WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT

Final Technical Report on Site Based Research in Ghana and The Gambia

PARTICIPATORY LAND-SEASCAPE VISIONING

in Densu Estuary, Narkwa Lagoon, and Whin Estuary, Ghana

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Photo Caption: Densu Estuary, Ghana (Courtesy of Google Earth). Changes in land use from 2009 to 2018.

Photo Credit: Google Earth, composed by Lalisa Duguma, ICRAF.

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ACRONYMS

DOPA	Densu Oyster Pickers Association
NGOs	Non-Governmental Organizations
USAID	United States Agency for International Development
USAID-SFMP	USAID Ghana Sustainable Fisheries Management Project

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SUMMARY

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.

1. INTRODUCTION

Ghana is a West African country bordered on the north, east, south, and west by Burkina Faso, Togo, the Gulf of Guinea (Atlantic Ocean) and Côte d'Ivoire, respectively. Its coastal region is divided into three distinct geomorphological zones – the west coast covering about 95kms, the central coast covering 321kms, and the east coast estimated at 149kms (Armah, 2005). Ghana is also endowed with over 100 coastal water bodies, including closed lagoons, open lagoons, and estuaries, accompanied by mangrove vegetation, mud, and tidal flat marshes (Yeleliere et al., 2018). These resources are essential in supporting fishing and fish-related enterprises that form the primary source of livelihood to the surrounding community. Oyster fishing is among the main economic activities dominated by females (Osei, 2020; Njie and Drammeh, 2011), thus the need for clear mechanisms to promote sustainable harvesting of shellfisheries and mangrove forests in the country. A recent study by Duguma et al. (2021) suggests that Ghana has lost a net of 539 square kilometers of mangroves in the last two decades, with the 2000-2010 period recording a loss of almost five times that of the 2010-2020 period.

Addressing the challenges related to degradation requires contextualized and community-led processes (Sagoe et al., 2021). The visioning process brings together communities in a well-guided process to understand the land-seascape changes, current situation, and their envisaged future. Contexts vary by location, and solution options should consider local realities. Developing and implementing such localized solutions could be costly in countries with poor financial capacity (CPI 2019). Due to the ineffectiveness and cost inefficiency of centralized government led approaches, community-based approaches dominate the African natural resources management space as noted by Roe et al. (2009). Therefore, it is crucial to devise means of designing a collective vision driven by local interests and aspirations and owned by communities who reside in the landscape for the long term. As described above, the vision should address and respond to the likely envisaged effects of climatic and non-climatic ecosystem stressors (Freduah et al., 2018). Community ownership is crucial because projects and programs are often time-bound (Thwala, 2010), and hence, there is a need for the interventions to become mainstream activities within the landscapes (Lachapelle, 2008).

Visioning is imagining, framing, and visualizing the future based on; 1) history, 2) current reality, and 3) emerging and likely priorities and interests. It is about 1) framing into context and promoting what we want to see more, and 2) designing strategies for what we want to see less in our landscapes. Broadly, visioning is based on the aspirations of the residents of the landscape and builds a future that can sustain recognizing the limitations, challenges, and opportunities existing in the land-seascape. A vision owned by local communities is the most realistic one, and it reflects their societal norms, cultural viewpoints, and social-ecological realities as McLeroy et al. (2003) argues. Developing such visions in a participatory manner has become a vital co-design process to induce the adoption of sustainable practices while reducing the intensity of destructive practices.

The purpose of this study is to present the process of developing a shared land-seascape vision to tackle pertinent environmental challenges that communities relying on shellfishing identify as crucial to be addressed. To achieve this, we adopted the Focus Group Discussion (FGD) approach as the vision must be a consensus among the broader community beyond the individual households. Focus group discussions were held in Densu Estuary, Narkwa Lagoon, and Whin Estuary in Ghana. The purpose was to collect data through dialoguing and consultations with shellfishers and other communities living close to the mangrove ecosystems and in agricultural landscapes adjacent to it. The discussions focused on assessing the perceptions of shellfishing communities based on their experiences of the state of their landscape concerning agricultural, forestry and fishery resource trends in the past, present, and future prospects using the landscape visioning tool. The aim is to develop a community-owned vision to improve their land-seascapes and livelihoods by creating a vision that helps them better manage their ecosystems.

2. METHODS

2.1 Description of study sites

The FGDs were conducted in five communities located along estuaries and lagoons off the Atlantic coast of Ghana, (i.e., the Gulf of Guinea), in three administrative districts. These are Tsokomey & Bortianor in Ga South District; Narkwa in Ekumfi District and Apremdo and Amanful in Kuma-Effia-Kwesimintsim sub metro of the Sekondi-Takoradi Metropolis. The socio-demographic, biophysical, and economic features of the sites surveyed are summarized in Table 1. Densu and Whin estuaries are adjacent to urban areas and economies, while Narkwa is peri-urban to rural. Infrastructural expansion is pronounced in Densu and Whin. Whin is the most populated of the three sites, with a population density of 6000/square km. National and multi-national companies undertake most of the economic activities in the agriculture, forestry, and service sector in these land-seascapes.

Table 1: Attributes of land-seascapes considered for assessing the degradation proxy.

Ecosystem element	Attributes
Production	Crops; livestock; fisheries; agroforestry (Four attributes)
Biodiversity	Aquatic animals; terrestrial animals (Two attributes)
Vegetation	Forests and woodlands; mangrove (Two attributes)
Soil condition	Soil fertility (One attribute)
Fresh water	Volume; availability and quality (Two attributes)
Settlements	Residential spaces (One attribute)

The study sites spanned an ecological/vegetation gradient from the drier coastal savannah plains of Densu, with the coastal strand/thicket vegetation through the dense shrubby vegetation of Narkwa, to moist savannah semi-deciduous forest vegetation at Whin (Figure 1). Climate is equatorial across all sites with two rainy seasons between April and November. Temperatures vary from 22-34°C,

while rainfall ranges from 790mm in the drier equatorial zone of 'Densu to over 2000mm in the moist equatorial zone of Whin. Soils are primarily orchrosol and loamy, although they could be saline in some areas. The soil supports the production of a range of vegetables, staples, fruits, pulses, and tree crops. Each area is well-endowed with at least two major water resources that drain into the sea.

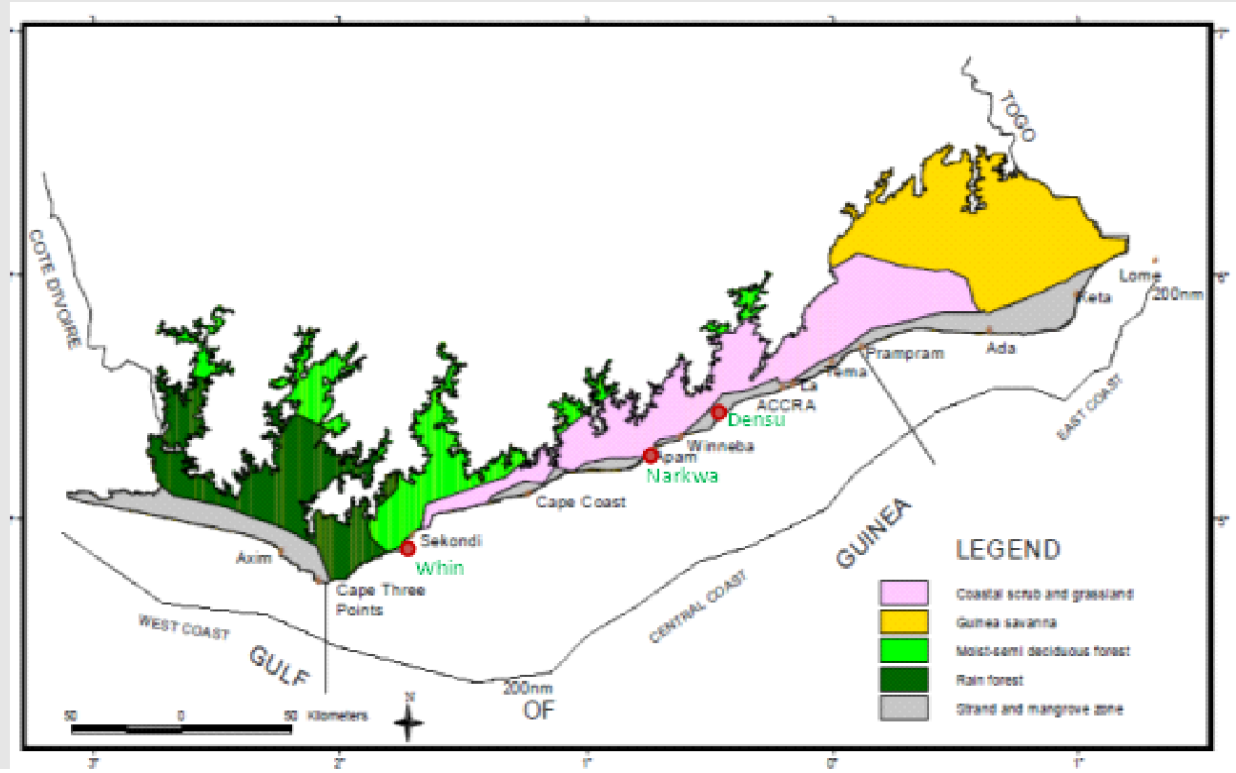

Figure 1: Ghana study sites: Densu, Narkwa, and Whin (Adapted from DeGraft-Johnson et al., 2010).

The three sites have agrarian communities involved in crop, livestock, and fishery activities. Whin has the least households engaged in agriculture while Narkwa has the most, with agriculture and fisheries employing over 95 percent of the labor force (www.ghanadistrcits.com). Subsistence crop production (mainly vegetables: tomato, garden eggs, pepper, onion, okra, and staples: maize, cassava, plantain) is the predominant agricultural activity, largely rain-fed and practiced under slash and burn with relatively low external inputs (Rankoana, 2017). Cash crops including pineapple, citrus, oil palm, and coconut are also produced. Livestock (sheep, goats, poultry, and pigs) is kept mainly on a subsistence basis. Artisanal sea fishing is predominantly practiced by local fisher folks in these coastal communities. Oyster harvesting is a predominant livelihood activity of women and children in the three sites (Chuku et al., 2020).

