SEA-LEVEL RISE RISK IN COASTAL RURAL COMMUNITIES IN GHANA

Richard Adade [1], Dukiya Jaiye [2], Nana Ama Browne Klutse [3], Michael Thiel [4] and Appollonia Aimiosino Okhimamhe [1]

[1] WASCAL Doctoral Research Programme in Climate Change and Human Habitat, Federal University of Technology Minna, Minna P.M.B. 65, Niger, Nigeria
[2]Department of Urban and Regional Planning, Federal University of Technology Minna, Minna P.M.B. 65, Niger, Nigeria
[3] Department of Physics, University of Ghana, Accra 00233, Ghana
[4]Department of Remote Sensing, Institute for Geography and Geology, Julius-Maximilians University of Würzburg, Oswald-Külpe-Weg 86, 97074 Würzburg, Germany
email: adade.r@edu.wascal.org

Introduction

The earth's climate is warming and coastal areas have to cope with increasing risks related to sea level rise (SLR). The environmental consequences of sea-level rise on coastal areas may not be limited to increased flooding and erosion, but also loss of vital coastal ecosystems such as mangroves and salt marshes. Adaptation measures include social and environmental process modifications, climate risk perception, actions to reduce climate risk and the exploration of new opportunities to cope with the modified environment. Ghana has over the years implemented protective measures such as the construction of groynes and revetment to serve as barriers to sea waves in major cities and towns to prevent sea erosion and flooding. For vulnerable rural coastal communities, the planned retreat is often proposed; however, relocation costs are often underestimated as losses of future social and cultural value are not always adequately taken into account (The World Bank, 2017). Coastal rural communities experience double jeopardy of direct risk to human lives and indirect risk to important ecosystem services they rely on as their primary means of sustenance (Osman et al., 2016). Proper measures to build coastal rural communities' resilience to the impact of SLR require the understanding of future risk as well as adaptative behaviour to the changing environment. Thus, this study employed an innovative mixed-methods approach to assess the risk and adaptation behaviour to different scenarios of sea-level rise in three rural coastal communities in Ghana to provide the basis for policy and adaptation strategy improvement for rural coastal communities which are mostly neglected in climate change assessments.

Methods

Table 1: Summary of data types, methods, and outputs

Data type	Processes	Software used	Output
UAV Images	Image processing, orthorectification with GCPs, Point cloud classification, masking, and interpolation	Pix4Dmapper and ArcGIS Pro	Digital Terrain Model (DTM) Orthophoto and Slope
Sentinel Satellite images	Image pre-processing and Classification, Accuracy assessment	ArcGIS Pro	Land use/cover maps
Aerial orthophotos (1975-2021)	Georeferencing, digitization, calculation of shoreline rates	ArcMap, DSAS	Erosion and accretion rates
Social Survey (FGD, household survey, expert survey and Interviews)	Data processing, descriptive analysis, exploratory factor analysis, post-hoc test and logistic regression	Microsoft excel, IBM SPSS	Exposure indicator Socio-economic Vulnerability indicators Adaptation behaviour

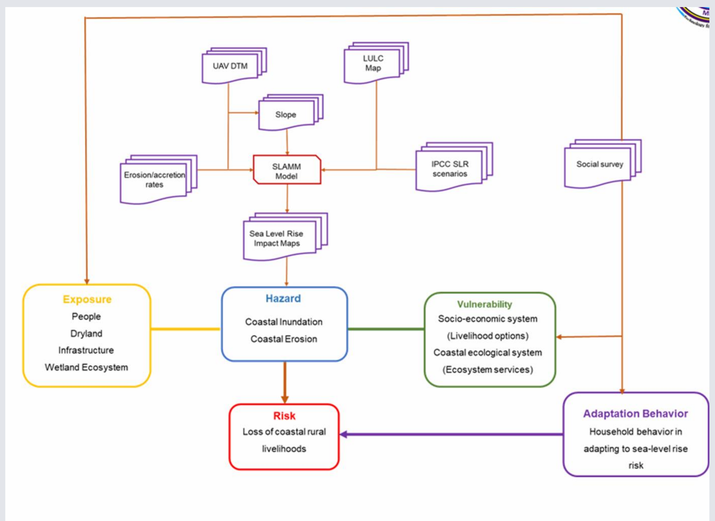

Figure 1: Methodological workflow for the study

Results and Discussion

Hazard

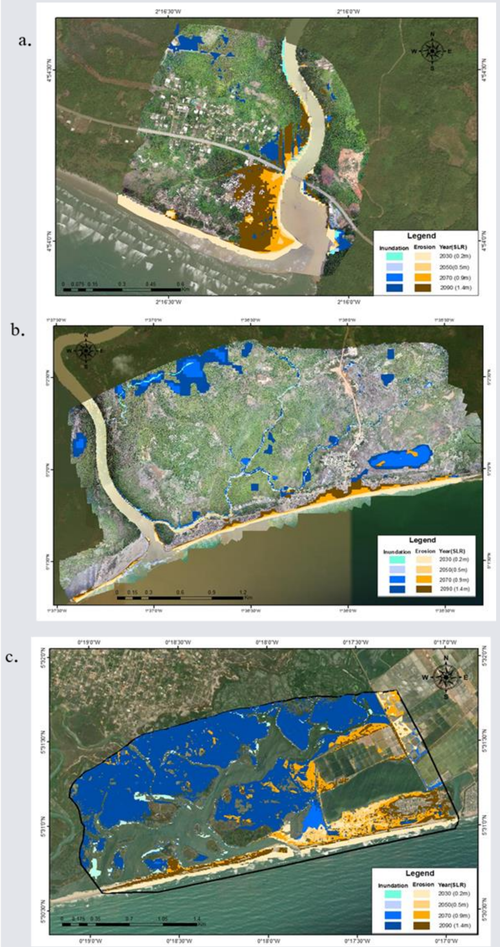

Figure 2: Land area impacted by coastal erosion/inundation due to increased SLR in (a)Sawoma (b) Anlo Beach and (c) Glefe-wiaboman

