

Keta Lagoon Local Scale Pilot Project

The proposed study, outlined below, will be initiated at the University of Cape Coast through a GOAP resourced fellowships linked to the Keta Lagoon Pilot Study Project. Titled “Determining the importance of Mangroves to the Ocean Economy of the Keta Lagoon complex, Ghana” this study will investigate the development of a mangrove account to enhance understanding of the importance of this resource for local communities, while determining the associated pressures and impacts on this natural resource. This study will address several aspects of ecosystem accounting, including extents and condition, ecosystem services and ecosystem service factors as well as several physical, monetised and pressure components of mangrove timber harvesting in the Keta Lagoon / Volta Delta region. The selected candidate for the project will be based at the Africa Centre of Excellence in Coastal Resilience (ACECoR) which falls within the Centre for Coastal Management at UCC.

Determining the importance of mangrove resources to the Ocean Economy of the Keta Lagoon Complex, Ghana

Introduction:

Mangrove forests are highly productive and biodiverse ecosystems, providing numerous ecosystem goods and services to coastal environments globally. These goods and services include, but are not limited to, nursery environments for important fish species, offering coastal protection from storms and surges, and sequestering carbon from the atmosphere. However, globally, mangrove forests are declining due to numerous anthropogenic threats such as deforestation, habitat destruction and alteration, pollution and unsustainable harvesting. Similarly, in Ghana, up to 30% of mangroves have been lost due to degradation in the last 25 years (World Bank). This decline in mangrove habitats will likely see a reduction in the environmental, economic and cultural ecosystem goods and services which many people depend on (Awuku-Sowah et al. 2023).

There have however been community-driven efforts towards replanting and restoring mangrove habitats, which have been encouraged by government and NGOs (Aheto et al. 2016). Three genera of mangrove are represented along the coastline of Ghana, namely *Avicennia*, *Rhizophora* and *Laguncularia*. However, the exact number of species varies among recent accounts. A recent study of the mangrove forests of Ghana revealed that the Volta region had the largest expanse of mangrove forest along the coastline (Nunoo & Agyekumhene, 2022). This is likely attributed to the mangrove planting practices generating income by the communities in the Volta region. However, nationally, Ghana’s mangrove forests are declining at a rate of 8.1 km² per year, with the harvesting of mangrove timber being the principal threat nationwide (Nunoo & Agyekumhene, 2022). Several factors, including the collapse in agriculture following the damming of the Volta River have led to an increase in the harvesting of mangrove timber as an alternative source of livelihood for the local communities (Rubin et al. 1999).

Sekey et al. (2023) showed that the three leading users of fuelwood harvested from mangrove forests in Keta Lagoon, were fish smokers (93.16 kg/day), commercial food vendors (63.93 kg/day) and households (61.08 kg/day). The harvesting and trade of mangrove fuelwood typically supports the livelihoods of vulnerable groups, such as aged community members and

particularly women (Sekey et al. 2023). Mangrove timber is the primary fuel wood used for the smoking of fish as it is believed that it imparts a unique taste and colour to the fish during the smoking process, therefore attracting higher prices when subsequently sold at the market (Nunoo & Agyekumhene 2022). The System of Environmental Economic Accounting (SEEA) was developed as a standardised way to measure environmental stocks and flows, and the relationship of these to the economy (Gacutan et al., 2022). Specifically, the SEEA Ecosystem Accounting (SEEA-EA) framework provides a means to quantify the extent and condition of ecosystem assets and therefore the supply and use of the services generated (Gacutan et al. 2022). Therefore, this framework allows for the integration of ecological data into more traditional economic accounting systems, providing insight into the link between environmental sustainability and economic development. To determine the ecosystem services and provided by an area of interest, it is first necessary to identify and classify the types of ecosystems present.

