on these findings, the percent of survey respondents (40 percent) replying yes to the two criteria that had a statistically significant change (have tools and identify plans) was applied to the total number of unique workshop participants (168 participants).

In retrospect this custom indicator is overly complex and conducting virtual rather than in-person events, as well as surveying participants virtually, presented challenges in capturing robust data for this indicator in a meaningful way for all participants. For example, survey response rates for the first and second workshops were 25 and 33 percent respectively and responders are not representative proportionally of the types of workshop participants. Resource users made up 30 percent and 29 percent of participants in the first and second workshops respectively, but only 10 percent and 13 percent of survey respondents. In the first workshop, government representatives made up 15 percent of participants and 38 percent of survey respondents.

Number of people trained in sustainable natural resources management and/or biodiversity conservation as a result of USG assistance (USAID Standard Indicator EG.10.2-4).

A total of 168 people (77 female and 91 male) were trained in FY22, representing a 227 percent achievement of the FY22 indicator target. These are resource users, government, academia, NGOs, and regional/international stakeholders who participated in one (132 people) or both (36 people) of the Women Shellfishers and Food Security virtual regional workshops in FY22 (see Table 10 above). An exact disaggregation of unique participants by type (resource user, government, etc.) is not available. Data come from a combination of participants who registered and participated through their own registration on-line plus those who participated in-person with a registered participant, which was the case for many resource users. The information on disaggregates by affiliation of participant for all of the non-registered participants is incomplete, but a minimum of 60 resource users are documented to have participated in one or both of the virtual regional workshops. Participant data on disaggregates by affiliation suggests that the FY 22 target for this indicator was largely exceeded due to the larger than planned number of participants in the resource user and academic/research categories. The original targets were set to target at a minimum 6 per country (2 each from resource users, government, and academia/other) x 11 countries for a total of 66, plus 4 regional institutions with 2 participants each for an additional 8 participants and an overall target of 74. The virtual format of the workshops is another factor contributing to the larger than anticipated number of participants, which would have been limited to the planned number if it had been possible to conduct the workshops in-person.

Number of Toolkits produced (Project Custom Indicator).

One Toolkit on Empowering Women for Shellfish Management, Food Security and Biodiversity Conservation in Estuarine Ecosystems in West Africa as produced and is available at: https://pdf.usaid.gov/pdf_docs/PA00ZHT6.pdf. This represents 100% achievement of the FY22 indicator target.

Number of Dissemination Activities (Project Custom Indicator).

A total of 24 dissemination activities have been used to date to disseminate project products and results (see Table 8). This represents 141% achievement of this indicator in FY22. The activities included:

- 2 Virtual Regional workshops.
- 8 conference or session presentations (6 done, 2 prepared and submitted)
- 3 peer reviewed journal papers (This includes 1 published in the prestigious Frontiers in Marine Science, and 2 submitted).
- 10 on-line platforms.
- 1 set of 170 Toolkit hard copies printed for distribution.

Although 11 country level workshops originally planned, were not conducted in favor of regional virtual workshops to ensure consistency of content, to focus on community of practice regionally, and due to logistics and COVID-19 challenges, the original target of more than 17 dissemination events/platforms was exceeded. This was due to a higher than anticipated number of conference and session presentations and on-line platforms. The potential for additional dissemination through both on-line and virtual platforms is high as many platforms identified in the original plans are yet to be engaged as of the end of this fiscal year.

Number of institutions receiving capacity development support (AFR/SD Custom Indicator CBLD-9-UAF).

The 64 organizations reported under this indicator, representing 173 percent achievement of the FY22 indicator target are detailed in Table 11 and Table 12. These are the organizations that were identified in stakeholder engagement outreach and wanted to increase their organization's technical capacity in the management of mangrove and estuarine ecosystem-based shellfisheries harvested primarily by women. These organizations received capacity development support to increase their technical and networking capacity on this topic through participation in one or more of the Women Shellfishers and Food Security project virtual regional workshops in FY22. These organizations participated in the country level shellfisheries assessments in their countries, were briefed on the West Africa Regional synthesis of these assessments, and were provided the final regional and country reports, which are accessible on-line in English and French (and Portuguese for Guinea Bissau). They were also presented the results of the project's multivariate analysis of site-based research in Ghana and The Gambia on Theory of Change linkages/Learning Questions. Across two workshops they were presented the draft Toolkit and provided input to its development, they were presented and trained on the final Toolkit for championing its further dissemination, and they provided recommendations for operationalizing the Toolkit at their level. The Final Toolkit has been made accessible to them and publicly in English and French with links to the regional assessment, 11 country reports, and 7 site based research technical reports in an annex.

