Renewable Energy for Rural-Coastal Development: Integrating Blue Economy Strategies with Faith-Based Climate Action

KAAKA, Fegalo J. D.
Department of Geography and Environmental Studies
Ignatius Ajuru University of Education
Rumuolumeni, Port Harcourt, Nigeria
Email: feghalo.kaaka@iaue.edu.ng
ORCID-1022https://orcid.org/0009-0007-4906

Pius Barinaadaa Kii, Ph.D.
Department of Religious and Cultural Studies
Faculty of Humanities, Rivers State University
Email: pius.kii@rsu.edu.ng
Phone: 08033097923
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Abstract
Rural-coastal settlements in developing nations suffer from immense energy poverty, climate vulnerability and lack sustainable livelihood options. If problems of the blue economy are resolved, renewable energy deployment can be a viable solution. Through this study, we want to integrate blue economy strategies with renewable energy initiatives and faith-based climate actions for sustainable development of rural-coastal sector. This research employs a conceptual-policy analysis approach, using comparative case studies to identify pathways for renewable energy adoption that will promote socio-economic development, environmental sustainability, and community resilience. According to the findings, using faith-based institutions can bring local acceptance, strengthen resources, and help in behavior change towards low carbon climate resilient coastal livelihood. A new research paper advises that integration of renewable energy technologies such as offshore wind, solar photovoltaic, and tidal energy with blue economy approaches enables economically and environmentally sustainable coastal development. Suggestion in Policy includes Supporting Local Governance Frameworks for Renewable Energy Deployment, Encouraging Community Participation and Promoting Faith-led Advocacy for Climate Action. This strategy offers practical knowledge for people that make decisions, development professionals, and coastal societies hoping to bring economic growth in line with environmental protection, and social equity.

Keywords: *Blue Economy, Renewable Energy, Rural-Coastal Development, Faith-Based Climate Action, Sustainable Livelihoods*

Introduction

Rural-coastal areas in the Global South are affected by energy poverty, unguarded livelihoods and increasing vulnerability to climate change. These communities often are at the frontline of environmental change where shoreline erosion, saline intrusion, falling fisheries and infrastructural deficits amplify social and economic vulnerability. As these crises converge, the development of renewable energy offers a low-carbon, decentralized alternative for diversifying livelihoods.

Nevertheless, governance irregularities, lack of community participation and poor compatibility of renewable energy interventions in rural-coastal zones often contribute to the ineffectiveness of these interventions.

The blue economy offers a transformative framework for the sustainable use of marine and coastal resources, ecological sustainability, and inclusive economic growth in this policy landscape. Incorporating renewable energy into blue economy strategies can speed up climate-resilient development through energy access, local economic enhancement and less pressure on coastal ecosystems. Still, existing scholarship pays limited attention to the socio-cultural dynamics that shape community responses to energy transitions.

The connection between faith and climate action is crucial in ensuring that the movement for renewable energies becomes widely accepted by the public. Many African coastal communities rely on religious institutions to govern behavior standards and create mass mobilization to tackle environmental and development challenges. The engagement they promote can strengthen ethical stewardship, enhance trust on technological interventions, and increase the governance processes for successful deployment.

In light of this, the study aims to enhance scholarly and policy interpretation of ways that renewable energy, blue economy strategies, and faith-informed climate action can synergize to achieve sustainable rural-coastal development.

Objectives of the Study.

To examine how renewable energy pathways can be strategically aligned with blue economy frameworks to enhance sustainable rural-coastal development.

To analyze the role of faith-based climate action in strengthening community acceptance, governance structures, and resilience within renewable energy transitions in coastal regions.

