Ministry of Lands
and Natural Resources

Keta Lagoon Complex Ramsar Site management plan

2023-2032

Forestry Commission

Keta Lagoon Complex Ramsar Site Management Plan 2023-2032

Financed by the Management of Mangrove Forests from Senegal to Benin project - PAPBio C1-Mangroves

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Abbreviations

AEWA – Agreement on the Conservation of African-Eurasian Migratory Waterbirds
CBD – Convention on Biological Diversity
CITES – Convention on International Trade in Endangered Species
CREMA – Community Resource Management Areas
CWMP – Ghana Coastal Wetlands Management Project
DA – District Assembly
EPA – Environment Protection Agency
GDSA – Gaborone Declaration for the Sustainability of Africa
GERMP – Ghana Environmental Resource Management Project
GEF – Global Environment Fund
FC – Forestry Commission
IUCN – International Union for the Conservation of Nature
IUCN PAPACO – IUCN's Program about Conservation and African Protected Areas
KLCRS – Keta Lagoon Complex Ramsar Site
LULC – Land-Use / Land-Cover
MPA – Marine Protected Area
NDC – Nationally Determined Contribution (to the UNFCCC Paris Agreement)
NCRC – Nature Conservation Research Centre
PNBA – Parc National du Banc d'Arguin (Banc d'Arguin National Park)
SDG – Sustainable Development Goals
UNFCCC – United Nations Framework Convention on Climate Change
WD – Wildlife Division
WDFC – Wildlife Division of the Forestry Commission

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ILLUSTRATION 1: PROJECT OF COMMUNICATION TOOL. REALISATION: SENYO ADZA

Introduction: The context of the update to the management plan of Keta Lagoon Complex Ramsar Site

Natural habitats and animal species are declining throughout the world. As an example, the African continent is experiencing an annual mangrove loss of 2% (IPBES, 2019), while mangrove cover in the West African sub-region declined by 25% from 1980-2006 (Feka and Ajonina, 2011). Other habitats are also facing declines: in Ghana specifically, alongside a decline of 24.3% in mangrove cover, healthy vegetation and dense shrublands are increasingly replaced by herbaceous shrubs/grasslands and built-up areas (EPA, 2018). In the context of the Keta Lagoon Complex Ramsar Site (KLCRS), mangroves and dense forests declined significantly (24% of mangrove and dense forest surface area decreased since 1991 – Duku et al. (2021) and 17% of mangrove surface area decreased in the recent years – GMES & Africa (2020)), Urbanisation and urban sprawl increased quickly (Brown, 2020; Duku *et al*, 2021), fishes are more and more overexploited (Lamptey and Ofori-Danson, 2014; Brinks, 2017), while contamination of fresh water supplies and indiscriminate waste disposal occurred more frequently (Ahmed and Isaac, 2016; Yidana *et al*, 2010). Finally, coastal erosion (WACA, case study 6, 2019) and climate change (IUCN & IESS, 2020; Brinks, 2017) are increasingly threatening the Ramsar Site.

In light of these challenges that confront the KLCRS, good management is essential, so that efforts are wisely orientated towards the effective conservation of the KLCRS environment. KLCRS is legally protected thanks to national law on wetlands L.I. 16-59 (1999). The Wildlife Division of the Forestry Commission is in charge of managing this protected area. Even though the Wildlife Division management team is working to mitigate the impacts of human activities & climate change on the environment while protecting the remarkable biodiversity in the site, they are faced with the challenge of limited resources and a lack of adequate materials. Additionally, the strategic document framing the management team's activities – i.e. the KLCRS Management plan – is outdated. It was developped in 1999 and therefore does not adequately reflect the contemporary landscape and the changes/challenges that it faces. Considering that most management plans are designed for 5–10-year time frames, the KLCRS has existed for more than a decade, without a valid management plan. To note that Wildlife law and other WD internal documents such as the Standard Operational Manual (SOM) are also framing WD activities.

The International Union for Conservation of Nature (IUCN) has secured funding from the European Union for the implementation of a four-year project (2019-2022) titled "*Management of Mangroves Forest from Senegal to Benin*" called 'PAPBio C1-Mangroves' funded by the European Union. The global objective of this project is to achieve an integrated protection of fragile ecosystems and biodiversity present in mangrove habitats in West Africa and enhance their resilience to climate change. The specific objective of the project is to strengthen stakeholders in the management of protected areas and unprotected mangrove sites. Thus, the project considered that it was necessary to revise the 1999 management plan for the Keta Lagoon Complex Ramsar Site in Ghana, and made it one of its concrete actions.

This revised document is the updated management plan for the Keta Lagoon Complex Ramsar Site. This management plan, by reflecting the current context, aims at improving the management of the Keta Lagoon Complex Ramsar Site as well as the development of its resources for nature and people. The purpose of the management plan is to: (i) synthesise the knowledge about the site, (ii) define and structure the axes of intervention, and (iii) set out management prescriptions for implementation. The

management plan is a 10-year time frame with a yearly review to allow for evaluation of performance indicators and adjustment of targets where necessary. It is intended to guide the management team in its choices and to serve as a support for their work.

The first part (Part A) sets the context and describes key features (governance aspects, type of habitats, socio-political framework, etc.). The second part (Part B) lists the objectives of the management plan (long-term objectives, global objectives, specific objectives) and related zoning and management actions. Finally, Part C proposes ways of assessing the management of the site.

ILLUSTRATION 2: KETA INHABITANT BRINGING BACK WATER AT THE VILLAGE OF BEYIVE

Method and field study

The update of the KLCRS management plan occurred in three phases. Firstly, a comprehensive literature review was undertaken, followed by extensive field work, and lastly, writing up of the Management Plan based on the first two phases.

The field work phase was divided into several sections. Firstly, an inception workshop to inform key stakeholders (state institutions, traditional leaders, CSOs and community representatives), of the plans to update the management plan. This meeting was also an opportunity to gather contextual information from all the participants through round-tables discussions and to understand their expectations of the review process. This was followed by an immersion phase on site, and extensive interviews by the KLCRS management team and external consultants.

The interviews were carried out in all 6 districts. In total, 18 communities were consulted from June-July 2022 through 43 focus group interviews (See *Illustration 3)* and over 20 semi-structured interviews with key informants, opinion leaders, community leaders and stakeholders at administrative level. This process was preceded by round tables bringing together dozens of key stakeholders during a launch meeting.

ILLUSTRATION 3: EXAMPLE OF FOCUS GROUP INTERVIEWS

The groups interviewed in the focus group discussions comprised farmers, fishermen, salt miners, alcohol distillers, mangrove harvesters/sellers, chiefs and opinion leaders. The communities were chosen at strategic points and participants' features (ethnicity, profession, proximity to the lagoon…) were taken into account, so that the information gathered would best represent the situation of KLCRS in its entirety (See *Figure 1*). The semi-structured interviews were conducted with the District Assembly (DA) and NGO heads, community leaders, planning officers, scientists and other stakeholders at administrative levels.

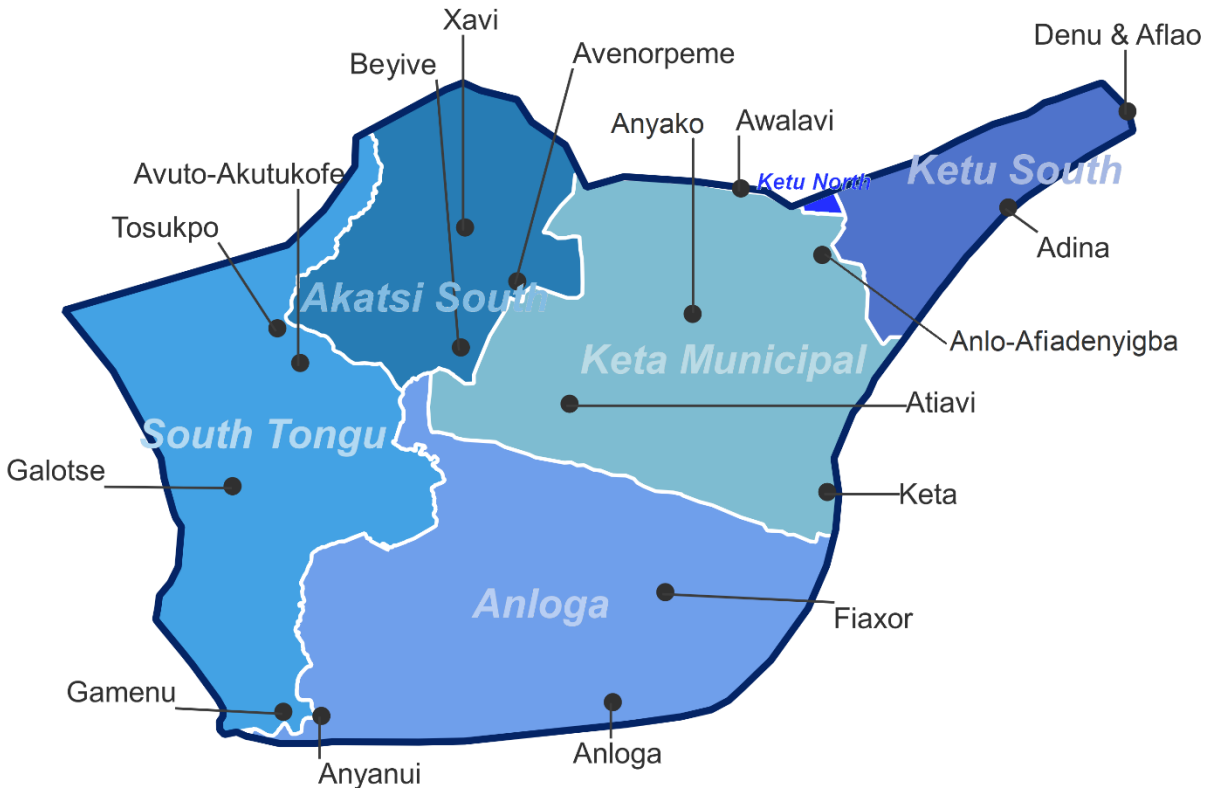

FIGURE 1: MAP OF COMMUNITIES VISITED

The main points raised in interviews were related to the following:

- The main characteristics of the site's environment;
- Identifying the 'human landscape' relating to the site, and mapping the relationships between the stakeholders;
- Identifying the main threats faced by the site;
- Identifying different areas on site, according to their roles and relative importance, in order to design an appropriate zoning;
- Reviewing the tools and actions available for the management team;
- Knowing how to involve users and residents in the management process.

The information gathered on site was coded manually to identify common themes and repeated statements. This helped to develop consistent themes/narratives that would assist in the development of appropriate management strategies.

Finally, following the production of a draft management plan, this document was examined and reviewed by on-site stakeholders during a validation workshop. Open discussions and round tables were carried out during this event, in order to refine the draft.

ILLUSTRATION 4: VILLAGE CHIEF AT GAMENU

PART A: Diagnosis and challenges

A.1. General Information

1.1. Creation of the Keta Lagoon Complex Ramsar Site (KLCRS)

In 1991, a management strategy document for Ghana's coastal wetlands was formulated. Based on this document, the Ghana Coastal Wetlands Management Project (CWMP) was initiated, spanning 1993-1999, funded by the Global Environment Fund (GEF) and implemented by the Wildlife Division (WD) of the Forestry Commission (FC) of Ghana. The CWMP's objectives were to strengthen conservation and regeneration of the the ecosystems and biodiversity in five wetlands in Ghana: Keta Lagoon Complex (which was already recognised by the Ramsar Convention on Wetlands as an area of international importance), Songor, Sakumo, Densu Delta, and Muni-Pomadze lagoons (WD, 1999). It sought to involve the communities who rely on these wetlands for planning and implementating on-site management strategies.

On 19 August 1999, the minister responsible for Forestry in section 11 of the Wild Animals Preservation Act, 1961 (Act 43) of Ghana, gazetted the Keta Lagoon Complex thereby protecting it under law LI 16-59 (WD, 1999). The key was to identify the common resources that benefit human and wildlife populations, and then educating and developing the capabilities of government and local communities on managing them without restricting their capacity to maintain biodiversity and ecological integrity, as well as the ability of people to derive benefit from the resources now and in the future (Mohan, P. C., 2002).

1.2. Summary of Ramsar laws and guidelines

On 19 August 1999, national legislation (LI 16-59 (1999) on wetlands) was initiated by the Minister of Forestry in accordance with the Ramsar Convention. As a consequence, KLCRS was given a formal management plan the same year.

Ramsar Convention has no internation coercitive power. However, Ramsar guidelines were turned into national law LI 16-59 (1999) in Ghana. According to Ramsar internationally recognised guidelines, within a Ramsar site it is illegal to (FC, 1999):

- Pollute any water;
- Fish out of season and with nets of mesh size below 25mm;
- Do any act that is likely to have an adverse effect on the environment;
- Use poison, explosions or chemicals for fishing.;

And prohibited to:

- Remove any forest vegetation or cultivate without consent from the managing body (namely the Wildlife Division);
- Deposit litter;
- Hunt, capture, harm or deliberately disturb any wild animal;
- Undertake unsupervised grazing of livestock, or grazing around nesting sites not demarcated by a managing authority;
- Engage in any act in general which may disturb the ecosystem;

Any person who breaks these laws/restrictions is liable for arrest, examination, and – if found guilty – a fine.

1.3. Location and boundaries of the MPA

The Keta Lagoon Complex Ramsar Site is the largest Ramsar site in Ghana. It lies in the far south-east of Ghana, bordering the international frontier with Togo in the east. To the west, it is bordered by the Volta River, and to the North, by the Tema-Aflao Highway (from the Sogakope Bridge in the West to the town of Tokor in the East). It is to note that on the western side of Volta River is situated another protected area: Songor Lagoon Ramsar Site. The southern and eastern boundary follow along the shoreline of the ocean (Gulf of Guinea). It covers a total area of 1360 km² (05º55'N 000º50'E) and encompasses whole or parts of six districts, namely: newly established Anloga district, South Tongu District, Keta Municipality, Akatsi district, Ketu North district, and Ketu South Municipality (Ramsar Sites Information Service, 2022). *Figure 2* below displays KLCRS in its regional context. Included are the districts and local names of communities present there.

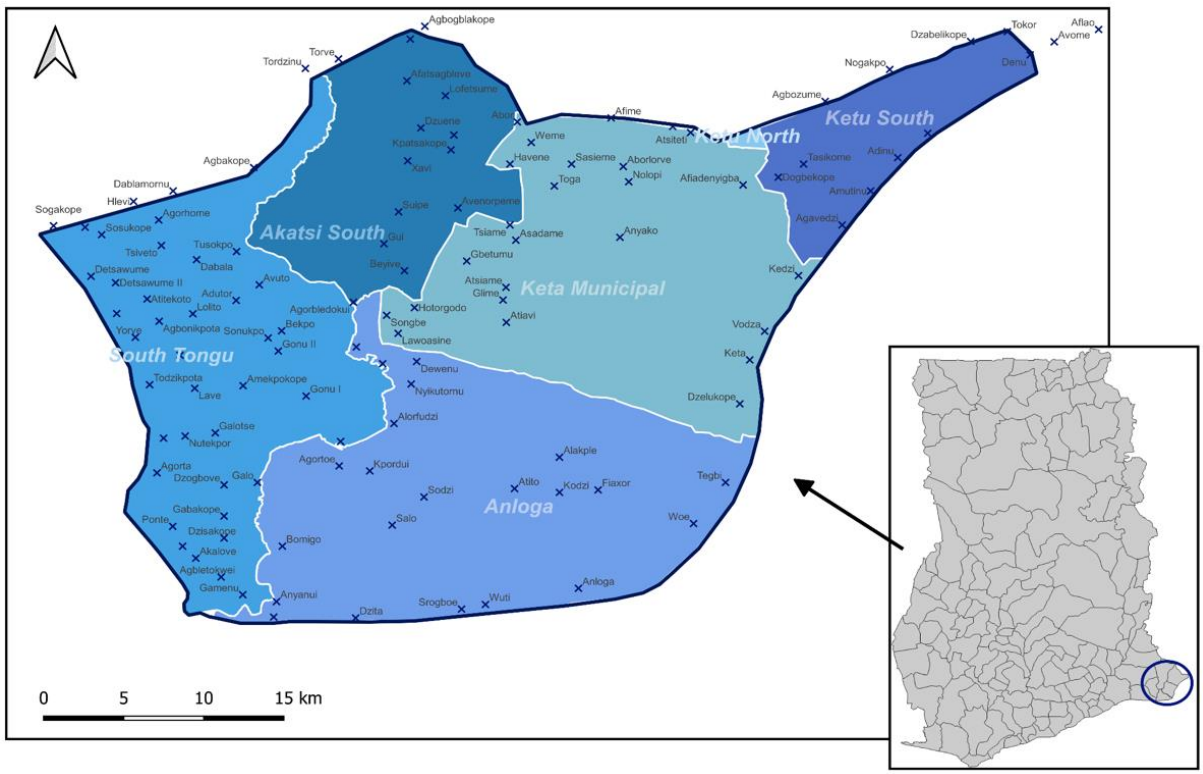

FIGURE 2: DISPLAY OF KETA LAGOON COMPLEX RAMSAR SITE IN ITS REGIONAL AND MUNICIPAL CONTEXT

The Ramsar Site comprises a large expanse of open lagoon with brackish water, flood plain, marshland, and extensive mangrove stands. It is connected to the Volta River estuary through a series of interconnecting streams. The main sources of water for the site are the Avu Lagoon, Todzie River, streams of Aka and Belikpa, the Volta River and sea water from the Gulf of Guinea. Along the main 'Accra --> Aflao (the Ghana/Togo coastal border town) road', the site area can be accessed from Dabala, Akatsi and Abor (WD, 1999). KLCRS is open to the sea through streams and estuaries of the Volta River in the south-west section of the site. The rest of the site is closed off from the sea. All the lagoon water supplying channels are increasingly becoming choked through siltation, and debris from vegetation and fishing/farming activities. The site stretches for 40 km along the coast and is separated from the sea by a narrow coastal ridge which is 2.5 km at its widest point and 0.92 km at the narrowest

portion (Lamptey, E., 2003). Total mangrove area approximates 58 km^2 in 2020, a decrease of 12 km^2 from 70 km^2 in 2015 (GMES & Africa, 2020).

1.4. Governance

1.4.1. Stakeholders, Organisations and contributions

A broad scale stakeholder analysis, which was partly adapted from IUCN & IESS (2020) report, was carried out. The analysis identifies entities, communities, and individuals who bear an interest in, or contribute to, the management of the KLCRS (IUCN & IESS, 2020). The on-site manager, directly mandated to conserve and protect biodiversity within the site, is the Wildlife Division (WD), an entity of the Forestry Commission under the Ministry of Lands and Natural Resources (a ministry of the Ghanaian government). CREMAs (Community Resource Management Areas) are included in this analysis as they represent a potential tool for sustainable management of KLCRS. *Figure 3* below depicts the web of stakeholders and their relationships within KLCRS.

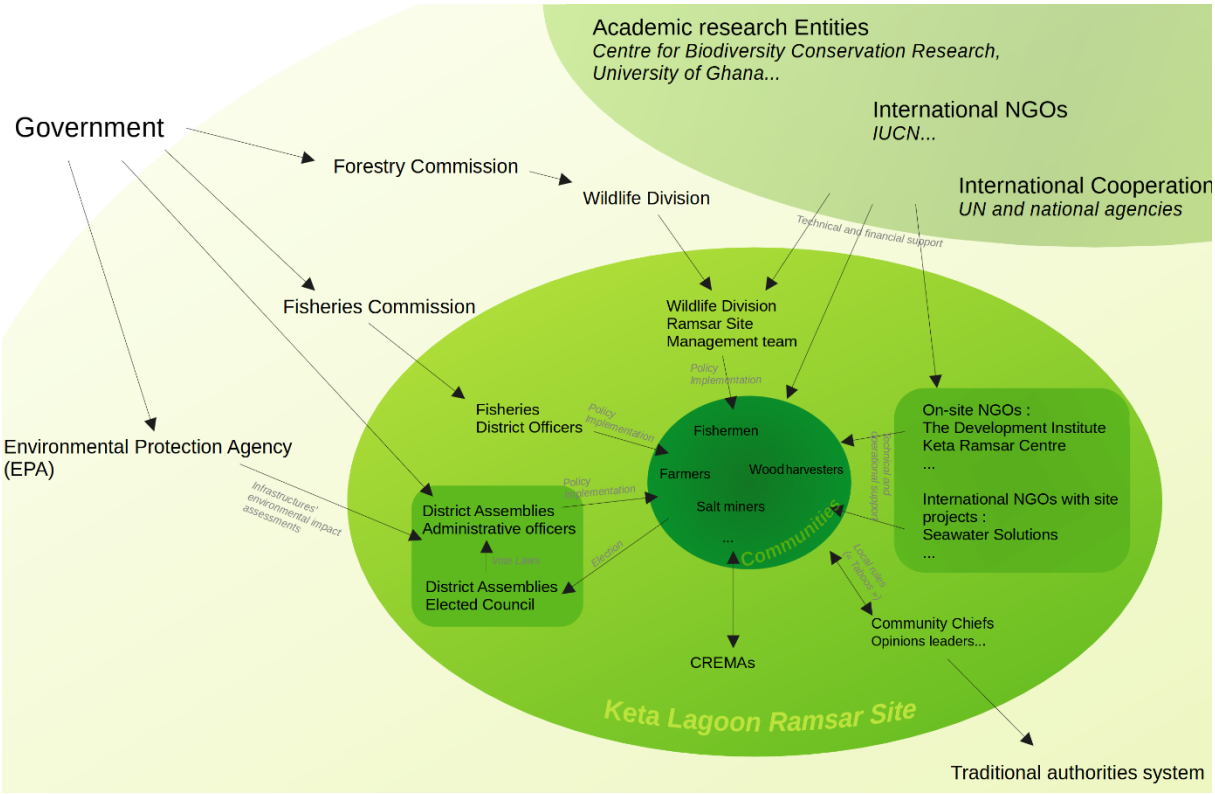

FIGURE 3: A DEPICTION OF STAKEHOLDERS AND THEIR RELATIONSHIPS WITHIN KLCRS

An in-depth analysis of stakeholders and their contributions, organised from international level to local level, is provided in *Table 1* below.

TABLE 1: ANALYSIS OF THE CONTRIBUTIONS OF STAKEHOLDERS INVOLVED IN KLCRS

Stakeholder	Status	Contribution and/or interest
NGOs and international conservation and development organisations such as The Development	Supporting bodies	Ongoing aid and undertaking of projects in the conservation and protection of nature in KLCRS.

Stakeholder	Status	Contribution and/or interest
institute, Keta Ramsar Center, Ghana Wildlife Society, Friends of Ramsar sites, and Friends of the Earth, Arocha Ghana, Seawater solutions, Friend of the Nation, IUCN, Donor Agencies, etc.		
Ministry of Environment, Science, Technology and Innovation	Supporting governmental body	To ensure that safe and sound environmental practices are applied through its agencies such as the EPA.
Ministry of Tourism	Supporting governmental body	Is able to provide legal governance to the KLCRS with the formulation of policies, regulations and standards in the context of tourism, especially ecotourism within KLCRS.
Ministry of Fisheries	Supporting governmental body	Is able to provide legal governance with the setting of policies and legal framework for fisheries development and sustainable management.
Ministry of Land and Natural Resources	Supporting governmental body	Is able to provide legal governance with the formulation of policies, standards in relation to sustainable management of land, forest and wildlife resources.
Environmental Protection Agency (EPA)	Supporting governmental body	Provides legal requirements and issuance of EPA permits when required such as impact assessments for big businesses who wish to operate within KLCRS.
Wildlife Division (WD) (A division of the Forestry Commission)	A government body and direct overseer of the KLCRS.	The on-site manager of KLCRS and the management staff are mandated to enforce the law and make arrests if necessary. The site manager is responsible for the management and the administration of the site. It provides, implements and coordinates policies, regulation and standards in relation to ecosystem and biodiversity conservation in KLCRS.
Forestry Commission (FC)	Direct supporting body	The supervisory body to the WD.
Water Resources Commission	Supporting governmental body	The preparation of a guide of the use and improvement in the management of water resources.
Fisheries Commission	Supporting governmental body	To provide information on current fisheries status and development. It provides, implements, and coordinates policies, regulation and standards in relation to fisheries.
Universities and research institutions	Supporting body	The conducting of research to help propose measures/actions needed for sustainable management of mangrove ecosystems.
District assemblies	Community representatives, management committees	Serve as liaison between the government and local communities. Assist in the formulation and promotion of bye-laws that conserve mangrove ecosystems whilst considering traditional norms. Provide permits for land acquisition and development.

Stakeholder	Status	Contribution and/or interest
		Pursue infrastructure and other developmental agenda on behalf of the Government Also provide various expertise such as District Planning. Currently involved in socio-economic development through tourism of the mangrove ecosystems.
Chiefs and traditional authorities	Community representatives, village committees.	Chieftaincy is one of the traditional institutions which symbolises socio-political and sacred power vested in chiefs, queen-mothers and priests. Chiefs are the opinion leaders within the communities. They are trusted by the people in their assessment of development projects, enhancing unity and understanding among traditional councils (KLCRS is owned by the Anlo traditional council). Involved in socio-economic development and just ownership and leadership of the land.
CREMAs - Community Resource Management Areas. (For example, the Awu Lagoon Community Protected Area, which is expected to become a CREMA soon)	Community Task force, surveillance and protection committees.	Responsible for the sustainable use, conservation, and protection of specific areas of importance within KLCRS. The only existing CREMA to date in KLCRS (Awu Lagoon) works in collaboration with WD. To note that this Community-protected Area has no official CREMA status yet, even if it is already operational. CREMAs are able to lobby for the creation of new bye-laws, in order to protect the site and the surrounding environment. In the case of Awu Lagoon, no bye-laws dedicated to the (expected) CREMA were created yet.
Inhabitants of local communities	Local Communities	Reliant on and derives benefits from ecosystem services provided by the surrounding ecosystems and biodiversity.
Landowners	Local Communities	Participates and is involved in decision making due to land tenure which is discussed further in *Section 1.6.1* of the management plan.
Opinion leaders	Local Communities	Are able to influence the attitudes and actions of local people and can therefore assist in project implementation
Farmers	Local Communities	Some areas of forests and mangrove forests are converted into farmlands. This can negatively impact the ecosystems. Irrigation is widely used in crops.
Fisherfolk (men and women)	Local Communities	Utilisation of the water bodies within KLCRS as fishing areas, which reduce ecosystem services such as fish breeding. Current concern is unsustainable fishing practices.
Fishmonger groups	Traders/Local Communities	Harvesting of tree stands in the mangrove forest to be used as fuelwood for fish smoking. Activities can degrade the lagoon natural habitats through deforestation, reeds/rushes harvesting, habitats modifications, etc.
Salt miners	Local Communities	Creation of salt pans in former shallow waters (fish breeding zones) and mangrove ecosystems along concerned coastal areas.