2.2 Selection of FGD participants

Community contacts identified and enumerated shellfishers and invited them to participate in FGDs voluntarily. The selected community members were clustered into groups based on location and

gender especially where men are also involved in shellfishing activities especially in Densu and Narkwa. In Whin, only women were involved in oyster collection, so the gender-based clustering was not relevant. A total of 115 shellfishers comprising 107 (93 percent) females and 8 (7 percent) males participated in the FGDs. Location-wise, 42 (Densu), 43 (Narkwa), and 30 (Whin) persons voluntarily participated in the FGDs.

Two protocols were followed during the FGDs. The participant consent form and the COVID-19 protocols. First, participants signed informed consent forms prior to voluntarily participating in the interactive focus group discussions. Second, Covid-19 protocols included provision of a washbasin, water, soap, tissue, and sanitizer were provided for cleaning hands. A face mask was provided for each participant. The facilitator ensured each participant wore the face mask before commencing the session. The facilitators tried to get group consensus for each question or issue discussed before finalizing each issue discussed.

Densu Estuary: At Densu, forty-two shellfishers comprising male (3) and female (39) participated in the FGD. According to the women, male shellfishers are in the minority and are formally organized into the Densu Oyster Pickers Association (DOPA). Members of DOPA from three communities (Tsokomey, Bortianor, and Tetegu) participated in the FGDs at a central location at Tsokomey. The largest proportion of DOPA members are from Tsokomey. Participants indicated that both Tsokomey and Tetegu communities are predominantly settlers from the Volta Region of Ghana and thus tend to be similar in characteristics in terms of ethnicity, resident status (mainly settlers) and livelihood options. Consequently, participants from Tsokomey (25) and Tetegu (3) were combined and segregated into two groups, i.e., male (5) and female (23). Participants from Bortianor (15) are the Ga people originating from the Densu area. Meetings are often held on Tuesdays as it is observed as a non-fishing day in the Densu community. It is a day of the week reserved for funerals and other social occasions.

Narkwa Lagoon: Narkwa is the only community bordering the Narkwa Lagoon where shellfishing is undertaken. The shellfish collectors are not organized into a group. Hence, snowballing was used by the community contacts to first identify and list or enumerate. The people of Narkwa have not set aside any special traditional day for non-fishing activities; thus, the community engages in fishing activities every day. At Narkwa, it was not possible to subcluster the women (43 individuals) hence seats for the women group were arranged circular but roughly in three clusters (i.e., right, left, and middle) for effective engagement.

Whin Estuary: The participants recruited for the Whin meeting were 30 shellfisher women from two communities, i.e., Apremdo (19) and Amanful Kuma (11). Like Narkwa, the women exploit shellfish resources from the Whin estuary every day. However, at Apremdo, the women were further grouped into subsistence and commercial collectors, where the latter was selected for this assessment to envision the landscape changes as they depend more on the lagoon and mangrove ecosystem.

Based on the responses provided by the focus group respondents, qualitative summary attributes were generated to represent change trajectories as increasing (improving), no change, or decreasing (declining). Also using the qualitative details on the change trajectories, we computed proxies for understanding the relative state of the land-seascapes on a scale of 12 attributes based on the ecosystem functions and services the land-seascapes provide to people and animals (see Table 1 above).

For all the 12 attributes, communities qualitatively graded them on a trend scale of improving, no change or declining (degrading). For each FGD group, the number of declining or degrading was counted and divided by the total number of attributes (12). An overall site score was then calculated summing the number of attributes ranked as degrading per community focus group and dividing by the number of focus groups times 12 attributes. The value was used as a degradation proxy, representing a synthesized community perception of land-seascape degradation for each site. In the computation, 'no change' and 'improving' are considered as no sign of degradation.

3. FINDINGS

3.1 Socio-demographics and livelihood options in the land-seascapes

Participants of the FGDs included largely female shellfishers (Table 2). The shellfishers are of average ages of 43, 47, and 51 years for Densu, Narkwa, and Whin respectively. Although shellfishers generally had some formal education from basic to secondary schooling across the three sites, Densu has the highest share of people who at least had formal primary education, relative to Whin and Narkwa. These results are comparable to those reported by Agbekpornu et al. (2021) in the Densu area.

Most shellfishers are born in the current areas they operate in, especially in Narkwa and Whin (Table 2). Those in Tsokomey & Tetegu in Densu are predominantly settler communities representing the Ewe people (Gbe ethnic group) originating from the Volta Region. Bortianor, Narkwa, and Whin are typically indigenous communities, with most residents originating from the area.

Most shellfishers engage in more than one livelihood activity with the widest range of activities at Densu. Shellfishing is a major livelihood activity among participants across the three sites, with oyster being the most collected species. The collection of periwinkle, cockle, and other species are undertaken, but predominantly at Whin by women. Sea fish sales, trading, and farming are three major additional income-earning activities undertaken by women shellfishers. However, 1 percent, 9 percent, and 11 percent of women at Densu, Narkwa, and Whin respectively depend entirely on shellfishing for their livelihood, and thus do not engage in any other income generating activity (Table 2). These results affirm the reports by Asare et al. (2019) highlighting the supplementary livelihood contribution of shellfishing in addition to other livelihood activities.

Table 2: Socio-demographic profile of FGD participants.

Parameter	Densu	Narkwa	Whin
Gender (%)			
Men	19	7	0
Women	81	93	100
Age (Years)			
Mean	43	47	51
Range	25-77	18-73	21-81
Education (%)			
None	18	73	60
Primary	47	12	17
Junior high/middle	26	10	10
Senior high (secondary)	9	5	13
Tertiary	0	0	0
Number of years lived in community			
Mean	32	47	50
Range	9-71	18-73	21-81
Livelihood activities (%)			
Shellfish (oyster) collection, processing & sale	64	31	34
Trading, including petty trade, etc.	5	17	8.5
Sea fish sale	1	24	2.5
Farming	0	15	16
Shellfish (periwinkle) collection and sale	-	-	11
Crab collection and sale	-	-	12
Sea fish processing (frying, smoking, etc.)	9	-	-
Trades (including dressmaking, hairdressing, masonry, carpentry)	6	1	-
Lagoon/estuary (freshwater fishing)	4	1	
Sea fishing	2	2	
Firewood collection/sale	1	-	5
No other livelihood aside from shellfishing	1	9	11

Livestock (sheep, goats, poultry and pigs) is generally reared among shellfishers across the three sites. Farming and wild fruits collection are most undertaken at Whin and Narkwa. Increasing urbanization with associated expansion in infrastructural development at Densu constrains adjacent upland areas for farming, particularly in Tsokomey and Tetegu. At Bortianor, some limited cropping is done on areas not yet developed for infrastructural expansion. At Whin, although some cropping is done, participants were not certain about the long-term use of the land due to insecure tenure or rights to perpetual use of their farmlands due to the continual conversion of farmlands for housing and corporate purposes.

3.2 Role of men and women in the land-seascapes

Women shellfishers generally undertake household chores in addition to collecting, processing, and sale of oysters, crabs, periwinkles, and cockles (Whin) which they catch from the lagoon or estuary. While all men engage in collecting shellfish for their spouses or sell to other women to process for sale, those at Densu also sometimes engage in sea and estuary fishing (Table 3).

Table 3: Activity profile of shellfishers by gender.

Community	Men's' main activities	Women's' main activities
Densu- Bortianor	Estuary fishing; Preparation and dumping of mangrove vegetation as fish traps into estuary water; sea fishing, oyster, collection, and sale	Household chores; oyster collection and sale
Densu- Tsokomey	Estuary fishing; Preparation and dumping of mangrove vegetation as fish traps into estuary water; sea fishing, collection, and sale of oysters	Household chores; oyster collection and sale
Narkwa	Collection of oysters for spouses to process for sale	Household chores, oyster, collection, and sale
Whin - Apremdo	N.A.	Oyster collection, processing, and sale
Whin - Amanful	Collection of oysters from stone/rock surfaces for spouses to process for sale	Collection from mangroves, processing, and sale of oysters

Across sites, shellfishing is done in the morning when the tides are low. Usually, shellfishers return home with their catch by 8 AM. However, commercial collectors at Whin set out in the night to harvest oysters from mangroves. They return at dawn, rest awhile before performing household chores and then process their oysters for sale. At Narkwa, according to the participants, men usually supplement sea fishing, their major occupation, with farming and shellfishing, whereas women work predominantly on farms and in the lagoon. Women appear to be more affected by changes in the landscape than men.

3.3 Typologies of livelihood activities in the land-seascape: current state and prospects

The main livelihood activities reported by respondents across the sites and communities included sea fishing and shellfishing (Table 4). Farming was also quite common and reported in all communities except Tsokomey & Tetegu (in the Densu estuary). An additional activity, to fishing and farming, was trading. At the Whin estuary, masonry (at Amanful) and sand mining (Apremdo) were also reported. In all studied communities, respondents reported a declining trend in livelihood activities over the last ten years, except for shellfishing at Apremdo which was reported to have had no change.

Table 4: Community perceptions of trends in main activities over the past decade, cause of change and future plans.