Literature Review

Renewable Energy Transitions in Rural-Coastal Contexts

The shift to renewable forms of energy is considered one of the most essential pathways for rural-coastal communities for mitigating chronic energy poverty and climate vulnerability. Okafor & Mensah (2020) suggest that decentralized renewable systems such as solar mini-grids, wind, and tidal offer resilient alternatives to centralized fossil-based infrastructure that often fails to reach dispersed coastal communities. Research has shown that renewable energy enhances productivity, supports fisheries, and promotes rural enterprises, which leads to socio-economic improvements (Bassey, 2022). Nevertheless, there are challenges to implementation. These include a weak institutional capacity, limited financing, and infrastructure deficits. Together, this limits the scalability of energy innovations in coastal settings (Sarkodie & Adams, 2019). A holistic approach is needed to make technological interventions just that little more inclusive.

Blue Economy as a Framework for Coastal Sustainability

The blue economy paradigm has changed the way the world thinks of coastal development issues. A paradigm which uses ocean and coastal resources not just for economic growth but environmental regeneration and social inclusion (Zhang & Kumar, 2021). According to research, renewable energy is one of the main components of blue economy strategies such as offshore wind farms, marine current turbines, and ocean thermal energy conversion system (OECD, 2020). These technologies lessen pressure on fisheries, reduce carbon emissions, and diversify coastal livelihoods (Nyiwul, 2022). To summarize, the blue economy model has been critiqued for potentially reproducing extractive patterns that displace coastal ecological communities, unless these interventions are supported by robust governance, community involvement and ethical monitoring. This suggests that adopting renewable energy in the blue

economy strategies requires good governance mechanisms that promote social justice, ecological protection, and inclusive participation.

Faith-Based Climate Action and Community Engagement

Faith-based groups have joined the battle against climate change and environmental degradation as actors in environmental governance especially where the intersecting identities create values and social norms and influence collective choices. Research shows that faith organizations can legitimize climate actions and make them socially acceptable by framing them as a moral issue grounded in a common norm (Onuoha, 2020). Faith leaders are also crucial in community mobilization, climate information dissemination and building trust between local communities and external agents (Akanmu & Yusuf, 2021). People are likely to welcome behavior change that will not incur costs, especially without prior experience of and/or confidence in generating profits from change of livelihood, coastal job creation, etc. (Uzondu, 2022) This means that climate action is a stable and socially embedded energy transition. It is not on the sidelines.

Blending renewable energy, blue economy strategies, faith-based action

Recent scholarly work is advocating a systems-based framework which connects technological, ecological and socio-cultural dimensions of coastal development Ferràs et al 2023. Economic integration of renewable energy and blue economy strategies leads to environmental regeneration (Campbell & Tsuria, 2021). According to Adeniran and Ojong, 2023 faith-based climate action integration will improve institutional trust and local government and community adaptation. As the view that coastal development should be technologically sound, ecologically regenerative and socially inclusive emerges, a synthesis of such an interdisciplinary approach is crucial.

Methodology

This study takes on a mixed research design comprising qualitative insight, quantitative assessment, and framework-based synthesis to explore how renewable energy can advance rural–coastal development through the blue economy and faith-based climate action.

Research Design

Researchers used a research design that integrated various approaches and techniques to understand complex coastal problems. They combine these efforts with various datasets to develop better energy and resource solutions. Triangulation across data types helps to enhance validity.

Data Sources

To gather primary qualitative data, we carried out semi-structured interviews with coastal households, faith-based institutions, local energy developers, and... The national and international energy database, public statistics from the national government, and scientific literature were used as secondary materials. Which was analyzed on prices for renewable energy? Coastal demographic? Marine resource potential? Climate vulnerability?

Analytical Framework

The data was analyzed using a thematic coding which aligned with the three analytical pillars of renewable energies adoptions, blue economy opportunities and faith-based climate governance. Did you like this example? Let us know! Findings were synthesized into an integrated systems model.

Results and Findings

The results will be delivered in three dimensions: renewable energy potential, blue economy integration and faith-based governance pathways.

