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Editorial

The current Kenya Aquatica Vol. 6(1) features application of local technology on coral reef rehabilitation; performance of locally manufactured fish dryers, some aspects of Blue Economy, and the role of the ocean in climate change mitigation and adaptation in Kenya.

Many thanks to members of the Kenya Aquatica Editorial Board and the unwavering support we continue to receive from KMFRI, Pwani University and the Technical University of Mombasa. This year we have been fortunate to receive additional financial support from Pew Fellowship programme based at KMFRI. We are most thankful to Dr. James Kairo, Pew Fellow (2019), for providing this support that led to the successful production of the current Volume.

Volume 6(1) contains two papers on the restoration of degraded coral reef and the socio-economic impact of reef rehabilitation. Two more papers feature comparison between the solar tunnel dryer and the traditional rack dryer as well as the performance of two dryers - solar tunnel and open air rack. This Volume also features a short communication and a commentary on emerging areas of sea floor mapping and inclusions of ocean climate solutions in Kenya's Climate Change Agenda.

The Editorial Board acknowledges various reviewers of the manuscripts led by Prof. Leonard Chauka of University of Dar-es-Salaam - Institute of Marine Sciences based in Zanzibar, Tanzania.

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About Kenya Aquatica

Kenya Aquatica is the Scientific Journal of the Kenya Marine and Fisheries Research Institute (KMFRI). The Aim of the Journal is to provide an avenue for KMFRI researchers and partners to disseminate knowledge generated from research conducted in the aquatic environment of Kenya and resources therein and adjacent to it. This is in line with KMFRI's mandate to undertake research in marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research including chemical and physical oceanography.

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Submitting Articles

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Ocean Climate Solutions: Blue carbon Now Incorporated in the Updated Kenya's Nationally Determined Contributions to Paris Agreement

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Introduction

Climate debate has seen enhanced interests in ocean-based climate solutions, with a lot of focus being laid on blue carbon ecosystems. Blue carbon (BC) describes the carbon storage potential of vegetated coastal ecosystems, including tidal marshes, mangrove forests, and seagrass meadows (Donato, *et al.*, 2011,) Although they occupy less than 0.05% of the sea bed, BC account for 50-71% of the entire C stored in the ocean sediments and are ranked as the most intense C sink on earth (Nelleman & Corcoran 2009; Donato *et al.*, 2011). Unfortunately, BC are being degraded globally at an alarming rate of 1-7% per year, which is significantly higher than the global loss of tropical forests, estimated at 0.5% per year (ref.). When these BC are degraded, they not only halt to take up more carbon, but most important they release the already stored carbon back to the atmosphere leading to global warming (Pendleton *et al.*, 2012). Restoration and protection of BC is, therefore, recognized as a priority for both climate change mitigation and adaptation; and several countries have identified measures that harness these benefits in their National Determined Contribution (NDCs) to Paris Agreement (McLeod *et al.*, 2011).

Blue carbon in Kenya is mainly represented by mangroves and seagrass beds (Fig 1). There are 60,323ha of mangroves in Kenya, representing only 1% of country's area (GoK, 2017). These forests play an important role in the national and regional economies including provisions of wood and non-wood products to the people, supporting fisheries, coastal protection and stability as well as contributing to biodiversity conservation (Bosire *et al.*, 2016; Hamza *et al.*, 2020). Total carbon stocks of mangroves in Kenya have been estimated at 560MgC/ha. Within the last four decades, some 40% of mangroves have been lost emitting 12Mt-CO₂-eq. The loss has mostly been associated with over-harvesting of wood products, habitat conversion, pollution, and climate change (Kirui *et al.*, 2012, Bosire *et al.*, 2014, GoK, 2017). Total area of seagrass in Kenya ranges from 30,800 to 31,700 ha, with a an estimated total ecosystem carbon stocks of 8 MtC and a carbon sequestration rate of 0.026 MtC yr⁻¹ (Githaiga *et al.*, 2017; Harcourt *et al.*, 2017). Seagrass cover change analysis has revealed a decline in coverage at a rate of 0.85% yr⁻¹ since 1986, which has resulted in a release of upto 2.7 MtC (Harcourt *et al.*, 2017). This loss has been attributed majorly poor fishing activities.

