Volume 6, Issue No.1

KENYA Aquatica

A Scientific Journal of Kenya Marine and Fisheries Research Institute

KMFRI

Editorial

The current Kenya Aquatica Vol. 6(1) features application of local technology on coral reef rehabilitation; performance of locally manunfactured 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 unwevering 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.

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.

Manuscripts may be submitted to the Chief Editor through Director@kmfri.co.ke

KENYA AQUATICA
SCIENTIFIC JOURNAL OF THE KENYA MARINE AND FISHERIES RESEARCH INSTITUTE
Volume 6, Issue No.1
2021

Subscription Information
The Kenya Aquatica is published semi-annually. It is an open access journal available free online at www.kmfri.co.ke
ISSN 2077-432X (print)
ISSN2077-432X-4-1

ISSN 2617-4936 (online)
ISSN2617-4936-4-1

Hard copies may be obtained free of charge from the Kenya Marine and Fisheries Research Institute.

Submitting Articles
Submissions to the Kenya Aquatica Journal are accepted year round for review.

Short Note

Blue Economy: Potential Use of Multibeam Echo-Sounders in Seafloor Mapping

Amon Kimeli* and Melckzedeck K. Osore

Kenya Marine and Fisheries Research Institute, P. O. Box 81651, Mombasa, Kenya.

*Corresponding E-mail: kimeli.k.amon@gmail.com

Introduction

To the ordinary Kenyan, the country covers an area of just over 580,000 km^2 comprising of the terrestrial landmass. However, Kenya also boasts of 9,700 km^2 of territorial sea and an extra 142,000 km^2 square kilometers of the Exclusive Economic Zone (EEZ) in the Indian Ocean. The more than 150,000 km^2 extra excluding the inland water bodies constitute the platform upon which Kenya can explore, develop, exploit and sustainably manage its Blue Economy. Figure 1 shows the map of the Kenya coast with track line of the hydro-acoustics surveys conducted by Kenya's RV Mtafiti from south to north including the EEZ. According to the United Nations Convention on the Law of the Sea (UNCLOS), every maritime state boasts of inherent sovereign rights on the territorial sea (up to 12 nautical miles equivalent to 22 km) and the EEZ extending to 200 nm (370 km). These sovereign rights include the exploration and exploitation of both living and non-living resources in the water column, the seafloor and beneath.

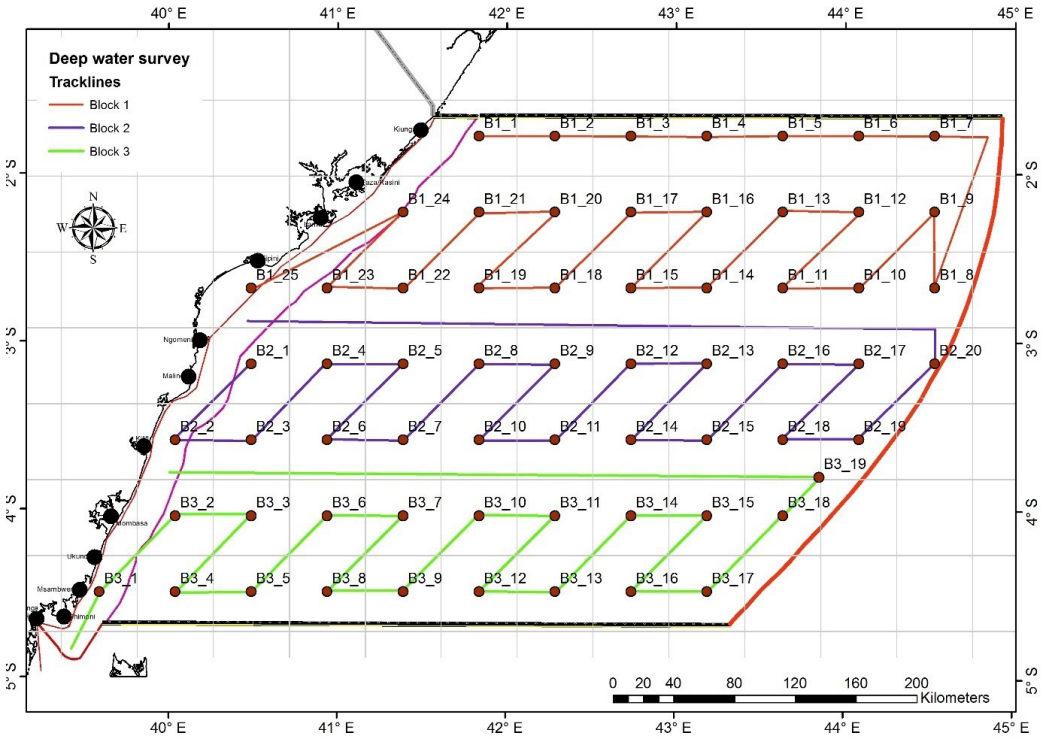

Fig.1: Map of the Kenya coast showing the track line of the hydro-acoustic survey conducted by RV Mtafiti between 2014 and 2020 from south to north including the EEZ