Exposure

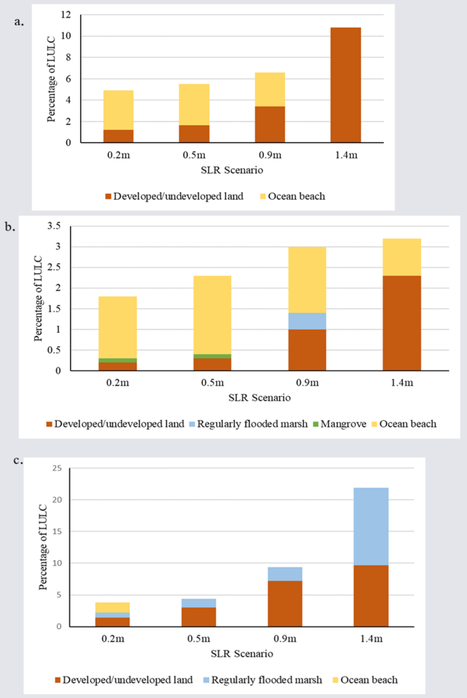

Figure 3: Percentage of Land use/cover likely to be exposed to SLR impacts in (a)Sawoma (b) Anlo Beach and (c) Glefe-wiaboman

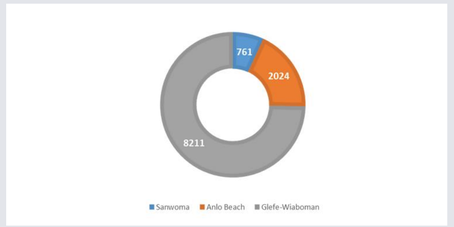

Figure 4: Number of people likely to be exposed to SLR impacts

Vulnerability

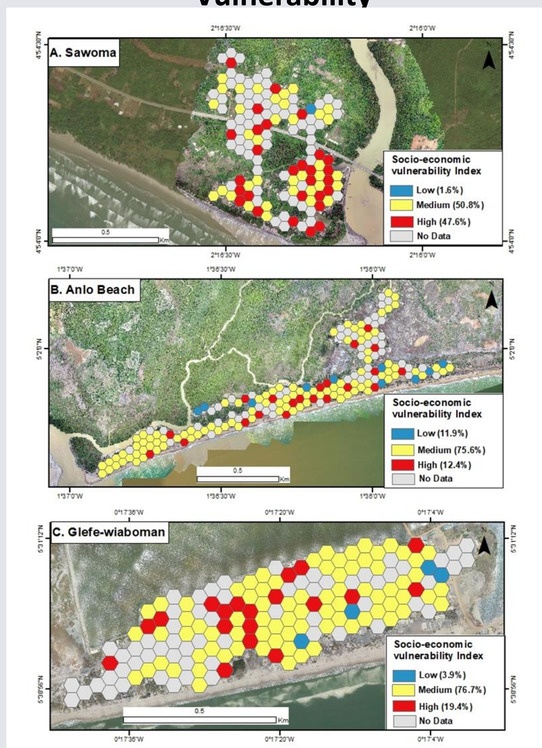

Figure 5: Socio-economic vulnerability levels of the study communities

RISK

Table 2: Indices for hazard, exposure, vulnerability, and risk for the study communities

Community	Hazard	Exposure	Vulnerability	Risk	Level
Sawoma	0.01	0.31	0.49	0.27	Medium
Anlo Beach	0.25	0.48	0.60	0.44	Low
Glefe-wiaboman	1	0.7	0.43	0.71	High

Summary and Conclusion

The finding of the study indicated that about 3.8 km2 area will likely be affected by erosion and inundation induced by SLR. As a result, a significant number of people and coastal ecosystems will likely be exposed to these impacts and will have a significant negative effect on the livelihood of the communities. With the socio-ecological integrity being threatened by climate change extreme events, the livelihood of the coastal community will likely worsen with the increase in SLR. The socioeconomic situation is a major factor contributing to the vulnerability of the coastal rural communities. The study examined risk levels of the rural coastal communities under study to impacts of projected sea-level rise by aggregating indices from the risk component. Although Glefe-wiaboman had a high socioeconomic structure and population density than the other communities, it was identified as a high-risk community due to its location as a low-lying area.

Acknowledgement

The German Federal Ministry of Education and Research (BMBF) primarily funded this research through the West African Science Service Centre on Climate Change and Adapted Land-Use Doctoral Research Programme in Climate Change and Human Habitat hosted in the Federal University of Technology Minna, Nigeria.

References

1. Osman, A., Nyarko, B. K., & Mariwah, S. (2016). Vulnerability and risk levels of communities within Ankobra estuary of Ghana. International Journal of Disaster Risk Reduction, 19, 133–144. https://doi.org/10.1016/j.ijdrr.2016.08.016.
2. The World Bank. (2017). Stakeholder and Political Economy Analysis for Ghana.