Stakeholder	Status	Contribution and/or interest
Tree cutters	Local Communities	One of the lead contributors to terrestrial forests and mangrove degradation within KLCRS. Often resulted from poverty and a lack of opportunities.

1.4.2. Wildife Division (WD) of the Forestry Commission (FC)

Staff

The primary management committee is the Wildlife Division of the Forestry Commission. The WD comprises one site manager, 7 staff members and 1 driver. The main office is at Anloga, and there is a secondary office at Akatsi. In addition, there is a staff bungalow in Afiadenyigba. Most staff (5 people including the manager) are stationed in Anloga, 1 staff is situated at Afiandenyigba and 3 at the Akatsi office.

Infrastructure

The Wildlife Division secures equipment and infrastructure (logistics) necessary to carry out the minimum managerial tasks through central government and projects. However, there is a need for increased funding and procurement of new equipment to adequately carry out important managerial tasks such as law enforcement, monitoring and surveillance.

Currently, there are staff offices and accommodation in Anloga (head office – most members of staff are stationed there), and in a secondary office at Akatsi. Both these sites began renovations at the end of 2021. In addition, there is a staff bungalow in Afiadenyigba. The main office has one pick-up vehicle and one motorbike, along with guns for law enforcement. Beneath is a broad list of equipment, with a proposed list of new equipment:

Equipment

- One computer and basic office supplies for the site manager;
- A few pairs of semi-functional binoculars;
- A pick-up truck and a motorcycle;
- Basic security equipment (handcuffs, personal self-defense gears…).

Proposed new equipment

- Inboard motorized boat for river/lagoons patrols and wildlife monitoring;
- Another vehicle - for deliveries, staff use, patrolling etc;
- Office equipment for staff members - computers, desks, chairs, printer, etc;
- Long distance terrestrial telescope with cam reader (for distances);
- ATV (All Terrain Vehicle) such as quad bikes for beach & rural areas patrols;
- Tactical gear - handcuffs, new guns and radios, Tasers, and surveillance equipment;
- Camping equipment.

Management approach

The Wildlife Division of the Forestry Commission is the management authority of the KLCRS and has the responsibility/mandate to enforce the law, as stated in LI 16-59 for the site following Ramsar Convention guildelines, in accordance with the 'wise-use' principle. This principle states: "The wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development" (Ramsar, 2014). Ecosystem approaches involve the planning processes for promoting the delivery of wetland ecosystem benefits/services in the context of maintenance and enhancement of the wetlands ecological character at necessary spatial and temporal scales (Ramsar, 2014). To note that Wildlife law and other WD internal documents such as the Standard Operational Manual (SOM) are also framing WD activities.

Planning processes for promoting the delivery of wetland ecosystem benefits/services should be formulated and implemented in the context of the maintenance or enhancement, as appropriate, of wetland ecological character at appropriate spatial and temporal scales.

The WD's approach to managing the area is to empower communities with knowledge and resources to sustainably manage and derive livelihood from their surrounding natural resources.

The WD has the power to make arrests and enforce the law. The staff are trained in this and regularly collaborate with the local administrative entities in charge of law enforcement.

Relationship with the community

- Overall: An important note that needs to be rectified is that not all community members were aware of the WD's, district assemblies', or other site managers' roles. However, already existing relationships between the WD and chiefs and local communities are reported as "on good terms". Based on the information gathered during fieldwork, over 90% of communities within the region are keenly interested to be involved in the management of the site and to collaborate with the WD. In some areas (such as communities around Awu Lagoon and communities that were part of the former FAO-led "Coastal Management Club" project in Fiaxor surroundings), the communities have actively set up monitoring and surveillance teams to assist the WD around the site. This is a considerable advantage when developing/ reviewing a management plan (See *Part B*).

- Conflict: Some conflicts have arisen between WD and local communities regarding poaching and land use. Tension arises when laws restrict communities from deriving livelihood from certain resources without provision of alternatives. These conflicts were always handled with consideration and resolved in the best way possible. To this end, the management team and the traditional authorities work in harmony, under the mediation of the local chiefs

Primary management practices

According to the management staff, the current activities that are carried out on a regular basis within the Ramsar site are as follows:

1. Habitat rehabilitation:
    a. A tree nursery has been established where they distribute seedlings and juvenile trees to surrounding communities.

b. They engage in tree planting activities and try to reduce deforestation.

2. Law enforcement:
    a. The goals are to combat illegal killing of wildlife/extraction of plants, and to conduct patrols to check for any other illegal activities.
    b. The WD staff is mandated to arrest people, and has been trained and equipped to do so. The task force also work with police and local community task forces. They arrest people and confiscate anything illegal - material, animals, etc. These duties present significant risk of tensions and thus require tact and effective strategies.

3. Building capacity of stakeholders.
    a. The goals are to increase community participation and support for wildlife and wetland conservation.
    b. Workshops are carried out within communities and schools on nature advocacy, sensitisation (threats and benefits etc.), and communication.

4. Collaborative Resource Management
    a. The goals are to enhance natural resource management through community participation.
    b. This involves the support and training of CREMA communities.
    c. The WD is in contact and working with, volunteer community task forces and watch dogs.
    d. A former beneficial project implemented by FAO was the 'coastal management club' which still exists, although not very widespread, in areas around Anloga to Anyanui, and Fiaxor.

5. Biodiversity monitoring and synergistic resource management.
    a. Biodiversity monitoring is done at least on a monthly basis (and more frequently when possible) and quarterly reports are produced from this information.
    b. Currently there are 4 main species being monitored along with mangrove forest cover:
        - The Sitatunga: An amphibious antelope.
        - Three species of sea turtle (Olive Ridley, Leatherback and Green)
        - Manatees
        - Birds (migratory and resident)

Quarterly reports

For every quarter of the year, the WD works towards certain objectives that are then consolidated into quarterly reports. The topics of these reports are described below:

- Reduce loss of biodiversity;
- Enhance community participation in sustainable natural resource management through awareness creation;
- Records of monitoring surveys (ecological monitoring);
- Ensure sustainable use of wetlands and water resources;
- Increase the visibility of the Wildlife Division among the stakeholders and local population.

1.5. Inventories, classifications and international / national / regional /local commitments relevant to KLCRS

The KLCRS is of great international, national and local importance. In this way, it is aligned with international and national commitments. Included are regional specific bye-laws and taboos encountered on site which are helpful when identifying insertion points for laws, management measures and possible homogenising of laws and bye-laws across KLCRS in relation to nature conservation and protection. These commitments that may be of influence for KLCRS management, from international to regional, are outlined in *Table 2* below.

TABLE 2: AN OUTLINE OF THE INTERNATIONAL, NATIONAL, REGIONAL AND LOCAL COMMITMENTS RELATED TO KLCRS

Level:	Name:	Commitment:
International (From stats compendium 2020)	Ramsar Convention on wetlands	To protect the natural biodiversity and ecosystems of the area.
	Convention on International Trade in Endangered Species (CITES)	To protect any endangered species such as bird life, sitatunga, manatees and turtles.
	Convention on Biological Diversity (CBD)	Strategy for the integrated management of land, water and living resources.
	Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	Intergovernmental treaty dedicated to the conservation of migratory water birds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago.
	Gaborone Declaration for the Sustainability of Africa (GDSA)	The Gaborone Declaration for Sustainability in Africa stemmed from a 2012 Summit on Sustainability with visionary, corporate leaders and heads of states of nine African countries including Ghana.

Level:	Name:	Commitment:
	Abidjan Convention	Convention dedicated to the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region. The convention went into effect in 1984.
	Stockholm Convention	It is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the natural habitats.
	Sustainable Development Goals (SDGs)	Building on the principle of "leaving no one behind", the United Nations's new Agenda emphasises a holistic approach to achieving sustainable development for all. The Environmental Protection Agency (EPA) is the agency in charge of implementation.
	United Nations Framework Convention on Climate Change (UNFCCC) (NDCs).	Provision of ecosystem services important in reaching Nationally Determined Contributions' (NDCs) goals, especially reduction in CO2 levels (Such as carbon sequestration of mangrove ecosystems).
National	Buffer Zone Policy	A policy that provides appropriate measures and actions that guide the coordinated creation of vegetative buffer zones in order to preserve the functioning of water bodies and vital ecosystems in Ghana.
	National Wetland Strategy and Action Plan	Management of wetlands according to ecosystem and biodiversity sustainability.
	Coastal environment strategies by government	Coastal Zone Management Indicative Plan Integrated Coastal Zone Plan National Wetlands Conservation Strategy and Action Plan.

Level:	Name:	Commitment:
Regional	Local bye-laws from the District Assemblies.	1. It is illegal to hunt/kill certain wildlife such as the sitatunga, pythons, monitor lizards, tortoises, manatees and waterbirds. 2. Small fishing nets are forbidden such as monofilament or mosquito nets. 3. Forbidden entry and/or exploitation to certain areas which are either sacred or contain important biodiversity and/or ecosystems. 4. Use of chemicals for fishing is forbidden. 5. Waste deposition into the lagoons is forbidden. 6. Fishermen must remove their fishing equipment after use. (Only in a few districts) 7. Bush burning is also forbidden in certain districts.
Local	Taboos	1. Certain wildlife is of traditional importance and is taboo to kill, such as the pythons and monitor lizards. Or crocodiles and birds in the 'Lotor river'. 2. On certain days/weeks it is taboo to fish such as Friday in Anloga. (Changes regionally) 3. There is a mass general cleaning in South Tongu once a year. 4. Annual sacrifice rituals in Keta/Ketu. 5. Creation of sacred areas, forests, rivers. For example, in Keta it is prohibited to harvest mangroves in the Dasiamedokui forest. 6. The colour red, footwear and women on their period are forbidden to go into the lagoons. 7. Some communities have implemented days of no farming or fishing. For example, in some communities in South Tongu, farming is prohibited after the Dabala market (Agashigbe day). In Anloga, fishing is prohibited on Sundays.

1.6. The land and regulatory context

Many of the communities in the KLCRS rely on the landscape for their livelihoods. Where lands are dominantly wetlands and crop farming, government's ability to administrate is limited. Mangroves are considered a renewable resource and are managed as commercial tree plantations which are harvested for income.

Individual ownership regimes seem to be most prominent in the Keta region whereby Individuals have the right to grant access to the mangroves. This is in contrast to the Songor Ramsar Complex, to the West of KLCRS, where a joint ownership between the Forestry Commission and Groups in some Communities is most common (Asante, 2017). In Songor Ramsar Site, a memorandum of understanding is signed between the two parties and the FC is effectively given the power to oversee the exploitation of the land by the family members according to 'wise-use' principles (Aheto, 2016).

At a national level, the law in Ghana stipulates that communities are able to benefit from natural resources such as mangroves on their land, provided the resources are managed sustainably.

In KLCRS, according to customary rights, land is predominantly owned by clans, but the mangroves are owned by individuals. So, clan members cannot harvest mangroves just because the land is owned by clans; it is the individual mangrove planter who has access rights to the mangroves. However, the land still remains the property of the clan, not the individual, so land transfer for instance, is the sole prerogative of the clan not the individual (Aheto, 2016).

Land ownership arrangements provide the basis for mangrove ownership and opportunities for individual, family, or clan management. The main ownership rights that grant access for mangrove exploitation and management belongs to the community, family and clan members. Consequently, communities, clans, families, or individuals, enter into agreements for the exploitation of their land or mangroves (Aheto, 2016).

If individuals do not own land, they are able to enter shared tenurial arrangements, where they enter a shared land exploitation agreement between themselves and the land owner/s for a limited period of time.

The WD has acknowledged that there is a trend globally to move away from strict regulatory conservation and administer approaches that understand rural people's importance in the conservation of nature (IUCN & IESS, 2020). In response to this, the WD is trying to establish Community Resource Management areas (CREMAS). CREMAs are a common resource management system developed by the Government of Ghana, which attempts to combine existing land-use and conservation of a specific area with the specific local 'community' as the management entity. They also promote education on wildlife conservation issues and general public awareness of the site (Asare *et al*, 2013).

The Avu Lagoon conservation area is already an implemented CREMA in KLCRS, even if it hasn't reached an official status yet. It is the only one operational to date (see next Figure). Another project to implement a CREMA is under development in the area around Dzita. The development of the Avu Lagoon CREMA started in 2006 with combined efforts from the WD, the Nature Conservation Research Centre (NCRC) (a Ghanaian NGO), and the Calgary Zoological Society. The initial reason for creating the CREMA was for the protection of the sitatunga, an amphibious antelope that was thought to be extinct but later 'rediscovered' in the area (Mcpherson *et al*, 2016). It is located in three districts namely, Keta, South Tongu, and South Akatsi, covering 30 000 ha and comprising 15 communities. Major livelihood activities include fishing, sugarcane cultivation and the distillation of ethanol (Ahmed and Gasparatos, 2020).

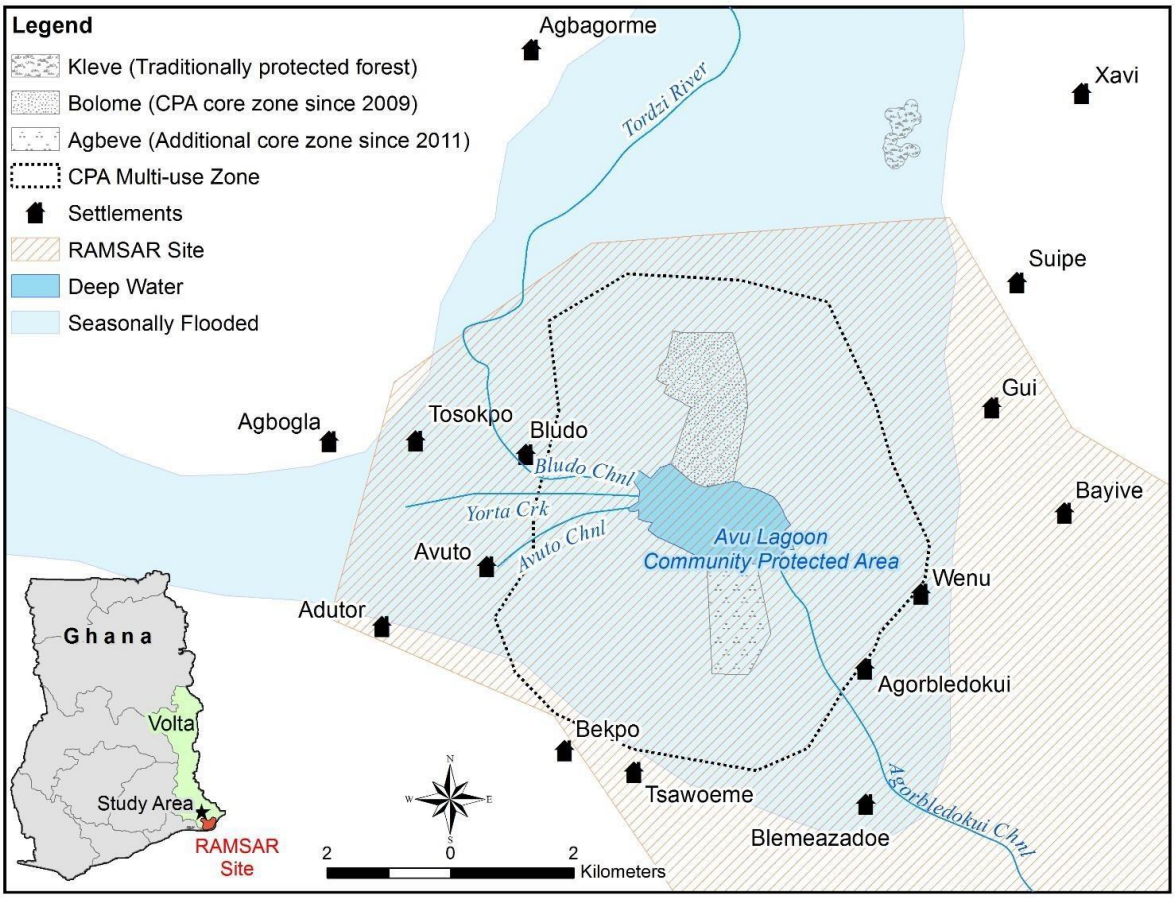

FIGURE 4: MAP OF AVU LAGOON CREMA. SOURCE: THE DEVELOPMENT INSTITUTE

1.7. Historical evolution and Land-use/Land-cover (LULC) of the Ramsar site

An understanding of the evolution of land-use in KLCRS is critical to understanding contemporary threats to the site and necessary management measures.

1.7.1. The 1930s

Historically, before the 1930s, the population of the Keta lagoon complex has survived sustainably off the land. They relied primarily on farming food crops, harvesting coconuts, and fishing. In the 1930s the production of coconuts collapsed and driven by a rapidly increasing population, the inhabitants were forced to shift to an intense horticultural culture based on vegetable production (carrots, shallots, peppers, okra, and tomatoes) (T. W. Awadz, 2007).

1.7.2. 1960s, construction of the Akosombo hydropower plant.

In the 1960s the Akosombo hydroelectric dam was constructed in the upper regions of the Volta River. The reduction in water flow and flooding of the plains and farmlands resulted in a decline in fish stock and availability of arable farming lands. The population was then forced to seek livelihoods elsewhere, primarily in the cutting of mangrove forests (WD, 1999). Another by-product of the creation of the dam was the massive reduction in sediment to the lower regions of the Volta River. This created a sediment deficit and a massive erosion problem, with a loss of livelihood and homes in the coastal districts of Keta and Ketu (Boateng, 2016).

1.7.3. Contemporary landscape and Land-cover/Land-use (LULC) analysis

The contemporary landscape of KLCRS has changed dramatically since the Ramsar Convention and implementation of the previous management plan in 1999 (Duku *et al*, 2021; IUCN & IESS, 2020; Brown *et al*, 2022). A comprehensive analysis and understanding of the contemporary landscape and changes through time is vital for the development of appropriate mitigation measures and management relating to environmental conservation. Duku et al.(2021) presents a comprehensive analysis of LULC for KLCRS from 1991-2020 and net changes for each category (*Table 3* below*)*.

TABLE 3: AREA OF EACH LULC CATEGORY THROUGH TIME IN SQ. KM. NET (+) = INCREASE IN AREA; NET (-) = DECREASE. ADAPTED FROM DUKU ET AL (2021)

	Area 1991 (Km^2)	Area 2007 (Km^2)	Area 2020 (Km^2)	Net 1991-2007	Net 2007-2020	Net 1991-2020
Mangrove & Dense Vegetation (MDV)	490.88	339.51	373.92	-151.37	34.41	-116.96
Water (W)	291.07	315.27	321.54	24.2	6.27	30.47
Marshland/Grassland (MGL)	387.36	384.92	284.04	-2.44	-100.88	-103.32
Cultivated (CT)	104.61	230.12	179.94	125.51	-50.18	75.33
Bareland (BL)	68.53	27.95	10.51	-40.58	82.95	-58.02
Built-up Area (BU)	36.06	80.74	108.17	44.68	27.43	72.11

Of particular note is the decrease in Mangrove & Dense Vegetation (MDV) and Marshland/Grassland (MGL) through time coupled with the nearly 400% increase in Built-up Areas from 2007-2020. The change in each category was also much higher for the second time period (2007-2020), which is in line

with Ghana's economic and population growth rate. *Figure 5* below graphically depicts this change through time.

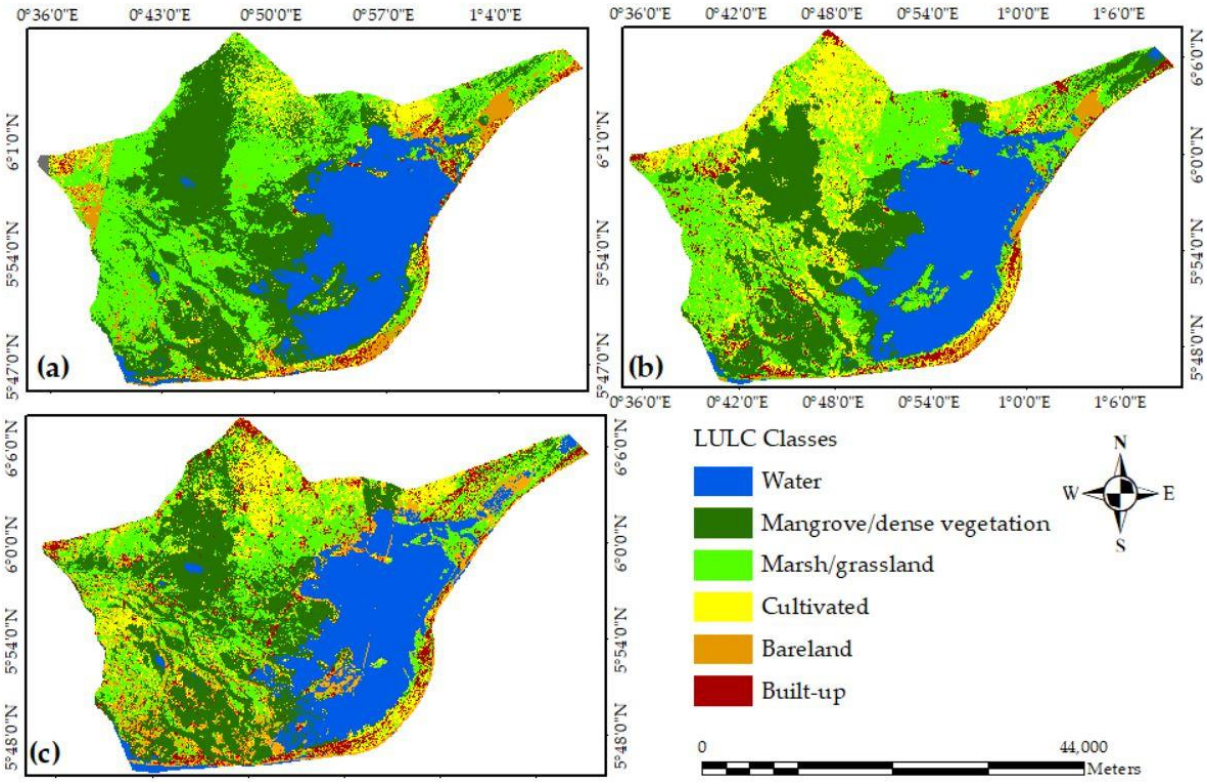

FIGURE 5: CHANGE IN LAND-USE/LAND-COVER FROM 1997 (A); 2007 (B); 2020 (C). SOURCE DUKU ET AL, (2021)

Loss of mangrove cover

As the study from Duku et al.(2021) (previous sub-section) doesn't make the distinction between mangroves and dense forests, there is another study from GMES and Africa (2020) which shows the sharp decline in mangrove surface area in recent years (from 70 sq. km in 2015 to 58 in 2020), especially around Anyanui, Bomigo, and Gamenu (see *Figure 6*).

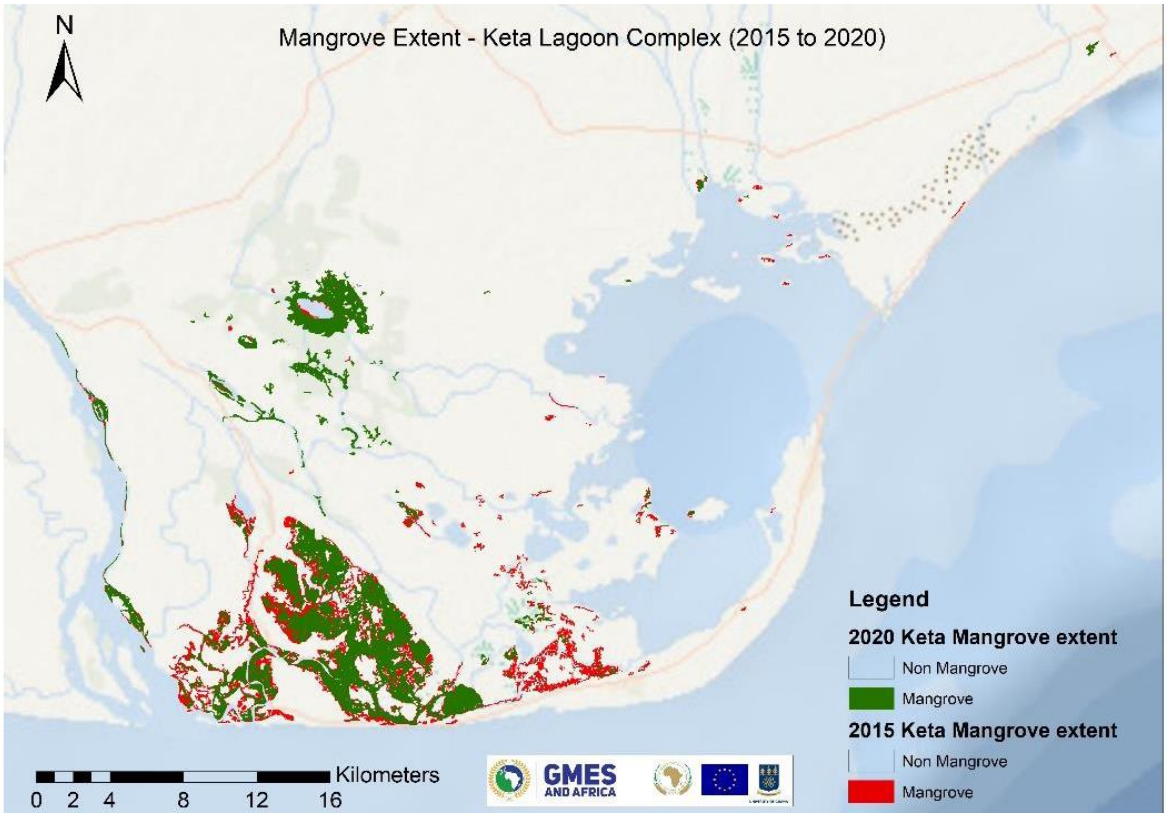

FIGURE 6: MANGROVE COVER FOR 2015 (RED, 70 SQ. KM) AND 2020 (GREEN, 58 SQ. KM). SOURCE: GMES & AFRICA (2020)

This is reinforced with reports from IUCN & IESS (2020) in their analysis of LULC for the Keta-Anlo landscape. This underpins the need for improved protection, replanting, and regeneration initiatives from site management. The areas of red (Mangrove cover from 2015) also shows possible spaces for regenerative initiatives.