Renewable Energy Opportunities in Rural-Coastal Regions

An assessment has shown that solar irradiance has a strong potential. The onshore wind potential is moderate. There is moderate potential for tidal and wave marine technologies. The cost of solar mini-grids and small wind systems has seen a steep decline, making them suitable for dispersed coastal settlements.

Table 1. Summary of Renewable Energy Potentials in Rural-Coastal Areas

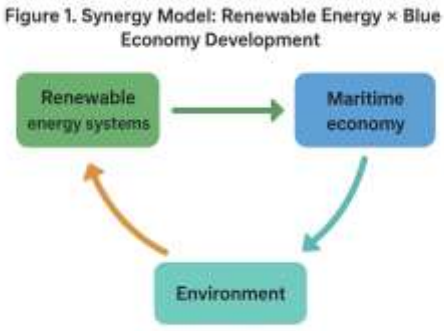
Resource Type	Potential Level	Key Constraints	Development Suitability
Wind (onshore/offshore)	Moderate–High	Environmental permitting	Moderate
Tidal/Wave	Emerging	Technology maturity, cost	Future potential
Biomass	Moderate	Feedstock variability	Context-dependent

The table compares the potentials for solar, wind, tidal/wave, and biomass rural-coastal zones. The most immediately feasible energy forms are solar energy, although financing and maintenance limits exist. Wind energy offers a moderate to high potential, but is constrained by permitting. Tidal and wave energy remain constrained by cost and technological immaturity to the future option. Biomass energy is context-specific and highly dependent on feedstock availability. When viewed as one thing, the table displays diverse but promising opportunities needing resource-specific strategies. In brief, policy support, regulatory streamlining and technical capacity will drive increasing renewable energy scales for energy poverty alleviation and coastal resilience strengthening.

Blue Economy Linkages

The study found that renewable energy going hand in hand with blue economy activities fisheries modernization, cold-chain, eco-tourism, etc improves livelihoods in rural areas. Cold storage powered by renewables, desalination of water, and transport by sea were priorities.

Figure 1. Synergy Model: Renewable Energy × Blue Economy Development



The diagram shows a three-way relationship between the renewable energy systems, maritime economy and environment. In the fisheries, aquaculture, tourism and marine

transport sectors, it provides evidence that renewable energy mitigates emissions and lowers operational costs. Healthy ecosystem enhances energy deployment and productivity in the blue economy. A systemic interpretation of the model indicates that sustainability is a result of cause and effect interrelationships between technology, economy and ecology. The discussion outlines that integrated planning can maximize co-benefits, and resilient coastal development with good governance and investment.

Faith-Based Climate Action Pathways

Interviews show strong faith-based institutions in both reaction and action. They wield high trust levels in the community. Moreover, they strongly shape norms. Similarly, they also send environmental messages while promoting mediation between different conflicts. When people have a good understanding of the advantages of renewable energy, they will accept their locals and support its usage.

Table 2. Roles of Faith-Based Institutions in Coastal Climate Action

Role	Function	Impact
Awareness	Environmental teachings	Increased climate literacy
Governance mediation	Trust building	Higher public acceptance
Mobilization	Collective action	Improved project sustainability

The table shows the three different roles of faith-based institutions (FBIs) such as awareness, governance mediation and community mobilization. What they teach people helps them understand climate change, mediation creates trust in projects, and mobilization helps project longevity. When looked at together, the table shows that FBIs bridge institutional gaps, stimulate acceptance, and support participatory climate action. To put it concisely, their engagement helps to enhance the socio-cultural underpinnings crucial for effective renewable energy and coastal adaptation strategies.

Figure 2. Integrated Coastal Resilience Pathway (ICRP) Model: Energy Access × Ecosystem Health × Community Adaptation

The model shows a circular relationship between improved access to renewable energy, ecosystem health, and community adaptation. Damaging shocks, crises, and stressful events shouldn't overwhelm essential services, destabilize ecosystems, or strain communities' long-term resilience. The model shows resilience in a holistic fashion indicating that a positive growth in any one domain helps the other domains to grow too. In a nutshell, it shows that building coastal resilience requires coordination of energy supply, environmental protection and community preparedness.