The ocean provides numerous economic, environmental and ecological values to mankind. These values include the air we breathe, food, transportation, climate regulation and mitigation, recreation and revenues through ocean-based economy. Increased knowledge of our oceans expands our understanding of our marine ecosystems and life that would hitherto unlock a huge potential and new opportunities. Among other key ocean management domains that would benefit from our enhanced knowledge on the ocean include integrated coastal zone management, maritime transport, marine spatial planning, ocean climate solutions, and ocean governance.

It would, therefore, be fair to ask about ocean economy and how much of the global seafloor we currently know.

According to a 2017 report by the World Wildlife Fund for Nature (WWF), if we were to consider the global ocean as a country, it would be the world's 7th largest economy with its Gross Marine Product (GMP) estimated at US$ 2.5 trillion. Closer home, the estimated Western Indian Ocean (WIO) region – comprising of African nations bordering the Indian Ocean along the East Africa coast - Gross Marine Product (GMP) was ranked the 4th largest at US$ 20.8 billion compared to Gross Domestic Product (GDP) of individual countries behind only South Africa (US$ 349.89), Kenya (US$ 60.9) and Tanzania (US$ 49.2). This is despite 85% of the global ocean seafloor remaining unmapped.

On the basis of these facts, it is inevitable and of high priority for the world and individual maritime states to see to it that the ocean seafloor is fully mapped. Bathymetry - the measurement of water depths relative to the sea level - started as early as 2000 BC and appeared for the first time in the 16th Century in European navigational charts as depth soundings and contours (OECD, 2016; 2019). Several bathymetric measurements are used to visualize the topography and relief of the seafloor. Bathymetry allows for the exploration of both living and non-living resources and understanding of the critical ocean and seafloor processes. Bathymetry mapping as we know it today started in 1807 when the then President Thomas Jefferson of the United States of America (USA) signed the Act named "Survey of the Coast" to provide for surveying and production of complete and accurate charts of the entire coast of the USA purposely to improve the safety of navigation and promote transatlantic maritime trade. Notably, a major sea-floor mapping was done between 1873 and 1876 aboard the research vessel the HMS Challenger during the famous grand world tour christened the "Challenger Expedition" covering a total of 128,000 km and organized by the Royal Society in collaboration with the University of Edinburgh. During the Challenger Expedition, a total of 492 bathymetric soundings were obtained and the first recording of the deepest part of the ocean at 10,920 m and subsequently named the Challenger Deep within the Mariana Trench in the Western Pacific Ocean was made. To give a real and relatable reference, the highest point on land is Mount Everest at 8,848m above sea level located at the Nepal-China border. With a heightened collection of bathymetric data and due to non-standardized nomenclatures and terminology used on charts, "the 7th International Geographic Congress (1899) formed a commission to standardize nomenclature and also produce and publish a global bathymetric chart". With the chairmanship of Prince Albert I of Monaco, the first edition of the General Bathymetric Chart of the Ocean (GEBCO) was produced and published in 1905. GEBCO has grown tremendously since the beginning of the 20th century transitioning from initial paper charts to the current freely available 3 dimension digital bathymetric chart of the ocean albeit at low resolution.

In the recent past, the Nippon Foundation - a Japanese non-profit organization - has supported the development and improvement of GEBCO. In this regard, during the Forum for Future Ocean Floor Mapping held in Monaco in July 2016, GEBCO and Nippon Foundation joined forces to establish the Seabed 2030 Project - now under the auspices of International Hydrographic Organization (IHO), Intergovernmental Oceanographic Commission (IOC) and GEBCO - an international collaborative effort to facilitate the complete mapping of the world ocean by 2030 (IOC, 2017). Seabed 2030 Project had been a long time coming and was borne of the fact that only a paltry 15% of the world ocean was/is covered by publicly available high-resolution bathymetry data. Our planet Earth's global ocean seafloor topography is far less known than the surfaces of other planets in our solar system including Mars and the Moon. Comparatively, Mars and the Moon are fully mapped to "better spatial coverage and very high resolutions" and remarkably at extraordinary costs. Despite the considerable effort over many years to map the oceans seafloor, it is a pity that a huge swath of our own planet's seafloor remains un-mapped in the 21st century.

