

NEWSLETTER

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Dear Readers,

It is with great pleasure that I present to you the 9th edition of the Ocean Quest newsletter. We kick started this year by reaffirming our commitment to developing the Ocean Economy agenda of the Government.

With the view of enhancing national capacity in the field of GIS, a workshop was successfully conducted at the beginning of the year to train MOI staff and local stakeholders in the use and applications of GIS. Geographic Information Systems (GIS) maps are routinely used in our everyday life; however, the skills required to generate these maps are highly specific. In the field of Oceanography, GIS maps are very often used to depict the various different attributes of a particular region of interest, in a simple manner to policy- and decision-makers, and stakeholders.

For example, a GIS map of Flic-en-Flac lagoon has been generated at the Institute to show not only the bathymetry and current profiling but also the benthic habitat coverage and nutrient distribution in this region.

Mauritius remains vulnerable to anthro-

pogenic and climatic impacts that challenge the health of our marine environment. Ocean acidification (OA)- a direct result of climate change- poses a significant threat to our marine resources. At the MOI, we have initiated a study to monitor ocean acidification in partnership with The Ocean Foundation (USA), which directly addresses the United Nation's SDG 14.3 (Life under Water), which aims to "minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels". Through this international collaboration, scientists are monitoring global trends of ocean acidification, the results of which would not only help us understand the carbonate system of our ocean but also help in defining measures to be taken to control rising acidification levels. Currently, the MOI and the UoM, both members of the GOA-ON, are initiating collaborative monitoring and research activities on oceanic carbonate chemistry in the EEZ of Mauritius. Through a funding opportunity by the WIOMSA, both institutes have successfully entered into a unique collaborative proposal to consolidate the OA monitoring plan in Mauritius and sustain ongoing research activities as part of OA-Africa.

Another interesting and new research development at the MOI is the award of the GEF-UNDP-IMO GloFouling Project to Mauritius as a Lead Partnering Country. The Director of Shipping Division, Ministry of Ocean economy, Marine resources, fisheries and Shipping and Mr P. Mussai, Research Scientist, MOI will be the National Focal Point and National Project Coordinator of the project respectively. Mauritius

is located on important shipping routes connecting the Eastern part of the world to the Western side. As such, the transfer of invasive species through ship's biofouling is common in our waters. This global partnership developed between the United Nation's IMO and developing countries will help to address and minimize the harmful effects of invasive aquatic species.

Please read on to find out more about these and other exciting new developments in the field of oceanography in Mauritius. A more exhaustive description of our research projects can be found on the Mauritius Oceanography Institute's website.

Dr. Ruby MOOTHIEEN PILLAY
Director



PREFACE BY CHAIRMAN



I am the ocean, I am water and I cover most of this planet. Every stream, every cloud and every rain drop ..they all come back to me.

I do not owe humans a thing. I give... they take and they take more of their share. They poison me and they expect me to feed them. If I am not kept healthy, humans won't survive. The ocean does not need humans : but humans need the ocean. It is as simple as that"... Extract from "Ocean is speaking to humans"

The Mauritius Oceanography Institute has a very important role to play in sensitising humans on the importance of keeping the ocean around us healthy and nourishing. The content of the 9th issue of the MOI newsletter provides a window through which readers can have a clear view the different activities being carried out by the scientists and the efforts being undertaken by the Institute to maintain the sustainability of our ocean.

Blue economy is the buzz term of the moment The newsletter starts by clarifying further the term as seen by several countries and organisations. One definition that catches our imagination is as follows;

The sum of all kinds of activities associated with the development, utilization and protection of the marine environment. This notion of sustainability is crucial.

To fulfil its mission , the MOI has organised and participated in several events, planned and successfully conducted workshops and trainings programmes .

These are listed and explained in the newsletter.

To address the issues as laid down in the above extract, the MOI has set up a dynamic and sustainable network with several countries and organisation for sharing data and for exchange programmes in the sectors of marine biotechnology, bioprospecting, marine renewable energies, port and shipping related security issues and ocean monitoring and surveillance amongst others.