Discussion

The results show that renewable energy transitions in rural–coastal areas necessitate a systems-based approach that connects technology with socio-cultural and ecological realities. The combination of renewable energy and blue economy strategies creates opportunities for livelihood diversification, emissions reduction and climate resilience. Technological feasibility is not enough alone; trust, social legitimacy, and community participation need infrastructural interventions.

Faith-based bodies are evolving as important agents for these times. The effective influence will help create bridges between the communities and the outside agencies thus making it easy for the adoption of renewable technologies. When religious leaders weave together energy planning discussions involving ethics and morals, there will be a cultural match for climate action which helps ease the behavioral and institutional barriers.

Sustainable coastal development must reflect a balance in economic growth, environmental stewardship, and socio-cultural governance. Renewable energy is hence not only seen as an infrastructure resource but as an inclusive development platform characterized by blue economy prospects and faith-based climate leadership.

Recommendations

An integrated coastal energy framework embedding renewables into blue economy development plans should be adopted by policymakers. Efforts will be made to streamline regulatory regimes for marine renewables, incentivize coastal mini-grids, and strengthen multi-level governance to harmonize energy expansion, ecological systems protection and national climate objectives.

It is important to formally engage faith-based organizations in climate action partnerships. When communities trust an enterprise, it can make a project smoother and less prone to protests or other opposition. Training faith leaders in climate awareness and energy management will enhance the community's ownership and acceptance.

Technical and economic approaches must focus upon site-specific renewable models suitable to coastal context. A demonstration project should be undertaken for the hybrid systems which include solar, wind, and marine energy. This also should include training programs for local capabilities on system function and maintenance. By building a stronger connection between research and industry, they can create affordable marine technologies and enhance long-term energy resilience.

Conclusion

This work shows that connecting renewable energies with blue economy practices and faith-based climate action can help transform rural–coastal development.

Sustainable development relies on three pillars, namely energy access, ecological regeneration, and community trust. Through partnership, we achieve them all.

A model that is systems-based where renewable technologies can help coastal economic sectors, with faith-informed governance, is a socially legitimate path. The findings show that there is a need for working together, local area energy planning and moral frameworks which facilitate equitable participation.

In short, integrating renewable energy, blue economy development, and faith-based programs can be a strategic and inclusive approach to advance climate ambitions and community well-being.

References

Abdullah, K. (2020). Review on marine energy program. Journal of Physics: Conference Series, 1469(1), 012101. https://doi.org/10.1088/1742-6596/1469/1/012101

Agarwala, N. (2020). Monitoring the ocean environment using robotic systems: Advancements, trends, and challenges. Marine Technology Society Journal, 54(5), 42–60. https://doi.org/10.4031/MTSJ.54.5.7

Agarwala, N. (2021a). Managing marine environmental pollution using artificial intelligence. Marine Technology Research. https://doi.org/10.33175/mtr.2021.248053

Agarwala, N. (2021b). Powering India's blue economy through ocean energy. Australian Journal of Maritime & Ocean Affairs. https://doi.org/10.1080/18366503.2021.1954494

Agarwala, N. (2021c). Sustainable exploitation of deep seabed mineral resources in the Indo-Pacific through practical cooperation under the Indo-Pacific Ocean

Initiative. Journal of Indian Ocean Region, 17(3), 289–305. https://doi.org/10.1080/19480881.2021.2001986

Agarwala, N. (2022b). Is LNG the solution for decarbonised shipping? Journal of International Maritime Safety, Environmental Affairs, and Shipping, 6(4), 158–166. https://doi.org/10.1080/25725084.2022.2142428

Agarwala, N. (2023b). Reducing plastic litter for a cleaner planet. International Journal of Environmental Studies, 80(5), 1456–1477. https://doi.org/10.1080/00207233.2023.2228624