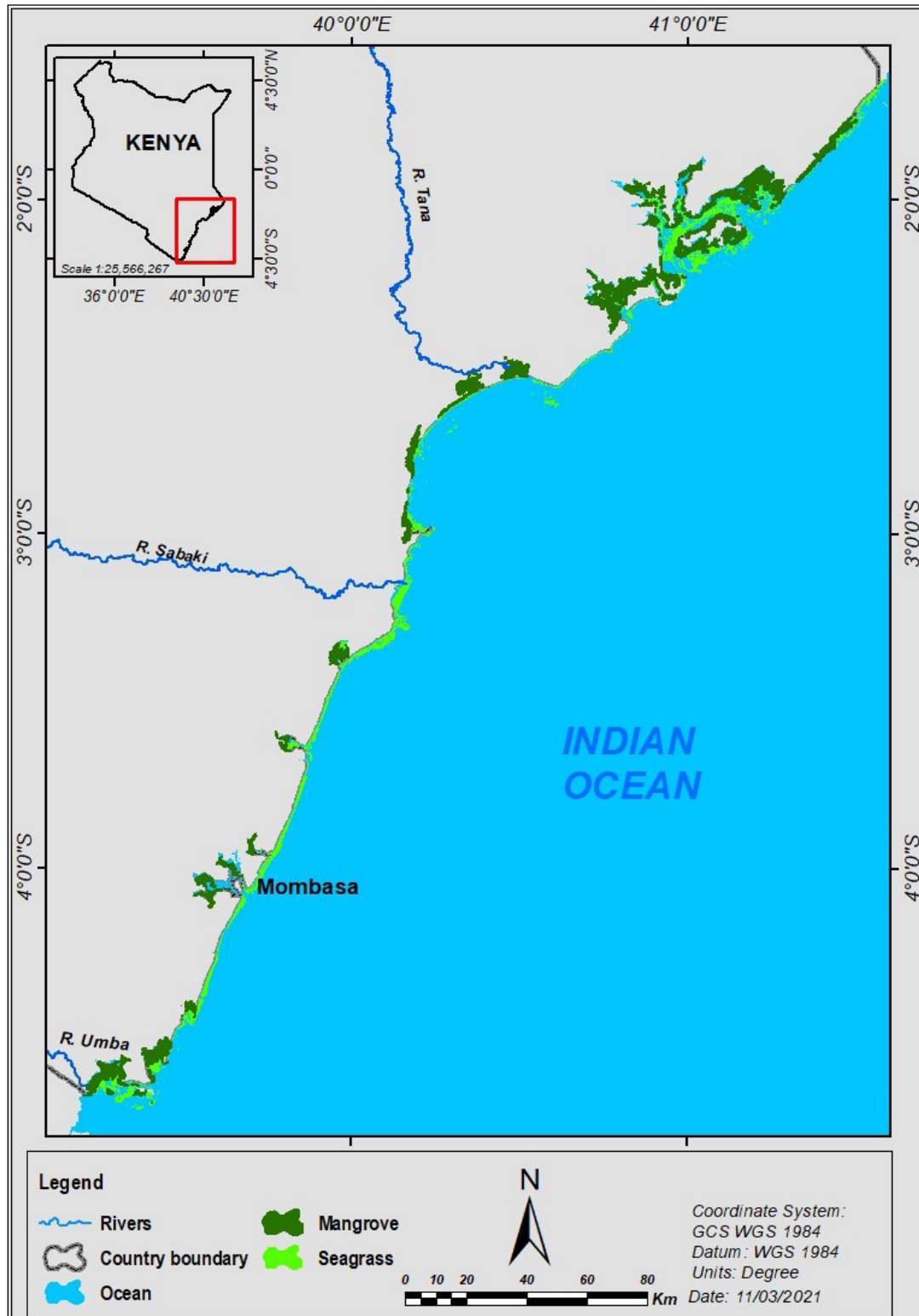


Fig. 1. Mangrove forests along the Kenya coast (to be updated)

Kenya's NDCs

Kenya is very vulnerable to climate change effects; with current projections suggesting that its temperature will rise by up to 2.5°C between 2000 and 2050, while rainfall will become more intense and less predictable (ref). Food security, rural livelihoods, human health, physical infrastructure and

water resources rank high among climate change vulnerability concerns along the coast and the country in general (NCCAP, 2018).