Site	Community	Specific livelihood activities	Trend in the last 10 years and underlying reasons for the observed trends	Plans for the next 10 years and reasons for proposed changes
Densu	Tsokomey & Tetegu	Fishing	Declining: Light fishing, nets with very tiny holes thus catching all types of fish, over exploitation	Increase: To provide more fish for higher incomes
		Farming	Declining: Due to conversion of vegetation for building due to population increase	Increase: To improve food security
	Bortianor	Fishing	Declining: Pollution; Use of dangerous chemicals for fishing; Diversion of estuary by community	Increase: To improve and return to original
		Overflow	Expanding: Use of more advanced fishing equipment e.g., light fishing and trawler fishing	Increase: Diversion of estuary by community at a time of overflow
Narkwa	Narkwa	Shellfishing	Declining: Declining: Use of dangerous chemicals for fishing, use of light for fishing	Increase: To ensure return of higher yields
		Trading	Declining: Lack of finance	Increase: To ensure improved livelihoods
		Farming	Declining: Poor rains and soils	Increase: To ensure higher yields for food security and better livelihoods
Whin	Amanful	Masonry	Declining: Reduced job opportunities	Increase: To be able to obtain more resources for improved livelihood
		Fishing	Declining: Some cultural practices have not been adhered to; filling up of the lagoon especially during rainy season results in lower harvests since they cannot enter; Declining mangroves	Increase: They want it to improve because there are no other jobs in the area, so they rely on it
	Apremdo	Sand mining	Declining: The job is difficult; Land has greatly reduced so sand quantities have reduced	Stop: It should be stopped in future because it is increasing depth of the lagoon and reducing the quantities of fish

Site	Community	Specific livelihood activities	Trend in the last 10 years and underlying reasons for the observed trends	Plans for the next 10 years and reasons for proposed changes
		Farming	Declining: Reduced rains, land use intensification and poor fertility	Increase: Hoping for alternative livelihood activities to augment
		Fishing	No change: Cannot do it during heavy rains because water must recede	Increase: To ensure higher yields

The major reasons underlying changes observed in fishing activities are the use of light in fishing, fine mesh nets with tiny holes, use of chemicals for fishing, and high-water tides during the rainy season. At Bortianor (in Densu basin), it was reported that the diversion of the course of the estuary also affected shellfish yields. The underlying reason for decline in trading among respondents at Narkwa was lack of financial capital. Respondents at Amanful indicated that masonry jobs had also declined due to reduction in the number of job opportunities available in recent times. Concerning mining activity at Apremdo, the underlying reason for the decline was stated by participants as related to the unavailability of lands for sand collection and the very laborious nature of the activity.

Generally, communities desire their livelihood activities to be expanded in the next ten years except for sand mining which they want to eliminate. The apparent reason for the desired increase in livelihood activities or productivity was to ensure improved incomes and food security, and general wellbeing.

There was more diversification in livelihood activities at Tsokomey and Tetegu than the other sites for both men and women. Narkwa was the place with fewest livelihood activities, especially for men. In this site, participants stated that the only livelihood activity common among men in the communities covered by this research was sea fishing. The most familiar livelihood activity for women was stated as fishing in the lagoon (for shellfish, crabs, periwinkle, etc.), followed by petty trading, fish porters (carrying), and fish processing.

3.4 Seasonality of livelihood activities

The communities pursued different livelihood activities during the year. At Densu, shellfishers undertake five main activities during the year:

1. Fishing from the sea and the estuary throughout the year
2. Oyster fishing from May till about November when the oyster season is closed
3. Fish smoking and sale throughout the year
4. Carrying fish (throughout the year)
5. Farming (Bortianor mainly) from March to December.

Trading (usually small-scale businesses) is generally a secondary activity undertaken by some women shellfishers. However, in Bortianor, men may trade to augment fishery activities from January to February (Table 5).

Table 5: Primary and secondary livelihood activities during the year in Densu.

Month	Tsokomey & Tetegu	Bortianor
January	Fishing; oyster closed season; Fish smoking and sale, fish carrier	Fishing; Trading
February	Fishing; oyster closed season; Fish smoking and sale, fish carrier	Fishing; Trading
March	Fishing; oyster closed season; Fish smoking and sale, fish carrier	Farming; Fish smoking and sale, fish carrier
April	Fishing; oyster closed season; Fish smoking and sale, fish carrier	Farming; Fishing; Fish smoking and sale, fish carrier
May	Oyster (oyster season opens); Fish smoking and sale, fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
June	Fishing & reduced oyster fishing due to rainfall; Fish smoking and sale, fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
July	Fishing & reduced oyster fishing due to rainfall; smoke fish, Fish sale & fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
August	Fishing & reduced oyster fishing due to rainfall; smoke fish, Fish sale & fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
September	Smoke fish, Fish sale & fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
October	Smoke fish, Fish sale & fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
November	Smoke fish, Fish sale & fish carrier	Farming; Oyster fishing, Fish smoking, and sale, fish carrier
December	Fishing only; oyster closed season; smoke fish, Fish sale & fish carrier	Farming; Fish smoking and sale, fish carrier

At Narkwa, shellfishing and fishing in the lagoon and fish sales are three main activities undertaken by shellfishers, mainly women, throughout the year. Farming is a secondary activity done for only four months from May to August during the major cropping season (Table 6). Women are the major gender group involved in farming while men concentrate on fishing mainly from the sea and to a lesser extent from the lagoon.

At Whin, shellfishers undertake four main activities during the year as follows:

1. Fish sales except June-October when fish harvest is impossible due to heavy torrential rains. Sea fishing is done throughout the year by men at Amanful, except during periods of torrential rains.
2. Shellfishing throughout the year, with farming and trading occurring frequently.

3. Farming mainly during the rainy season (April-August), especially at Apremdo
4. Trading throughout the year, especially at Amanful

Trading is a major livelihood activity from the second to the fourth quarter of the year at Amanful and becomes a secondary activity undertaken by some women during the first quarter. During this period, shellfishing is done as a secondary activity and sometimes may not be pursued at all from June to October when the rains are torrential and water volume swells (Table 6). Farming is a major women's activity only during the rainy or growing season especially at Apremdo.

Table 6: Primary and secondary livelihood activities across the year in Narkwa and Whin estuaries.

Month	Narkwa	Whin (Apremdo)	Whin (Amanful)
January	Shellfishing, fishing, fish sales	Shellfishing	Shellfishing; Trading
February	Shellfishing, fishing, fish sales	Shellfishing	Shellfishing; Trading
March	Shellfishing, fishing, fish sales	Shellfishing	Shellfishing; Trading
April	Shellfishing, fishing, fish sales	Farming; Shellfishing	Shellfishing; Trading
May	Shellfishing, fishing, fish sales; Farming	Farming; Shellfishing	Trading; Shellfishing, fish sales
June	Shellfishing, fishing, fish sales; Farming	Farming; Shellfishing	Trading
July	Shellfishing, fishing, fish sales; Farming	Farming; Shellfishing	Trading
August	Shellfishing, fishing, fish sales; Farming	Farming; Shellfishing	Trading
September	Shellfishing, fishing, fish sales	Shellfishing	Trading
October	Shellfishing, fishing, fish sales	Shellfishing	Trading
November	Shellfishing, fishing, fish sales	Shellfishing	Trading; Shellfishing, fish sales
December	Shellfishing, fishing, fish sales	Shellfishing	Trading; Shellfishing, fish sales

3.5 Community perceptions of the state of the land-seascape attributes: past, present, and future perspectives

As defined in the methods section, the state of the land-seascapes was assessed using responses from the FGDs conducted in site. The results of the perceptions of the communities show that Densu site experienced a significant degradation extent (88%), compared to what was there in the past. The figures for Narkwa and Whin are also not that very good with degradation proxies of 67% each, on average. The observed perception is quite understandable when the growing extractive pressure from the growing coastal population and communities in the adjacent landscapes is considered. The designation of Densu as one of the Ramsar sites is based on the realization that the site is extensively degraded and there is a need to reverse that. It is this degradation, as also perceived by the communities, that has led to numerous community and institutional actions to restore the land-seascapes, particularly in Densu. Among the notable local actions are the mangrove planting activities

by Development Action Association and the Densu Oyster Pickers Association. Table 7 summarizes the land-seascape degradation perceptions of the communities.

Respondents at all sites indicated that the benefits (e.g., food, feed, fiber, income, etc.) generated from the land-seascapes are generally declining over the last decades. The trend was attributed to various causes which varied with communities. The causes for decline in sea fishing, shellfishing, and farming were similar at all the sites (Tables 8-10).

Table 7: Participant perceptions of the state of the land-seascape in the sites from Ghana.

Ecosystem elements	Attributes	Densu		Narkwa	Whin	
		Tsokomey	Bortianor	Narkwa	Apremdo	Amanful
Production	Crop	▼	▼	▼	▼	=
	Livestock	▼	▼	▼	▼	▲
	Fishery	▼	▼	▼	▼	=
	Agroforestry	=	▼	=	▼	▼
Biodiversity	Aquatic animals	=	=	▼	=	=
	Terrestrial animals	▼	▼	=	=	=
Vegetation	Forests and woodlands	▼	▼	=	▼	▼
	Mangrove	▼	▼	=	=	▼
Soil condition	Soil fertility	▼	▼	▼	▼	▼
Freshwater	Volume	▼	▼	▼	▼	▼
	Availability and Quality	▼	▼	▼	▼	▼
Settlements	Residential spaces	▼	▼	▼	▼	▼
Community level degradation proxy		10/12 (83%)	11/12 (92%)	8/12 (67%)	9/12 (75%)	7/12 (58%)
Overall Land-seascape degradation proxy for the site			88%	67%		67%

Note: The color codes and signs indicate the following: yellow–no change (=); red–declining (▼); green–improving (▲).

Crop cultivation trends over the past decade in the communities, show that similar crops were cultivated in the past and present (Table 8). However, harvest quantities declined due to reducing land sizes. To continue crop cultivation, the communities highlighted the need for agricultural inputs such as manure and fertilizer to improve yields due to depleted soils. Over the decade, Tsokomey & Tetegu completely lost the tomatoes, onions, and peppers they cultivated in the past as all idle lands previously farmed have been converted into beach resorts by private developers. Regarding the future, the responses from all communities were unanimous stating the wish to improve farming activities as an alternative livelihood option to augment their household needs. However, the main barriers or

limitations to achieving this vision were listed as lack of land due to infrastructural development, depleted soil fertility, and poor rainfall patterns.