Agarwala, N. (2024). Is hydrogen a decarbonising fuel for maritime shipping? Maritime Technology Research, 6(4), 271244. https://doi.org/10.33175/mtr.2024.271244

Agarwala, N., & Polinov, S. (2021). Curtailing anthropogenic carbon dioxide to meet the targets of the Paris Agreement using technology support mechanisms. Journal of Human-centric Research in Humanities and Social Sciences, 2(1), 1–24. https://doi.org/10.21742/jhrhss.2021.2.1.01

Agarwala, P., Chhabra, S., & Agarwala, N. (2021). Using digitalisation to achieve decarbonisation in the shipping industry. Journal of International Maritime Safety, Environmental Affairs, and Shipping, 5(4), 161–174. https://doi.org/10.1080/25725084.2021.2009420

Ahmed, N., & Thompson, S. (2019). The blue dimensions of aquaculture: A global synthesis. Science of the Total Environment, 652, 851–861. https://doi.org/10.1016/j.scitotenv.2018.10.123

Aryai, V., Abbassi, R., Abdussamie, N., Salehi, F., Garaniya, V., Asadnia, M., … Penesis, I. (2021). Reliability of multi-purpose offshore-facilities: Present status and future direction in Australia. Process Safety and Environmental Protection, 148, 437–461. https://doi.org/10.1016/j.psep.2020.11.012

Bădîrcea, R. M., Manta, A. G., Florea, N. M., Puiu, S., Manta, L. F., & Doran, M. D. (2021). Connecting blue economy and economic growth to climate change: Evidence from European Union countries. Energies, 14, 4600. https://doi.org/10.3390/en14154600

Bennett, N. J., Blythe, J., White, C. S., & Campero, C. (2021). Blue growth and blue justice: Ten risks and solutions for the ocean economy. Marine Policy, 125, 104387. https://doi.org/10.1016/j.marpol.2020.104387

Bujas, T., Koričan, M., Vukić, M., Soldo, V., Vladimir, N., & Fan, A. (2022). Review of energy consumption by the fish farming and processing industry in Croatia and the potential for zero-emissions aquaculture. Energies, 15(21), 8197. https://doi.org/10.3390/en15218197

Campbell, L. M., Fairbanks, L., Murray, G., Stoll, J. S., D'Anna, L., & Bingham, J. (2021). From blue economy to blue communities: Reorienting aquaculture expansion for

community wellbeing. Marine Policy, 124, 104361. https://doi.org/10.1016/j.marpol.2020.104361

Choudhary, P., Subhash, G. V., Khade, M., Savant, S., Musale, A., Kumar, G. R. K., … Dasgupta, S. (2021). Empowering blue economy: From underrated ecosystem to sustainable industry. Journal of Environmental Management, 291, 112697. https://doi.org/10.1016/j.jenvman.2021.112697

Cisneros-Montemayor, A. M., Croft, F., Issifu, I., Swartz, W., & Voyer, M. (2022). A primer on the "blue economy:" Promise, pitfalls, and pathways. One Earth, 5(9), 982–986. https://doi.org/10.1016/j.oneear.2022.08.011

Cisneros-Montemayor, A. M., Moreno-Báez, M., Voyer, M., Allison, E. H., Cheung, W. W. L., Hessing-Lewis, M., … Ota, Y. (2019). Social equity and benefits as the nexus of a transformative blue economy: A sectoral review of implications. Marine Policy, 109, 103702. https://doi.org/10.1016/j.marpol.2019.103702

De Oliveira Neto, G. C., da Silva, P. C., Tucci, H. N. P., & Amorim, M. (2021). Reuse of water and materials as a cleaner production practice in the textile industry contributing to blue economy. Journal of Cleaner Production, 305, 127075. https://doi.org/10.1016/j.jclepro.2021.127075