The target for FY 22 of 37 organizations was largely exceeded due primarily to more than double the number of academic/research organizations benefitting. Also, distinct units/institutes within a

single academic institution were counted individually. NGOs/Other types of organizations also contributed to exceeding the target, as the original plan was a minimum of at least 1 each of resource user, government, and academic/research organizations per country (i.e., 3 per country = 33 organizations), plus 4 regional organizations. Although the overall target was exceeded, 6 countries did not have resource user organizations benefitting, even though individual resource users from those countries participated. This is because, as revealed in the regional assessment, while women shellfishers are present in all 11 countries, they are in many cases not organized into groups and associations. In all 11 countries, at least one government institution benefitted. Regionally, the project had anticipated also engaging with ECOWAS. Contacts there were not able to participate in the scheduled workshops, but they expressed interest in learning more about the initiative.

Table 11: Summary of organizations receiving technical capacity development support in women's shellfisheries by country and type of organization.

Country	Number of Organizations				Total
	Resource User	Government	Academia	NGO/Other	
Senegal	3	2	2	2	9
The Gambia	2	1	3	0	6
Guinea Bissau	0	1	0	0	1
Guinea	0	1	1	1	3
Sierra Leone	0	1	3	0	4
Liberia	0	1	0	0	1
Cote d'Ivoire	1	1	1	1	4
Ghana	1	1	6	2	10
Togo	0	5	1	1	7
Benin	2	1	3	2	8
Nigeria	0	2	3	3	8
Regional/Intl.	1	2	0	0	3
TOTAL	10	19	23	12	64

Table 12: Organizations receiving technical capacity development support in women's shellfisheries.

No.	Organization	Country/Region
1	Organisation des femmes ostréicultrices du Bénin	Benin
2	Women Association for Promotion of Sustainable Oyster Production (WAPSOP)	Benin
3	Ministère de l'Agriculture, de l'Elevage et de la Pêche/ Direction de la Production Halieutique	Benin
4	Institut de Recherches Halieutiques et Océanologiques du Bénin (IRHOB)	Benin
5	Laboratoire d'écologie et de management des écosystèmes aquatiques, Université d'Abomey-Calavi	Benin

No.	Organization	Country/Region
6	Université d'Abomey-Calavi	Benin
7	ONG-CEPRAEDES	Benin
8	ECO-BENIN ONG	Benin
9	Mareyeur (wholesale fish merchant)	Côte d'Ivoire
10	Ministère des Ressources Animales et Halieutiques	Côte d'Ivoire
11	Université NANGUI ABROGOUA	Côte d'Ivoire
12	UNSCOMAFHA CI	Côte d'Ivoire
13	Try Oyster Women's Association	The Gambia
14	National Sole Fishery Co-Management Committee (NASCOM)	The Gambia
15	Fisheries Department, Ministry of Fisheries and Marine Resources	The Gambia
16	GREAT Institute	The Gambia
17	Institute of Social Research and Development	The Gambia
18	The University of The Gambia	The Gambia
19	Densu Oyster Pickers Association	Ghana
20	Fisheries Commission, Ministry of Fisheries and Aquaculture Development	Ghana
21	Department of Fisheries and Aquatic Sciences, University of Cape Coast	Ghana
22	ACECoR University of Cape Coast	Ghana
23	Centre for Coastal Management, University of Cape Coast	Ghana
24	Kwame Nkrumah University of Science and Technology	Ghana
25	University of Environment and Sustainable Development	Ghana
26	University of Ghana	Ghana
27	Development Action Association	Ghana
28	Hen Mpoano	Ghana
29	Direction Nationale de la Pêche Maritime (DNPM)	Guinea
30	Centre National des Sciences Halieutiques de Boussoura (CNSHB)	Guinea
31	NGO DOIPMAG	Guinea
32	Ministério das Pescas	Guinea-Bissau
33	National Fisheries & Aquaculture Authority (NaFAA)	Liberia
34	Calabar South Local Government	Nigeria
35	Ilaje Local Government	Nigeria
36	Olusegun Agagu University of Science and Technology	Nigeria
37	University of Ibadan	Nigeria
38	University of Uyo	Nigeria
39	Ifesowapo Club	Nigeria
40	Bridge That Gap Initiative	Nigeria
41	Nigerian Conservation Foundation	Nigeria
42	Association des femmes de Fadiouth	Senegal

No.	Organization	Country/Region
43	Association Nebeday	Senegal
44	FELOGIE Niodior	Senegal
45	Direction des Aires Marines Communautaires Protégées (DAMCP)	Senegal
46	Direction des Pêches Maritimes (DPM)	Senegal
47	Institut Universitaire de Pêche et d'Aquaculture	Senegal
48	Université Cheikh Anta Diop de Dakar	Senegal
49	Wetlands International Africa	Senegal
50	FAO/FISH4ACP	Senegal
51	Department of Fisheries	Sierra Leone
52	Institute of Marine Biology and Oceanography (IMBO), University of Sierra Leone	Sierra Leone
53	University of Sierra Leone	Sierra Leone
54	Njala University	Sierra Leone
55	Président du comité local de pêche du Lac Togo	Togo
56	Collectivité Locale	Togo
57	Direction des pêches et de l'aquaculture	Togo
58	Haut conseil pour la mer	Togo
59	Ministère de l'environnement et des ressources forestières	Togo
60	Université de Lomé	Togo
61	Agbo-zegue (Association togolaise pour la conservation de la nature)	Togo
62	Confédération Africaine des Organisations de Pêche Artisanale (CAOPA)	Regional/Senegal
63	Food and Agriculture Organization of the United Nations (FAO)	Intl./Italy
64	FAO/Poseidon	Intl./France

Number of host country higher education institutions receiving capacity development support with USG assistance (AFR/SD Custom Indicator ES.2-1).