Fishing (both sea fishing and shellfishing) is on the decline. For sea fishing, the causes for decline as stated by participants were the use of light fishing, use of fine mesh nets, pair trawling by boats, use of dangerous chemicals for fishing, and general overexploitation of fish. At New Amanful (in the Whin basin), the respondents believed that recent non-adherence to certain cultural practices (sacrifices to gods) that bring bumper harvests was also a cause of fish decline. For shellfishing, the causes were pollution of lagoons, siltation of the lagoon due to erosion, destruction of mangroves, creation of wooden traps in the lagoon, and high-water levels in the lagoon during the rainy season that make it impossible for women to collect shellfish.

Petty trading by women has also declined in recent years. The respondents at the three sites attributed the cause of declining trading among women to a lack of financial capital. At Apremdo community in the Whin basin, the respondents attributed the leading cause of declining sand mining to the laborious nature of the work and the depletion of sand quantities from continuous mining. For other minor livelihood activities (e.g., carpentry, masonry, catering, etc.), respondents indicated that jobs were irregular, hence people with such skills experienced insecure livelihoods.

Livestock rearing: Poultry and goats were the most common livestock reported to have been reared in the past in all communities (Table 8-10). It was reported that while rearing some livestock types (pigs and goats) have stopped altogether in recent times, livestock quantities have reduced drastically for other types of livestock like poultry. The main reasons for the decline are infrastructural development, leading to lack of land and inability to practice free grazing and disease outbreaks leading to the death of livestock. Those households still engaged in livestock rearing reported an increase in cost due to the need for animal shelter and feed. When asked about the future of livestock rearing, communities indicated continuing with the practice despite the overarching barriers such as lack of land due to infrastructural development, inability to practice free grazing, and disease outbreaks that cause mortality of animals. Possible solutions for these limitations are the adoption of intensive livestock rearing and the involvement of veterinary services to protect the animals from diseases and mortality.

Vegetation cover and agroforestry: At all sites, respondents indicated that the vegetation cover in the past years (both natural and planted tree cover) was better than the present. The leading causes for declining tree cover and agroforestry are land sale, settlements expansion, and wood harvesting for various needs (timber, charcoal, firewood). At Bortianor, residents indicated a remnant forest area that they are currently protecting. Some respondents believed a wall should be erected around the remnant forest to protect it. They generally stated a desire to increase vegetation cover and agroforestry but recognized that a major limitation is the limited availability of land. While acknowledging the importance of forests, some people also expressed fear that forests could become a hiding place for criminals and dangerous animals.

Table 8: Community perceptions of the land-seascape attributes in the past, present and desired future at Densu.

Attribute	Specifics	Tsokomey			Bortianor		
		Past (5-10 years)	Present	Desired future (5-10 years)	Past (5-10 years)	Present	Desired future (5-10 years)
Production	Crop	Diverse crops grown with good yield	Still done with fertilizer and other inputs (Reduced yield)	Expanding the farms would be great.	Tomatoes, onions, pepper	No crop farming due to lack of land	Looks impossible but to grow more is okay.
	Livestock	Poultry, sheep, goats, ducks, guinea fowl, pigs	All except pig and goats	Desire to have more livestock in future as income sources	Piggery, poultry including ducks	No livestock since area is all developed	Hope we have more cattle with cattle enclosures
	Fishery	There was good harvest and stocking	Still there but reduced	Restoration of fish stocks to original	was undertaken	Still ongoing	Hoping it will continue and even improve
	Agroforestry	None	None	None	None	None	Land scarcity will not allow it.
Biodiversity	Aquatic animals	Crabs, shellfish, turtles, fish)	No change	Improved diversity	None	Anchovy fish (Keta school boys), Tilapia, Octopus, oyster (note: sizes have reduced)	
	Terrestrial animals	Rats, grass cutter, antelope, monkey, snakes, snail, scorpion, lizard	All except antelope which is not any more available.	We wish they will be back.	Goats, snails, rats, snakes, lizards, crabs	All are available but in reduced numbers. Snails no longer present	Desirable to have forests and woodlands but seems unlikely due to scarce land

Attribute	Specifics	Tsokomey			Bortianor		
		Past (5-10 years)	Present	Desired future (5-10 years)	Past (5-10 years)	Present	Desired future (5-10 years)
Vegetation	Forests and woodlands	There was community protected remnant forest (> 20 acres)	This cover has reduced but still available	To protect the current ecosystem (Building a wall around it)	Trees like neem, cassia, bushes,	Have been heavily reduced	Hoping for more restored forests
	Mangrove	Was there and got degraded	Degraded and plantation has been done for 4 years ago and up to 2 meters	To plant more mangroves and plant coconut and other species to protect water and give shade	Present before	Has drastically reduced	Hoping for big mangroves vegetation
Soil condition	Soil fertility	Soil was fertile	Has been degraded	Restoration of fertility desired e.g., manure	Was better	Heavily reduced.	Wish this would be restored
Freshwater	Volume	Water was deeper	Volume reduced due to siltation and rubbish	Restoration to former state	River Densu was deeper	The Densu river is now shallower	Wish this would be restored
	Availability and Quality	Quality was much better	Quality has reduced	Restoration to former state	Better water quality that was drinkable	Water quality has deteriorated	Wish this would be restored
Settlements	Residential spaces	There was more land for building.	Drastically reduced due to land sale for building	No land will be left	More land was available	Land now scarce for settlements	Seems unlikely that more space will be available

Table 9: Community perceptions of the land-seascape attributes in the past, present and desired future at Narkwa.

Ecosystem elements	Attributes	Descriptions		
		Past (5-10 years)	Present	Desired future (5-10 years)
Production	Crop	Maize, Pineapple, Tomatoes, Pepper	Same crops production reduced due to insufficient rains	Hoping for an improvement in future
	Livestock	Sheep, Goats	Quantities reduced	Wish for the possibility to rear more
	Fishery	High in the past	Reduced quantities	Hoping for higher production
	Agroforestry	None	None	Wish for a possibility but does not look likely
Biodiversity	Aquatic animals	Keta schoolboys, Herrings, Redfish	Now the quantities have declined	Wish for an increase in quantities
	Terrestrial animals	None	None	None
Vegetation	Forests and woodlands	None	None	Wish for a possibility but does not look likely due to land limitation
	Mangrove	None	None	None
Soil condition	Soil fertility	Was better	Now declined	Hoping for improvement
Freshwater	Volume	None	None	None
	Availability and Quality	None	None	None
Settlements	Residential spaces	More land in the past	Reduced but still manageable	None

Table 10: Community perceptions of the land-seascape attributes in the past, present and desired future at Whin.

Ecosystem elements	Attributes	Apremdo			Amanful		
		Past (5-10 years)	Present	Desired future (5-10 years)	Past (5-10 years)	Present	Desired future (5-10 years)
Production	Crop	Productivity was better.	Things have gone worse with lower yields	Wish for better rains and yields	None	None	None
	Livestock	Goats, Quantities were higher	Disease outbreak wiped the livestock	Hoping for higher number	Goats, poultry, cat	Livestock quantities have improved	Hope for improvement
	Fishery	Oyster (Anante), Periwinkle (Apoorfii), Adode (Clams)	Clams has not increased; Crabs not increased; Periwinkle has reduced	Hoping things continue like current situation	Tilapia spp, Periwinkle Oysters, Shrimps, Crocodile	No visible change in types and quantities available	Wish for same or improvement
	Agroforestry and commodity plantations	Only trees left on farm for shade	No new planting of trees	Hoping for more trees	None	None	None
Biodiversity	Aquatic animals	Different kinds of fish, Oyster, Periwinkle, Crabs	The same as in the past	Hoping that it will remain same	Fish, Crabs, Periwinkle, Oysters	No visible change in types and quantities available	Hope for same or improvement
	Terrestrial animals	Birds, grass cutter, antelope, snake, scorpion	Still same as in the past	Hoping that it will remain as current	Birds (like duck, long neck, etc.) Vulture, Snakes, deer	The same animals as in the past	They don't want to have dangerous animals but wish for useful ones to remain

Ecosystem elements	Attributes	Apremdo			Amanful		
		Past (5-10 years)	Present	Desired future (5-10 years)	Past (5-10 years)	Present	Desired future (5-10 years)
Vegetation	Forests and woodlands	Better tree cover	Reducing due to charcoal production from harvested wood	Hoping for more forest as it brings more rains	Was better in the past	The quantities have reduced	Youth do not want forest due to fear and crime in the forest.
	Mangrove	There was better mangrove presence	Same as past due to re-sprouting	Hope it will remain the same	Was more in the past	Has reduced	Hoping for improvement
Soil condition	Soil fertility	Fertility was good	Has declined compared to the past	Hoping it will improve and remain same	No farming in the area	Has reduced	Hoping for same condition or improvement
Freshwater	Volume	The water was deeper	Greatly reduced due to siltation	Help is needed to restore the river	There was higher volumes.	Has reduced	Hoping for better state
	Availability and Quality	There was better water quality	Greatly reduced e.g., illegal mining	Help is needed to restore the river ecosystem	There was better quality of water	Has reduced	Hoping for improvement
Settlements	Residential spaces	Land was available for settlement	Reduced, most of the land has been sold	It is unlikely it can be improved	More land was available for settlement	Has reduced due to expanding buildings	Due to increasing population, it is expected to reduce further

3.6 Factors underlying the dynamics of the land-seascape attributes

At Densu basin, and for both Bortianor and Tsokomey/Tetegu communities, all land-seascape attributes assessed were generally degrading or declining (see Table 8 above). The main factors causing a decline in crop production were reduced land for cultivation (see Table 11 below). The cause of livestock decline was lack of space due to settlements. The decline in the fishery was attributable to pollution and overharvesting. Also, the decline in biodiversity of aquatic animals was attributed to the use of light in fishing, the use of fine mesh nets leading to over-exploitation. The decline in biodiversity of terrestrial animals was attributed to habitat destruction and the building of settlements. Further, the cause of decline in forests and woodlands was the conversion of forests for infrastructure. The decline of mangroves was due to intensive harvesting, while the decline in soil fertility was attributed to over-cultivation of the same land over years. Increasing population and high demand for land aggravated the shrinkage in available residential spaces. Decline in freshwater availability and quality was caused by pollution (due to deposition of refuse, excretion, etc.), erosion, and sand mining.