Seabed 2030 Project seeks to synergize and valorize the efforts of governments, industry, research, and academia in the collection, assimilation and

compilation of bathymetric data in order to develop and produce a definitive, high-resolution bathymetric map of the entire world ocean by 2030. This ambitious project's mission is to "empower the world to make policy decisions, use the ocean sustainably, and undertake scientific research that is informed by a detailed understanding of the global seafloor". It is estimated that one research vessel fitted with modern equipment (e.g. a multibeam echosounder) would take over 900 years to map the entire 140 million square miles of the entire global seafloor including the shallow waters (0 – 200 m). In this regard and due to the high costs associated with bathymetric mapping, Seabed 2030 Project seeks to create a pool of several research vessels from different nations and institutions (both public and private) and partition the global seafloor into manageable regions. If 100 vessels were to be involved, the ~900 years can easily be reduced to ~10 years. Kenya's effort in this regard is boosted by the KMFRI research programme on board RV Mtafiti (Fig. 2). Seabed 2030 Project also seeks to tap into crowd-sourcing, citizen science and vessels of opportunities by seeking partnerships with private vessels on transit and operating deep sounding equipment. Seabed 2030 Project supports the sustainable development goals (SDG) especially SDG 14 on life under water. It has also fortunately, coincided with the United Nations Decade of Ocean Science for Sustainable Development therefore creating a new impetus and focus coupled with the heightened interest in the largely un-tapped Blue Economy.

Fig.2: RV Mtafiti entering the Kilindini Harbour of Mombasa after a typical cruise of plying the coastal waters of Kenya. Photo credit KMFRI (2018)

Kenya through its research vessel (RV) Mtafiti has embarked on EEZ-wide survey entailing fish acoustics and single-beam bathymetric data collection. Figure 3 shows KMFRI scientist at work in a recent research cruise on board RV Mtafiti. The data collected would assist in further understanding and precise estimation of fish biomass and abundance that would allow for data-based/backed fishing in the deep sea. Singlebeam bathymetric data are equally important but not up to level with otherwise high-resolution multibeam bathymetric data being envisioned for Seabed 2030. Kenya therefore will still have to seek advanced equipment notably a multibeam survey equipment, a hydrographic-suited or a multi-discipline research vessel for the same and continue to build capacity to supplement that which is already available. Kenya has taken vital steps towards fully under-

standing its ocean, however, further steps would form a basis for increased knowledge and optimization for the benefit of the Blue Economy (Obura *et al.,* 2017).

Fig. 3: KMFRI researchers on board RV Mtafiti prepare to cast plankton net into the Indian Ocean (Photo Credit by MK Osore)

Kenya's desire to become a strong maritime nation was further demonstrated in November 2018 when it hosted the 1st Sustainable Blue Economy Conference in Nairobi (SBEC, 2019). To become a strong maritime nation requires sound knowledge of the adjacent ocean, its floor and what it entails. Furthermore, Kenya has become a member of the United Nation Security Council (UNSC), a coveted slot with relevance not only to the Nation of Kenya, but also the WIO region at large. As President Uhuru Kenyatta said in his final pitch for the UNSC seat, "Kenya's win will advance the regional and Pan-African agenda of global peace, solidarity and multilateralism". Kenya, the WIO region and Africa at large can therefore leverage on this position to advance collaborative research within the Indian Ocean as the world seeks to achieve a 100% coverage of the global seafloor by 2030. Within the Commonwealth Charter, Kenya has been nominated as a champion for blue economy.

The Figure 1 shows the expansive Indian Ocean currently covered by a paltry 2% by publicly-available high-resolution multibeam bathymetry data. The data as shown in the legend has been collected by various institutions including the Geological Institute, Russian Academy of Sciences (GINRAS), Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Kenya Marine and Fisheries Research Institute (KMFRI), United Kingdom Hydrographic Office (UKHO), National Aquatic Resources Research and Development Agency (NARA) of Sri Lanka, Royal Netherlands Institute for Sea Research (NIOZ) and others collated by data repositories including the Marine Geoscience Data System (MGDS) and National Centers for Environmental Information (NCEI) from various data contributors.

Among the direct and low-lying tangible benefits of high-resolution bathymetric maps would be the maritime trade. This would be occasioned by increased maritime traffic underpinned by high resolution and up-to-date navigation charts. Knowledge of the seafloor also directly allows for the understanding of its geological history and would provide a gateway for exploration of otherwise un-tapped minerals, oil, and gas. However, in the context of unlocking the full potential of the Blue Economy, a complete global and high-resolution bathymetric map would unlock otherwise unknown and untapped opportunities for public-private-academic partnerships and the Blue Economy entrepreneurship (Rayner, 2019a; 2019b). The success of Seabed

2030 Project will also lead to a global and a consolidated and publicly available data sources for global bathymetry and ocean observation data to support future business endeavors and natural resource exploration. By joining forces, the map of our world's oceans seafloor can be achieved. The Seabed 2030 initiative seeks to tap into efforts of individual nations and private entities to contribute data. Seabed 2030 is therefore a rallying global call to action in this massive (yet very vital) undertaking that can only be achieved through cooperation and collaboration at the local, regional and global scales.