As shown in Table 12 highlighted in blue, the 14 higher education institutions reported under this indicator are a subset of the total number of institutions of all types receiving capacity development support. For this indicator, multiple units (laboratories, outreach, and research centers) within a single higher education institution were not counted separately. They include one or more higher education institutions from 9 of the 11 West Africa countries (except Guinea, Guinea-Bissau, and Liberia). The capacity development support received is described above.

ANNEX 1 – THEORY OF CHANGE AND RESULTS CHAIN FRAMEWORK

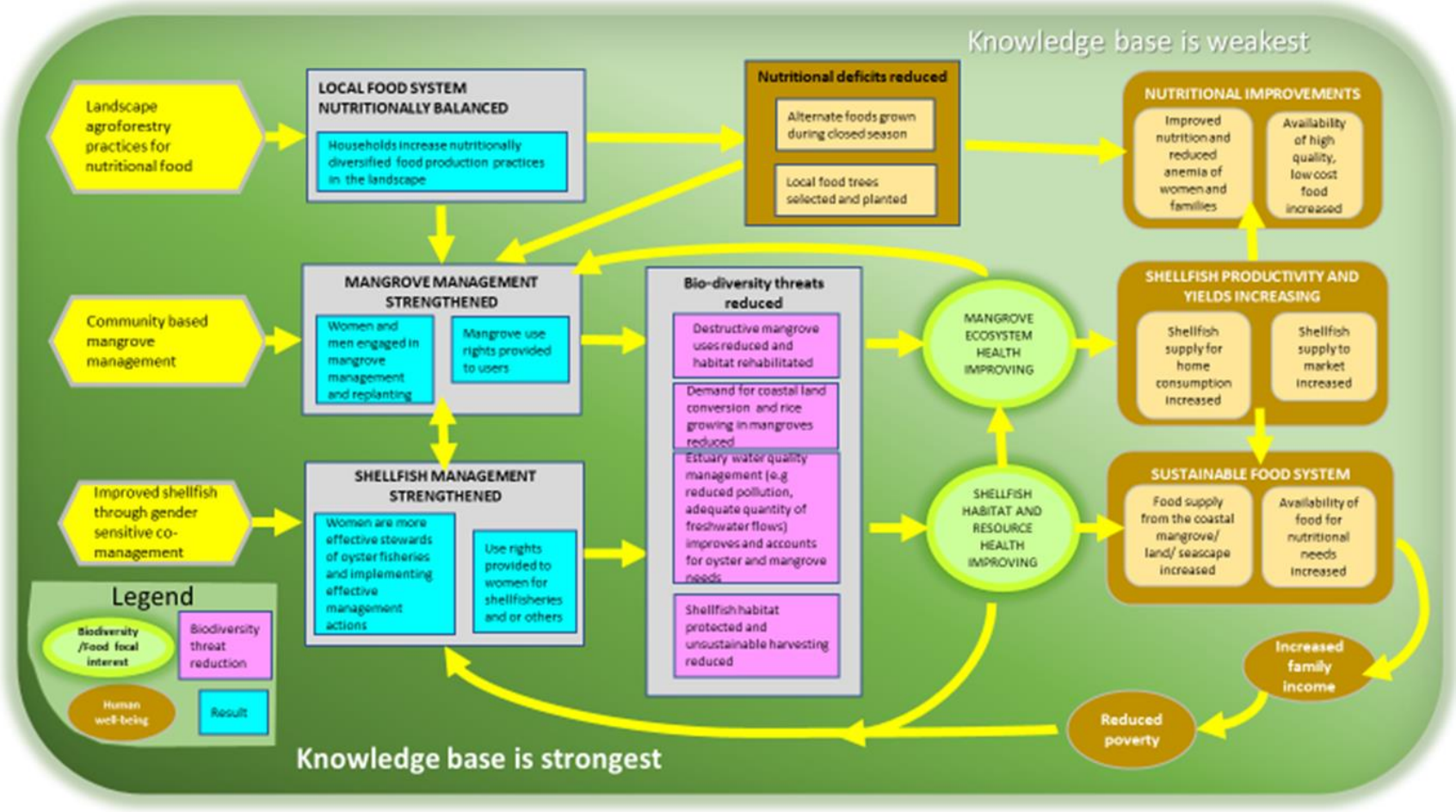

Figure 8: Visualization of the Theory of Change and Results Chain Framework.

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