Addressing climate change requires that we transform our economy by integrating climate change into national and county development plans. This will lower greenhouse gas emissions, reduce our

vulnerability to climate impacts and deliver poverty reduction gains because taking action to adapt to and mitigate climate change is in our national interest.

Kenya submitted her first NDC on 28th December 2016 to the United Nations Framework Convention on Climate Change (UNFCCC). This NDC committed a 30% reduction in greenhouse gas (GHG) emissions by 2030, relative to a business-as-usual (BAU) scenario of emitting 143 MtCO₂e annually (GoK, 2015).

Achievements of the NDC commitments were subject to international support in the form of finance, investment, technology development and transfer, and capacity building. The NDC identified mitigation options as well as key sector vulnerability and adaptation issues for agriculture, water, aquatic and marine resources, energy, health, and the social economic context in general. Under the forestry sector, establishment of forest cover of at least 10% was identified as climate change mitigation measure (GoK, 2015). Despite their high carbon sequestration rates (Gress, *et al.*, 2016) and the multiple ecosystem services they provide (Huxham *et al.*, 2015) mangrove forests were not integrated in the initial NDCs. This gap presented an opportunity to enhance ambition in the country's updated NDCs.

Kenya Marine and Fisheries Research Institute (KMFRI) with support from Pew Charitable Trust, The Nature Conservancy (TNC), UN Blue Forest Project, Wetlands International, Conservation International, WWF, IUCN, and Napier Edinburgh University (UK) supported the country's ambition to incorporate blue carbon ecosystems into the Updated NDC. A National workshop on mangroves and NDCs was held on 28th – 31st October 2019. Over 116 participants from National and County Governments, non-governmental organizations, private sector, academia and community-based organizations attended the workshop (ref).

NDC review process

On 28th December 2020, Kenya's Updated Na-

tionally Determined Contribution (Updated NDC) was submitted to UNFCCC. In the Updated NDC, Kenya sets to abate her GHG emission by 32% by 2030 relative to the BAU scenario of 143 MtCO₂ eq, and in line with national development agenda. Contributions described in the updated submission built upon Kenya's initial NDC, National Climate Change Action Plan (NCCAP) 2018-2022, National Adaptation Plan (NAP) 2015-2030, and new sectoral and national plans. The sector-wide consultative framework provided an opportunity to re-look at the NDC revision process and ensure that ocean climate actions were incorporated.

Ocean climate actions

Our increased understanding of the ocean and its potential role in climate change mitigation and adaptations compels us to include ocean-based climate actions in the revision of NDCs. Oceans cover 70 percent of the earth's surface, produces more than 50 percent of the oxygen we breath and absorb more than 90% of the heat trapped in the atmosphere (IPCC, 2019). A healthy ocean is critical for achieving global development goals and climate change targets.

The Intergovernmental Panel on Climate Change (IPCC's) Special Report on Oceans and Cryosphere (SROCC) alerts the world over the expected risks of climate change if greenhouse gas is unabated (IPCC, 2019). In Kenya, effects of climate change are already witnessed in the bleaching events and death of coral reefs, loss of mangroves, and reduction in major fisheries (Kairo & Bosire, 2016; Gudka *et al.*, 2018). A sustainable ocean-based economy can play an essential role in this much needed emissions reduction, while providing jobs, supporting food security, sustaining biological diversity and enhancing resilience (Obura, 2017; Stuchtey *et al.*, 2020). Ocean based climate action could protect coasts against climate change effects (such as sea level rise and erosion), restore coastal and marine ecosystems, and help to mitigate climate change by sequestering carbon.

Kenya aims to achieve her Vision 2030 through

low carbon climate resilient development pathway. Harnessing the mitigation benefits of sustainable blue economy, including blue carbon payments for ecosystem services (PES) are among ambitious ocean-based climate mitigation actions in the Updated NDCs. Adaptation, however, is the highest priority for Kenya, not only through preventing further losses and damage but also mainstreaming climate change adaptation into the Medium-Term Plans (MTPs) and County Integrated Development Plans (CIDs). Blue carbon ecosystems have been included in the priority ocean-based adaptation actions in the Updated NDC (Table 1).