Ecosystem extent, and condition, therefore, form the basis of the SEEA EA framework and ocean accounting process. Remote sensing, through satellite and aerial imagery, offers a rapid means to assess, map and monitor coastal ecosystems such as coral reefs, seagrass beds and mangroves (Pettorelli et al., 2014). Using high resolution remote sensing, from multi-spectral imagery platforms such as the European Space Agency (ESA) Copernicus Sentinel-2 satellite, provides an effective tool to gather imagery of the study area. Object-based segmentation and classification of the imagery using software such as Quantum GIS allows for the classification of coastal ecosystems and quantification of their spatial extents. To improve the analytical veracity of this process, in situ ground truthing of the extent maps is critical. This can be achieved through ground surveys of the study area, or through low altitude UAV surveys which increase the spatial resolution of the imagery. In doing so, ecosystem type can be confirmed, and the accuracy of the extent maps can be improved. In addition, measurement of ecosystem condition cannot be performed using remote sensing techniques, and thus requires in situ assessment.

Following the SEEA EA framework, these classified, and appropriately ground-truthed ecosystem extent maps can then be used to quantify the ecosystem services provided within the study area. Understanding the flow of ecosystem services and the beneficiaries of these services is vital in linking the environment to the people who depend on it. Incorporating this data into the SEEA EA framework can allow for a better understanding of this (Farrell et al. 2021). Finally, the SEEA EA framework will allow for the development accounts to record the supply and use of the ecosystem services provided by each of the ecosystem types identified in the study area. For the proposed pilot project in the Keta Lagoon region, this will centre on the extent and utilisation of the mangrove forests within the coastal ocean economy.

Research Questions:

This research will primarily focus on the stocks (extent and condition) and flows (services and benefits) of the mangrove forests in the Keta Lagoon region. To understand this, the following questions are suggested:

1. What is the extent and condition of the mangrove forests in the Keta Lagoon complex?
2. Who is harvesting mangrove timber – communities?
3. Where does this timber end up – who benefits from the harvesting?
4. What is the extent of the value chain?
5. How vulnerable is the value chain to change?

References

- Aheto, D. W., Kankam, S., Okyere, I., Mensah, E., Osman, A., Jonah, F. E., & Mensah, J. C. (2016). Community-based mangrove forest management: Implications for local livelihoods and coastal resource conservation along the Volta estuary catchment area of Ghana. *Ocean & coastal management*, 127, 43-54.
- Awuku-Sowah, E. M., Graham, N. A., & Watson, N. M. (2023). The contributions of mangroves to physiological health in Ghana: Insights from a qualitative study of key informants. *Wellbeing, Space and Society*, 4, 100137.
- Farrell, C., Coleman, L., Kelly-Quinn, M., Obst, C., Eigenraam, M., Norton, D., O'Donoghue, C., Kinsella, S., Delargy, O., Stout, J., 2021. Applying the System of Environmental Economic Accounting-Ecosystem Accounting (SEEA-EA) framework at catchment scale to develop ecosystem extent and condition accounts. *One Ecosyst.* 6, e65582.
- Gacutan, J., Pınarbaşı, K., Agbaglah, M., Bradley, C., Galparsoro, I., Murillas, A., Adewumi, I., Praphotjanaporn, T., Bordt, M., Findlay, K., 2022. The emerging intersection between marine spatial planning and ocean accounting: A global review and case studies. *Mar. Policy* 140, 105055.
- Nunoo, F. K., & Agyekumhene, A. (2022). Mangrove Degradation and Management Practices along the Coast of Ghana. *Agricultural Sciences*, 13(10), 1057-1079.
- Pettorelli, N., Laurance, W.F., O'Brien, T.G., Wegmann, M., Nagendra, H., Turner, W., 2014. Satellite remote sensing for applied ecologists: opportunities and challenges. *J. Appl. Ecol.* 51, 839–848
- Rubin, J. A., Gordon, C., & Amatekpor, J. K. (1999). Causes and consequences of mangrove deforestation in the Volta estuary, Ghana: Some recommendations for ecosystem rehabilitation. *Marine Pollution Bulletin*, 37(8-12), 441-449.
- Sekey, W., Obirikorang, K.A., Boadu, K.B., Gyampoh, B.A., Nantwi-Mensah, A., Israel, E.Y., Asare-Ansah, O., Ashiagbor, G. and Adjei-Boateng, D. (2023) Mangrove plantation and fuelwood supply chain dynamics in the Keta Lagoon Complex Ramsar Site, Ghana. *Wetlands Ecology and Management*, 31(1), pp.143-157.