Urbanisation

Alongside the loss of natural vegetation depicted in *Figures 5* and *6* is the visible urbanisation and accompanied urban sprawl (shown in red in *Figure 7*) which can be viewed on site especially along the coastal isthmus encompassing the southern Keta and Anloga districts. The KLCRS is now completely surrounded by urban developments. This urbanisation is expected to continue, alongside fast-paced national development coupled with high population growth and an expansion of human and economic activity, hence a need for proper management and control (See *Section 1.8.1* on demographics*).*

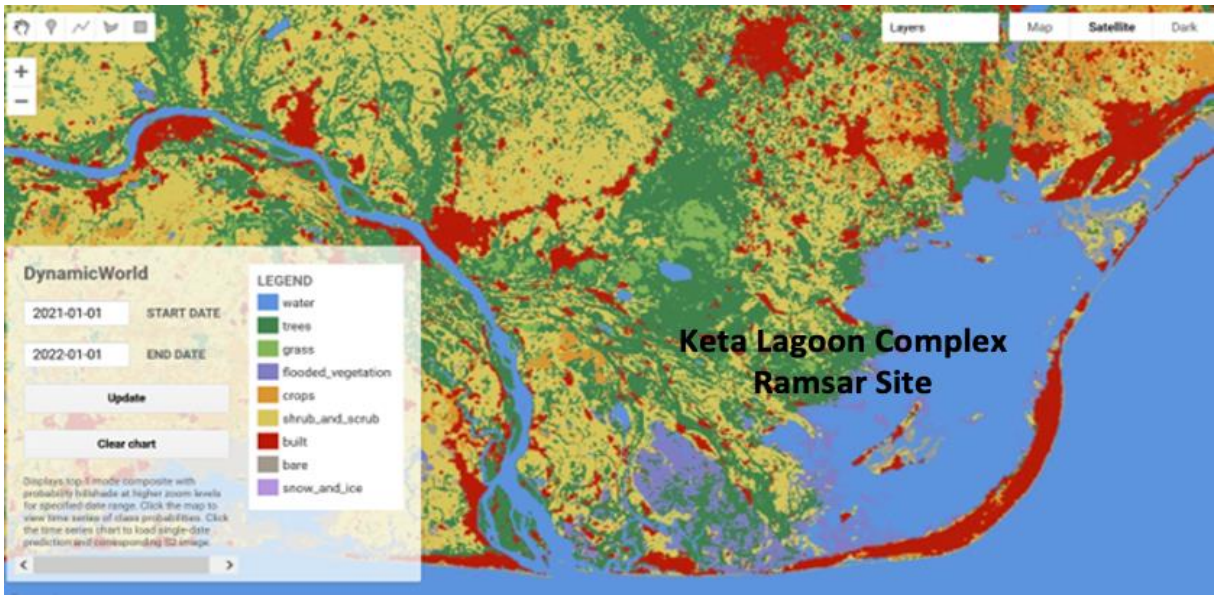

FIGURE 7: A URBAN AREAS (RED) FOR AREAS AROUND KLCRS IN 2022. SOURCE: BROWN ET AL, (2022)

Land-use and Land-cover (LULC) analysis

Four trends of interest were identified:

1. A decrease in mangrove cover of 23.83% for the site between 1991 and 2020 (*Table 3*), and between 2015-2020, about 17% (70km^2 -> 58km^2) (see *Figure 6*).
2. A nearly 400% increase in Built-up Areas (*Table 3*). The site is completely surrounded now by urban areas (*Figures 5* and *7* above). Urbanisation and the resulting urban sprawl together with population increase appear to be drivers of rapid natural resource exploitation and degradation in the size and health of natural habitats on site.
3. The nearly 100 km^2 decrease in Marshland/Grassland between 2007-2020 (*Table 3*), coupled with the nearly 400% increase in Built-up Areas suggest that marshlands, grasslands, shrubs and other less dense vegetation are hot spots for land reclamation and continued urbanisation (Duku, 2021).
4. Beachlands and barelands have also decreased significantly suggesting urban encroachment into these areas and loss of coastal areas due to erosion. This was also observed during WD/IUCN/Consultants in charge of this updated management plan field work carried out in June-July 2022.

1.8. Socio-political context

The population of Ghana is currently sitting at 33,475,870 with an average growth rate of 2.07% per annum. The major sectors of Ghana are services, agriculture and industry (*Figure 8*). GDP per capita from 2021 is 2,445.3 USD with a current poverty rate of 11.3% (All stats taken from Statista statistical services; *accessed 01-09-2022)*.

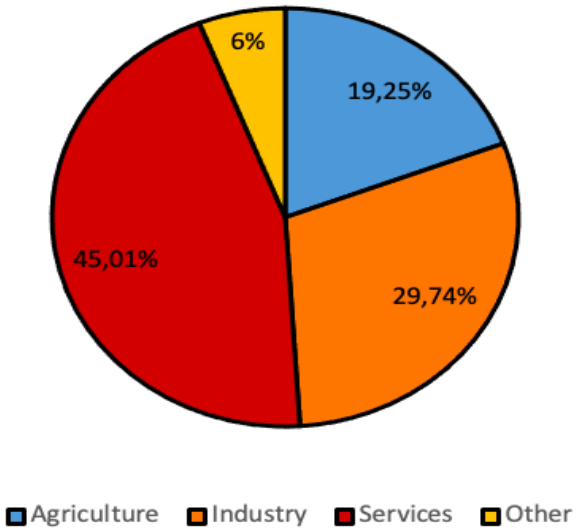

FIGURE 8: PERCENTAGE SHARE OF GDP BY MAJOR SECTORS IN GHANA IN 2020. SOURCE: STATISTA STATISTICAL SERVICE.

Table 4 displays the population demographics for each district in KLCRS from 2010 and 2020, giving an idea of the rapid population increase over time.

TABLE 4: THE POPULATION OF DISTRICTS AT LEAST PARTIALLY ENCOMPASSED BY KLCRS. SOURCE: GHANA STATISTICAL SERVICE (GSS), ACCESSED SEPTEMBER 2022.

2010				**2020**			
District	Male	Female	Total	Male	Female	**Total**	% increase (2010-2020)
South Tongu	40019	47931	87950	55127	56870	111997	21.47
Keta Municipal	68556	79062	147618	91829	94786	186615	20.9
Ketu South	75648	85108	160756	97235	100998	198234	18.9
Ketu North	46551	53362	99913	61689	63677	125366	20.3
Akatsi	45497	53187	98684	59038	60941	119979	17.75
Totals	276271	318650	594921	355108	378144	733254	18.87

Apart from Keta and Anloga Municipal which are fully within the KLCRS boundary, the remaining districts have only a portion of their landscapes within the Ramsar site.

The exact social, economic, and political statistics as a whole for KLCRS are difficult to obtain (fertility, literacy, occupation, etc.). Statistics from each district that are at least partially within the KLCRS, are included. This way, an overall description of the local context is depicted. *Table 5* below, displays particular social and economic dimensions of the demographic variables for each municipality which are at least partially within the KLCRS. Overall, the population is young and predominantly rural (except

for Keta District – including recent Anloga district in this case), despite a higher population density than the national average, while the level of education and the activity rate are relatively low.

TABLE 5: POPULATION STATISTICS FOR ALL DISTRICTS OF KLCRS. SOURCES: PHC (2021); GSS IN CODJOE ET AL. 2020; GHANA STATISTICAL SERVICE (2014)

Population statistics	Sub-Indicators	South Tongu	Anloga	Keta Municipal	Ketu South	Ketu North	Akatsi South	Average Ghana
% below 15 years old	–	39.9	34.6		37.8	43	37.6	36.9
% living in urban/rural areas	–	Rural 87.1%	Urban 53.3%		Rural 53.4%	Rural 65.8%	Rural 67.7%	Urban 56.7%
Population Density	Person per sq. km	170.2	294.9	177	971.5	248.4	174.1	129
Fertility rate	Average number of babies born during reproductive years	3.6	3.1		3.1	3.4	3.4	–
Literacy rate (%)	11 years and older	73.9	75.1		72	69.5	70.7	72.8
Education (%)	3 years and older in school	49	38.8		37.3	37.7	40.2	–
	Have attended school	22.1	22.4		25.6	34.4	34	–
	Never attended school	–	38.8		37.1	27.9	–	–
Economically active (%)	15 years and older	70.9	63.9		71	70.2	73	58.1
Occupation (%)	Agriculture, forestry and fisheries	46.4	34.8		17.3	47.1	57.3	–
	Service and sales	15.9	21.8		28.2	16.7	15.3	–
	Craft and related trade	20.5	25.4		31	19.8	–	–
	Managers, professional, technicians	–	2.3		–	6.5	–	–
Waste disposal (Solid, %)	Most common	Burning (39.9%)	Thrown into the streets (48%)		Public dump-site (37.%)	Public dumpsite (34.8%)	Public dumpsite (31.9%)	–
	Other	Public dump-	Dumped indiscriminately (8.4%)		Dumped indiscri	Dumped indiscri	Burned (26.7%)	–

Population statistics	Sub-Indicators	South Tongu	Anloga	Keta Municipal	Ketu South	Ketu North	Akatsi South	Average Ghana
		site (23.7%)			minatel y (21%)	minatel y (17%)		
	Waste collective services	8.3	2.8		6.9	7.4	–	–
Waste disposal (Liquid, %)	Into the streets	26.1	46.3		38.6	32.6	34	–
	Onto owned property	66.6	45.7		57	58.7	60.7	–

A.2. Physical characteristics

2.1. Climate

Climate of Ghana

Ghana's position is unique as it lies just above the equator and is also traversed by the Greenwich Meridian. Its climate is tropical with two primary seasons, the wet and the dry. The dry season, also called harmattan, begins in November and ends in March. The rainy season is from April to September. Temperatures fluctuate regionally with a maximum monthly average of 31°C and a minimum of 21°C recorded between 1981-2018 (Stats compendium, 2020).

KLCRS Climate

The climate of the KLCRS is tropical-savannah ("AW" category according to Köppen-Geiger classification) which spans the entire south-eastern coastal belt of the country (Beck *et al.*, 2018).

Rainfall

KCLRS experiences two rainfall maxima with a mean annual ranging from 688-855 mm and a mean annual evaporation of 1964 mm, with the primary rainy season being April to July and the second being September to November (IUCN & IESS, 2020). The highest mean value of rainfall occurs in June at 187.5 mm, with the minimum occurring in January at 10.6 mm (Banoeng-Yakubo et al., 2005; Yidana, 2009). The dry season spans January to March.

The seasons, and corresponding rainfall, have a massive impact on the socio-economic structure of KLCRS. In general, the peak wet season matches peak activities for fishing and farming (approximately April-September/October). Exceptions are Akatsi South, where many areas are flooded in these months, and South Ketu where, because of good irrigation, they are able to farm during the dry season. The peak dry season activities are salt mining and mangrove harvesting (approximately December-March). The KLCRS primary economic sectors are also threatened by a changing climate and irregular rainfall patterns resulting in rains coming too early, too fast, or too late and too slow (based on field work reports and on-site focus group interviews from June-July 2022 by WD/IUCN/Consultants in charge of

this updated management plan, when over 30% of respondent reported growing irregular rainfall patterns).

Due to the changes in productivity of farming and fishing during the dry season, people are forced to search for alternatives, usually mangrove harvesting, which puts added strain on the mangrove ecosystems.

Wind

Winds are predominantly south-westerly between March-November (Lamptey *et al.*, 2013) and can occasionally blow from the northwest during harmattan season (December-February). The winds in this coastal region follow the Intertropical Convergence Zone (ITCZ) and create the seasonal rainfall described above. Daily wind speed is quite weak in this area (Lamptey *et al.*, 2013), as daily average have been recorded from 21.1-29.0 km/h (Finlayson et al, 1998).

Temperature:

The highest mean temperatures recorded have been 31°C, with the lowest at 24°C. Daily temperatures average 27°C-28°C (Lamptey *et al.*, 2013; WD, 1999).

Humidity:

High rates of evapo-transpiration are experienced with a relative humidity of 90% during night-time and 65%, with a 15% seasonal variability, during the day (Sorensen, 2003).

2.2. Hydrology

Total area of water of the site in 2020 is estimated at 321.54 km², a relatively stable surface area compared to a decade ago (an increase of 2% from 2007 – Duku, Mattah, Angnuureng (2021)). However, over 40% of interviewed local communities reported a loss of aquatic surface area in the creeks situated at the edges of the main lagoons (obtained from field surveys). The major hydrological systems comprise of the Volta River, Keta Lagoon, Avu Lagoon, Todzie River and the rivers of Aka and Belikpa (See *Figure 9* below). Generally, the stream flow is seasonal and corresponds with the dry and wet periods mentioned above.

2.2.1. Water bodies

KLCRS is dominated by flood plains and lagoons irrigated by seasonal rainfalls. Main sources of freshwater are identified in *Figure 9* below.

FIGURE 9: OVERVIEW OF THE HYDROLOGICAL FEATURES OF THE KLCRS. SOURCES: WATERBODIES: BASED ON RAMSAR SITES INFORMATION SERVICE (2022); KLCRS OUTLINE: WD, 2022; BACKGROUND IMAGE: GOOGLE EARTH PRO.

The Volta River

The Volta River is the largest drainage system in the country with a total drainage of 379000km^2. It flows along the eastern boundary of the Greater Accra Region and provides the western boundary of the KLCRS through various tributaries. It is dammed at Akosombo and Kpong to provide electricity for the country through hydropower stations. After the construction of the dams, the river had an annual run-off depth varying between 30 mm and 240 mm and a mean annual flow of 1100 m^3/s downstream of the Kpong dam. The highest recorded flood on the Volta River was 14 200 m^3/s in 1963. The river discharges into the sea at Ada Foah over an area of more than 400000 km^2 (Finlayson *et al,* 1998).

The Keta Lagoon

The Keta Lagoon is the largest lagoon in Ghana. It is the largest water body in the KLCRS and covers a significant portion of the eastern section of the site. It is estimated to hold 300 km^2 of water which varies seasonally and is fed from a catchment area of around 2900 km^2. Average depth of the Keta Lagoon fluctuates between 0.48m-1.46m depending on the time of year (Finlayson *et al,* 1998; Duku, 2021).

The Avu Lagoon

The Avu Lagoon is situated to the north-west of the Keta Lagoon and receives the majority of water from the Todzie river discharge. It is one of the main contributors to the freshwater influx into the Keta Lagoon. In line with seasonal rainfall patterns, daily gauge heights at the staff gauge on the Avu lagoon at Avuto between 1989 to 1992 indicated that the highest water levels occurred in July (0.9 m) and the lowest in April (0.2 m) (Finlayson *et al,* 1998).

The Todzie River

The Todzie River discharges into the Avu Lagoon from a catchment area of approximately 2200 km^2. It has a mean annual flow of 11 m^3/s. It contributes significantly to flooding in the Keta Lagoon with a maximum 100-year flood estimated at 140m^3/s. The river discharges into the Avu lagoon (Finlayson *et al,* 1998).

Rivers of Aka and Belikpa

The rivers of Aka and Belikpa have a combined catchment of 700 km^2 and are two of the primary water sources for the Keta Lagoon. They drain into the Keta Lagoon through canals crossing the Accra-Aflao highway at Afife and Atiteti (marked on *Figure 9* above). Aka has an area of 420 km^2 and Belikpa 280 km^2. The run-off for June in rainy months can be as high as 25% of the annual run-off. The combined flow of the two streams could be as high as 25 x 106 m^3, Aka being 5.8 m^3 per second and Belikpa 3.8 m^3 per second. They are known to dry out between December and April each year (Finlayson *et al,* 1998).

2.2.2. Groundwater

The KLCRS has high ground water refill and storage potential due to deep, well-developed permeable soil, dense vegetation cover and gentle slope nature (Nerquaye-Tetteh, 1993; Yidana, 2010). The main features are described in Appendix 2.

In the Keta area, the only piped system is in the deep limestone aquifer. Shallow hand-dug wells in the recent deposits along the coastal area also provide some of the water requirements of the people, although these sources are potentially at risk of contamination from surface wastes and salt intrusion. Potential well-fields exist around Agbosome, Afiadenyigba and Nagopo, however, these high-yielding boreholes stand the high risk of saline intrusion (Finlayson, 1998). They also require high pumping heads which translate into high operational costs.

2.3. Geology and geomorphology

2.3.1. History of geological formations

As this information only has minor contribution to the management of KLCRS, the main features are described in Appendix 3.

2.3.2. The nature of the soils

The soils of the KLCRS were previously investigated by K Amejepkor for the purpose of the previous management plan (Amejepkor, K. 1997; Forestry Division 1999). In areas of red mangrove forest, the Tukru series, classified as typic sulfihemists (USDA) or Thionic Histosols (FAO), occurs. The wet pH of surface levels of the Tukru series ranges from 6.0-7.3 (slightly acid to neutral). When oxidised with H_2O_2, the pH drops to 2.0-3.0 (extremely acidic) and when air dried the pH values decreased by 0.5 to 2.5. The content of calcium, magnesium and pyrite (FeS_2) is high. Pyrite ranges from 33 to 240 g/kg. This particular Tukru series therefore, is a potential acid sulphate soil which is able to develop into true acid sulphate soils upon drainage and oxidation (WD, 1999).

At the degraded mangrove sites, the acid variant of the Oyibi series occurs. These are mineral soils classified as Typical Sulfaquets (USDA) or Thionic Gleysols (FAO) and on the site, are fully developed acid sulphate soils. The wet pH scores range from 3.9 to 4.9. When air dried the pH values decrease by 1.0 to 0.5 units, and when rapidly oxidised with H_2O_2 the values decrease by 1.0 to 2.0 units. Compared to the Tukru series, this Oyibi series contains relatively low FeS_2, Ca and Mg. The Mg content is generally higher than Ca (WD, 1999).

On the higher grounds of the site, in the surroundings of the mangrove swamp areas, Keta, Amo and Oyibi (normal) series are found. The Keta soil series develop on the narrow coastal sand dunes separating the sea and lagoon areas. The Amos series are developed in Volta Alluvium, and the Oyibi (normal) series are developed around the edges of the lagoon and undergo periodic flooding by brackish water (WD, 1999).

2.4. Landforms and their dynamics

Generally the site is flat, with altitudes varying from 108 m (inland) to 5 m below sea level (*Figure 10)*. There is an average elevation of 12.39 m. More than half of the KLCRS has lower than average elevation levels and comes under a gentle slope.

Areas under 12.39m (average):

- Lagoon area and narrow sand spit
- Areas of the Volta River at Sogakope and Volta Estuary towards south-western section of the site
- Also North East section at Denu.

Areas higher than 12.39m:

- Most parts of Akatsi South district
- The remainder of the Northern section of the KLCRS.

Land surface slope is generally 0-3 degrees whilst a few areas show slope of above 5 degrees.

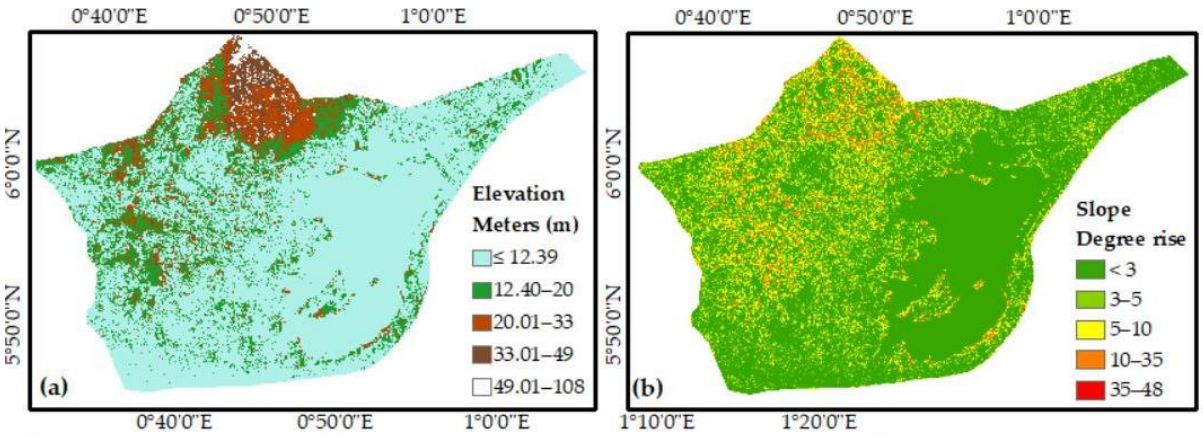

FIGURE 10: ELEVATION AND SLOPE FOR KLCRS. SOURCE: DUKU ET AL (2021).

2.4.2. Coastline:

The primary geologic variables include sandy beaches, rocks, estuaries and lagoons (Boateng, 2016). Sea-level rise in this region has been calculated at 2 mm/yr. The population along the coast is highly vulnerable to sea-level rise as a large portion of KLCRS is below the 5 m contour and without adequate structural defence (See *Figure 11 below*) (Addo *et al*, 2018). The lagoon of the KLCRS is open to the sea only through some tributaries and streams of the Volta River (see *Figure 9 above*). However, these streams and tributaries are becoming choked. The tidal range of the open sea is about 1 m, while it is only 10 cm in the lagoon due to tidal choking. The delay of the tide in the lagoon causes the high tide to reach the lagoon 5 hours after the sea high tide. Coastal erosion is estimated at 2-7million m^3 of sand per year. Coastal erosion poses a large threat to the communities who live along the coast in KLCRS (WACA case study 6, 2019).

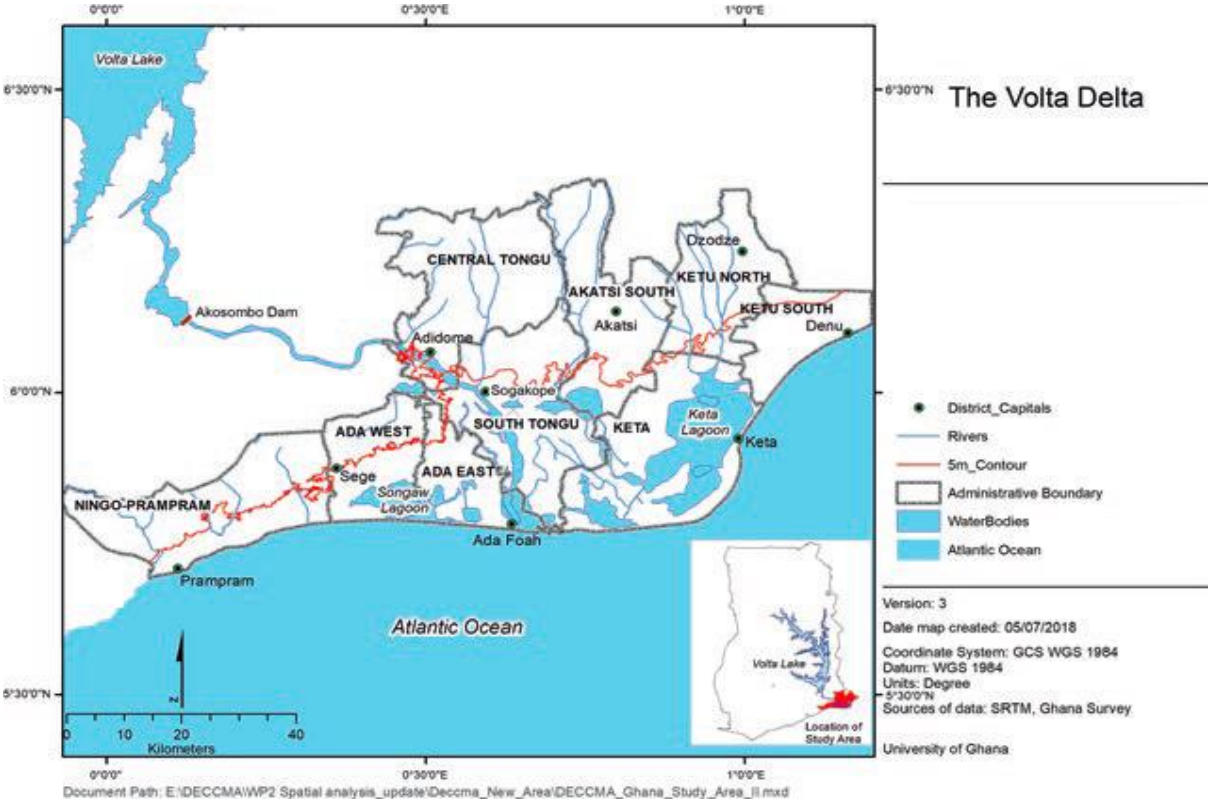

FIGURE 11: MAP OF THE VOLTA DELTA AREA DEPICTING THE 5 M CONTOUR BOUNDARY OF THE DELTA AND THE NINE ADMINISTRATIVE DISTRICTS PARTLY OR WHOLLY WITHIN THE DELTA. SOURCE: CODJOE ET AL (2020).

The morphology of the Volta River delta and seafront is undergoing changes due to this erosion. *Figure 12* below depicts this shoreface, noticeably the prograded section between Anloga and Keta where the shoreline has retreated (Anthony, 2016). Coastal erosion is phenomenal at the site and has implication on livelihood, property loss and biodiversity. Some coastal infrastructures (walls, groins) have been built in the area near Anyanui and Kedzi. However, shoreline reatreat is continuing all along KLCRS.