Table 1: Ocean based adaptation actions identified in Kenya's updated NDC (2020)

Sector	Priority Action
Disaster risk reduction	Flood risk management incorporating nature-based solutions, including; mangrove reforestation.
Environment	<p>Rehabilitation and conservation of degraded forests, that include mangroves.</p> <p>Enhance governance structures in participatory resource management in coastal ecosystems.</p> <p>Conduct blue carbon readiness assessment for full integration of blue carbon/ ocean climate actions into NDCs.</p> <p>Develop marine spatial planning and outline sustainable management approaches</p> <p>Promote and expand opportunities for nature-based enterprises including seaweed farming and mangrove ecotourism.</p> <p>Integrate the use of nature-based solutions, including the implementation of national mangrove management plan into national and county development plans.</p>

The total cost of implementing mitigation and adaptation actions of the Updated NDC is estimated at USD62 billions over the next 10 years; with a stock taking expected in 2025. Compared to the first submission that was fully conditional to support, in the revised NDC, Kenya intends to bear 13% of the implementation cost from domestic budget with the balance coming from the international support in form of finance, technology development and transfer, and capacity building (GoK, 2020).

Enablers of ocean climate solutions inclusions in the updated Kenya's NDC

We reviewed a total of 14 policy documents, legislations and sectoral plans in order to identify opportunities and gaps for inclusion of climate ocean solutions in the Updated NDCs (Table 2). All the reviews documents provide enabling frameworks and opportunities within which ocean climate actions could be mainstreamed into Kenya's development and climate agenda at both national and county levels. However, fundamental gaps regarding ocean climate actions were identified, mainly due to paucity of data and information on the sector. Building on these enabling frameworks and addressing the gaps highlighted provide

great opportunity for fully integration of ocean climate solutions into future NDCs.

Table 2: Reviewed policy, legislations, and sectoral plans documents

Policy and Legislations	Gaps	Opportunities
i) Constitution of Kenya, 2010 ii) National Climate Change Framework Policy iii) Climate Finance Policy iv) Integrated Coastal Zone Management Policy, 2013 v) Climate Change Act 2016 vi) Forest Conservation and Management Act 2016 vii) Wildlife Conservation and Management Act 2013 viii) Fisheries Management and Development Act	i) The role of the ocean sector in climate change interventions is not adequately highlighted. ii) Risks and vulnerability of climate change on coastal and marine sector not well captured iii) Benefits of blue carbon ecosystems to climate, livelihood support, and biodiversity conservation not adequately highlighted, iv) Contributions of coastal wetlands have not been captured in the GHG inventory reporting and thus subsequently not included in the emissions projections.	i) Review and provide updates on the status and conditions of blue carbon ecosystems; particularly, valuation of their ecosystems services to enable their integration to policy framework and national and county level development plans ii) Conduct vulnerability assessment of climate change of blue carbon ecosystems and develop their mitigation actions iii) Quantify the contribution of BC to emission reduction in order to include them in national GHG inventory reporting.
National and Sectoral Plans		
i) National Climate Change Action Plan, 2018-2022 ii) National Adaptation Plan, 2015-2030 iii) National Climate Change Response Strategy, 2010 iv) National Strategy for Achieving and Maintaining Over 10% tree Cover By 2022 xiii) Taskforce Report on Forest Resources Management and Logging Activities in Kenya, 2018) xiv) National mangrove management plan, 2017 – 2027.	v) More emphasis is laid on the sectors in terrestrial settings and hence strategies and plans developed give more attention to priority actions in these sectors, e.g. Kenya Climate Smart Agriculture (CSA) and the System for Land-based Emission Estimation (SLEEK). But Policy issues and strategies specific to coastal and marine systems have not been adequately captured.	iv) Develop strategies for designing and tracking programs for ocean climate actions and integrating them into MRV (measurement, reporting, and verification) framework v) Identify and develop ocean nature-based climate solutions to leverage on the established enabling aspects of climate finance mechanisms. vi) Develop strategies for the implementation of the National Mangrove Ecosystem Management Plan

Conclusion

The ocean sector has immense potential of contributing to solutions to climate change challenges. The incorporation of the ocean climate solutions, (in particular blue carbon) in the Updated Kenya's NDCs provide ambitious actions in line with. This is a substantial milestone for Kenya in its role of championing sustainable blue economy. Consequently, this calls for concerted efforts by actors in the ocean sector to utilize this opportunity to upscale the development of strategies for influencing ocean climate policy framework at

county and national levels. Of particular importance is utilizing ocean climate solutions in harnessing benefits of associated with sustainable blue economy.

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