Table 11: Community perceptions of main drivers of change and threats at Densu.

Ecosystem elements	Attributes	Tsokomey		Bortianor	
		Factors that led to degradation	Possible threats in the future	Factors that led to degradation	Potential threats in the future
Production	Crop	Land for farming has been reduced	Lower rainfall	Fertile land sold for building; heavily depleted soils remain	Lower rainfall and irregular rainfall
	Livestock	Settlements have affected space for keeping livestock	Disease outbreaks	Development has taken over all land, and free-range rearing is no longer feasible	Disease outbreaks
	Fishery	Pollution and over-harvesting	Over-exploitation	Fishing trolleys have now increased on the sea; Use of light for fishing on the sea has also reduced stocking	Over-exploitation
	Agroforestry and commodity plantations		Lack of land	Conversion of lands into settlements	Lack of land
Biodiversity	Aquatic animals	Light fishing, fine mesh nets thus catching small juvenile fish, overexploitation	Over-exploitation	Fishing trolleys have now increased on the sea; Use of light for fishing on the sea has also reduced stocking	Over-exploitation
	Terrestrial animals	Habitat destruction and building	Habitat destruction	Destruction of forests and vegetated areas has led to habitat destruction for these animals	Habitat destruction
Vegetation	Forests and woodlands	Conversion of forests for building due to population rise	Cutting of trees and forests	Deforestation and conversion of forest lands into settlements	Deforestation
	Mangrove	Mangrove harvesting	Land encroachment	Mangrove harvesting for firewood, trap making, building	Land encroachment
Soil condition	Soil fertility	Over-cultivation on the same land	Over-cultivation	Over-cultivation	Overcultivation
Freshwater	Volume	Dumping of refuse, defecation, erosion leading to siltation	Siltation of river	Erosion leading to siltation	Siltation of river

Ecosystem elements	Attributes	Tsokomey		Bortianor	
		Factors that led to degradation	Possible threats in the future	Factors that led to degradation	Potential threats in the future
	Availability and Quality	Pollution resulting from refuse deposition, defecation, and erosion	Pollution	Plastic pollution and other pollution, e.g., fish traps and salt mining	Pollution
Settlements	Residential spaces	Increasing population and demand for land	None	High demand for space to build	None

At Narkwa basin, some of the land-seascape attributes were degrading or declining while others had no change, but none was reported to be improving (Table 9). Communities reported crop production, livestock production, biodiversity of aquatic animals, soil fertility, and residential spaces were on the decline. Communities also reported agroforestry and commodity plantations, biodiversity of terrestrial animals, forests and woodlands, mangroves, freshwater volume, and quality to have remained the same. Table 12 presents the main factors communities thing might have led to the changes in Narkwa.

Table 12: Community perceptions of main drivers of change and threats at Narkwa.

Ecosystem elements	Attributes	Factors that led to degradation	Possible threats in the future
Production	Crop	Land shortage and declining soil fertility	Lower rainfall
	Livestock	Most of the land is converted to infrastructure	Disease outbreaks
	Fishery	The use of light fishing has negative effects	Overexploitation
	Agroforestry	-	-
Biodiversity	Aquatic animals	The use of fishing trawlers leads to over-harvesting; the use of light for fishing on seas has reduced stock	Overexploitation
	Terrestrial animals	-	Habitat destruction
Vegetation	Forests and woodlands	-	Overexploitation
	Mangrove	-	-
Soil condition	Soil fertility	Intensive use	Overcultivation
Freshwater	Volume	None	Siltation of the river
	Availability and Quality	None	Pollution of the river
Settlements	Residential spaces	High demand for residential lands	None

The main factors causing decline are as follows: for crop production, it was the reduction in land for cultivation and declining soil fertility; for livestock, it was lack of space due to settlements; for fishery and biodiversity of aquatic animals, the causes were the use of light for fishing and industrial trawler fishing in marine waters. Also, the decline in soil fertility was attributed to over-cultivation of the same land over the years, while the decline in residential spaces was attributed to increasing population and high demand for land. The main threats identified included lower crop production, disease outbreaks for livestock production, over-exploitation for fishery and aquatic biodiversity, and over-cultivation of land in the case of soil fertility.

At Whin basin, and for both Apremdo and Amanful communities, the land-seascape attributes were generally degrading or declining: except biodiversity of aquatic and terrestrial animals, and mangrove

vegetation at Apremdo. At Amanful, more land-seascape attributes were reported to have had no change, namely, crop production, fishery, aquatic animals, and agroforestry and commodity plantations. Livestock production in the Amanful community was reported to be improving.

The main factors causing a decline in the Apremdo community were reported as follows (Table 13): for crop production, it was a reduction in land for cultivation and declining rainfall; for livestock, it was disease outbreaks and theft; for fishery, the cause was over-exploitation; for forests and woodlands as well as agroforestry and commodity plantation, the cause was harvesting of trees. Also, the decline in soil fertility at Apremdo was attributed to over-cultivation of the same land over the years, while the decrease in residential spaces was attributed to land sales for infrastructure and settlements. Further, freshwater volume and quality decline are reportedly caused by siltation from different sources, including erosion, pollution, and illegal mining. The main threats identified by respondents at Apremdo community included lower/erratic rainfall in the case of crop production, disease outbreaks for livestock production, over-exploitation for fishery, lack of land in the case of agroforestry and commodity plantations and cutting of trees in the case of forests and woodlands. Other threats to land-seascape attributes were over-cultivation in the case of soil fertility and siltation and pollution in the case of freshwater volume and quality.

At the Amanful community, the main factors causing decline in livelihood activities were reported as follows: for forests and woodlands as well as mangrove vegetation, it was harvesting of trees, for decline in soil fertility, was attributed to over-cultivation of the same land over the years, while the decline in residential spaces was attributed to increasing population and needed for infrastructure. Further, freshwater volume and quality decline are reportedly caused by siltation from different sources, including erosion, pollution, and illegal sand mining. On the other hand, the cause of the reported increase in livestock production is that more people are rearing livestock. The main threats identified by respondents at Amanful community were similar to those identified at Apremdo and already enumerated above.

Table 13: Community perceptions of main drivers of change and threats at Whin land-seascape.

Ecosystem elements	Attributes	Apremdo		Amanful	
		Factors that led to degradation	Possible threats in the future	Factors that led to degradation	Potential threats in the future
Production	Crop	Lack of rainfall Reduced land thus over-cultivated	Lower and erratic rainfall	None	Lower and erratic rainfall and poor soils
	Livestock	Disease outbreaks and stealing	Disease outbreaks	More people rearing	Disease outbreaks
	Fishery	Pollution of water bodies	Overexploitation	None	Overexploitation
	Agroforestry and commodity plantation	Harvesting of tree products	Lack of land	None	Lack of land
Biodiversity	Aquatic animals		Overexploitation	None	Overexploitation
	Terrestrial animals		Habitat destruction	None	Habitat destruction
Vegetation	Forests and woodlands	Land conversion to houses and fuelwood	Cutting of trees	Deforestation and settlements expansion	Cutting of trees
	Mangrove	None	Land encroachment	Harvesting of mangroves	Land encroachment
Soil condition	Soil fertility	Due to intensification	Over-cultivation	Pollution of land	Over-cultivation
Freshwater	Volume	Due to siltation from various activities, e.g., pollution	Siltation of river	Siltation, e.g., from erosion	Siltation of river
	Availability and Quality	Quality affected by illegal mining and pollutants	Pollution of river	Pollution of water bodies, e.g., from illegal mining	Pollution of river
Settlements	Residential spaces	Land mostly sold out	None	Increasing population and continuous infrastructure development	None

3.7 Understanding the envisaged change trajectories in the land-seascapes

Tables 14 and 15 present the activities that need to be stopped, expanded, or introduced as perceived by the communities.

Table 14: Change trajectories envisaged and underlying reasons in Densu.

Location	Activities to eliminate (Stop doing) and the reason	Activities to expand and the reason	Activities to introduce (new activities) and the reason
Tsokomey & Tetegu	▪ Light fishing: Because it has reduced the quantity of fish catch and affected livelihoods; ▪ Pollution of water bodies: This causes hygiene problems and also affects the fish quantity and water quality	▪ Planting mangroves: Increase fish production	▪ Introduction of advanced fishing boats: to improve fishing; ▪ Market linkages: to provide better markets for locals
Bortianor	▪ Dumping of refuse in the water: Reducing yields of harvests from the lagoon; ▪ Defecating into the river: to avoid polluting the water; ▪ Cutting of mangroves and other trees: To avoid degradation of the mangroves; ▪ Light fishing (fishing with light): to avoid over-fishing; ▪ Using of fine mesh nets: to avoid catching all sizes of fish, including juveniles; ▪ Chemicals for fishing such as carbide: to avoid killing all the animals present in the water; ▪ Use of wooden traps in water/trap fishing: to avoid catching all sizes of fish, including juveniles	▪ Planting mangroves: to promote spawning of fish; ▪ Improve school infrastructure: education will promote cleanliness	▪ Mangrove planting: to improve mangrove forests; ▪ Introduce birds, crabs, etc. to restore the ecosystems: to restore ecosystem biodiversity and services

At Densu basin, the main activities to be stopped at Bortianor, Tsokomey, and Tetegu were light fishing and pollution of water bodies. At Bortianor other activities were listed, including fine mesh nets, use of chemicals for fishing, cutting of mangroves, and use of wooden traps for fishing. At the Narkwa basin, the main activity to stop was light fishing. At Whin basin, the Apremdo community wanted to stop sand mining while the Amanful community wanted to stop the shoreline protection activities (e.g., seawalls and groynes) which are designed to prevent beach erosion but then do not

allow access for beaching artisanal fishing canoes. For activities to expand, both communities in the Densu basin mentioned planting mangroves, while the Narkwa and Whin basin wished to expand shellfishing.