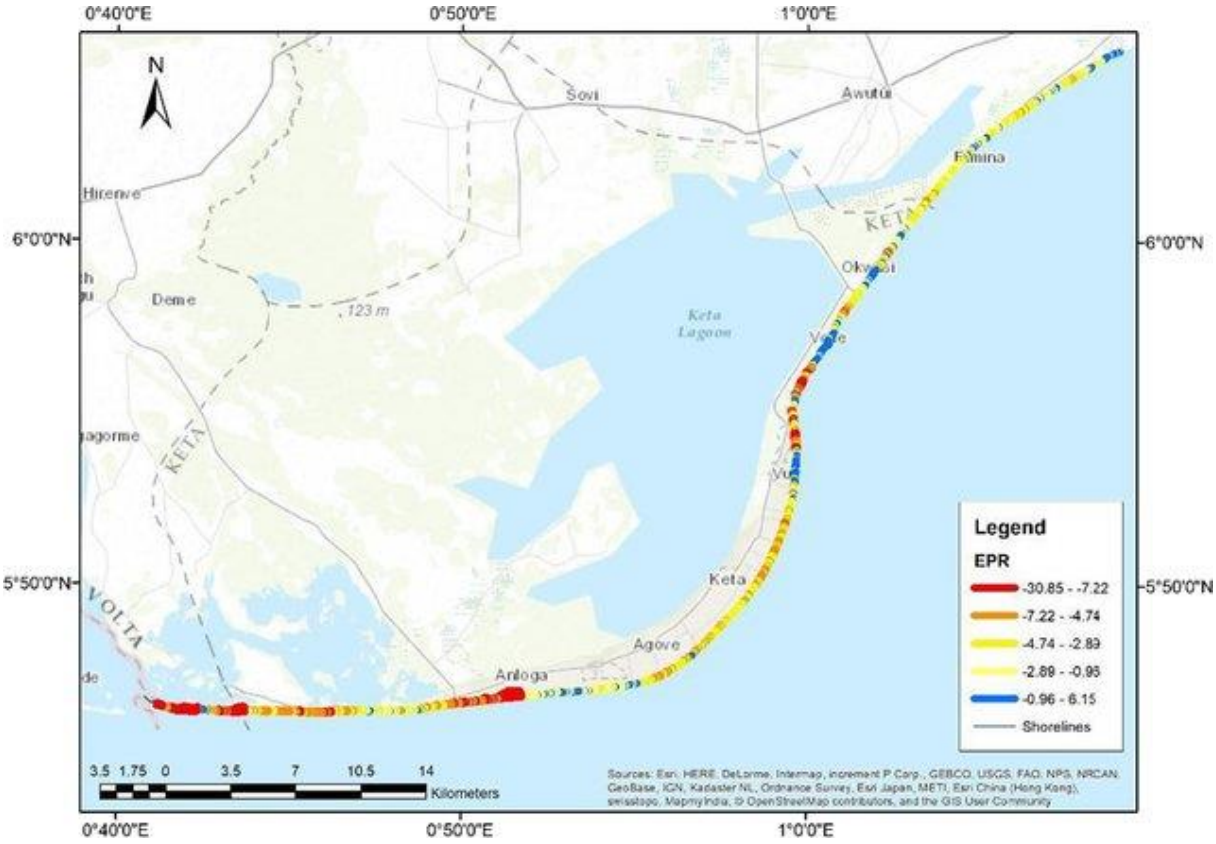

FIGURE 12: A DEPICTION OF THE COASTLINE OF KETA LAGOON RAMSAR SITE. SOURCE: ANTHONY ET AL (2016).

A.3. Biological characteristics

3.1. Habitats and ecological processes

The KLCRS comprises an extensive, brackish waterbody situated to the east of the Volta River estuary, comprising the open water of the lagoon and the surrounding floodplains and mangrove swamps. The lagoon is bordered by numerous settlements and the surrounding floodplain that consists of marshland, scrubland, farmland and substantial mangrove stands, which are heavily exploited for fuel wood (rsis.ramsar.org).

The mangrove ecosystems host a vast amount of biodiversity and are one of the most productive ecosystems in the world. They house a huge variety of birds (migratory and non-migratory), marine creatures (fish nurseries, turtles, manatees, crustaceans, etc.), and reptiles, in addition to associated flora. The enormous amount of fish and invertebrates that live in these coastal waters provides an abundance of food for monkeys, turtles, aquatic birds, and other marine life, as well as communities living alongside them (Bojang, F., 2009).

As depicted in the Land Use Land Cover (LULC) of the lagoon complex Ramsar site (*Section 1.*7.3) the landscape and vegetation have changed drastically since the creation of the protected area. In particular the decrease in mangrove, barelands, and grassland cover, and the increase in built-up areas. Recent studies show that the KLCRS is completely surrounded by urban settlements (Brown, 2022).

3.2. Plant and animal species

As stated above, due to the resulting rapid urbanisation and increased population, the ecosystems and biodiversity of KLCRS have suffered a profound modification over time. This change is mainly related to human activities and climate change. This has had a dramatic effect on vegetation and the wildlife found within the protected area. This section rely on information collected form previous management plan (WD, 1999), to which updated information coming from recent academic studies and WD's quarterly reports have been added.

3.2.1. Vegetation:

Vegetation has been classified into five main zones with a description of plant species found in each zone as described below.

Sand Dunes or Beachheads

Primary vegetation types found here are herbaceous shrubs *(Ipomoea-pes-caprae, Canavalia rosea),* grasses (*Plasplaum vaginatum, Sporobolus robustus, S Virginicus),* the succulent forb *(Sessuvium portulalcastrum),* shrubs *(Agave sisalana, Aloe buetlneri. Opuntia sp, Euphorbia glancophyll),* and the sodom apple *(Rauvolfia vomittoria).* The areas are usually fringed by coconut *(Cocos nucifera)* plantations, and covering the ground is mainly rhizomatous and straggling species (WD, 1999).

Lagoon Margin and Saline Marshes

Primary flora include the forb *(Sessuvium portulalcastrum),* grasses *(Pasplaum vaginatum, Sporobolum virginicus),* sedges *(Cyperus articulatus),* reeds *(Typha domingesis),* and shrubs *(Ipomoea-pes-caprae, Opuntia* sp). On the outskirts are specimens of white mangrove (*Avecinnia africana* and *Laguncularia)* especially towards Adina area, whilst towards the more freshwater areas westwards from Dabala to Anyanui are extensive cover of *Rhizophora.* Isolated diminutive specimens of the branch Dum palm *(Hyphuene iJiehmni)* occur along the shores on drier ground with isolated trees of *Thespesia populnea.* Submerged, but in larger areas of the southern end of the Keta lagoon is an annual seagrass *(Ruppia* sp) cover (WD, 1999).

Inland Wet-Grasslands/Marshes

Primary plant species are *Andropogon gayanus, Brachiaria mutica, Chloris barbata, Heteropogon contortus, Imperata cylindrinca, Vetveria fulvibarbis* and to a much lesser extend the herbaceous species *Cassia mimosoides, Croton lobatus, Indigofera* sp., *Kylinga* sp., and *Vigna arnbacensis* (WD, 1999).

Grassland Thickets and Shrubs Zone

Associated with these areas are small trees and climbers on drier and higher ground. These areas include: *Allophyius africanus, Baphica nitida, Griffornia simplicifolia, Milletia thonningii, Securinega virosa,* and prickly plants *(Parkinsonia aculeata, Zanthoxylum xanthoxyloids},* succulent-leaved herbs

(Aloe buettneri, Sansevieria liberica), and trees *(Eleaophorbiu drupijera. Diospvros mespiliformis).* In addition are isolated trees of the tan palm *(Borassus uethiopiim),* savana date palm (Phoenix redinata), baobab *(Adansonia digitata)* silk cotton (*Ceiba penlandra)* and the introduced tree species. Indian almond *(Terminalia catapa),* mango *(Mangifera indica)* and neem *(Azadirachta indica)* the latter being the most common of the introduced tree species (WD, 1999).

Flora of Wetlands Along Permanent and Intermittent Streams and Pools/Stagnant Water

The main tree species include *Baphia nitida,* Black velvet tamarind *(Dialium guineense*), *Lonchocarpus* sp., and *Milletia thonningii.* The vegetation in and around water bodies include the rhizomatous sedge *Cyperus articulatus';* floating plants *Lemna paucicostata, Pistia stratiotes, Nymphaea lotus, N. micrantha;* emergents *Typha domingensis, Ludwigia hyssopifolia, L. erecta, Ludwigia stolonifera;* and the water *oouatica.* The floating plants have become a pest which block important water channels to and from the Avu and Keta Lagoons (WD, 1999).

3.2.2. Animal species

The Wildlife Division conducts monthly surveys on wildlife in KLCRS, which are then recorded into quarterly reports. This subsection is based on these quarterly reports, as well as files from the previous management plan, and other academic articles which were synthesised to form an updated list of wildlife (WD, 1999, 2020-2022; BirdLife International, 2022; Lamptey *et al.*, 2014; Lamptey, 2014; Ofri-Danson, 2014, Ameiaw-Akunii *et al.*, 1998).

Fish

In a survey conducted in 2014, a total of 18 different fish species belonging to 13 families were encountered (see *Appendix 1* for complete list). The most dominant species found were *T. guineensis* and *S. melanotheron,* and *Porogobius schlegeli*. This is a change from the 1999 management plan where the black chin tilapia *(Sarotherodon melanotheron)* was the main dominant fish species. *C. amnicola, Mugil spp., Ethmalosa fimbriata* and *Chrysichthys spp.* have also become very rare (Ofri-Danson, 2014; Lamptey, 2014). According to local fisher folks, both fish stocks and fish biodiversity declined during the last two decades (collected from field work interviews).

Invertebrate

Common invertebrate found are the blue-legged lagoon crab *(Callinectes ammcola),* Pink Shrimps (*Peneus notialis),* Caramote prawn (*Penaeus kerathurus)* and the Black Tiger prawn (*Parapenaeus atlanlica),* all of which are found in the Keta Lagoon waters. The land crabs (*Cardiosoma armcitum)* are dominant on the flood plains and the West African mud creepers (*Tympanotonus fuscalus)* are common within the mangrove roots and on the mud flats (Lamptey, 2014) (see *Appendix 1* for the complete list).

Mammals and Reptiles

The largest mammal present in the wetland is the sitatunga, an amphibian antelope dependent on the water rich habitat. This mammal is rare in Ghana and is of major importance for tourism around the Avu

Lagoon. The wetland is also a home to several species of common rodents, notably the commensals - Common mouse *(Mus musciilus},* Common rat *(Rattus rattus),* Nile rat *(Mastomys),* and Giant rat *(Cricetomys gambianus).* Reptile inhabitants include the Nile monitor *(Veranus nilolicus),* Graceful chameleon *(Chemaeleo gracilis),* African python *(Python setae),* Royal python *(Python regius),* Puff adder *(Bitis arietans),* and marine turtles (*Lepidochelys olivacea*, *Chelonia mydas* and *Dermochelys coriacea)* and manatees (see *Appendix 1*) (WD's 2020-2022 Quaterly reports; Ameyaw-Akumii *et. al.* 1998).

Birds

The Keta Lagoon Complex Ramsar Site is ecologically important for the large numbers of waterbirds it supports. It currently hosts over 100,000 birds which includes 50+ species and about 80% of all listed wetland bird species in Ghana (see *Appendix 1*). Species which were known to occur in large numbers during former decades were *Dendrocygna viduata*, *Himantopus himantopus*, *Calidris ferruginea* and *C. minuta,* as well as several heron and egret species. Some of the important species that frequent the site include: Curlew sandpiper *(Calidris ferruginea),* Ringed plover *(Charadrius hiaticula),* Greenshank *(Tringa nebularia)*, Spotted redshank *(Tringa erythropus),* Little stint *(Calidris minute),* and Black-winged stilt *(Himantopus).* The site is also known to have recorded the largest concentrations of ducks, mainly the White-faced tree duck *(Dondrocygna viduata).* The most important areas of the lagoon for waterbirds are the Fiaxor, Woe, Tegbi, Adina, and Afiadenyigba sections (BirdLife International, 2022; WD, 1999; Lamptey, 2014). In most recent quarterly reports (2020-2022), 53 species were recorded, with little egrets, black-winged stilt, marsh / common /curlew sandpipers, western reef egrets, great egrets, pied kingfishers, long tail cormorans, grey herons, terns, white face ducks and little ringed plovers being the most abundant ones.

3.3. Rapid assessment of wetlands ecosystem services (RAWES)

The development of the RAWES approach considers the requirements of the Ramsar Convention (available at Rsis.ramsar.org), particularly the need for qualitative assessments that are not resource intensive and can be applied within Ramsar Convention-related reporting (McInnes, Everard, 2017; RRC-EA, 2020).

A list of services is grouped into functional categories, namely: provisioning, regulating, cultural and supporting services. These services are then further expanded into sub-categories based on the context (in the context of KLCRS: fresh water, wood, climate regulation, etc.). These receive a rating based on their importance and a scale of benefit alongside a description of the service. *Table 6* below presents the rapid assessment of ecosystem services of the KLCRS based on the RAWES practitioners guide (RRC-EA, 2020).

TABLE 6: TABULATION OF THE RAPID ASSESSMENT OF THE ECOSYSTEM SERVICES PROVIDED BY KLCRS

++ Significant positive benefit **+ Positive benefit** **0 Negligible benefit** **- Dis-benefit** **- - Significant dis-benefit** **? Gaps in evidence**		**Importance**	**Description of benefit**	**Scale of benefit**		
				Local	Regional	Global
Provisioning services	Fresh water wells	++	Population reliant on it for irrigation, drinking.		x	
	Fishing, farming, hunting	++	Fishing is a major source of protein; mangrove oysters, shrimps, fish etc. Shallots, peppers, okra, tomato, chilli pepper, maize, cassava are mainly grown. Also livestock.		x	
	Fuelwood	++	Wood is used for cooking, smoking fish, building, charcoal production, the main source of livelihood for a lot of inhabitants.		x	
	Grass	++	Fodder for livestock. Also used for weaving bags/items for sale in the local markets, also in making traps and nets.		x	
	Genetic resources	++	Turtle breeding area: Three major turtles, Green, Olive Ridley, and Leatherback. Manatees The only waterbuck in the world is found here, Sitatunga. Holds significant populations of waterbirds of international importance. Abundance of fish and butterfly species.		x	
	Natural medicines or pharmaceuticals	0	Locals do find local medicines within the wetland but are not reliant on it.	x		
	Ornamental resources	0	Mangrove oyster shell used for building construction. Ornamental species for aquariums.		x	
	Clay, mineral, aggregate harvesting	++	Salt is a stable economic resource for a large proportion of the population. Sand is also extracted for use as clay in building materials.			x
Regulatory services	Local climate regulation	++	Bodies of water that generate a large amount of evapotranspiration. Local climate regulation/buffering of change.		x	

++ Significant positive benefit **+ Positive benefit** **0 Negligible benefit** **- Dis-benefit** **- - Significant dis-benefit** **? Gaps in evidence**		**Importance**	**Description of benefit**	**Scale of benefit**		
				Local	Regional	Global
			Presence of forests and mangrove trees is strongly believed by local population to assist in rain regulation.			
	Global climate regulation	++	Regulation of the global climate through carbon sequestration.			x
	Water regulation	+	Low lying area with dense vegetation, slow surface run-offs so huge groundwater recharge potential. Inconsistent water flow into the main lagoon system due to construction of the dam.		x	
	Flood hazard regulation	++	Keta and Avu Lagoons are able to hold vast amounts of water and thus protect surrounding areas from flooding.	x		
	Storm hazard regulation	+	Dense vegetation and water retention abilities help in storm hazard regulation.	x		
	Pest regulation	++	Provides natural predators for pests such as birds, frogs etc.		x	
	Disease regulation - human	++	Water purification by mangroves and reeds to prevent waterborne diseases.		x	
	Erosion regulation	++	Soil, sediment and nutrient retention due to presence of dense vegetation and mangrove cover.		x	
	Water purification	+	Water purification/waste treatment or dilution by aquatic plants, mangroves and reeds.		x	
	Pollination	++	Polliniser species such as butterflies and other insects are abundant on site.			x
	Salinity regulation	++	Fresh water in the lagoon provides a barrier to saltwater intrusion. Salinity is increasing however due to choked freshwater channels.	x		
Cultural services	Recreation & tourism	++	Huge tourism potential. Recreational fishing.			x

++ Significant positive benefit **+ Positive benefit** **0 Negligible benefit** **- Dis-benefit** **- - Significant dis-benefit** **? Gaps in evidence**		**Importance**	**Description of benefit**	**Scale of benefit**		
				Local	Regional	Global
	Spiritual & inspirational	+	Spiritual taboos present. Sacred waters, lakes, forests, ponds, animals.	x		
	Educational	++	Multiple educational activities: Natural resource management. Community management. Agriculture.			x
	Scientific	++	Important knowledge systems, importance for research (scientific reference area or site). Studies on climate change, erosion, local knowledge source for West Africa.			x
Supporting services	Provision of biodiversity	++	Supports a variety of all life forms including plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part.		x	

ILLUSTRATION 5: ARTISANAL FISH TRAPS IN KETA LAGOON

A.4. The socio-economic and cultural framework.

The socio-economic and cultural framework is analysed primarily from field visits/interviews to the site in June-July 2022, coupled with a thorough literature review.

4.1. People's perception of the KLCRS Marine Protected Area

People's understanding of the MPA varied amongst the communities, but a common trend was that nearly 50% are either unaware or know very little about the KLCRS or the WD and their management practices. *Figure 13* below represents the existing awareness of communities of the KLCRS.

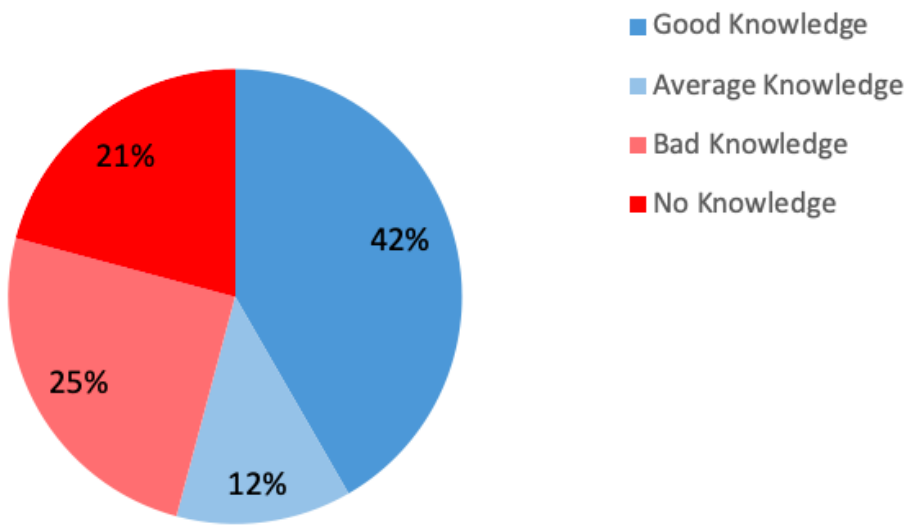

FIGURE 13: PIE CHART DEPICTING THE COMMUNITIES' LEVEL OF KNOWLEDGE ABOUT THE RAMSAR SITE

- Good knowledge: 42% people know about the Ramsar site and understand it, have some info about it and the WD and its management.
- Average: 12% knew about the Ramsar Site and WD but information was limited.
- Bad: 25% knew either about the existence of the WD or the Ramsar site but nothing else.
- No: 21% knew nothing about the Ramsar site.

This underpins a communal lack of awareness and sensitisation on how the KLCRS functions as a whole. It therefore identifies a need for education and awareness building campaigns. Most remote areas were the ones with the least awareness about KLCRS/WD's work.

4.2. People's perception of nature

Communities lack an integrated vision and knowledge of their environment, such as the interconnectedness of ecosystems and the services they provide. For example, fishermen understand environmental aspects relating to fishing (such as state of overexploitation and water salinization), with very limited understanding of other aspects which may indirectly affect them such as deforestation or changes in climate. Similarly, farmers care about the environmental aspects relating to their farming activities, but very little about the threats relating to the aquatic environment.

4.3. Cultural landscape

The Keta Lagoon, in terms of lands property, is owned by the Anlo Traditional Council. The surrounding creeks and smaller water bodies are owned by individual families and clans. As the chiefs and traditional councils hold local knowledge about the wetlands and influence amongst local communities, they are able to assist WD with site management, in conflict resolution, and the creation and implementation of new bye-laws.

Taboos are 'community laws' which are also an important aspect of life in KLCRS, and people generally live in accordance with them. Many taboos assist in environmental conservation, for example, no fishing on Thursday in the Avu Lagoon (and on Friday in Anloga), september-october mass cleaning in Keta (to ward off ghosts and disease), and it is forbidden to kill the pythons or monitor lizards (a more comprehensive list is presented in *Table 2*, *Section 1.5*). The possible stressing of taboos in each district could prove positive for the environment. However, younger generations are less and less respectful of these traditional practices, alongside with a decline of faith in traditional beliefs.

4.4. Socio-economic activities

The majority of the population in the KLCRS is engaged in mangrove forest and reed/grass harvesting (approximately 70% of the working population in the Anloga district, according to the DA head), agriculture (vegetables, rice, sugar cane, etc.), and fishing. Secondary activities are salt-mining, cattle farming, hunting, tourism, and big industry such as big shrimp farming and salt mining companies. The main wet season is from April-July and the secondary from September-November. The main dry season spell is from January-March. Towards the more urbanised areas, such as the coastal cities of Keta and Anloga, secondary economic activities vary between trading, retail, tourism and manufacturing. *Table 7* below displays primary economic activities for each district, their peak season, followed by a more in-depth description in *Section 4.4.1*.

TABLE 7: PRIMARY ECONOMIC ACTIVITIES AND CORRESPONDING PEAK SEASON FOR EACH DISTRICT IN KLCRS

District	Activities	Peak Season	Low Season
Anloga:	Mangrove harvesting	Dry (And August)	Wet
	Fishing (Primarily: Tilapia, shrimps, crabs, some anchovies and mackerel)	Wet	Dry
	Agriculture (Primarily: Tomatoes, onions, shallots, maize, cassava, peppers, okro…)	Wet (okro is farmed until Dec)	Dry
	Tourism	–	–
South Tongu	Fishing (Primarily: Tilapia, shrimps, crabs, some anchovies and mackerel)	Wet	Dry
	Farming (Primarily: Cassava, maize, okro, beans, tomatoes, pepper, sugar cane)	Wet	Dry

	Gin distillers (from sugar cane)	Dry	Wet
	Mangrove harvesting	Dry (And August)	Wet
Akatsi South	Fishing (Primarily: Tilapia, crabs, shrimps etc, all from the Avu Lagoon)	October/Nov and May/June	Dry
	Farming (Primarily: Rice, eggs, okro, maize, sugarcane, cassava, whatever they can grow)	Dry (Oct-Apr due to flooding)	Wet
	Eco-tourism (the Avu Lagoon)	All year	
Ketu North/South	Farming (Mainly rice. Also okro, onion, lettuce, carrots, sweet pepper, okra, cabbage, reddish, sweet potatoes spinach, yellow pepper)	Wet	Dry
	Fishing (Mainly tilapia from the lagoon, varied fish from the sea)	Wet	Dry
	Salt mining	Dry	Wet
Keta	Gin Distilling	All year	
	Fishing (Primarily: Tilapia, “gborvilolo” (fingerlings), mackerel, redfish, shrimps, anchovies)	Wet	Dry
	Salt harvesting	Dry	Wet
	Agriculture (sugar cane, okro, tomatoes, pepper, carrots, sugarcane, okra, lettuce, shallots onions, reddish, watermelon, maize, cassava and beans)	Wet (although carrots and okra are all year long)	Dry
	Mangrove harvesting	Dry (And August)	Wet
	Tourism	–	–

4.4.1. Description of activities

Mangrove and reed harvesting

Primarily, the wood from mangroves, which comprises the prop roots and main stems, is used as fuelwood for cooking and fish smoking. Mangroves are a major source of fuelwood in the region making them an important commodity at the local markets. Wood is also used for the production of charcoal and as building material (IUCN & IESS, 2020). More recently due to low crop yields, people have been increasingly pushed towards mangrove forest harvesting as a primary economic activity. Often mangrove forests are being harvested and not replanted, putting huge pressure on the mangrove ecosystems.

Agriculture

Farming is generally labour intensive and not mechanised. Crops produced in the KLCRS are shallots, onions, carrots, okro, lettuce, cassava, cabbage, green and sweet pepper, chillies, garden eggs, rice, maize, sugarcane and coconuts. These are farmed by the communities themselves. Coconuts occur mainly along the coast, and vegetables on low-lying dry, relatively fertile sandy belts along the lagoon. Rice and sugarcane occur more in the interior near the wetlands and rivers in the north-eastern part. Sugarcane is also cultivated to be used in the production of a local alcoholic drink called ‘Akpeteshie’. Irrigation systems are widespread around Keta and Anloga, while remote areas can’t afford such infrastructures.

Fishing

Fishing is an important source of protein and income for a large proportion of the population. Anloga, Woe, and Anyanui are amongst the largest fishing communities. Fishing is especially important when agricultural yields are low such as during floods or droughts. The presence of mangroves, the influx of fertile fresh water from the Avu Lagoon, and the influx of salty water from the ocean makes the Keta Lagoon a perfect place for fish. The Keta Lagoon is also an important nursery ground for juvenile fish species. Most commonly used practices are boats with nets and a variety of traps including the Acadja (Brush parks) and basket traps (Lamptey, 2014). Harvesting of invertebrates and other fish species includes clams, crabs and mudfish. A huge pressure on the fisheries is the disconnection of the Keta Lagoon from the ocean due to choking of the rivers and estuaries to the sea.

Salt-mining (salt evaporation)

This activity used to be engaged on a small scale by community members. However, recently large businesses have taken over the market. It is primarily sold to Mali and Burkina Faso, but also in local markets.

Livestock

Livestock keeping (i.e. cows) also seems to be increasing, especially in the northern and dryer part of the KLCRS (Brinks, 2017). The north-west and north-east areas of KLCRS are situated on some stable lands without floodplains. It is also cited as a potential for diversification of agriculture and job creation.

Tourism

Tourism attains a relatively small presence (mostly around Keta and Anloga), but with massive potential due to diverse species and natural beauty. The WD is currently trying to promote bird watching and night turtle walks. A small amount of money has been raised. A critical obstacle is that most tourism side infrastructures (shops, leisure activities, hygiene infrastructures…) are not sufficiently developed. Remoteness caused by poor tourism infrastructure contributes to this. Low investments and undeveloped tourism products also cause the destination to be unattractive. The Avu Lagoon CREMA is an important entity, where biodiversity conservation is promoted, which in turn attract tourists that are keen on natural areas and wildlife species.

Hunting (Can be related to poaching)

Still a source of food and livelihoods for some community members. Illegal activity is frequent such as poaching of turtles and seabirds, primarily due to lack of alternatives and poverty. Certain animals like the sitatunga, crocodiles and turtles are protected by local bye-laws, however community members mention that people do not always obey the law.