Diallo, M. S., Kotte, M. R., & Cho, M. (2015). Mining critical metals and elements from seawater: Opportunities and challenges. Environmental Science & Technology, 49(16), 9390–9399. https://doi.org/10.1021/acs.est.5b00463

Dillon, T., Maurer, B., Lawson, M., Jenne, D. S., Manalang, D., Baca, E., & Polagye, B. (2022). Cost-optimal wave-powered persistent oceanographic observation. Renewable Energy, 181, 504–521. https://doi.org/10.1016/j.renene.2021.11.124

Farghali, M., Osman, A. I., Chen, Z., et al. (2023). Social, environmental, and economic consequences of integrating renewable energies in the electricity sector: A review. Environmental Chemistry Letters, 21, 1381–1418. https://doi.org/10.1007/s10311-023-01587-1

Fusco, L. M., Schutter, M. S., & Cisneros-Montemayor, A. M. (2022). Oil, transitions, and the blue economy in Canada. Sustainability, 14, 8132. https://doi.org/10.3390/su14138132

Gerhardinger, L. C. (2020). Crafting a sustainability transition experiment for the Brazilian blue economy. Marine Policy, 120, 104157. https://doi.org/10.1016/j.marpol.2020.104157

Jouffray, J.-B., Blasiak, R., Norström, A. V., Österblom, H., & Nyström, M. (2020). The blue acceleration: The trajectory of human expansion into the ocean. One Earth, 2(1), 43–54. https://doi.org/10.1016/j.oneear.2019.12.016

Kazimierczuk, K., Henderson, C., Duffy, K., Hanif, S., Bhattacharya, S., Biswas, S., … Tarekegne, B. (2023). A socio-technical assessment of marine renewable energy potential in coastal communities. Energy Research & Social Science, 100, 103098. https://doi.org/10.1016/j.erss.2023.103098

Langer, J., Quist, J., & Blok, K. (2020). Recent progress in the economics of ocean thermal energy conversion: Critical review and research agenda. Renewable and Sustainable Energy Reviews, 130, 109960. https://doi.org/10.1016/j.rser.2020.109960

Le Gouvello, R., & Simard, F. (2024). Towards a regenerative blue economy: Mapping the blue economy. IUCN. https://portals.iucn.org/library/sites/library/files/documents/2024-005-En.pdf

Mofor, L., Goldsmith, J., & Jones, F. (2014). Ocean energy: Technology readiness, patents, deployment status and outlook. IRENA. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_Ocean_Energy_report_2014.pdf

OECD. (2016). The ocean economy in 2030. https://doi.org/10.1787/9789264251724-en

Patil, P. G., Virdin, J., Diez, S. M., & Roberts, J. (2016). Toward a blue economy: A promise for sustainable growth in the Caribbean. The World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/25061/Demystifying0t0the0Caribbean0Region.pdf?sequence=4

Ravago, M.-L. V., Balisacan, A. M., & Chakravorty, U. (2015). The principles and practice of sustainable economic development: Overview and synthesis. In A. M. Balisacan, U. Chakravorty, & M.-L. V. Ravago (Eds.), Sustainable economic development (pp. 3–10). Academic Press. https://doi.org/10.1016/B978-0-12-800347-3.00001-7

UNEP. (2014). Blue economy concept paper. United Nations Environment Programme. https://sustainabledevelopment.un.org/index.php?page=view&type=111&nr=2978&menu=35

World Bank. (2019). Where sun meets water: Floating solar market report. https://openknowledge.worldbank.org/bitstream/handle/10986/31880/Floating-Solar-Market-Report.pdf?sequence=1&isAllowed=y

Yuan, J., & Nian, V. (2020). A preliminary evaluation of marinized offshore charging stations for future electric ships. Asian Development Bank Institute. https://www.adb.org/publications/preliminary-evaluation-marinized-offshore-charging-stations-future-electric-ships