For new activities to introduce, the Densu basin communities proposed introducing advanced fishing boats, mangrove planting, market linkages, and restoration of ecosystems. At Narkwa, there was a request to introduce potable water for domestic use, while a new activity common to Narkwa and Whin was the introduction of alternative livelihood options.

Table 15: Change trajectories envisaged and underlying reasons in Narkwa and Whin.

Location	Activities to eliminate (stop doing) and the reason	Activities to expand and the reason	Activities to introduce (new activities) and the reason
Narkwa	Use of light fishing: Results in low fish yields	Shellfishing: To improve production and livelihoods	Introduction of new job opportunities: To prevent diseases that may occur due to lack of food resulting from lack of income and livelihood benefits from the land-seascapes.
	Water pollution: Health risks		Clean drinking water: To improve livelihoods
Whin - Apremdo	Sand mining: Seabed supporting fish is disturbed*	Shellfishing: Major livelihood activity hence important to expand	Introduction of other livelihood options: To diversify income sources
Whin - Apremdo	Sea defense program **: Increasing depth of the lagoon	None	Manage expansion of the sea Alternative livelihood activities: To improve livelihoods and income

Note: * This has affected livelihood activities based on the collection of seashells for terrazzo making. ** denotes efforts to stop shoreline erosion a by using engineering techniques (e.g., building a sea wall).

The various proposed change trajectories have a common purpose: to improve community livelihood activities and hence people's wellbeing. The proposal to stop light fishing, pollution of water bodies (through various means), cutting of mangroves, use of chemicals in fishing, use of wooden traps, use of fine mesh nets, and sand mining are all aimed at improving sustainability in fishing activities. For instance, stopping the activities mentioned above will ensure clean water resources and prevent depletion of aquatic animals and reduced yields. Also, the proposal to expand mangrove planting activities and shellfishing would increase aquatic animal harvests. For instance, mangroves are critical for providing suitable habitats for reproducing many marine animals, including shellfish.

Community aspirations to replace beach pollution with cleaning of beaches, and replace tree cutting with tree planting, would help ensure improvement in water conditions and lead to higher yields of harvests. Concerning new activities to introduce such as advanced fishing boats, mangrove planting,

market linkages, restoration of ecosystems, the introduction of potable water for domestic use, and the introduction of alternative livelihood options are all geared towards improving community livelihoods and wellbeing.

3.8 Stakeholder organizations and their roles in the land-seascapes

Diverse stakeholders are present in the different landscapes. While the Bortianor and Tsokomey/ Tetegu communities in Densu had up to eight stakeholder organizations each, the Amanful community in Whin and Narkwa had three recognized stakeholder groups while the Apremdo community (also in the Whin basin) reported two stakeholder groups with involvement in fishing activities.

The prominent roles played by the identified stakeholders varied considerably depending on the type of stakeholder (Table 16). Based on the contribution of each stakeholder to their livelihood activities, respondents at the Densu basin identified Development Action Association, a non-governmental association (NGO), as the most important stakeholder followed by the Densu Oysters Pickers Association, a community group, and then the Ministry of Fisheries. At Narkwa, the fishers' group was identified as the most important followed by the USAID/ SFMP project in the community. At New Amanful, the fishmongers group was more important followed by the USAID. Municipal and District Assemblies are key stakeholders in local governance across sites but were only mentioned at Densu, where it plays a key role in co-management of the oyster shellfishery in the estuary.

Table 16: Perception of communities about stakeholder type, roles, and importance in land-seascape.

Full name of stakeholder/actor	Typology	Engagement activities (roles) in the land-seascape	The overall importance of the stakeholder (Rank on a 1-10 scale)
Chief / Elders	Community (Traditional authority)	Cultural performance like a libation. Enforcement of bylaws like taboos	4
Development Action Association (DAA)	Association	Supervise DOPA Capacity building of fishers; Advocacy for food security; provides enterprise support to communities	1
Densu Oyster Pickers Association (DOPA)	Communal group	Oyster collection/processing Mangrove planting, Cleaning	2
Village Savings & Loans Association (VSLA)	Communal group	Provide loan facilities to community members	8
Fishers group (Densu-Bortianor)	Business	Managing fishing activities and create awareness on prevailing regulations and byelaws	8
Fishermen group (Narkwa & Whin)	Communal group	Monitor fishing activities and check compliance to local byelaws	1
Fishmongers Association	Communal group	Supporting each other in social events, No government interactions	1
Ghana National Canoe Fishermen Council	Group	Create awareness and advocacy for the wellbeing of fishermen	7
Community youth group	Communal group	Cleaning of beach	8
Ministry of Fisheries & Aquaculture Development	Government (Public)	Policy direction/support	3
Forestry Commission	Government (Public)	Provide mangroves planting materials and train/support communities on planting	5
District Assembly	Government (Public)	Co-management of the lagoon, etc.	5/6
USAID	Government Aid Agency	Assist shellfisher groups in various ways	2

Note: The USAID project communities referred to is the USAID SFMP which closed in 2021.

3.9 Mangroves as unique elements of the land-seascape: their state, health, and contributions to shellfishing

Communities in Densu believed the mangroves are improving, while it is the opposite in Amanful in the Whin basin. At Apremdo (also in New Amanful), the community reported no change in their mangrove forest. The mangrove forests at all communities were of good health except at New Amanful (Table 17).

Table 17: Trends in mangrove forest relationship with shellfishing.

Status of mangrove	Densu		Narkwa	Whin	
	Bortianor	Tsokomey & Tetegu	Narkwa	Apremdo	Amanful
The trend of mangrove forest	Expanding	Expanding	None	No change	Declining
Current mangrove health condition	Healthy	Healthy	None	Healthy	Not healthy
Relation between mangrove and shellfish	Yes	Yes	None	Yes	Yes

The respondents agreed that mangroves are important for shellfishing in all the communities where mangroves currently grow. They explained that mangroves provide a habitat for shellfish to live and reproduce. In the light of this, respondents indicated a willingness to plant more mangroves to realize the associated benefits. Van Lavieren et al., (2012) and Hutchison et al., (2014) also stated the sustainability of oyster farming depends on the mangrove state. At Densu, the most important indicator of the health status of mangroves is its appearance. Where the vegetation looks physically good with vigorous growth, its attributes will be normal green leaves if the mangrove is healthy. Leaves will be curled and yellow with weak looking or degraded plants, signs of harvesting, and high sunshine in the area if the mangrove is unhealthy. A second important indicator is the presence of animal species. A healthy mangrove attracts or is inhabited by several animal species, particularly birds. The presence of high quantities of shellfish in general, oyster and crabs, are indicators of a healthy mangrove, while it is unhealthy for the reverse, where shellfish yields will be reduced (Table 18).

Participants at Whin believed that the form of the mangrove tree is the most important indicator of how healthy the stand is. The stand is healthy when the trees are growing well, with the trees re-sprouting when cut.

Table 18: Indicators and attributes of health status of mangroves.

Site	Community	Indicators	Description	Healthy mangrove attributes	Unhealthy mangrove attributes
Densu	Tsokomey & Tetegu	Physical appearance	Good physical appearance of mangrove vegetation	Mangrove stands that are not degraded; green leaves	Degraded stand; curled, yellow leaves
	Bortianor	Physical appearance	Healthy mangroves appear vigorous and not degraded	Normal green leaves, vigor in growth	Yellow leaves, curled leaves, weak looking plants
		Presence of animal species like birds	If the mangrove vegetation is healthy, certain animal species will be found	Presence of high quantities of shellfish and oysters	Low presence of shellfish and oysters
Whin	Amanful	Mangrove trees	Mangrove trees appear healthy and growing well	When cut, they can re-sprout themselves	

4. DISCUSSION

The findings from this study indicate highly vulnerable communities along the coastal areas whose livelihood options are heavily restricted to land and water resources around them. Lawson et al. (2012) also reported the intertwined nature of the environment-livelihood nexus in coastal areas of Ghana and how vulnerable they could easily be if ecosystems are not managed well. With the land-seascape under intense degradation pressure and with climate change directly posing a significant challenge (Atindana et al., 2020; Freduah et al., 2017), the livelihood of the communities is highly threatened. Other studies such as Daniels et al. (2021) highlighted similar concerns.

There are opportunities for meaningful interventions if communities have awareness about the prevailing challenges, the causes of those challenges, and what can be done to improve the status quo (Strain et al., 2019). Further, local people have a very good appraisal of what to stop doing, what to expand and what to introduce to minimize the degradation of their land-seascapes. More importantly, local people have a good mental picture of the future they desire to achieve by implementing various interventions in various niches within the land-seascape (Figure 2).