Industry

Brinks (2017) established a fairly complete list (see below) of businesses operating in the area. However, the Seven Seas salt mining business, which is a recent company, was not mentioned yet. Certain districts are actively trying to attract big business in order to boost the economy, especially agribusiness in areas of South Tongu (Brinks, 2017). What is lacking is communication with the WD and other administrative authorities within KLCRS. Some of these industrial infrastructures may have adverse effects on the environment and/or on the local communities (because of land & resources grabbing).

List of businesses:

1. Large-scale commercial salt mining:
    a. Indian-owned company Bayswater International in Adina and Diamond Salt in Afiadenyigba
    b. Seven Seas salt mining company in Adina.
2. Aquaculture: Indian-owned company near Bomigo
3. Rice farming: A Brazilian-owned company called Brazil located near Lolito in the South Tongu district.

Trading, retail, manufacturing

In urban areas (mainly along the "Anloga - Keta - Kedzi" axis), service activities, as well as purchase-resale, are significant. About local natural resources extraction, the Anyanui mangrove wood market is the main regional hub, while the selling channels spread to the entire region. In addition, there are many local markets for fish, where products are partly captured by wholesalers, in order to be sold throughout the whole region.

A.5. Values and Challenges

The Keta Lagoon Complex hosts a series of important fresh water bodies (river, streams, estuary etc.) and brackish and saline water bodies (Keta and Avu Lagoons and smaller dependancies). Interconnected with these water bodies are a multitude of interdependent ecosystems including vast sections of mangrove cover, which are critical in supporting diverse species of flora and fauna of national and international importance. The ecosystem services provided by KLCRS also support hundreds of thousands of people who directly and indirectly depend on the natural habitat for their livelihood. Potential for tourism and research is also high due to the biodiversity, natural landscape, and beauty. Alongside the tremendous value of the KLCRS, come many challenges which are presented in the ensuing text.

5.1. Ecological value

5.1.1. Biodiversity

The fact that the Keta Lagoon area has been declared a Ramsar site is in itself a representation of the hugely diverse ecological value present. More than 1% of the global population of two species of waterbird live within the mangrove areas as they provide feeding, roosting and nesting sites, namely: the Whiskered tern (*Chlidonias hybridus*) and the Caspian tern (*Hydroprogne caspia*). It is the home of the world's only amphibious buck, the sitatunga, and provides habitats for many wetland dependent wildlife including three globally threatened turtle species. The lagoon waters provide important habitats and nurseries for migratory and juvenile fish populations which are critical in fish stock replenishment. Over fifteen families of fin fishes comprising 18 genera and 20 species have been recorded. The wetland is also home to African/Royal pythons, several species of rodents, the Nile monitor, manatees and macro-invertebrates such as crabs, molluscs and shrimps (see *Appendix 1* for more detail).

5.1.2. Ecosystems and their services

The mangrove and wetland regions moderate and slow down water flow which allows groundwater recharge and provides flood relief to surrounding areas. This is hugely valuable to surrounding rural communities as they rely on groundwater for crop irrigation and drinking water and often farm in and around the rich, fertile floodplains and water bodies. Mangrove ecosystems and general vegetation in the KLCRS also serve as protectors of soil in the case of coastal erosion.

In terms of global and national ecological value, mangroves forests are amongst the most carbon rich habitats and account for 14% of global coastal ecosystem carbon sequestration (acquisition and storage) (Alongi, 2014). They are extremely productive and produce carbon at a rate similar to that of tropical, humid forests (Alongi, 2014). In this way, the conservation and regeneration of the mangrove ecosystems in KLCRS will assist global CO^2 levels and could help Ghana towards reaching their Nationally Determined Contributions (NDCs), in particular lowering CO^2 emissions.

5.2. Cultural Value

The KLCRS has many traditional, sacred sites (sacred forests, water bodies, etc), and sacred animal species such as crocodiles, sitatunga, pythons and manatees. The rural population is mostly aware of the environment and place a lot of value on it. Many aspects such as the livelihood that it provides to them and richness in biodiversity are source of local pride. The Keta Lagoon is of particular cultural/ traditional significance. In the traditional Anlo belief system, it is believed that the lagoon has gods who must be worshipped. In line with this cultural heritage are traditional laws or 'taboos' protecting the environment (see *Section 1.5, Table 2*).

5.3. Socio-economic value

The primary economic activities in KLCRS are dependent on natural resources. The fisheries, fertile farmlands, and mangrove forests, are primary economic resources. Fish is a major source of protein for the population and smoked fish from the lagoon is sold in markets all around the KLCRS, providing many with valuable income. The mangrove forests are cut, sold and also used for fuelwood, fish smoking, and building material, while the associated grasses are harvested for mat and basket weaving. For instance, the Anyanui community is highly dependent on a vibrant market supported by the active planting and harvesting of mangroves along the creeks and lower limbs of the Volta River. A study by Aheto et al (2016) indicates that mangrove farming can generate a profit of 383.12 USD for traders and 4824.88 USD per hectare/year.

Eco-tourism activities, such as bird watching, night turtle watch, nature exploration, and getaway locations, is viewed as one of the most sustainable and underexploited industries in the KLCRS.

5.4. Challenges

Identifying the challenges to the management of KLCRS and threats to the ecosystems, biodiversity and population is essential to the establishment of the new management plan in order to develop appropriate mitigation measures and identify avenues for intervention. They have been identified through the direct experience of the KCLRS inhabitants (field study in June-July 2022), coupled with a thorough literature review. Many threats were identified, along with their drivers (see *Figure 14*). Solutions to these threats were also discussed. Interestingly, the communities of KLCRS linked a relatively small amount of drivers to each threat. 'Other' categories of *Figure 14* are responses that were infrequent or did not make sense, given the context.

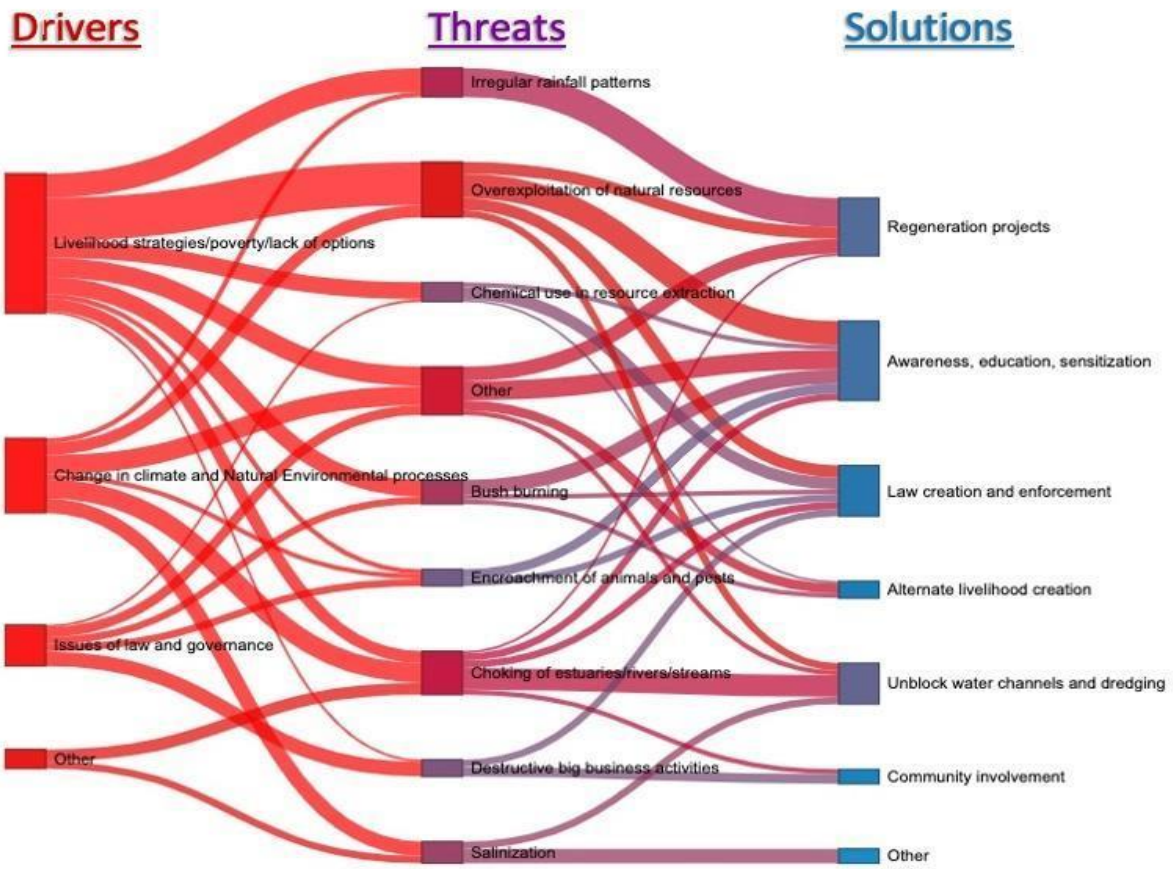

FIGURE 14: SANKEY DIAGRAM DEPICTING THE COMMUNITY-PROPOSED THREAT DRIVERS, THREATS AND THREAT SOLUTIONS.

The population of KLCRS was fairly consistent and congruent in their threat identification and certain threats emerged clearly. These are listed in *Figure 15* and are explained in the text that follows. Following subsections are explanations of the diagram in a simplified and yet detailed way.

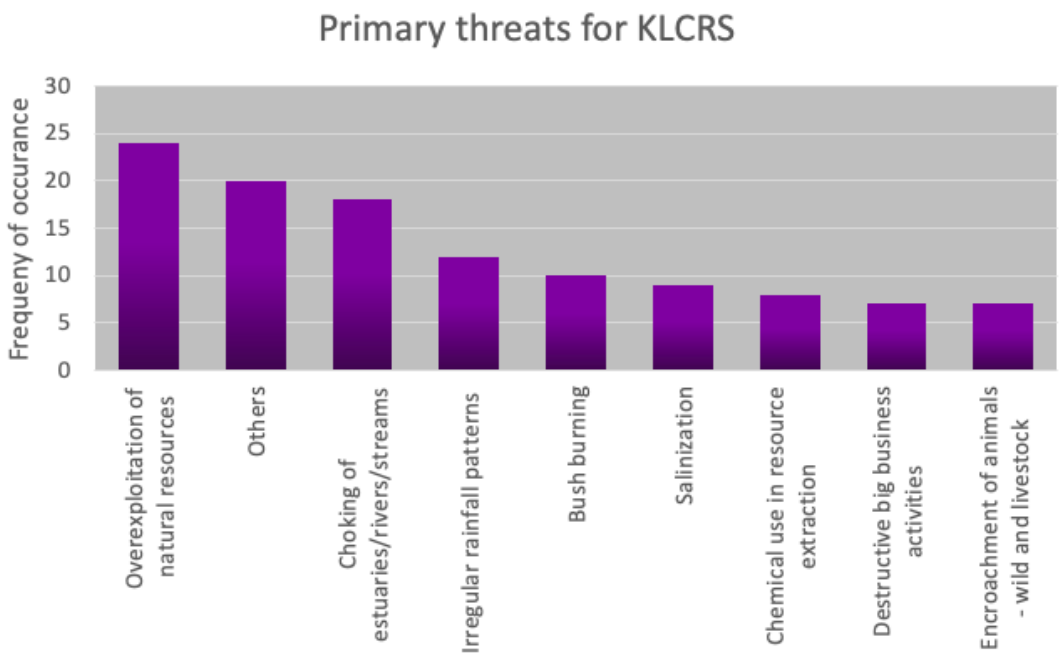

FIGURE 15: DEPICTION OF THREATS AND THEIR FREQUENCY OF OCCURRENCE AMONGST INTERVIEWED COMMUNITY GROUPS/MEMBERS AND KEY STAKEHOLDERS.

5.4.1. Conservation challenges

The overexploitation of natural resources

Included in this threat is the overexploitation and associated deforestation of mangrove ecosystems, the state of overexploitation of the fisheries, and poaching of endangered species such as sea turtles and waterbirds. Overall mangrove cover has dropped by around 17% in the last 5 years (GMES & Africa, 2022). Fisheries are in a state of overexploitation, with fishermen forced to use smaller and smaller nets at the detriment of all marine species. In some cases, fishermen have resorted to putting chemicals into the water and collecting the dead fish which float to the surface.

The choking of estuaries/rivers/streams/lagoon with sand/debris/floating vegetation, both natural and anthropogenic

Many water channels are blocked with either sediment or debris. Sediment can be from natural sediment deposition processes. Debris consists of leftover fishermen nets/items, wood, roots and other plant material.

Primarily, many marine life (fish, shrimp, crabs, etc.) use mangroves as nurseries during early life stages. The blocking of the estuaries connecting the Keta Lagoon to the sea and the Volta River estuaries prohibits marine flows of water and marine life from entering the lagoon, which is hugely disruptive to fish stock replenishment cycles. Decreased water entering the lagoons from the Keta Lagoon and other water channels has also resulted in water depletion and increased salinity. These water channels also serve as habitats and food sources for waterbirds and other terrestrial wildlife.

Water contamination and salinization

Inhabitants use ground and surface water for crop irrigation and drinking. They cited poor water quality as a problem. The contamination or salinization of this water poses a significant threat to the livelihood of communities. Studies assessing the quality of ground water have been carried out by *Lamptey, 2013* and *Yidana, 2009*. Both studies found poor water quality to exist in shallow, commonly used aquifers, which contain high salt levels and/or leached agrochemicals (Lamptey, 2013; Yidana, 2009).

Bush burning

Fires are created to clear areas of vegetation for either hunting or farming. For hunting, it becomes easier to locate wildlife as burrows are exposed or animals flee before the fire. Farmers use it as a cost and time effective way of claiming new farmlands. Fires apparently lose control sometimes, causing increased and unnecessary destruction to biodiversity. This was cited as a major threat to biodiversity in KLCRS and therefore must be addressed with appropriate management measures.

Improper waste disposal

The KLCRS severely lacks proper waste disposal systems resulting in the indiscriminate dumping of waste (Ghana EPA, 2004). During round tables with local stakeholders, many regretted that KLCRS was subject to the pun ‘Wetlands = Waste lands’. This is causing a reduction of the aesthetic value and water quality of the area. The continuous dumping of refuse and open defecation has resulted in bad odour and the attraction of unwanted insects such as flies and mosquitoes to the environment. Prolonged dumping of both household and non-household solid wastes around the lagoon could lead to severe sanitation problems with increased risks of the spread of diseases such as cholera, malaria, and typhoid among residents in the area (Ahmad, S., Issac, S., 2016).

Destructive big business & industrial activities

Businesses within surrounding communities are having negative impact on the environment such as destruction of fish nurseries, mangroves, natural vegetation) and surrounding communities have experienced loss of livelihoods (further reinforced in Brinks, 2017). For example, fishermen can no longer enter their local fishing areas which are now demarcated off by the ‘Seven Seas’ salt mining company, and others are experiencing exacerbated flooding due to land reclamation of natural flood reservoirs. Further communication and collaboration amongst multi-leveled stakeholders is necessary to prevent further disruption. Community involvement and participation in the decision-making process was stressed by the inhabitants, WD and DAs for future endeavours.

In addition, a major industrial port construction is planned within the next few years between Keta and Kedzi, which could have unprecedented impacts on the naturalness of the entire Ramsar site.

Encroachment of animals and pests

Due to limited space, population growth, and environmental change, animals are encroaching into the territory of the communities. Many farmers expressed the need for proper law enforcement in the case of controlling roaming cattle. As well as assistance in controlling insects and birds eating their crops.

Sand mining

Removing sand in critical areas of coastal erosion has become a problem for residents and is said to exacerbate existing issues of erosion.

5.4.2. Challenges related to climate change and environmental processes

Irregular rainfall patterns associated with deforestation and disturbance of natural ecosystems

The inhabitants struggle to adequately predict weather patterns, seasons and rainfall. They may plant too early (and no rain comes) or too late (and flooding occurs). They strongly associate the problem of irregular rainfall patterns with deforestation and climate change.

Coastal erosion

Severe coastal erosion has become a problem along the coast and the ruins of eroded houses are a common sight from Keta through Vodza to Kedzi. This is especially true for the eastern section of Keta/Ketu districts. The construction of the Akosombo hydroelectric dam in 1961 is believed to be a contributing factor to a major shortage of sediment deposits in the lower Volta River region, this coupled with low-lying lands, unconsolidated (soft) sediment structures, and general orientation, has created severe coastal erosion and sand displacement equalling between 2-7 million m^3 of sand per year. This problem was exacerbated by the prevailing wave habits and submarine topography (WACA, case study 6, 2019).

Flooding

Coupled with irregular rainfall, flooding continues to affect communities living on the fringes of water bodies and lower marshy areas. Apart from rainfall, drivers of this threat are linked to blocking of the waterways and encroachment on natural flood reservoirs by businesses (such as Seven Seas salt mining).

5.4.3. Challenges of governance

It is noticeable that business and urban planning can be improved in KLCRS. Local plans are all ‘under process’, while breaking of the rules (especially those dealing with the limitation of environmental impacts by new infrastructures) are frequent.

In addition, communication and collaboration between the Wildlife Division and other administrative entities needs to be enhanced in order to understand the possible impacts of planned activities on the environment and take needed steps collectively to address them. Due to this poor collaboration, urban sprawl continues, destroying areas of high natural value (fish breeding areas, hotspots for birds, etc.). Also, some factories that have strong impacts on the environment (salt extraction, industrial aquaculture) recently settled in the Ramsar site. A direct mission of the field work undertaken in the development of this management plan was to create exchanges between the Wildlife Division and the other administrative services. The District Assemblies expressed their interest in working more closely with the Ramsar site management team.

Financial challenges

As presented in *Section 1.4.3* about the WD, understaffing and inadequate infrastructure and equipment is hampering efforts by the WD in surveillance, law enforcement and regeneration projects.

5.5. Drivers of threats/challenges

- Livelihood strategies - Anthropogenic action, directly related to deriving livelihood as a result of poverty and lack of options. As an example, based on the many interviews undertaken with local communities, people would not continue to use smaller nets (often illegally) or fish in protected areas unless there was no other option.
- Climate change and environmental processes - Environmental action which may cause disruption in KLCRS.
- Issues of law and governance - Concerning law enforcement, inadequate/lack of bye-laws and stakeholder involvement. Also included are the activities of businesses which are activity driving issues presented in *Section 5.4*.

5.6. Community proposed solutions

Along with the challenges and drivers, the community of KLCRS also presented solutions to these problems. Primary solutions mentioned were:

- Awareness, education and environmental sensitivity raising campaigns
- Environmental regeneration projects
- Increased law enforcement
- Unblocking of water channels
- Alternative livelihood creation and
- Community involvement.

The connection between drivers, challenges or ‘threats’ and solutions are depicted in the Sankey diagram above (*Figure 14*). The community-proposed solutions are discussed more in-depth in Part B, since they have influenced the management measures to be implemented.

ILLUSTRATION 6: WOOD TRANSPORTATION IN ANYANUI WOOD MARKET

PART B: Objectives and activities

B.1. Initial ambition related to the creation of KLCRS and the previous management

Keta Lagoon was recognised by the Ramsar Convention as a wetland of international importance since 1992, as it was found to regularly support more than 1% of the individuals in a biogeographic population of one species or subspecies of waterbird: namely the Whiskered tern (*Chlidonias hybridus*) and the Caspian tern (*Hydroprogne caspia*). In addition, the surrounding environment was of great natural condition with flood plains, lagoons, and mangroves, on which local communities relied upon. Finally, the area has a great biodiversity, including key species such as manatees, sitatungas, turtles, crocodiles etc. As a result, the government of Ghana decided to legislate, in order to protect the overall environment around Keta lagoon.

The 1999 KLCRS management plan:

The conservation of the Keta Lagoon Complex Ramsar Site in Ghana was envisaged as a component of the Ghana Environmental Resource Management Project (GERMP). The initial management strategy proposed for the site, emphasised its importance as a bird habitat. This was later reformed in accordance with the Ramsar Convention's emphasis on the interdependency of man and his environment (WD, 1999).

The long-term management objectives for the 1999 KLCRS management plan were stated as follows (WD, 1999):

1. To maintain and enhance the value of the wetland as a wildlife habitat and integrate wildlife conservation into the existing human use of the wetland.
2. To enhance benefits derived from the wetland and improve the quality of life for the local communities who live in the vicinity of the wetland and whose activities influence the wetland ecosystem.
3. To control, monitor and coordinate the activities which affect the coastal zone within the Ramsar site (e.g. human settlement, industrial developments, salt production, agriculture, fisheries, recreation etc.) so as to ensure the maintenance of the health of the coastal environment and a sustainable use of the wetland resources.
4. To create awareness about the rich ecological value of the Keta Lagoon and develop the infrastructural base requisite for the sustainable use of this heritage for education, recreation and tourism.

Identified in the specific objectives of the update to the 1999 management plan is the strengthening of stakeholders' ability to manage protected areas and unprotected mangrove sites. This, coupled with the original intention of conserving and maintaining the existing habitats and biodiversity, is the framework on which the new objectives are built.

B.2. Long term objective

The long-term objective of the 2022 KLCRS management plan is to conserve, and regenerate where possible, the species and habitats that makes the site of international importance while at the same time develop the capability of stakeholders to sustainably manage and derive livelihood from KLCRS natural resources.

This management plan contributes to achieving this objective by planning and implementing concerted actions, while involving all the traditional stakeholders, based on current efforts of the WD and the recommendations of the mission carried out in June-July 2022.

B.3. Management Plan Overall objectives

3.1. The process to identify the global objectives

The threats identified by community members are outlined in the previous section which is named 'Challenges' (see *Section A.5.4)*, along with the primary drivers and community proposed solutions. Creating the global and specific objectives was primarily done through identification and careful analysis of challenges and threats to KLCRS. Based on these analyses, appropriate objectives were developed to mitigate or improve the state of challenges and threats as well as improve the overall ecological integrity of the site. Included was the involvement (through interviews, views, opinions, expert and key stakeholder advice, etc.) of stakeholders at all levels (as outlined in the introduction).

As a part of this process, and stakeholder involvement, communities and stakeholders at decision-making level were asked about their expectations of the new management plan. They proposed methods to improve site management and solutions to the identified threats. The next sections outline these expectations, proposed site improvements and threat solutions. From this, consistent narratives emerged which could assist in the identification of potential intervention areas and management objectives.

3.1.1. Expectations of the new management plan by the local stakeholders and communities

Included in the group interviews and semi-structured interviews with key stakeholders (outlined in the introduction), was a question about the community's expectations of the site (*Figure 16* below). These were recorded and classified into specific words. Key words were identified according to their relevance into interviewees' answers. The number of mentions of these words was identified and a word cloud was then generated below to depict the most consistent narratives in terms of the expectations of the site.

FIGURE 16: WORD CLOUD DEPICTING OVERALL COMMUNITY EXPECTATIONS OF NEW MANAGEMENT PLAN. WORD SIZE CORRELATES TO IMPORTANCE.

The primary expectations of the stakeholders were grouped as follows, listed from biggest expectations to smallest (frequency mentioned):

1. Conservation: Greater efforts in mangrove and biodiversity conservation and protection. (28)
2. Economic: Provision of subsidies to assist for better equipment, materials and infrastructure. Also, to provide consultancy in boosting the economy within KLCRS in terms of creating and promoting local markets (rice and vegetable markets for example). (24)
3. Unblock: Unblock the many estuaries and water channels that connect to the lagoons (Keta and Avu). (21)
4. Alternatives: The creation and/or promotion of alternative livelihoods, such as poultry and cattle, in place of their current livelihoods which could be destructive to the ecosystems and biodiversity of KLCRS such as mangrove harvesting and hunting. (17)
5. Law: The creation of new bye-laws in favour of conservation and well-being and also greater enforcement of these laws and olds laws. (17)
6. Education: Educating people in the sustainable management of wetlands including the effects of chemical use, bush burning. Also 'awareness education' about the Ramsar site. (15)
7. Involvement: The communities want to be involved in decision making, create community watch dogs, and help in restoration and education projects. (14)
8. Transportation: To improve road and waterway transportation networks. (5)
9. Ecotourism: The promotion of ecotourism in KLCRS. (4)
10. Zoning: The creation of specific zones of importance which will be protected by laws

and surveillance operations. (4)

11. Remaining words - 1 mention or less.

3.1.2. Community-proposed solutions

After defining threats and their drivers for KLCRS, com
munities and key stakeholders were asked to present solutions to these. These solutions are outlined in *Figure 17* below:

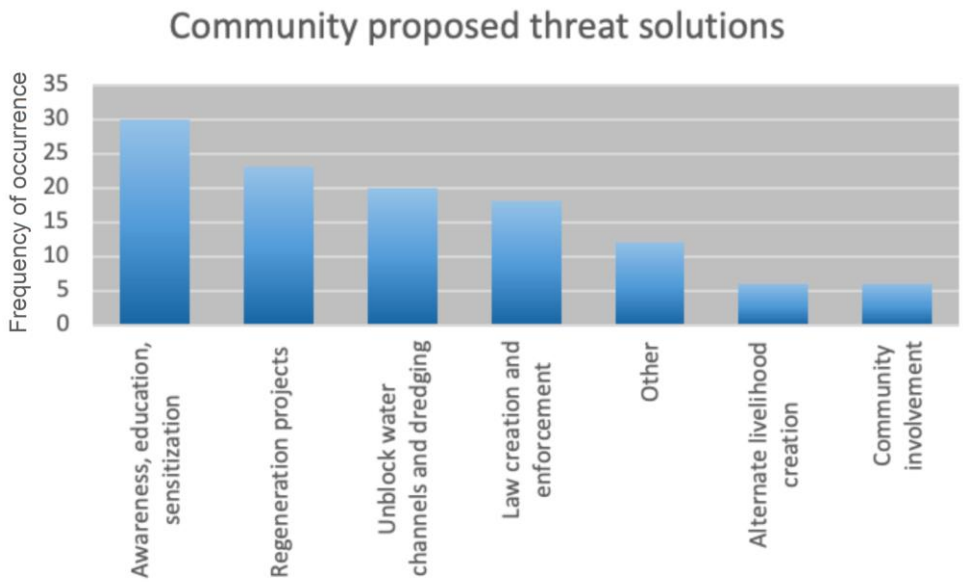

FIGURE 17: FREQUENCY OF MENTION OF COMMUNITY-PROPOSED SOLUTIONS TO THREATS TO KETA LAGOON COMPLEX RAMSAR SITE. NOTE: THE "OTHER" REFERS TO INFREQUENT OR NONSENSICAL RESPONSES

Solutions were grouped into 7 categories:

- Awareness, environmental sensitisation and education.
- Regeneration projects.
- Unblocking of water channels.
- Improved law enforcement and creation of new laws protecting certain aspects of KLCRS.
- Alternate livelihood creation - In the case that activities become prohibited such as poaching or use of agrochemicals in agricultural practices for example.
- Community involvement.
- 'Other'- an assortment of responses that are either infrequent or incoherent, considering the context.