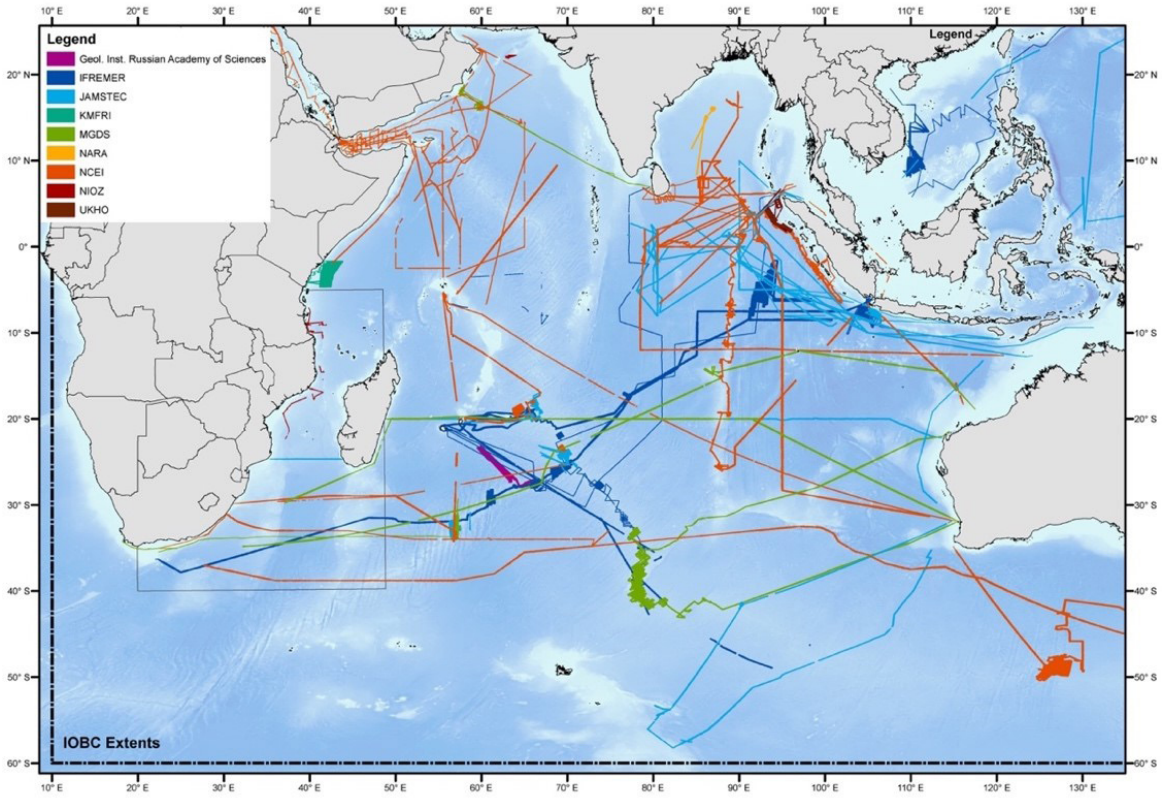

Fig. 4: Map of the Indian Ocean region showing transects of major cruise undertaken by various research programmes and institutions (Source & Credit Dr. Rochelle Wigley, 2018)

References

KMFRI (2018) The RV Mtafiti: Marine Research towards Food Security and Economic Development for Kenya. Njiru JM, Ruwa RK, Kimani EN, Ong'anda HO, Okemwa GM and Osore MK (eds). Kenya Marine and Fisheries Research Institute, Mombasa, Kenya. 102pp.

SBEC (2019) Report on the Global Sustainable Blue Economy Conference 26th – 28th November 2018 Nairobi, Kenya. Retrieved from http://www.blueeconomyconference.go.ke/wp-content/uploads/2018/12/SBEC-FINAL-REPORT-8-DECEMBER-2018-rev-2-1-2-PDF2-3-compressed.pdf

OECD (2016) The Ocean Economy in 2030. Paris: OECD Publishing.

OECD (2019) Rethinking Innovation for a Sustainable Ocean Economy. Paris: OECD Publishing

Rayner R, Gouldman C, Willis Z (2019a) The Ocean Enterprise – understanding and quantifying business activity in support of observing, measuring and forecasting the ocean. Journal of Operational Oceanography, 12(sup2), S97–S110. [https://doi.org/10.1080/1755876X.2018.1543982]

Rayner R, Jolly C, Gouldman C (2019b) Ocean Observing and the Blue Economy. Frontiers in Marine Science, 6(330), 1–6. [https://doi.org/10.3389/fmars.2019.00330]