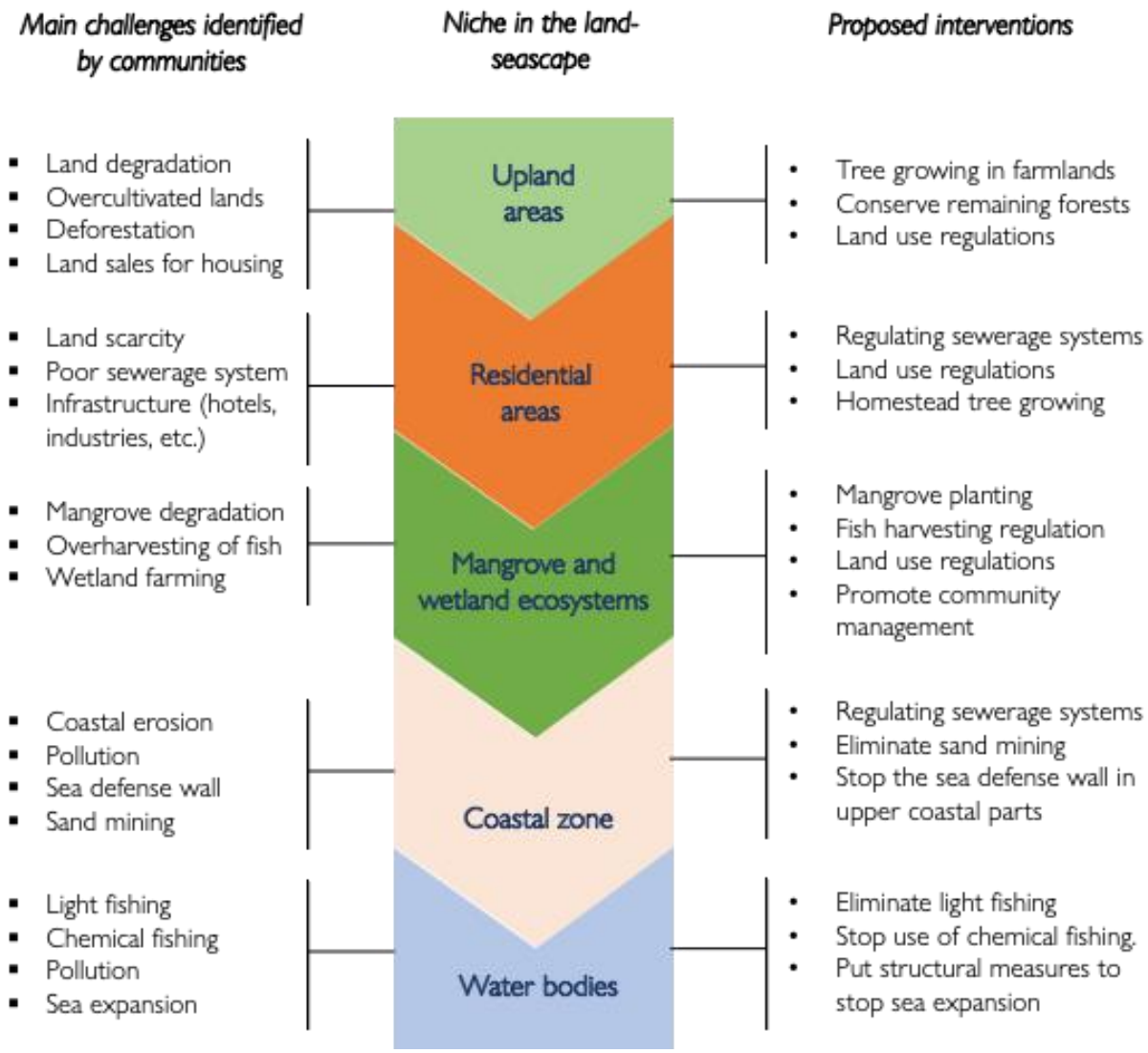

Figure 2: Niche based challenges identified and interventions proposed for a better land-seascape in Ghana. Note: the proposed interventions are mostly from the communities, but some are also added from the researchers based on their knowledge of the area.

One notable observation from the challenges the communities identified and the measures they proposed is the very strong need for regulatory measures to be implemented in their land-seascapes (Figure 2). For instance, light fishing, chemical fishing, sand mining, illegal expansion of houses and construction, etc. all need the interventions of government agencies to be actively playing their roles in minimizing degradation of the land seascapes. They could be very critical in developing legislative instruments (i.e., policies, strategies, and guidelines) as the enablers for local actions (Table 19). However, as indicated in the preceding sections of this report, governments do not always have sufficient workforce and skills to effectively implement specific measures that should happen at every locality. This is where empowering local resource governance systems through the communities could

be very complementary. This needs the deployment of co-management schemes, contextualized to the local realities.

Table 19: Potential enablers and inputs needed to implement some of the key community proposed interventions towards improved land-seascapes.

Community proposed interventions	Key enablers	Key inputs
Tree and mangrove planting	Enforcing forest and mangrove vegetation restoration	Planting materials supply; granting community management rights where feasible; Technical support systems e.g., extension services
Conserving remnant forests	Empowering communities to manage the remnant forests; Legislating and implementing forest management schemes that promote co-management	Exploring alternative policy measures such as community-based management that is expanding in many other countries;
Land use regulations	Policy and regulatory instruments such as land use policy	Land use maps; Local infrastructural development guidelines
Fish and oyster harvesting regulations	Policy and legislative support for enforcing existing regulations, updating them timely, and developing new resource use guidelines when and where needed.	Awareness forums for local communities and other fisherfolks; logistic support for continuous monitoring of harvest conditions.
Eliminating sand mining	Guidelines on sand mining in coastal areas and enforcement of the same	Empowering local communities and administrative bodies on monitoring and reporting sand mining.
Regulating residential areas sewerage systems	Guidelines for sewerage systems management and implementation; Incentives schemes for recycling wastes	Investment for sewerage systems management in settlement areas; Awareness creation forums
Manage sea shore expansion	Strategic guidance on socially and environmentally sound seashore erosion control measures	Investments for local relevant and participatorily defined seashore erosion control techniques e.g., mangrove restoration, use of stone boulders (see Addo and Addo 2016)

Communities have also highlighted practice measures that they could implement with the support of various stakeholders in the land-seascapes. For instance, mangrove planting, tree growing, sustainable agriculture promotion, waste management, etc. Although communities mentioned farming and other land-based livelihood activities, locals indicated a higher dependence on sea- or water-based activities

than land, owing to many challenges. They aspire to improve these land-based activities if existing barriers can be removed or circumvented. Observations of the community distribution further revealed some potential to make better use of the upland areas in the communities. Under the existing circumstance, it is possible to design and implement agroforestry interventions to improve/optimize current land use and provide additional benefits and resources to communities, including enhanced agricultural productivity, multiple ecosystem services, and human well-being (Brown et al., 2018). For instance, woodlot-based timber farming could generate substantial income on land and meet the domestic energy demands primarily in the upland parts, and as a result contribute to reducing soil erosion often resulting in siltation in the coastal areas (Eshetu et al., 2018). Another alternative is fodder tree growing for livestock rearing which could easily be combined with the zero-grazing approach.

Useful multi-purpose tree species could be introduced for planting in the communities (Kankam et al., 2021). Although locals complained about inadequate spaces for planting, a close observation of the communities reveals that some tree integration is possible. For instance, trees could be planted in homesteads (home gardens), home boundaries, and on the farms of those who have land. Major constraints to the successful introduction of trees include inadequate knowledge about tree planting and nurturing, exposure of planted tree seedlings to livestock, poor technical knowledge on dealing with saline soils, lack of access to planting materials and commitment to nurture planted trees until maturity (Airoldi et al., 2021). These constraints can largely be resolved through training and capacity building for local people. Providing certain basic inputs such as tree seeds or tree seedlings would also help overcome the challenges and improve chances of success.

For the expansion of livestock rearing in the communities, the major constraint is the lack of space to practice the traditional free-range approach of livestock rearing. A possibility would be to adopt a zero-grazing approach where the animals are fed in stables. Other constraints are disease outbreak and theft (Timpong-Jones et al., 2014). For diseases, involvement of veterinary services would help, while housing livestock would also minimize or eliminate theft. Successful implementation of livestock-based intervention in these communities would also require that local people be given some training on the new ways of keeping and caring for livestock. It was evident from the agricultural and wild biodiversity assessment that feedstocks for goats and sheep were primarily limited to cassava leaves and peels except for Narkwa where fodder from Ficus spp. was occasionally harvested for sheep. There is a possibility of introducing fodder species from the wild or planting on farms, in home gardens, or boundaries if livestock are put in enclosures. There may also be a need to create linkages between local people and extension service providers.

5. SUMMARY

We deployed a participatory landscape visioning process to engage coastal communities in focus group discussions to appraise resource and livelihood trends and understand the change trajectories on selected land-seascape attributes. Participants were enthusiastic in responding to the questions discussed. The major highlights and implications of the findings are summarized below.

Most shellfishers were female (over 40 years of age) with a minority of male involvement. Even where males were involved in shellfishing, they performed specific tasks along the value chain, leaving certain specific aspects to females, thus highlighting gender differentiation in participation of livelihood activities.

The crops cultivated across sites included staples (e.g., maize, plantain, cassava), vegetables (e.g., tomatoes, onions, okra, pepper) and fruits (pineapple), while livestock included poultry (fowls and ducks), pigs, and ruminants (goats and sheep). Across all sites and communities, changes have occurred in landscape productivity towards declining availability of resources over the past 5-10 years. Resource availability was declining for almost all resources (e.g., crops, livestock, fishery, biodiversity, soil, etc.). The drivers of resource decline did not differ much across sites and communities, and the major causes are the increasing human population and the subsequent high demand for resource supplies. For instance, increasing population led to over-exploitation/ over-utilization of lands/ soils, biodiversity, vegetation of all kinds, and water. The main threats to resource availability, going forward, were identified to include erratic/ reduced rainfall, disease outbreaks, and continuous over-exploitation of resources. These threats can further worsen the current situation in the communities.

The main livelihood activities across the sites and communities were fishing and farming and were reported to be on the decline. Alternative livelihood options independent of the existing natural sources (sea and land) are almost non-existent in the study sites; only masonry, trading and sand mining were mentioned in some communities, but their scale of practice was low. This situation would invariably lead to further worsening of the already existing over-dependence on these natural resources and thus increase the vulnerabilities of inhabitants.