3.1.3. Preferred mitigation measures by stakeholders

When the communities' expectations (*Figure 16)* and proposed threat solutions (*Figure 17),* are compared, what emerges are consistent narratives from which an analysis can be drawn and used to assist in the identification of appropriate management measures and objectives. Summarised below are these narratives:

- Local communities highlight the need for replanting and other environmental regeneration activities.
- They stress a need to raise awareness about the importance of the environment and existing legal protection framework.
- Unblocking of water channels also appears important.
- A willingness of local communities to be involved in the management of the site, including decision making processes.
- The rigorous implementation of the law, increased surveillance and patrolling, and the addition of a new legal framework in the form of bye-laws.
- Creation or support in alternate livelihood options for inhabitants. Inhabitants cited interest in cultivating fruit trees, poultry, eggs etc. Ecotourism could also be included in this.
- Some expectations/solutions fall outside of WDs scope such as supplying drinking water, the repairing/development of public infrastructures, intervention in the market economy (to increase the demand for agricultural products, industrialisation of agriculture, subsidies, etc.).

These are consistent with the current goals and activities of the WD (see *section 1.4.3)*.

3.2. Identified overall objectives

The overall objectives are designed to facilitate the achievement or maintenance of a state considered ideal for KLCRS (basically so that all ecological, socio-economic and cultural values are maintained and preserved). The overall objectives are long-term by nature and could be maintained for multiple management plans.

In line with this facilitatory purpose, the overall objectives have been synthesised from a thorough analysis of the threats and challenges present in KLCRS, the above consistent narratives from local communities, academia relating to the site, and interviews with key stakeholders involved in the decision-making process such as the WD, community leaders, DA heads, NGOs, etc. They are presented as follows:

1. **The conservation of natural habitats and biodiversity.**

Conservation was the primary reason for creation of the management plan. This is to secure the survival of species and ecosystems and allow their development in optimal conditions. Emphasis will therefore be placed on protection and regeneration schemes, the development of technical infrastructure, the strengthening of surveillance efforts, and the continued monitoring of habitats and species (birds, mammals, reptiles, fish, mangroves, etc.).

KLCRS covers more than 1200 km^2, therefore key to conservation efforts will be the demarcation of important ‘zones' which contain biodiversity or habitats of significant importance. Identification and demarcation of these zones will allow streamlined and organised movements towards education, conservation and protection such as implementation of community surveillance forces, mangrove replanting and sustainable resource exploitation strategies. Such zones are matching with the only CREMA in place to date. The ‘zones’ are described in Section B.4 (‘Important zones’), and specific actions related to each zone are described in Section B.5 (‘Specific Objectives’) and B.6 (‘Action plan’).

Linked to the conservation of natural habitats and biodiversity is the optimal functioning of ecosystems and their services. Of particular priority in this regard is to unblock the water channels which allow free movement of water throughout KLCRS.

2. Effective administrative management is in place.

Amongst the threat drivers in *Section A.5.5* are issues related to law and governance. Included in this driver is inadequate communication between governing authorities, on-site NGOs, and the private sector (big businesses). An important aspect of this objective is to open channels of communication between these stakeholders to ensure involvement of the WD in future operations on the site and reduce environmental impact. Strict law enforcement is also a necessary factor to reduce overexploitation of resources and illegal activities.

As the WDs capacities are limited by funding and staff, it is recommended that appropriate community task forces be set up in collaboration with the WD and District Assemblies to assist in natural resource management, such as surveillance and monitoring, law enforcement, dredging operations, and regenerative strategies, especially around the demarcated important biodiversity zones. Particular attention should be paid to poaching and killing of threatened wildlife such as turtles, the sitatunga, manatees and waterbirds.

Furthermore, other administrative and governmental bodies will be called to action on particular subjects such as the implementation of waste management systems and to reduce the detrimental effects of particular big businesses on the surrounding communities and biodiversity.

3. Integration of local populations into site management.

About 50% of community members are not aware of the existence of the KLCRS, the WD, or their management practices. A major step in integrating local populations into site management regimes is therefore education, awareness, and environmental campaigns towards sensitivity, which can promote community participation and support for wildlife and wetland conservation while raising important environmental issues. Once a majority of communities are aware of the WD, the KLCRS, and the intricate ecosystems and biodiversity it possesses along with the relevant management practices, an integration into site management becomes increasingly available and will surely reduce the pressure on the environment.

Positively, more than 90% of communities expressed the will to protect the environment for future generations, and thereby securing their own livelihood. Furthermore, a strong willingness to collaborate with WD and management practices was encountered on-site.

The WD has already carried out many education and awareness campaigns within KLCRS, including radio presentations, school workshops and community meetings. This objective hopes to supplement and escalate these current efforts by the WD through support of other administrative bodies, authorities, institutions and NGOs.

Governing authorities (DAs, spatial planners working in the districts/working at the Land Commission) are also in the process of creating spatial plans. There are three types: 1 - Special Development plan lasting 20 years. 2 - Structure plans on a local level over a short time period which will plan activities. 3 - Detailed plans for real estate purposes. Part of this objective will therefore be to encourage DAs to create these spatial plans for each district that will be added alongside the zones created in line with WD objectives of nature and biodiversity conservation presented in *Section B4 ('Important Zones')*. Also, to mitigate conflict of land use, a community-identified demarcation of space and zoning needs to occur, in particular the separation of agriculture and livestock farming. This has potential to be included in the 'under-process' of the DAs structure plans mentioned above (see *Section A 5.4.3*).

Integration of CREMAs in the management effort by the WD is also mentioned in this overall objective. As an example, the zoning of key biodiversity intervention area is matching with the only operational CREMA to date in the KLCRS (the Awu Lagoon CREMA).

4. Contribute to the improvement in livelihoods of the local population.

Currently poverty and lack of options/inadequate options are resulting in overexploitation of natural resources and environmental degradation. A diversification of livelihood could therefore reduce pressure on currently overexploited resources such as fisheries and mangroves while providing different income sources and food security to local communities. Provision of alternatives was commonly cited as a solution to many threats in KLCRS (see *Sections A.5.6* and *B.3.1).* The population of KLCRS could therefore benefit greatly from a diversification of agriculture into fruit trees, poultry and eggs, and livestock. Proposed management strategies revolve around lobbying for this diversification and providing support to the process.

The KLCRS is distinguished by the presence of exceptional and particularly threatened species with high ecotourism potential such as manatees, the sitatunga, marine turtles, and the huge populations of waterbirds alongside the beautiful aesthetic nature of the site. Ecotourism is still in its infancy therefore a structured plan of action is necessary to identify potential areas, manage these areas, and promote them to the public both nationally and internationally. What can be built on is: already known sites (such as Xavi and Avu Lagoon), and already existing activities of bird watching and nature walks created by the WD.

ILLUSTRATION 7: CUTTED MANGROVE WOOD IN ANYANUI

B.4. Important zones

In order to achieve KLCRS overall objectives, and due to the size of the site, the demarcation of important zones has been included in the management plan (*Figure 18* below). These zones have been chosen due to their ecological importance to the KLCRS as a whole. Concerted efforts will be made in these zones to conserve and regenerate ecosystems and biodiversity where possible.

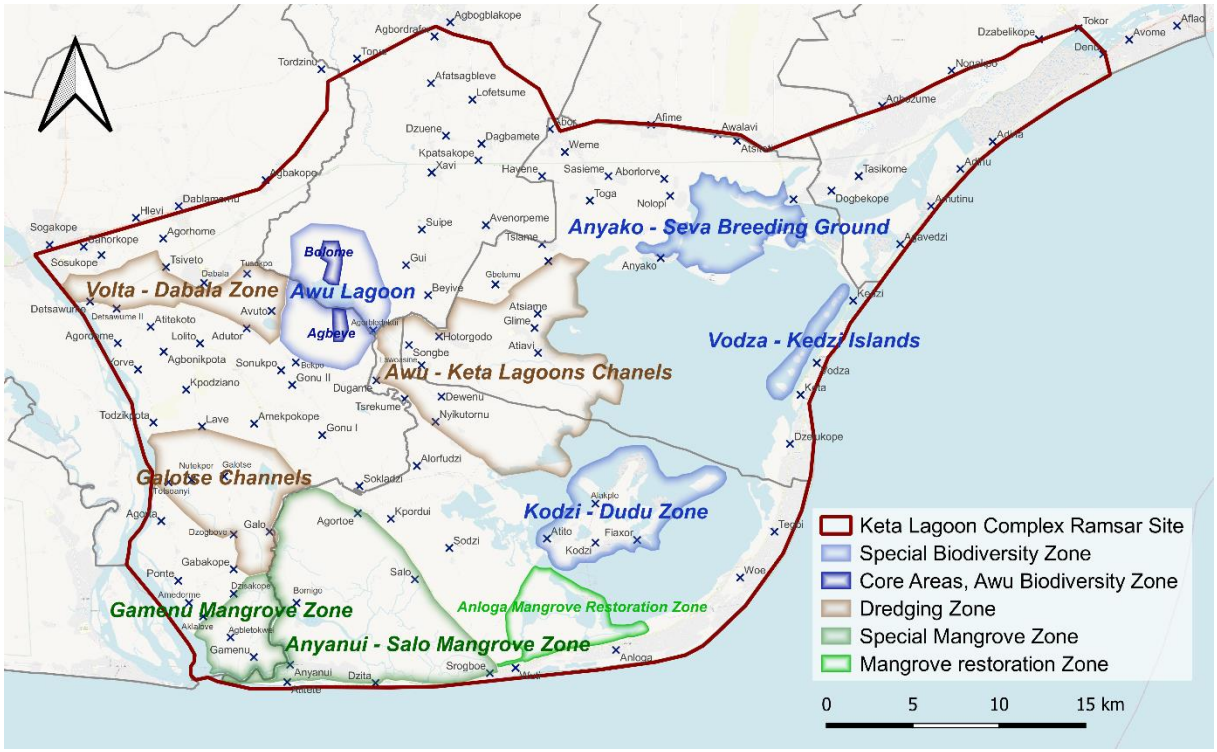

FIGURE 18: DEMARCATED ZONES FOR WILDLIFE DIVISION MANAGEMENT STRATEGIES.

4.1. Special biodiversity zones

These have been allocated to areas of significant biodiversity that also house breeding grounds or nurseries for fish juveniles. It is highly important to conserve habitats (water channels are open, natural vegetation is protected) in these zones as loss of habitat is severely affecting species presence and numbers.

- Anyako - Seva Breeding Ground: Attains a hugely diverse bird and fish population. It also serves as a breeding ground and nursery for these populations. Anyako and Seva are two communities present in this area who could be mobilised to assist with conservation efforts. Approximate surface area: 29.67 km^2.

- Vodza - Kedzi islands: The highest priority is protecting the major bird populations present on these islands. Large shrimp populations and nurseries are also known to be present. Communities in close proximity are Kedzi, Vodza and Keta. Approximate surface area: 8.35 km^2.

- Kodzi - Dudu zone: Area of major fish and bird populations. Communities present are Fiaxor, Antito and Kodzi. Approximate surface area: 41.92 km^2.

Awu Biodiversity zone

Awu/Avu Lagoon and its fringe communities are hotspots for biodiversity and hold great potential for eco-tourism. It is already an established Community-managed Resource Area (CREMA)– even if it has having no official status yet – and the local communities are integrated into conservation efforts (see *Section 1.6)*. Approximate surface area: 41.16 km^2.

4.2. Dredging zones

These are areas of water channels that are significantly important to the movement of water around KLCRS. Free movement of water in these areas is of great biological and ecological importance, as mentioned in *Overall objective 1* above.

- Volta - Dabala zone: Connects the Avu Lagoon to the Volta River through a series of interconnecting streams and rivers. It supplies important fresh water to the Avu Lagoon. Communities present are Avuto, Adutor, Tsiveto, and Detsawune. Approximate surface area: 30.04 km^2.

- Galotse channels: Galo, Galotse. This area has the potential to better connect Keta Lagoon the Volta River, and thus ensure favourable ecological status of habitats. Approximate surface area: 43.87 km^2.

- Avu - Keta Lagoon connecting channels: Avu Lagoon supplies highly important fresh water to the Keta Lagoon, including fish and other aquatic species. WD should ensure that channels between Avu and Keta Lagoons are cleared, so as to maintain connectivity for highly important species. Communities present are Atsiame, Glime, Atiavi, Hotorgodo, Songbe, Dewenu, Nyikutomu, and Dugame. Approximate surface area: 102.6 km^2.

4.3. Special mangrove zones

These are large areas of mangrove forest that are vulnerable to overexploitation and therefore need to be sustainably managed and conserved. It is recommended that research be conducted in these zones in relation to sustainable mangrove exploitation. Once information is obtained such as the amount of trees that can be sustainably cut and suitable areas as well as minimal impact on ecosystems present in these mangrove ecosystems, this information can then be shared and implemented in the form of strategies with harvesters and merchants.

- Gamenu mangrove zone: Large tracts of mangrove forests are present here and are heavily exploited. To date, mangrove restoration efforts have not matched the rate of exploitation. This area should be sustainably managed and protected to prevent continued overexploitation and destruction of mangrove area. Communities involved are Gamenu and Bomigo. Approximate surface area: 20.46 km^2.

- Anyanui - Salo mangrove zone: Next to the Gamenu mangrove zone and equally important. Contains massive tracts of mangrove forests, water channels, and lakes, and is a significant provider of ecosystem services in KLCRS. Communities involved are at Anyanui, Dzita, Atitete, Srogboe, Salo, and Agortoe. Approximate surface area: 96.23 km^2.

4.4. Mangrove restoration zone

This is an area where mangrove forests have been significantly depleted. Restoration activities will be concentrated in these areas.

- The Anloga Mangrove Restoration Zone has been significantly affected by industrial aquaculture infrastructure and vast tracts of mangrove forests have been lost. Since large areas were hosting mangroves just few years ago, it is expected that restoration activities could be successful there (favourable environmental features should nevertheless be in place). Closest communities are in Anloga and Wuti. Approximate surface area: 25.35 km^2.

B.5. Specific objectives

The specific objectives are operational by nature and will continue for the timeframe of the management plan (10 years). They present concrete ways of achieving parts of the global objectives within the duration of the plan and reduce the effects of factors negatively affecting conservation of the site. Each specific objective is in turn made of dedicated actions that are then described in Section B.6. ("Action Plan").

Overall Objective 1. Natural habitats and biodiversity are conserved.

Specific Objective 1.1. Area of priority intervention for biodiversity (Special Biodiversity Zones – 121 km^2) are protected.

Poaching and loss of habitat are resulting in a decline of biodiversity. The goal here is to see increasing numbers of wildlife and increased efforts in protecting areas rich in biodiversity (Anyako - Seva Breeding Ground, Vodza - Kedzi islands, Kodzi - Dudu zone, Avu Biodiversity zone) mentioned in *Section B4 'Important zones'*. This will be done through rigorous surveillance operations and monitoring of key species such as the sitatunga, sea turtles, manatees, waterbirds and mangrove forests. Due to limited capacities of the WD such as staff and funding, attempts to mobilise communities and NGOs will be made where possible to assist in protecting natural resources. Management actions are detailed in section B.6. ("Action Plan").

Specific Objective 1.2. Improved knowledge of biodiversity

With improved knowledge of location/presence and numbers/cover of key biodiversity, they may be better conserved. This specific objective is to develop a yearly baseline of information (presence, location, numbers) on biodiversity in important biodiversity zones and on key species throughout the site, namely: manatees, waterbirds, sea turtles and the sitatunga. From this yearly baseline of information, all monitoring tasks can be created and task forces can be mobilised to protect these areas of importance.

Specific Objective 1.3. Free circulation of water between Keta Lagoon, Avu Lagoon and the Volta River.

Blocked and dry water channels are resulting in displacement of wildlife (waterbirds especially). It is imperative that there is free flow of water between the lagoons and Volta River estuaries. This would be a monumental task for WD alone. It is therefore recommended that communities are empowered to

seek for the dredging/unblocking of channels, with specific importance given to demarcated dredging zones (cumulated surface area in the Dredging zones: 177 km^2). Critical areas for dredging have to be clearly identified in these specific zones. Dredging activities should then be implemented, while monitoring and surveillance has to be carried out on a regular basis, thanks to local informants.

As this specific objective is of major importance, the KLCRS staff and the WD have to lobby regularly NGOs, international donors/funding agencies and international institutions to set up projects to clear and maintain the water channels.

Specific Objective 1.4. Area of priority intervention for Mangroves (Special Mangrove Zones – 117 km^2) are sustainably exploited.

Many communities of the KLCRS are significantly dependent on mangrove resources. It is therefore imperative that sustainable mangrove harvesting strategies are put in place. Currently, there is no information on how to sustainably exploit mangrove plantations which necessitates the need for research in this area. NGOs, research institutes, and researchers will be called on to collaborate with the WD in this regard.

Specific Objective 1.5. Overall restoration of natural habitats.

It is critical, given the current state of drastic decline in natural vegetation cover and biodiversity in KLCRS, that natural habitats are restored where possible and regenerative strategies are in place. Identified in the 'zoning' section 'Anloga mangrove restoration zone' (25 km^2), actions will be prioritised in this zone first.

Overall Objective 2. Effective administrative management is in place.

Specific Objective 2.1. Strict enforcement of the law.

According to the communities in KLCRS, non-compliance with the law is putting added strain on environmental resources. It is therefore imperative that strict law enforcement is in place in order to better protect natural resources.

Specific Objective 2.2. Communication and collaboration between administrative bodies (WD, DAs, EPA, Fisheries Commission), private companies and NGOs (operating in the area) are in place.

Currently there is inadequate communication between administrative authorities such as WD, DAs, Fisheries Commission and the EPA. Due to the size and scope of issues facing KLCRS, effective communication and collaboration will be key to successful site management. As mentioned before, communication between various stakeholders is important. Part of this is communication between WD, local DAs and NGOs, and businesses wishing to operate within KLCRS limits. This will ensure that local DAs and WD are seen as administrative bodies and are consulted before any projects are undertaken so as to reduce the impact on the environment and the inhabitants. The overexploitation of natural resources is a major threat facing KLCRS, involving the depleting fisheries of the lagoons and surrounding ocean. Some fishing practices are aggravating this threat such as the use of small monofilament nets, bottle traps, chemicals, etc. These practices often occur in designated special zones such as the Anyako-Seva breeding grounds and Vodza-Kedzi islands. Also, the fisheries are the primary food for the vast bird populations that frequent KLCRS. The Fisheries Commission and WD therefore have common objectives and even if both entities are already collaborating, closer cooperation between them will be beneficial to both.

Specific Objective 2.3. WD capacity building.

It is important that the WD undertakes training to improve their own management capabilities. This is a suggested endeavour and can be undertaken in various ways. This could be through attendance of online courses and in-person workshops in environmental/sustainability management in the context of protected areas, or (though definitely the more costly option) through exchange visits with other protected areas in Ghana or West Africa (such as Mole National Park in Ghana and Banc d'Arguin National Park - PNBA - in Mauritania), whereby information and management practices can be shared and used for the benefit of both sides involved.

Overall Objective 3. The integration of local populations into site management.

Specific Objective 3.1. Continued strengthening of awareness and sensitivity to the environment amongst the communities.

Currently a majority of inhabitants know very little about KLCRS as a whole, about ecosystem services provided, or management or environmental concerns. Continued awareness-raising and educative campaigns are therefore critical to integrating local populations into site management. Mentions of unsustainable fishing practices and fishing practices leading to the choking f estuaries should be included. Innovative means for communication and diffusion of information should be used, such as local radios, newsletters (contents based on WD's quarterly reports), social medias, diffusion of hard copies of quarterly reports to traditional authorities (including in local languages), etc.

Specific Objective 3.2. Community zoning.

Alongside the zones set out for the WD (special mangrove areas, dredging zones, regenerative zones, and important biodiversity areas), a need for spatial plans of other sectors such as residential, farming, mangrove harvesting, etc., has been cited as important by planning officers and DA leaders. Part of this objective is to assist and lobby for the creation of these spatial plans.

Also, an issue mentioned in the field work carried out in June-July, 2022 was a conflict in land-use between agriculture farmers, hunters, livestock farmers, mangrove harvesters, etc. Assistance is suggested therefore, to be given to relevant DAs and district planners in creating different land-use zones based on the communities' needs. Furthermore, WD should lobby and support local communities and traditional leaders for planning and to organizing spatial uses at the community level.

Specific Objective 3.3. Enhanced natural resource management through community participation.

Due to the size and scope of KLCRS, the WD will need to empower communities to mobilise in site management through the creation of community task forces to assist with surveillance operations and regenerative strategies (clearing of the channels, nurseries, replanting, etc.) in the areas surrounding them. An initial assessment indicated that communication between administrative authorities and communities was inconsistent and infrequent. Part of this objective is therefore, to open regular channels of communication between the WD and communities to allow for better conflict resolution and conservation strategies such as unblocking channels, replanting, law enforcement, etc. Partnerships between the WD and local communities should be formalized through Memorandum of Understanding (MoU) and other tools. Facilitating inclusive participation of women, youth and minorities/ vulnerable groups in decision making and management actions should also be mentioned during these disussions.

Finally, equitable benefit sharing among all communities' members (based on their cultural, gender and other roles) should be ensured as part of this specific objective.

Specific Objective 3.4. Assistance given to the creation and implementation of Community Resource Management Areas (CREMAs).

The creation of CREMAs was cited by communities as a possible approach to resource management. Therefore, assistance will be given to the decision-making process and possible identification and creation of CREMAs within KLCRS. To date, only one CREMA has been implemented, although it does not yet have official status (Avu Lagoon CREMA). Other projects to create CREMAs are under discussion, the most advanced one being located along the Atlantic coasts in the municipality of Dzita (specialized in conservation and eco-tourism related to sea turtles). Areas of priority intervention (special biodiversity zones, special mangrove zones, dredging zones and mangrove restoration zones) could be potential areas in which to create CREMAs. Moreover, Awu Lagoon special biodiversity zone's outline is harmonised with Awu Lagoon CREMA's outline. In addition, Dzita proposed CREMA is located in a Special Mangrove Zone.

In addition to supporting local communities and NGOs in the identification and creation of CREMAs, the WD should work closely with the local committees and stakeholders in the CREMAs, in order to support them in the daily implementation/administration/animation.

Specific Objective 3.5. Ensuring gender inclusiveness and equity in the management of the KLCRS.

Currently, there are differences for access to education and decent income between men and women in the Volta Estuary region (Ghana Statistical Service, 2021). As a result, women have an average literacy rate and average income lower than men. Women are either confined to domestic activities or to difficult jobs that generate little income, with no perspectives of improving their living standards.

WD has a role to play in addressing gender gaps. WD can act on women's chances to access good professions. Thus, women should be supported in engaging into valuable entrepreneurial activities. In addition, WD should emphasize the need for women to take part of management actions, while involving local communities to the management of KLCRS. Moreover, WD should act on allocating profits from overall activities in a more equitable way. Finally, special support must be provided to women, so that they can benefit from training conditions conducive to their emancipation. Training workshops on the creation of sustainable income-generating activities, but also on the reinvestment of income should, for example, be carried out. As KLCRS staff is already carrying out extensive capacity building to local communities, such supplemental points should easily be integrated to already-existing training.

Overall Objective 4. Contribute to the improvement in livelihoods of the local population.

Specific Objective 4.1. Local communities benefit from the support and diversification of agricultural activities (fruit trees, coconut artefacts, poultry, livestock, etc.).

Resources of the KLCRS are under pressure. The fisheries are overexploited, alongside mangrove forests and other wildlife. A diversification of agriculture will assist to reduce pressure on the environment and provide alternate means of livelihood for many of the population. Fish has also been cited as an important source of protein for the community; the inclusion and expansion of poultry and livestock resources will therefore certainly improve current food security. Despite WD having little room for manoeuver and low intervention capability on these aspects, the management staff can still lobby for the diversification of the activities by discussions with local communities, other administrative offices, and other stakeholders.

Specific Objective 4.2. Continued support in the development of ecotourism.

Ecotourism holds big potential in KLCRS due to its natural beauty and biodiversity. Income generated through ecotourism could fund continued efforts in conservation and create income streams for inhabitants. The main goals are to identify specific zones that hold potential for ecotourism (only the surroundings of Anloga, Tegbi and Keta host extensive touristic infrastructures), lobby for the creation of task forces to manage and conserve these zones, and then promote on national and international levels.

B.6. Action plan

The following action plan presents a list of activities or practical means of achieving the above declared specific objectives. Each global objective is stated here, followed by its specific objective and the related activities.

Alongside each activity is:

- The approach to implementing each activity (method).
- The indicators that can be used to assess the success of each activity.
- The document that can be used to verify that each activity is performed.
- The agencies responsible for partaking in the given activity.
- The requirements of each task, including staff, funding, equipment, etc.
- A priority scale. 'High' and 'medium' priority is given to activities according to the order of importance outlined in *Section A.5.4* (see *Figure 14-17).* 'Low' priority is given for recommendations.

It should be noted that many described actions overlap with each other, which means WD could cover a large amount of activities from *Table 8* while actually completing a smaller number of activities. However, this has to be strategically planned by the site manager and the management staff.