The respondents identified some activities they wish to stop/ eliminate, expand, and replace. Additionally, some activities were identified as necessary to introduce in the communities. The activities to be stopped or replaced are those with negative consequences on resource availability and, by extension, livelihoods, including pollution of waters (sea and lagoon), causing over-exploitation of aquatic animals such as the use of light fishing and cutting of mangrove forests. Alternatively, activities to expand or introduce are perceived to impact communities and their livelihoods positively. These include planting mangrove forests, expanding shellfishing, restoring ecosystems, introducing advanced fishing boats, and providing market linkages for local fisher folks.

Stakeholder organizations are actively present in the Densu basin but not in the other sites (Narkwa and Whin). The presence of relevant stakeholder organizations influences the communities in the

execution of their daily livelihood activities; thus, it has been observed that the Densu basin is exposed to certain opportunities and activities that are non-existent in the Narkwa and Whin basins. For example, while the shellfishers at Densu basin have all been engaged and thus have knowledge about mangrove planting, shellfishers at Narkwa and Whin basins have no such knowledge and experience. Consequently, the mangrove stands have expanded at Densu because of planting and appears healthy from community perceptions. At Whin, mangrove stands at Apremdo have not changed but are healthy, those at Amanful have reduced in size and appear unhealthy.

The indicators of healthy mangroves mentioned by respondents include physical appearance of mangrove plants, presence of indicator species like birds, presence of shellfish and crabs due to presence of mangroves. On the other hand, the indicators of unhealthy mangroves include signs of harvesting, high sunshine in the area, and reduced yield of shellfish.

Generally, coastal livelihoods are increasingly threatened as water resources and the general landscape seem to be declining with overuse, infrastructural expansion, and climate change. Apart from land scarcity issues at Densu, irregular climatic patterns leading to high temperatures and unexpected drought during the main growing season negatively affect farming, particularly at Narkwa and Whin. At Narkwa, the coping strategy for some people has been digging wells for watering especially for pineapple production.

REFERENCES

Addo, K. A., & Addo, I. A. (2016). Coastal erosion management in Accra: Combining local knowledge and empirical research. Jàmbá: Journal of *Disaster Risk Studies,* 8(1), 1-10.

Airoldi, L., Beck, M., Firth, L., Bugnot, A., Steinberg, P., Dafforn, K. (2021). Emerging solutions to return nature to the urban ocean. *Annual Review of Marine Science*, 13, 445-477.

Armah, AK. (2005). The coastal zone of Ghana: Vulnerability and adaptation assessment to climate change. Vulnerability and adaptation assessment training workshop, 18-22 April 2005, Maputo, Mozambique.

Asare, B., Obodai, E.A. and Acheampong, E. (2019). Mangrove oyster farming: Prospects as supplementary livelihood for a Ghanaian fishing community. *Journal of Fisheries and Coastal Management*, 1(1), 7-14.

Atindana, S.A., Fagbola, O., Ajani, E., Alhassan, E.H. and Ampofo-Yeboah, A. (2020). Coping with climate variability and non-climate stressors in the West African Oyster (Crassostrea tulipa) fishery in coastal Ghana. *Maritime Studies,* 19(1), 81-92.

Brown, S.E., Miller, D.C., Ordonez, P.J. et al. (2018). Evidence for the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in high-income countries: a systematic map protocol. *Environ Evid*. 7, 24. https://doi.org/10.1186/s13750-018-0136-0

Chuku, E.O., Yankson, K., Obodai, E., Acheampong, E. and Boahemaa-Kobil, E.E. (2020). Effectiveness of different substrates for collecting wild spat of the oyster Crassostrea tulipa along the coast of Ghana, *Aquaculture Reports,* Vol. 18. 100493, https://doi.org/10.1016/j.aqrep.2020.100493.

Climate Policy Initiative [CPI]. (2019). Global landscape of climate finance 2019. London. Available at: https://climatepolicyinitiative.org/publication/global-climate-finance-2019/.

Coastal Resource Center-Ghana/Friends of the Nation. (2010), Rapid Biodiversity Assessment on the Essei and Butuah Lagoons and Whin River Estuary in the Sekondi-Takoradi Metropolis of the Western Region of Ghana. Coastal Resource Center in Partnership with Friends of the Nation on the Hɛn Mpoano Initiative in Ghana. Technical Report.

Daniels, T., Chan, J., Kankam, S, Murphy, M., Day, D., Fürst, C, Koo, H. (2021). Four shareworthy SEPR scenario ideas. *Socio-Ecological Practice Research*, 3(1), 9-15.

DeGraft-Johnson, K.A.A., Blay, J., Nunoo, F. K. E., Amakwah, C.C. (2010). Biodiversity Threats assessments of the Western Region of Ghana. The integrated Coastal and Fisheries Governance (ICFG) Initiative, Ghana.

Duguma, L., Liman, A., Bah, A., Carsan, S., Muthee, K., McMullin, S. et al. (2021). WE2.3: Mangrove Vegetation Dynamics in The Gambia and Ghana. Nairobi: World Agroforestry (ICRAF)

Effia Kwesimintsim Municipal Assembly, (2020). Demographic data. https://www.citypopulation.de/en/ghana/admin/western. assessed 28/08/21

Ekumfi District Assembly, (2020). Demographic data. https://www.citypopulation.de/en/ghana/admin/central/0219__ekumfi/ Assessed 28/08/21

Eshetu, S.B., Pretzsch. J. and Mekonnen, T.B. (2018). Financial Analysis of Smallholder Farmers Woodlot and Homestead Agroforestry Systems and its Implications for Household Income Improvement, the Case of Hawassa Zuria District, Southern Ethiopia. *J Agri Sci Food Res* 9: 1000236: 1-7

Freduah, G., Fidelman, P., & Smith, T. F. (2017). The impacts of environmental and socio-economic stressors on small scale fisheries and livelihoods of fishers in Ghana. *Applied Geography,* 89, 1-11.

Freduah, G., Fidelman, P., & Smith, T. F. (2018). Mobilising adaptive capacity to multiple stressors: Insights from small-scale coastal fisheries in the Western Region of Ghana. *Geoforum*, 91, 61-72.

Ga South Municipal Assembly, (2019). Composite budget 2019-2022. Assessed 28/08/21

Ga South Municipal, (2020). Demographic data. https://www.citypopulation.de/en/ghana/admin/greater_accra

Ghana Statistical Service. (2014). 2010 Population and Housing Census: District Analytical Report, Ekumfi District. Ghana Statistical Service.

Ghana Statistical Service. (2014). 2010 Population and Housing Census: District Analytical Report, Ga South Municipality. Ghana Statistical Service.

Ghana Statistical Service. (2014). 2010 Population and Housing Census: District Analytical Report, Sekondi-Takordai Metropolitan. Ghana Statistical Service.

Hutchison, J., Spalding, M., & zu Ermgassen, P. (2014). The role of mangroves in fisheries enhancement. University of Cambridge, The Nature Conservancy and Wetlands International, 54 pp.

Kankam, S, Inkoom, J, Koo, H, Fürst, C. (2021). Envisioning alternative futures of cultural ecosystem services supply in the coastal landscapes of Southwestern Ghana, West Africa. *Socio-Ecological Practice Research*, 3(3), 309-328.

Lachapelle, P. (2008). A Sense of Ownership in Community Development: Understanding the Potential for Participation in Community Planning Efforts. *Community Development,* 39(2): 52-59.

Lawson, E. T., Gordon, C., & Schluchter, W. (2012). The dynamics of poverty–environment linkages in the coastal zone of Ghana. *Ocean & Coastal Management*, 67, 30-38.

McLeroy, K., Norton, B., Kegler, M., Burdine, J. and Sumaya, C. (2003). Community-Based Interventions. *Am J Public Health*; 93(4): 529–533.

Njie, M. & Drammeh, O. (2011). Value chain of the artisanal oyster harvesting fishery of the Gambia. Coastal Resources Center, University of Rhode Island.

Osei, I. K. (2020). A study on the fishery, aspects of the biology and culture of the West African mangrove oyster, Crassostrea tulipa in the Densu Delta, Ghana. Unpublished PhD thesis, Department of Fisheries and Aquatic Sciences, University of Cape Coast.

Rankoana, S. 2017.. Subsistence food production practices: an approach to food security and good health. International *Journal of Environmental Research and Public Health*, 14(10), 1184.

Roe D., Nelson, F., Sandbrook, C. (eds.). (2009). Community management of natural resources in Africa: Impacts, experiences and future directions, Natural Resource. Issues No. 18, International Institute for Environment and Development, London, UK

Sagoe, A., Aheto, D., Okyere, I., Adade, R, Odoi, J. (2021). Community participation in assessment of fisheries related ecosystem services towards the establishment of marine protected area in the Greater Cape Three Points area in Ghana. *Marine Policy*, 124, 104336.

Strain, E., Alexander, K., Kienker, S., Morris, R., Jarvis, R., Coleman, R., Bishop, M. (2019). Urban blue: a global analysis of the factors shaping people's perceptions of the marine environment and ecological engineering in harbours. *Science of the Total Environment*, 658, 1293-1305

Thwala, W. (2010). Community participation is a necessity for project success: A case study of rural water supply project in Jeppes Reefs, South Africa. *African Journal of Agricultural Research.* 5(10): 970-979.

Timpong-Jones, E., Adogla-Bessa, T., Adjorlolo, L., & Sarkwa, F. (2014). Some constraints of ruminant livestock production in the Coastal Savannah Plains of Ghana. Development, 26, 5.

Van Lavieren, H., Spalding, M., Alongi, D. M., Kainuma, M., Clüsener-Godt, M., & Adeel, Z. (2012). Securing the future of mangroves. Hamilton, ON, Canada: United Nations University, Institute for Water, Environment and Health.

Yeleliere, E., Cobbina, S. J., & Duwiejuah, A. B. (2018). Review of Ghana's water resources: the quality and management with particular focus on freshwater resources. *Appl Water Science*, 8(3), 1-12. doi: https://doi.org/10.1007/s13201-018-0736-4