TABLE 8; ACTIVITIES PLAN

Global objective: 1. Natural habitats and biodiversity is conserved						
Specific objective: 1.1 Special biodiversity zones are protected						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Physical demarcation of special zones	1. Place signs and/or tags to signal boundaries on main KLCRS entries (along the roads). Place signs and/or tags to signal boundaries of each special zone. The goal is for people to know which areas are protected upon entry.	Number of signs. Number of demarcating operations.	Working reports	WD	Vehicle, 2 staff members,	Medium
2. Surveillance and law enforcement of special biodiversity zones	1. WD staff patrols in important biodiversity zones: Anyako - Seva Breeding Ground, Vodza - Kedzi islands, Kodzi - Dudu zone and Avu Lagoon Zone. Main objectives are to conserve habitats and reduce poaching.	Number of patrols. List of arrests.	Quarterly reports	WD	2 staff members, 1 off-road vehicle, 1 boat, fuel	High
	2. WD mobilises communities, through collaboration with DAs, to assist with surveillance patrols by setting up a community task force. The task force is responsible for a given area. See *Section B4 'Important zones'* above for specific locations and communities. Educate the task forces on the Anyako - Seva Breeding Ground, Vodza - Kedzi islands, Kodzi - Dudu zone and Avu lagoon zone (breeding areas, nurseries, species, etc).	List of community task forces. Number of workshops hosted. Number of patrols. List of arrests made.	Quarterly reports	WD staff, DAs, Community task forces.	2 staff members, 1 vehicle, fuel	High
3. Turtle monitoring and protection along the coast and beaches (Kedzi, Vodza, Keta, Dzelikope, etc.).	1. WD hosts meetings and/or workshops to mobilise communities through creation of community task forces along the coast to assist with surveillance and	Number of workshops. List of communities empowered. Number of operations.	Quarterly reports	WD, DAs, relevant Communities	2 people per operation	High

	protective operations.					
	2. WD staff patrols continued according to the latest information on species location/presence.	Number of patrols	Quarterly reports	WD	2 staff members, 1 All-terrain vehicle (ATV), fuel	High
4. Monitoring and protection operations of key biodiversity (manatees and mangroves especially) along the Volta River (out of Special Biodiversity Zones).	1. The establishment of key areas to be protected and monitored along the Volta River. This can be done by the WD staff in collaboration with relevant communities to establish updated records on presence/location of key biodiversity from which relevant monitoring and protection operations can be initiated. Highly important is provision of a boat for this operation.	List of locations.	Quarterly reports	WD, NGOs, research institutes	2 staff members per operation, 1 boat, surveillance equipment	Medium
	2. Monitoring operations and patrols can be undertaken either by the WD or by the mobilisation of communities through the creation of task forces which can then monitor key areas of biodiversity along the river.	Number of operations. Meetings held. List of task forces. Number of operations.	Quarterly reports	WD, DAs, Community task forces	2 staff members per operation, 1 boat, fuel, surveillance equipment	Medium
Specific objective 1.2: Improved knowledge of biodiversity						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Write an annual monitoring agenda, to include latest information on location/presence of key species (sitatunga, sea turtles, waterbirds, manatees, mangroves). The annual agenda should include	1. This information can be synthesised from the lastest, most thorough monitoring operation reports or WD staff can undertake an investigation of location/presence of key biodiversity, with priority given to Anyako - Seva Breeding Ground, Vodza - Kedzi islands, Kodzi - Dudu zone and Avu Lagoon Zone.	Reports of location/ presence of key biodiversity. Agenda is in place. Estimation of resources (fuel, staff, vehicles) are included in the agenda.	Working reports	WD	2 staff members per operation, 1 off-road car/motorbike 1 boat, Fuel	Medium

estimates of staff, vehicles and fuel needed.						
2. Monitoring and recording of key biodiversity (waterbirds, manatees, sitatunga, turtles, mangroves).	1. WD staff operation, following a detailed annual agenda, based on the latest information available on sea turtles, manatees, sitatunga, waterbirds and mangroves	Updated list of key species presence/locations. Key biodiversity monitoring reports.	Working reports	WD staff	2 staff members per operation, off-road car, boat, fuel	High
	2. Mobilisation of communities, with collaboration between WD and DAs, through creation of community task forces to assist with surveillance patrols / watchdogs of specific areas based on latest information of location/presence of key biodiversity species.	List of communities mobilised. Key biodiversity monitoring reports.	Working reports	WD, DAs, community task forces	2 people per operation	High
	3. Mobilise NGOs and researchers to monitor and record key biodiversity species. This can be done through collaboration with WD. The WD provides the most recent locations/hotspots. NGOs and researchers provide reports to be included in the WD quarterly reports.	List of projects/ NGOs. Key biodiversity monitoring reports.	Working reports	WD, NGOs	2 people per operation, boat, fuel	Medium
Specific objective: 1.3 Free circulation of water between Keta Lagoon, Avu Lagoon and Volta River						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Monthly surveillance operations in 'dredging zones' to locate blocked channels.	1. DAs and communities are empowered to locate and record blocked channels of importance in their area. These reports are shared with WD.	Number of workshops. State of channels in specific zones. List of community task forces.	Quarterly reports	WD, DAs, Community members	2 staff members, 1 vehicle, fuel	High
	2. WD undertakes surveillance missions and transfers information to relevant DAs and	Number of patrols. List of blocked areas or	Quarterly reports	WD	2 staff members, 1 vehicle, (optional	High

	communities	water channels.			boat), fuel	
2. Unblocking and/or dredging operations	1. Communities are empowered to unblock and dredge water channels. Workshops provided by WD on the special 'dredging zones', 'how to', also possible provision of equipment. Unblocking operations are reported to WD.	Number of entities empowered. Reports of unblocked channels.	Quarterly reports	WD + Community task forces	2 staff members. Dredging equipment	High
3. Lobbying NGOs, donors/funding agencies and international institutions to dredge the lagoon and the water channels	1. WD and KLCRS staff to advocate for the dredging of channels connecting the lagoons and the Volta estuary.	Number of meetings. List authorities reached.	Phone message, E-mail exchanges, working reports, Media appearances	WD		High
Specific objective: 1.4 Mangrove forests are sustainably exploited						
Activities	Means of implementation	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Research and monitoring conducted on sustainable mangrove exploitation (Cutting rate, exploitable areas, regenerative strategies, impact on ecosystems, etc.).	1. Collaboration between the WD and any relevant NGOs or researchers to undertake projects aimed at developing a method for sustainable mangrove exploitation.	List of collaborative meetings. List of projects and results.	Quarterly reports	WD, NGOs, researchers	WD manager, relevant staff/stakeholders	High
2. Lobby for the organisation and implementation of sustainable mangrove exploitation between WD, DAs and local communities.	1. Primary importance is establishing sustainable practices in the Gamenu and Anyanui - Salo Mangrove zones. Therefore, collaboration in sustainable mangrove exploitation in these 'zones' with relevant administrative authorities is of most importance. Eg. Administration in Anyanui, Dzita, Atitete, Bomigo, etc.	Number of meetings. List authorities reached.	Working reports	WD, DAs, relevant administrative authorities	WD manager, relevant staff/stakeholders	High

3. Surveillance and law enforcement in relation to sustainable exploitation of mangroves	1. WD staff to undertake surveillance and law enforcement operations to minimise overexploitation of mangrove forests.	Number of operations. State of mangrove cover in zones.	Working reports	WD	2 staff members, vehicle, 1 boat, fuel	Medium
	2. Communities are empowered, in collaboration with DAs, to monitor the sustainable use of their mangrove forests through creation of community task forces who monitor specific areas. This can be done by hosting capacity building workshops or meetings.	Number of workshops. Entities empowered. Number of operations.	Working reports	WD + DAs of Anloga + close communities (Anyanui, Dzita, Atitete, Srogboe, Salo, Agortoe, etc.).	2 staff members	Medium
Specific objective: 1.5 Overall restoration of natural habitats						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Implementation of replanting and regeneration projects in the 'Anloga mangrove regeneration zone'.	1. Communities and the DA of Anloga are empowered to undertake replanting and regenerative projects through provision of workshops, seedlings and collaborative replanting activities.	Number of workshops/ meetings held.	Working reports	WD, Anloga DA, relevant communities (Eg Anloga, Wuti).	Seedlings, 2 staff members per operation	High
	2. WD staff continues to create and implement replanting initiatives.	Number of initiatives. Results of initiatives. Number of seedlings planted/given to the communities	Quarterly reports	WD		High
2. Raising of plant nurseries (white mangroves, cassia, fruit trees, etc.) for provision in replanting initiatives.	1. WD continues to raise their own nursery and provide seedlings for regenerative projects.	Number of workshops given. Number of seedlings planted/given to the communities	Quarterly reports	WD + relevant communities + harvesters	2 staff members per operation. Seeds, seedlings.	High
	2. Alongside raising their own nurseries, the WD empowers communities to raise their own nurseries through	Number of workshops. List of other nurseries and	Quarterly reports	WD, + relevant communities, DAs	2 staff members per operation Seeds, seedlings.	Medium

	provision of workshops, training and seedlings to relevant communities.	locations.				
3. Monitoring and surveillance operations aimed at reducing destructive activities such as overexploitation, bush burning and waste deposition.	1. The mobilisation of DAs and communities through creation of task forces to assist in surveillance operations and monitoring of natural habitats.	List of community task forces. Number of meetings.	Quarterly reports	WD + Relevant community members	2 staff members	High
	2. WD staff operations.	Number of operations.	Quarterly reports	WD	2 staff members, Off-road car/motorbike Fuel	High
4. Regeneration of mangrove forests along the Volta River.	1. Empowerment of communities, by WD in collaboration with DAs, to undertake replanting initiatives. This can be through provision of workshops or meetings where seedlings are provided.	Number of meetings. Number of seedlings given to the communities State of vegetation along the Volta River.	Working reports	WD, South Tongu DA, relevant communities	2 staff members, seedlings, vehicle, fuel	Medium
Global objective: 2. Effective administrative management is in place						
Specific objective: 2.1 Strict enforcement of the law.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Monitoring and law enforcement operations looking for illegal activity and conflict resolution.	1. Continued operations by WD staff and further collaboration and strengthening of relationships with local law enforcement.	Number of patrols.	Working reports	WD, local law enforcement	Off-road vehicle, boat staff, fuel	High
	2. Mobilisation of communities, by WD in collaboration with DAs, through creation of task forces to assist with law enforcement.	Number of communities mobilised. List of community task forces.	Working reports	WD, DAs, communities	2 staff members, vehicle, fuel	High
Specific objective 2.2: Communication and collaboration between administrative bodies (WD, DAs, EPA, Fisheries Commission), private companies and NGOs (operating in the area) are in place.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Channels of communication opened between administrative	1. Facilitation of a meeting between administrative bodies to share contacts, any	Number of meetings. List of channels of	Working reports	WD, DAs, Fisheries Commission, EPA	--	High

bodies.	relevant information and future projects. Addition of a monthly check-in between all administrative bodies.	communication - contacts, numbers, etc.				
	2. Daily exchanges (meetings, emails, phone calls, etc) between WD and other administrative authorities about progresses, projects, check-ins, etc.	Number of visits to the office. Emails. Records of meeting attendance.	Reports	WD, DAs, Fisheries Commission, EPA	Telecommunications equipment (computers, phones, etc.).	High
2. Communication and collaboration with NGOs and private companies on future projects.	1. Meetings facilitated between administrative authorities (WD and EPA) and NGOs and private companies operating in KLCRS to establish clear communication channels and sharing of information on future projects. The goal here is effective communication and collaboration between management and other entities operating within KLCRS.	Number of meetings. Contact list. List of projects.	Working reports	WD, DAs, Fisheries commission, EPA, Operational Private companies (see *Section A4.4.1)*		High
3. Lobby for implementation of proper waste management systems.	1. Meetings facilitated between WD and other administrative authorities for development and implement strategies of waste management systems.	Number of meetings. Progress reports.	Reports and outcomes	WD, DAs, forestry sector, any relevant governmental agencies.		Medium
4. Lobby for opening communication and collaboration between salt mining companies and DAs located in Denu and Adina.	Facilitation of a meeting geared towards communication and collaborative resource management between DAs of Ketu South and the salt mining company there.	Number of lobbies. Details of collaborations.	Working reports	WD, South Ketu DA	WD manager, vehicle	Medium
5. Communication and collaboration with the Fisheries Commission on unsustainable fishing practices and state of the fisheries.	1. Meetings and regular exchanges between WD and Fisheries Commission HODs.	Number of meetings. Collaborative projects.	Working reports	WD, Fisheries Commission	WD and Fisheries Commission HODs.	High

Specific objective 2.3: The WD benefits from capacity building.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Development of WD staff capabilities in environmental management.	1. Participation in exchange trips to other protected areas in West Africa (e.g. Mole National Park, Ghana, PNBA) to record key aspects (sustainable or 'wise-use' of resources, monitoring, surveillance, law enforcement, etc.) for possible implementation in future management strategies.	Number of exchanges. Findings and list of key aspects.	Working reports	WD	Funding for transport, accommodation, food, etc.	Low
	2. Undertaking of online training in nature conservation such as the ones created by IUCN PAPACO (https://mooc-conservation.org/).	List of completed modules/ courses	Working reports	WD	Computer equipment and access to internet.	Medium
Global objective: 3. Local populations are integrated into site management.						
Specific objective 3.1: Awareness and communication about environmental issues is strengthened.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Continued implementation of educational workshops and awareness raising campaigns in all major districts and communities relating to existence and management of KLCRS, issues, ecosystems and services, etc.	1. WD continues to raise awareness through radio, promotion of 'nature days', hosting of community educational workshops, awareness raising programs, school programs, etc.	Number of workshops and locations.	Working reports.	WD	WD manager, vehicle, fuel	High
	2. Assistance with awareness raising and education can be given through the empowerment of DAs, local opinion leaders and chiefs to host workshops themselves.	Number of workshops and locations.	Working reports	WD, Chiefs, opinion leaders.	WD manager, vehicle, any workshop materials needed.	Low
	3. Diffusion of information about WD's work and environmental topics through newsletter, hard copies of quarterly reports (translated into local languages) social medias, local medias appearances (local radio	Number of appearances in local medias, number of people registered to the newsletter,	Quarterly reports, Official KLCRS account on social medias	WD		Medium

	& TV)	number of distributed hard copies of quarterly reports, official KLCRS account on social medias				
2. NGOs are mobilised to support awareness raising campaigns throughout KLCRS through collaboration with the WD.	1. Hosting of meetings between and relevant NGOs and the WD.	Number of meetings. Campaigns or programs hosted.	Working reports	WD, NGOs		Low
Specific objective 3.2: Community zoning.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Lobby for the creation and implementation of spatial plans by DAs.	Facilitation of meetings and workshops with DAs and WD.	Number of meetings. Progress reports of spatial plans.	Working reports	WD, DAs		High
2. Lobby for the creation of local specific zones at the community level to avoid conflict of use (agriculture, encroachment, etc.).	Facilitation of meetings between communities and associated DAs to demarcate specific areas for collaboration or separation of economic activity - 'Local economic zones'. E.g. demarcated sugar cane zones, cattle zones, vegetables, etc.	Number of meetings. List of zones.	Working reports	WD, DAs, relevant communities		Medium
Specific objective 3.3: Enhanced natural resource management through community participation.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Enhancement of communication with local communities to allow for quicker transmission of information.	Contact and exchanges are made with local chiefs, opinion leaders, and communities. Focal points (such as towns or communities within biodiversity hotspots) are made within communities. Regular	List of focal points. Contact lists. Number of meetings/ exchanges.	Working reports	WD	–	High

	calls/visits are made to these focal points alongside regular exchanges with local community representatives and chief. Formalization of collaboration through MoU, charters of work or other official statements are signed between the KLCRS staff and local communities' representatives					
2. Creation of community task forces to assist in natural resource management in all 'special diversity zones' and 'special mangrove zones'.	Community task forces can be set up in collaboration with relevant DAs and communities through provision of workshops and training (on surveillance and protective operations, wildlife monitoring, assistance to law enforcement, etc.). Task forces are set up to assist WD in their management activities. Communities close to special zones are of priority. For example, creation of task forces in Fiaxor and Kodzi to assist in management of the Kodzi-Dudu zone.	Number of workshops. Number of Communities/DAs empowered.	Working reports. List of community task forces.	WD, DAs, Communities	–	Medium
3. Community based plant nurseries are created.	Communities are empowered to create nurseries through workshops hosted by the WD in collaboration with DAs (*see activity 1.5.1 above).*	Number of workshops.	Working reports	WD, DAs, communities	Seeds, seedlings, basic gardening equipment.	Medium
4. Ensure equitable benefits sharing from activities carried out by the local communities	Communities are sensitized about the need for equitable and fair allocation of benefits amongst all communities' members. (Note: this action can be merged with other ones relating to capacity building among local communities)	Number of workshops	Working reports	WD, communities		Medium

Specific objective 3.4: Support to the creation of CREMAs (Recommendation).						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Support to the demarcation and creation of CREMAs.	Through the knowledge of experts and related field work, suitable places for the implementation of CREMAs can be identified (local support, satisfactory community-based organisation, high biodiversity). Areas or priority interventions (special biodiversity zones, special mangrove zones, dredging zones and mangrove restoration zones) could be potential areas in which to create CREMAs.	Project list for CREMA identification, List of CREMAs.	Reports	WD, DAs, NGOs. Research institutions.		Low
2. Support is provided to the implementation of CREMAs	1. Through expert advice and field knowledge, the WD can support the design of CREMAs, structure their specifications and advise on the allocation of tasks.	Status of CREMAs (in project, in development, operational, officially gazetted)	Official status of CREMAs, WD's and CREMAs' reports	WD, NGOs, Local communities (CREMAs committees)	Potential areas for the creation of CREMAs should be identified. Local support is needed in the identified areas.	Low
	2. Thanks to regular communication, the WD can act as an intermediary between the CREMAs and authorities (DAs, Land Commission, Fisheries Commission, Forestry Commission, etc.).	Formal and informal discussions	Phone and E-Mail exchanges	WD, NGOs, Local communities (CREMAs committees)		Low
3. Support is provided to local committees and stakeholders in the regular actions in the CREMAs	WD to bring workforce and presence in punctual management measures (arrestation, monitoring, events, infrastructures such as panels, other interventions…)	Number of interventions	CREMAs' reports, WD's quarterly reports	WD, NGOs, Local communities (CREMAs committees)	CREMAs should be already established	Low
Specific Objective 3.5. Ensuring gender inclusiveness and equity in the management of the KLCRS						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Ensure that formal or informal management	WD to lobby for the inclusion of women and minorities into all management committees	Number of discussions, number of committee	Percentage of women being	WD, traditional authorities, local communities		High

committees (CREMAs, Task forces dedicated to monitoring/surveillance, all other projects in development between WD and local communities) integrate the opinions of women and minorities	at the local levels: Surveillance/monitoring task forces, Local communities – WD watchdogs' networks, discussions about dredgings, CREMAs, management committees, etc.	meetings	local communities' correspondents with the WD			
2. Carry out capacity building workshops among local communities about gender issues and ways to alleviate them	WD to develop partnerships with specialized NGOs on Women Empowerment, and/or to carry out workshops in local communities to raise awareness about gender issues. Templates for such discussions should be asked to relevant NGOs. (Note: this action can be merged with other ones relating to capacity building among local communities)	Number of workshops, social indicators (average income, literacy rate, number of businesses owned by women…)	Quarterly reports	WD, traditional authorities, local communities		Medium
3. Skills training and support to women to provide additional livelihood opportunities. Skills training and support to women to wisely reinvest benefits/income of professional activities	WD to develop partnerships with specialized NGOs on Women Empowerment and/or to carry out workshops to women and young women about how to run businesses and how to keep proper accounting system. (Note: this action can be merged with other ones relating to capacity building among local communities)	Number of workshops, number of businesses owned by women	Quarterly reports, NGOs reports	WD, traditional authorities, local communities		Medium
Global objective: 4. Contribute to the improvement of livelihoods of the local population.						
Specific objective 4.1: Support is given to local communities for diversification of agricultural activities (fruit trees, poultry, livestock, etc).						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority

1. Creation of a fruit tree nursery.	1. Communities are empowered to create fruit tree nurseries of their own through skills training (growing, multiplication through cuttings, care, harvesting, etc) and collaborative workshops.	Number of workshops. Number of nurseries.	Working reports	WD, relevant communities.	Fruit tree seedlings, workshop material.	High
	2. WD collaborates with and empowers NGOs on creation of fruit tree nurseries amongst communities or key farming areas.	Number of meetings between NGOs. List of projects.	Working reports	WD, NGOs	–	Low
2. Provision of fruit tree seedlings to communities.	1. WD continues to raise seedlings and provide them to local communities.	Number of seedlings provided.	Working reports	WD	Fruit tree seedlings.	High
3. Lobby for the implementation of livestock and poultry farming programs within local communities.	1. Meeting is hosted by WD between Das, International UN agencies, and NGOs, to discuss diversification of agriculture and possible future plan of action (funding, areas of interest, etc.).	Number of meetings. Summary of meetings.	Working reports	WD, DAs, relevant NGOs.	–	High
Specific objective 4.2: Continued support in the development of ecotourism.						
Activities	Method	Success Indicator	Verification	Responsibility	Requirements (Preferred)	Priority
1. Identify sites of ecotourism potential.	Collaborative meetings and workshops between WD, NGOs, DAs and local communities on identification and creation of potential ecotourism zones (see *Brinks, 2017*).	Number of meetings held. List of zones.	Working reports	WD, NGOs, DAs		High
2. Lobby for the creation of a small ecotourism task force for each district to identify, conserve, and promote certain areas with potential.	Host meetings between WD, DAs and community leaders where information is organised and recorded.	Number of meetings held. List of task forces and sites.	Working reports	WD + NGOs + DAs		High
3. Promotion of ecotourism such as bird watching,	DAs and local communities are empowered through	Number of meetings and/or		WD, NGOs, DAs, any relevant		High

kayaking and wildlife walks on national and international platforms (travel blogs, bird watching platforms, specific journals, social networks, etc.).	collaboration with NGOs and/or other international bodies.	workshops held.		international bodies.		

B.7. Activities Timeline

The activities timeline (*Table 9* below) presents a suggested period for when activities should be carried out and their frequency. Included is a suggested budget for each activity. The rating starts at 0 and extends to light (+), moderate (++), and high (+++). High budget estimates require funding to be fully achieved (such as monitoring of the Volta River which requires a boat).

TABLE 9: TIMELINE, FREQUENCY AND BUDGET FOR ALL ACTIVITIES

Specific objective 1.1: Area of priority intervention for biodiversity are protected. **Goal:** Increasing numbers of species (especially manatees, sea turtles, waterbirds and sitatunga) and mangrove cover. At least 121 km^2 of key biodiversity areas (corresponding to the Special Biodiversity zones) are protected.	**Expected output** **1.** Areas of biodiversity importance are regularly monitored, watched and recorded by WD and task forces. **2.** Monitoring reports show increasing numbers of wildlife species and individuals						
Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
1.1.1 Physical demarcation of special zones.		x	x			–	+
1.1.2. Surveillance and law enforcement patrols of special biodiversity zones.	x	x	x	x	x	Weekly	+
1.1.3. Turtle monitoring and protection along the coast and beaches (Kedzi, Vodza, Keta, Dzeukope, etc.).	x	x	x	x	x	Weekly	+
1.1.4. Monitoring and protection operations of key biodiversity (manatees and mangroves especially) along the Volta River.	x	x	x	x	x	Weekly	+++

Specific objective 1.2: Improved knowledge of biodiversity. **Goal:** Key biodiversity is adequately monitored and recorded.	**Expected output** **1.** Agenda for the monitoring activities is in place. **2.** Up to date records of key biodiversity.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
1.2.1: Write an annual monitoring agenda, to include latest information on location/presence of key species (sitatunga, sea turtles, waterbirds, manatees, mangroves). The annual agenda should include estimates of staff, vehicles and fuel needed.	x	x	x	x	x	Yearly	+
1.2.2. Monitoring and recording of key biodiversity (waterbirds, manatees, sitatunga, turtles, mangroves) based on latest information on location/presence.	x	x	x	x	x	Monthly	+

Specific objective 1.3: Free circulation of water between Keta Lagoon, Avu Lagoon and Volta River. **Goal:** Water channels are regularly monitored for blockages and unblocking/dredging operations are carried out on an on-going basis. At least 177 km^2 of area (corresponding to the Dredging zones) are cleared in priority.	**Expected output** **1.** Communities are empowered to unblock channels and maintain free flow of water between the lagoons and Volta River estuaries.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
1.3.1 Monthly surveillance operations in 'dredging zones' to locate blocked channels.	x	x	x	x	x	Monthly	+
1.3.2. Unblocking and/or dredging operations.	x	x	x	(x)	(x)	When Necessary	+
1.3.3 Lobbying NGOs, donors/funding agencies and international institutions to dredge the lagoon and the water channels		x	x	x	x	Quarterly	0

Specific objective 1.4: Area of priority intervention for Mangroves are sustainably exploited. **Goal:** Mangrove forests stop decreasing in surface area over time. At least 117 km^2 of mangroves (corresponding to the Special Mangrove zones) are sustainably managed.	**Expected output** **1.** Sustainable mangrove harvesting is understood and KLCRS population is able to sustainably derive livelihood from mangroves.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2026 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
1.4.1 Research and monitoring conducted on sustainable mangrove exploitation (cutting rate, exploitable areas, regenerative strategies, impact on ecosystems, etc.).	x	(x)				Triweekly	++
1.4.2. Lobby to DAs and local communities about the organisation and implementation of sustainable mangrove exploitation.	x	(x)				Quarterly	0
1.4.3. Surveillance and law enforcement in relation to sustainable exploitation of mangroves.	x	x	x	x	x	Monthly	+

Specific objective 1.5: Overall restoration of natural habitats. **Goal:** Alongside mangrove, all natural vegetation is increasing in terms of surface area and ecosystem service productivity. At least 25 km^2 where mangroves used to be present in recent years (corresponding to the Mangrove restoration zone) are restored.	**Expected output** **1.** Replanting initiatives are carried out at degraded mangrove sites (especially in the Mangrove Restoration Zone). **2.** Vegetation on the banks of Volta River are restored.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
1.5.1 Implementation of replanting and regeneration projects in the 'Anloga mangrove regeneration zone'.	(x)	x	x	(x)		Monthly	++
1.5.2. Raising of plant nurseries (White mangroves, Cassia, fruit trees, etc) for provision in replanting initiatives	x	x	x	x	x	–	+
1.5.3. Monitoring and surveillance operations aimed at reducing destructive activities such as overexploitation, bush burning and waste deposition	x	x	x	x	x	Triweekly	+
1.5.4 Regeneration of mangrove forests along the Volta River	(x)	x	(x)			Monthly	++

ILLUSTRATION 8: CUTTED MANGROVE WOOD IN ANYANUI SURROUNDINGS

Specific objective 2.1: Strict enforcement of the law. **Goal:** Overall decline in illegal activity (poaching, usage of small nets in fishing, illicit fishing practices, etc.).	**Expected output** **1.** Collaboration with local law enforcement is increased. **2.** Regular patrols of protected areas by WD or other law enforcing entities such as community task forces.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
2.1.1 Monitoring and law enforcement operations looking for illegal activity and assistance in conflict resolution.	x	x	x	x	x	Triweekly	+

Specific objective 2.2: Communication and collaboration between administrative bodies (WD, DAs, EPA, Fisheries Commission), private companies, and NGOs (operating in the area). **Goal:** Open communication and collaboration amongst administrative authorities and businesses or NGOs operating in KLCRS.	**Expected output** **1.**Regular communication between administrative authorities. **2.** WD is consulted on all projects undertaken in KLCRS. **3.** The private sector, especially companies impacting the environment are sensitised about KLCRS and implement voluntary measures for mitigating their impact.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
2.2.1 Channels of communication opened between administrative bodies.	x	x	x	x	x	Monthly	0
2.2.2 Advocate for communication and collaboration with NGOs and private companies on future projects.	x	x	x	x	x	Yearly	0
2.2.3 Lobby for implementation of proper waste management systems.		x	x			Yearly	0
2.2.4 Lobby for opening communication and collaboration between salt mining companies and DAs located in Denu and Adina.	(x)	x				–	0
2.2.5 Communication and collaboration with the Fisheries Commission on unsustainable fishing practices and state of the fisheries.	x	x	x	x	x	Yearly	0

Specific objective 2.3: Capacity building of the WD. **Goal:** WD staff members further develop their protected area and natural resource management capabilities.	**Expected output** **1.** Knowledge and management strategies are obtained from other sources (protected areas, courses) to be employed in KLCRS.						
Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
2.3.1 Development of WD staff capabilities in environmental management.		x (2025)	x (2028)		x (2031)	Yearly	+++

ILLUSTRATION 9: CURRENT SITE MANAGER LAWRENCE TETTEH-OCLOO DOING AN AWARENESS & SENSITIZATION SESSION IN TOSSUKPO

Specific objective 3.1: Awareness and communication about environmental issues is strengthened. **Goal:** Majority of population knows about WD management, the KLCRS, sustainable practice, and environmental issues they are faced with.	**Expected output** **1.** Education workshops and awareness raising campaigns are carried out in all major communities. **2.** NGOs, DAs, and community leaders are empowered to raise awareness amongst their communities.						
Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
3.1.1 Continued implementation of educational workshops and awareness raising campaigns in all major districts and communities, using all innovative communication channels (local medias, social medias, newsletter, hard copies of quarterly reports…)	x	x	x	x	x	Weekly	+
3.1.2 NGOs are mobilised to support awareness raising campaigns throughout KLCRS through collaboration with the WD.	x	x				Monthly	0

Specific objective 3.2: Community zoning. **Goal:** A reduction in disputes related to land-use and encroachment of differing economic activities onto one another.	**Expected output** **1.** Spatial plans of each district are created. **2.**Particular areas are demarcated for particular economic activities such as vegetable farming, sugar cane, and livestock.						
Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
3.2.1 Lobby for the creation and implementation of spatial plans by DAs.		x	(x)			Yearly	0
3.2.2 Lobby for the creation of local specific economic zones to avoid conflict of use (agriculture, encroachment, etc.).		(x)	x			Yearly	0

Specific objective 3.3: Enhance natural resource management through community participation. **Goal:** Community leaders and members provide support to the WD's many management operations (surveillance, monitoring, law enforcement, regenerative initiatives, etc.).	**Expected output** **1.** An enhancement of communication between WD and community members. **2.** Community task forces are operational in all protected 'zones'.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
3.3.1 Enhancement of communication with local communities to allow for quicker transmission of information.	x	x	x	x	x	Weekly	0
3.3.2 Creation of community task forces to assist in resource natural management in all 'special diversity zones' and 'special mangrove zones'.	(x)	x	x			Yearly	0
3.3.3 Creation of community-based plant (white mangrove, cassia, etc) nurseries.		x		x		Yearly	++
3.4.3 Ensure equitable benefits sharing from activities carried out by the local communities		x	x			Yearly	0

Specific objective 3.4: Assistance given to the creation and implementation of CREMAs . **Goal:** CREMAs are located, designated and operational to assist with resource management.	**Expected output** **1.** Potential areas for CREMAs are identified and demarcated. **2.** CREMAs are effectively managed by communities.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
3.4.1 Support is given to the demarcation and creation of CREMAs.	x	x	x			Monthly	0
3.4.2 Support is provided to the implementation of CREMAs		x	x	x		Monthly	0
3.4.3 Support is provided to local committees and stakeholders in the regular actions in the CREMAs			x	x	x	Weekly	+

Specific objective 3.5: Ensuring gender inclusiveness and equity in the management of the KLCRS Goal: To tackle gender issues in all regular activities	**Expected output** **1.** Local communities are sensitized about gender issues **2.** Women are able to run businesses on an autonomous way						
Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
3.5.1 Ensure that formal or informal management committees integrate the opinions of women and minorities		x	x				
3.5.2 Carry out capacity building workshops among local communities about gender issues and ways to alleviate them			x	x			
3.5.3 Skills training and support to women to provide additional livelihood opportunities.				x	x		

Specific objective 4.1: Support is given to local communities for diversification of agricultural activities (fruit trees, poultry, livestock, etc). **Goal:** Dependence of the local population on overexploited natural resources is reduced.	**Expected output** **1.** Potential sites for diversifying agriculture are located. **2.** Poultry, livestock and fruit farming is occurring in all major communities.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
4.1.1 Creation of a fruit tree nursery.	(x)	x					++
4.1.2 Provision of fruit tree seedlings to communities.	(x)	x	x	x	x	As needed	+
4.1.3 Lobby for the implementation of livestock and poultry farming programs within local communities.	(x)	x				Quarterly (years)	0

Specific objective 4.2: Continued support in the development of ecotourism (except on the isthmus). **Goal:** Increasing revenue from tourism for WD and local communities.	**Expected output** **1.** Special areas are demarcated for ecotourism and are conserved and regenerated. **2.** Ecotourism task forces are established and operational in major ecotourism zones. **3.** Ecotourism in KLCRS is promoted on national and international platforms.

Activities:	**Time period in years**					**Frequency**	**Budget (0 → +++)**
	2023 - 2024	**2025 - 2026**	**2027 - 2028**	**2029 - 2030**	**2031 - 2032**		
4.2.1 Identify sites of ecotourism potential.	x	x	x			Monthly	+
4.2.2 Advocacy for the creation of a small ecotourism task force for each district to identify, conserve and promote certain areas with potential.	x	x				Yearly	++
4.2.3 Promotion of ecotourism such as bird watching and wildlife walks on national and international platforms.	x	x	x	x	x	Monthly	+

ILLUSTRATION 10: INHABITANT AND SEA SHORE IN KETA

PART C: Evaluation measures

This section relates specifically to the continued evaluation and updating of the management plan.

C.1. Annual evaluation

An annual evaluation of the management plan is essential to delivering flexible and adaptive management. This annual evaluation will happen for the duration of the management plan in order to continuously assess the status of activities ('achieved', 'partially achieved', 'not achieved', etc.), and budget spent. From this, the objectives can then be revised on an ongoing basis.

This annual evaluation will encompass the completion of an annual activity report card (*Table 11*) based on an achievement rating system (*Table 10*).

TABLE 10: ACHIEVEMENT RATING SYSTEM

Legend	
	Fully achieved and/or operational
	Partially achieved and/or operational: To be continued
	Not achieved and/or operational: Suggested abandonment or re-evaluation
	Postponement to a later date

The achievement rating system is used to assess the status of an activity. If it is fully achieved and/or operational, partially achieved and to be continued in the next year, or not achieved/operational at all, in which case, the task may be either abandoned or re-evaluated (a change in the specifics of an activity). An option is also given for tasks to be postponed to a later date.

At the end of each year, starting from the date of implementation of this management plan, all activities will be assessed in this annual activity report. **This is to be completed based on the assessment of working reports, success indicators, and quarterly reports from the WD from that year.** The WD staff themselves have to complete this annual assessment.

TABLE 11: ANNUAL ACTIVITY REPORT

Specific objective 1.1: Protection of biodiversity.	Timeline (Years)					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2023	1	2	3	4	5	6	7	8	9	10
1.1.1 Physical demarcation of special zones.															
1.1.2. Surveillance and law enforcement patrols of special biodiversity zones.															
1.1.3. Turtle monitoring and protection along the coast.															
1.1.4. Monitoring and protection operations of key biodiversity along the Volta River.															
Total budget:															

Specific objective 1.2: Improved knowledge of biodiversity.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
1.2.1: Write the annual monitoring agenda.															
1.2.2. Monitoring and recording of key biodiversity.															
Total budget:															
Specific objective 1.3: Free circulation of water between Keta Lagoon, Avu Lagoon and Volta River.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
1.3.1 Monthly surveillance operations in 'dredging zones' to locate blocked channels.															
1.3.2. Unblocking and/or dredging operations.															
Total budget:															

Specific objective 1.4: Mangrove forests are sustainably exploited.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
1.4.1 Research and monitoring conducted on sustainable mangrove exploitation.															
1.4.2. Lobbies between WD, DAs and local communities.															
1.4.3. Surveillance and law enforcement in relation to sustainable exploitation of mangroves.															
Total budget:															

Specific objective 1.5: Overall restoration of natural habitats.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
1.5.1 Implementation of replanting and regeneration projects in the 'Anloga mangrove regeneration zone'.															
1.5.2. Raising of plant nurseries (white mangroves, cassia, fruit trees, etc.) for provision in replanting initiatives.															
1.5.3. Monitoring and surveillance operations aimed at reducing destructive activities to habitats.															
1.5.4 Regeneration of mangrove forests along the Volta River.															
Total budget:															

Specific objective 2.1: Strict enforcement of the law.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
2.1.1 Monitoring and law enforcement operations.															
Total budget:															
Specific objective 2.2: Communication and collaboration between administrative bodies (WD, DAs, EPA, Fisheries Commission), private companies and NGOs (operating in the area).	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
2.2.1 Channels of communication opened between administrative bodies.															
2.2.2 Lobby for communication and collaboration with NGOs and private companies on future projects.															
2.2.3 Lobby for implementation of proper waste management systems.															
2.2.4 Lobby for opening communication and collaboration between salt mining companies and DAs located in Denu and Adina.															
2.2.5 Communication and collaboration with the Fisheries Commission.															
Total budget:															

Specific objective 2.3: Capacity building of the WD.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
2.3.1 Development of WD staff capabilities in environmental management.															
Total budget:															

Specific objective 3.1: Awareness and communication about environmental issues is strengthened.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
3.1.1 Continued implementation of educational workshops and awareness raising campaigns.															
3.1.2 NGOs are mobilised to support awareness raising campaigns throughout KLCRS.															
Total budget:															
Specific objective 3.2: Community zoning.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
3.2.1 Lobby for the creation and implementation of spatial plans by DAs.															
3.2.2 Lobby for the creation of local specific economic zones to avoid conflict of use.															
Total budget:															

Specific objective 3.3: Enhance natural resource management through community participation.	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
3.3.1 Enhancement of communication with local communities.															
3.3.2 Creation of community task forces to assist in resource natural management.															
3.3.3 Creation of community-based plant (white mangrove, cassia, etc.) nurseries.															
Total budget:															

Specific objective 3.4: Creation of CREMAs (Recommendation).	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
3.4.1 Support is given to the demarcation and creation of CREMAs.															
Total budget:															

Specific objective 4.1: Support is given to local communities for diversification of agricultural activities (fruit trees, poultry, livestock, etc.).	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
4.1.1 Creation of a fruit tree nursery.															
4.1.2 Provision of fruit tree seedlings to communities.															
4.1.3 Lobby for the implementation of livestock and poultry farming programs within local communities.															
Total budget:															

Specific objective 4.2: Continued support in the development of ecotourism (except on the isthmus).	Level of achievement each year					Budget spent each year									
Activities	2023 - 2024	2025 - 2026	2027 - 2028	2029 - 2030	2031 - 2032	1	2	3	4	5	6	7	8	9	10
4.2.1 Identify sites of ecotourism potential.															
4.2.2 Advocacy for the creation of a small ecotourism task force for each district to identify, conserve, and promote certain areas with potential.															
4.2.3 Promotion of ecotourism such as bird watching and wildlife walks on national and international platforms.															
Total budget:															

C.2. Mid/end of plan evaluation

2.1. Global objectives performance indicator (based on activities).

Table 11 below will assess the degree to which the global objectives have been reached over the course of the management plan. The level of achievement or performance of each objective will be the 'Number of activities achieved and/or operational' divided by the 'Total number of activities performed'. This will give a percentage or performance of the objective, and will indicate key areas of intervention for ensuing management plans and evaluations of the site. Included is the total budget spent on each objective for the timeline in question.

Table 12 below can be completed based on the yearly evaluations presented in *Section C.1*.

TABLE 12: PERFORMANCE INDICATOR FOR GLOBAL OBJECTIVES

Global objectives:	Total number of activities performed	Number of activities achieved.... and/or operational	Number of activities partially achieved....	Number of activities not achieved....	Achievement %	Budget expenditure
1. The conservation of natural habitats and biodiversity.						
2. Effective administrative management is in place.						
3. The integration of local populations into site management.						
4. Contribute to the improvement in livelihoods of the local population.						
Totals						

Table 12 is completed by using the information gathered in the annual activity report presented in *Section C.1*. The amount of activities relating to each column of *Table 12* is recorded, from which the achievement status can be calculated for each global objective.

2.2. Assessment of the specific objectives

Table 13 below presents an outline for assessing the degree to which specific objectives were met. This can be used to further deepen the understanding of where management measures and activities were successful and where they were not. This report does not include the 'activity report card' from *Section C.1* and therefore could be used to assess the impact of activities on reaching specific objectives.

TABLE 13: ASSESSMENT OF THE DEGREE TO WHICH SPECIFIC OBJECTIVES ARE ACHIEVED

Specific objectives	Expected outcomes	(%) reached	Assessment/comments
1.1 Protection of biodiversity.	1. Areas of biological importance are regularly monitored by task forces.		
	2. Monitoring reports show increasing numbers of wildlife.		
1.2 Improved knowledge of biodiversity.	1. Records of biodiversity, especially key species, are up to date and regularly monitored.		
1.3 Free circulation of water between Keta Lagoon, Avu Lagoon and Volta River.	1. Water channels are regularly monitored and unblocked if necessary.		
	2. Communities are empowered to unblock channels and maintain free flow of water between the lagoons and Volta River estuaries.		
1.4 Mangrove forests are sustainably exploited.	1. A method of sustainable mangrove harvesting is developed and KLCRS population is able to sustainably derive livelihood from mangroves.		
1.5 Overall restoration of natural habitats.	1. Regeneration initiatives are activated at degraded mangrove sites.		
	2. Vegetation on the banks of Volta River are restored.		
2.1 Strict enforcement of the law.	1. Collaboration with local law enforcement is increased.		
	2. Regular patrols of protected areas by WD or other law enforcing entities such as community task forces.		
2.2 Communication and collaboration between administrative	1. Regular communication between administrative authorities.		
	2. WD is consulted on all projects undertaken in KLCRS.		

bodies (WD, DAs, EPA, Fisheries Commission), private companies, and NGOs (operating in the area).	3. The private sector, especially companies impacting the environment are sensitised about KLCRS and implement voluntary measures for mitigating their impact.		
2.3 Capacity building of the WD.	1. Knowledge and management strategies are obtained from other sources (protected areas, courses) to be employed in KLCRS.		
3.1 Awareness and communication about environmental issues is strengthened.	1. Education workshops and awareness raising campaigns are carried out in all major communities.		
	2. NGOs, DAs, and community leaders are empowered to raise awareness amongst their communities.		
3.2 Community Zoning.	1. Spatial plans of each district are created.		
	2. Particular areas are demarcated for particular economic activities such as vegetable farming, sugar cane and livestock.		
3.3 Enhanced natural resource management through community participation	1. An enhancement of communication between WD and community members.		
	2. Community task forces are operational in all protected 'zones'.		
Specific objective 3.4: Creation of CREMAs (Recommendation).	1. Potential areas for CREMAs are identified and demarcated.		
	2. CREMAs are effectively managed by communities.		
4.1 Support is given to local communities for diversification of agricultural activities (fruit trees, poultry, livestock, etc.).	1. Potential sites for diversifying agriculture are located.		
	2. Poultry, livestock and fruit farming is occurring in all major communities.		
4.2 Continued support in the	1. Special areas are demarcated for ecotourism		

development of ecotourism (except on the isthmus).	and are conserved and regenerated.		
	2. Ecotourism task forces are established and operational in major ecotourism zones.		
	3. Ecotourism in KLCRS is promoted on national and international platforms.		

2.3. Protected Areas Management Effectiveness Assessment (PAME Assessment).

A PAME assessment carries out a complete diagnosis of a site, to check whether their conservation objectives are consistent, to ensure that the activities in progress are aligned with the global and specific objectives, and to detect any internal dysfunctions (Leverington et al, 2010). This approach makes it possible to improve the management of a protected area.

As a complementary process to the internal evaluations carried out by WD in *Sections C.1* and *C.2*, it is strongly recommended that a PAME assessment be carried out on a regular basis (every 3-5 years) in the KLCRS by an entity external to the WD such as the IUCN, any relevant NGOs, or administration outside of KLCRS management staff. It is also possible for the WD to be integrated into undertaking PAME assessments.

There are many methods for conducting a PAME assessment, however all relate to the framework for evaluating management effectiveness developed by the IUCN World Commission on Protected Areas (IUCN-WCPA) in the early 2000s (Leverington et al, 2010). This framework groups indicators according to six components of the management cycle namely: context, planning, inputs, processes, outputs and outcomes (Hockings *et al*, 2004). This framework of PAME assessment is depicted in *Figure 19* below.

FIGURE 19: THE WORLD DATABASE ON PROTECTED AREAS FRAMEWORK FOR PROTECTED AREAS MANAGEMENT EFFECTIVENESS ASSESSMENTS. SOURCE: HOCKINGS ET AL (2006).

The most widespread assessment methods used are Rapid Assessment and Prioritisation of Protected Area Management (RAPPAM), and the Management Effectiveness Tracking Tool (METT). For example, the RAPPAM method was used in the 2010 analysis of eight wildlife protected areas in Ghana (IUCN, PACO, 2010). In the context of West Africa, other methods are also used such as Integrated Management Effectiveness Tool (IMET), which is becoming more and more common, or Enhancing our Heritage (EoH), which was created by UNESCO.

ILLUSTRATION 11: FLOODED HOUSE IN KETA

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Appendix 1: Species Indices

Fish Species (Lamptey, 2014; WD 1999)

Species:	Common Name:
Cichlidae Sarotherodon melanotheron	Black-chin tilapia
Tilapia guineensis (Günther, 1862)	Red-chin tilapia
Oreochromis niloticus (Linnaeus, 1758)	Nile tilapia
Tilapia zillii (Gervais, 1848)	Red-belly tilapia
Hemichromis fasciatus (Peters, 1857)	Jewel fish
Hemichromis bimaculatus (Gill, 1862)	Jewel cichlid
Hyporhamphus picarti (Valenciennes, 1847)	African halfbeaks
Gobidae Porogobius schlegelii (Günther, 1861)	Schlegel's gobid
Mugilidae Mugil cephalus (Linnaeus, 1758)	Grey mullet
Liza falcipinnis (Cuvier & Valenciennes, 1836)	Sicklefin mullet
Gerreidae Eucinostomus melanopterus (Bleeker, 1863)	Mojarra
Peneidae Farfantepenaeus notialis (Pérez-Farfante, 1967)	Pink shrimp
Callinectidae Callinectes amnicola (Rochebrun, 1883)	Blue swimming crab
Clariidae Clarias gariepinus (Burchell, 1882)	Catfish
Sciaenidae Pseudotolithus typus (Bleeker, 1863)	Cassava fish
Pomadasyidae Brachydeuterus auritus (Valenciennes, 1832)	Burrito
Clupeidae Ethmalosa fimbriata (Bowdich, 1825)	Bonga Shad
Sardinella maderensis (Lowe, 1838)	Flat Sardine
Ilisha africana (Bloch, 1795)	West African Ilisha
Pellonula leonensis (Boulenger, 1916)	Guinean sprat
Cynoglossidae Cynoglossus spp. (Hamilton, 1822)	Tongue sole

Carangidae Alectis alexandrines (Saint Hilaire, 1817)	African threadfin
Lutjanidae Lutjanus fulgens (Valenciennes, 1830)	Red snapper

Invertebrates: (WD, 1999)

Molluscs
Gastropoda
Hydrobia accrensis
Tympanotonos fusecatus
Bolinus cornutust
Neritina adansoniana
Bivalvia
Brachidontes niger
Congeria Ornatat
Corbula trinat
Tellina nymphalist
Gastrana multangulat
Tivela tripla
Loripes aberranst
Melanoides tuberculatat
Pachymelania byronensis
Crustacean
Amphipods[a]
Isopod[aa]
Parapeneaopis atlantica

Penaeus kerathurus
Penaeus notialis
Callinectus amnicola
Cardisoma armatum
Occypode Africana
Sersarma huzardit
Uca tangeria
Insects
Isoptera (Macrotermes spp.)
Dermaptera
Odonata (nymphs)

List of Mammals and reptiles: (WD, 1999)

Name:	Scientific name:
Pygmy mouse	Mus minutoides
Common mouse	Mus musculus
Multimammate mouse	Mastomys natalensis
Nile rat/kusu	Arvicathis niloticus
Common rat	Rattus rattus
Giant rat	Cricetomys gambianus
Cane rat	Thryonomys swinderianus
Nile monitor	Varanus niloticus
Agama lizard	Agama agama
Graceful chameleon	Chameleo gracilis
Royal python	Python regius

African python	Python sebae
Puff adder	Bitis arietans
Green turtle	Chelonia mydas
Common frog	Rana galamensis
Common toad	Bufa regularis
White-toothed shrew	Crocidura oliveri
Bottego's shrew	Crocidura bottegi
Kemp's gerbil	Tatera kempi
Bushbuck	Tragelaphus scriptus
Sitatunga	Tragelaphus spekii
Olive baboon	Papio anubis

List of bird species: (Sythesised from WD, 1999 and Lamptey et al, 2014, WD's quarterly reports 2020-2022)

Bird species:
African jacana
Avocet
African swamp hen
Bar-tailed godwit
Black heron
Black tern
Black-tailed godiwit
Black-winged stilt
Caspian tern

Collared pratincole
Common Green Shank
Common knot
Common Ringed Plover
Common sandpiper
Common tern
Curlew
Curlew sandpiper
Dunlin
Dwarf Bittern
Eurasian Curlew
Fulvous tree duck
Glossy ibis
Goldfish heron
Great white egret
Greater black-backed gull
Green-backed heron
Grey heron
Grey plover
Gull-bulled tern
Intermediate Egret
Kittlitz's sandplover
Knot

Lesser black-backed gull
Little egret
Little stint
Little tern
Little Ringed Plover
Long-tailed cormorant
Marsh sandpiper
Moorhen
Pied Avocet
Pied kingfisher
Pratincole
Purple heron
Red Knot
Redshank
Reef heron
Ringed plover
Royal tern
Ruddy Turnstone
Ruff
Sanderling
Sandwich tern
Senegal wattled plover

Spotted redshank
Spur-winged plover
Spur-winged Lapwing
Squacco heron
Western reef heron
Whimbrel
Whiskered tern
White pelican
White-faced tree duck
Wood Sandpiper
Yellow Bill Egret

Appendix 2: KLCRS Aquifers

Four major aquifers have been identified in the Keta basin according to geography and surrounding geological setting:

- Weathered Dahomeyan Gneiss along the north-eastern rim of the basin.
- Surficial Neogen continental deposits of soft to semi-soft limontic argillaceous sands in the north-eastern and central parts of the basin.
- Quaternary coastal marine sands and gravels in the Volta River estuary and Keta Lagoon area. These unconsolidated sands and gravels are generally associated with high groundwater recharge and seem to favour occurrence of groundwater in areas where they show prominence. These occur mostly towards the south-eastern and north-eastern parts of the study area where two shallow limestone aquifers and a deep limestone aquifer exist.
- Cretaceous–Eocene marine limestones and sandstone beds that are exploited for drinking water in the central and south-eastern parts of the basin; these units constitute the major and most important deeper aquifer in the Keta basin (Nerquaye-Tetteh, 1993; Yidana, 2010).

Appendix 3: Geological formations

The Keta basin is a fault-controlled Mesozoic/Tertiary sedimentary basin along the coast of the Gulf of Guinea. The basement complex consists of early Precambrian Dahomeyan gneiss migmatites, and schists. These rocks were affected by the Pan-African orogeny and crop out along the fringes of the basin to the north. The basal sedimentary sequence in the basin comprises lower to middle Devonian marine shale, sandstone, and siltstone, which are overlain by Jurassic dolerites and sills, a series of Cretaceous–Eocene marine sediments composed of limestone, shale, and glauconitic sandstone outcrops in the eastern edge of the basin close to the Togo–Ghana boundary (Akpati, 1978;) (Banoeng-Yakubo, 2001; Yidana, 2010).

The sandstones and limestones in this area are highly consolidated and thicken towards the coast in the south-west of the basin. Scattered deposits of Neogene continental sediments unconformably overlying the Cretaceous–Eocene limestone and sandstones occur in the north-eastern sections of the basin. These materials are mainly made of unconsolidated to semi-consolidated limonitic argillaceous sands with gravelly beds at the base. The central part of the basin is dominated by quaternary unconsolidated (soft) coastal sediments, marine sands, and gravels, which are averagely 30 m thick around Keta, though they thicken to about 100 m towards the Volta River estuary (Akpati, 1978) (Banoeng-Yakubo, 2001; Yidana, 2010).

The Eoceme rocks:

- Are sedimentary rocks covering the cretaceous rocks.
- Consist of clay, loose sand, and gravel deposited at the mouth of major rivers and around the Keta Lagoon (Jorgensen, 2001).

The cretaceous rocks:

- Consist of sandstone, shale and limestone found at extreme ends of the coast. Prospects for shallow groundwater are good in the cretaceous and tertiary sediments. However, the water tends to be saline in some cases, probably due to ocean water intrusion.

Moving towards the sea, beach sand and raised beach sand become more common. In the lagoon area, clays containing crystals of gypsum and soluble salts are found (Yidana, 2010).

ILLUSTRATION 12: ANYANUI INHABITANTS INTERVIEWED BY KLCRS STAFF DURING A FOCUS GROUP INTERVIEW