Armed with appropriate tools and by using modern technology to capture the DNA of our ocean, the MOI is on its way towards becoming a centre of excellence in the region.

Enjoy reading the 9th edition of the MOI newsletter and your views are most welcomed.

**Prem Saddul, Associate Professor
Chairman**

The Ocean Economy

In contrast to the recent apparition of the term 'Blue Economy' in the world of ocean governance, the term Ocean Economy, has existed for many decades now. Very often, the two terms broadly used to describe developing the economic growth of the ocean are confounded and interchangeably used. However, a distinct connotation to the term Blue Economy, as explained in the previous newsletter article, is the 'sustainability' aspect ascribed to it, which is not so well clarified in the definitions of the term Ocean Economy.

The Ocean Economy has been described as either "the economic activities that take place in the ocean, receive outputs from the ocean and provide goods and services to the ocean", or "the economic activities that directly or indirectly take place in the ocean, use the ocean's outputs and contribute inputs to the ocean's activities." (Park and Kildow, 2014).

Major countries around the world have defined the term 'Ocean Economy' differently, thus disabling comparisons of the term among countries (Table 1). The variations in the definition of the term 'Ocean Economy' have largely arisen based on the inclusion and/or exclusion of specific ocean-related sectors falling under the Ocean Economy. Further ambiguity to the term 'Ocean Economy' has stemmed through its interchangeable use with the terms 'marine economy', 'ocean industry' and 'maritime industry'. Different countries have used one of these three variations to define and assess the economic importance and GDP contribution of the various activities pertaining to the Ocean Economy.

Table 1: Definition of the Ocean Economy by country

Country	Definition
United States of America	The economic activity, which is (a) an industry whose definition explicitly ties the activity to the ocean, or (b) partially related to the ocean and is located in a shore-adjacent zip code.
United Kingdom	Those activities which involve working on or in the sea, activities involved in the production of goods or the provision of services that will directly contribute to activities on or in the sea.
Australia	Ocean-based activity, with the focus being on whether the main input is the ocean resource or not.
Ireland	Economic activity which directly or indirectly uses the sea as an input.
China	The sum of all kinds of activities associated with the development, utilization and protection of the marine environment.
Canada	Those industries that are based in Canada's maritime zones and coastal communities adjoining these zones, or are dependent on activities in these areas for their income.
New Zealand	The economic activity that takes place in, or uses the marine environment, or produces goods and services necessary for those activities, or makes a direct contribution to the national economy.
Japan	Industry exclusively responsible for the development, use and conservation of the ocean.
South Korea	The economic activity that takes place in the ocean, which also includes the economic activity, which puts the goods and services into ocean activity and uses the ocean resources as an input.

(Adapted from Park and Kildow: Rebuilding the classification system of the Ocean Economy, 2014)

The Government of Mauritius, having recognised the importance of the ocean in the development of the economy, realigned its strategy to use the ocean for its sustained economic growth. Since 2015, the Government added 'Ocean Economy' into its Ministry of Fisheries to stress on its commitment for developing the marine sector in Mauritius, with the view of turning it into a new economic pillar for promoting the development of the island.



The World Bank published a report on how best to develop the Ocean Economy in Mauritius, including a roadmap on how to move from traditional ocean sectors such as Fisheries, Aquaculture, and Ports, onto newer emerging ocean sectors such as ICT and energy (The Ocean Economy in Mauritius: Making it happen, Making it last, 2017). This report also detailed a strategy for developing this sector, which it labelled the 'O2 strategy', doubling the investment of which would enable the Ocean Economy to double its revenue in a decade or so.

In view of this, the Mauritius Oceanography Institute has also realigned its Strategic Plan (2016-2020) to reflect the commitments of the Government to develop the Ocean Economy sector. Several new projects have been initiated since 2016 at the Institute towards this end in the sectors of marine biotechnology, bioprospecting, marine renewable energies, port and shipping related security issues and ocean monitoring and surveillance amongst others.

For instance, the project 'Community based coral culture in the Republic of Mauritius' has been developed to help rehabilitate the coral reefs around the island by bringing onboard the coastal, including fisher, community. This project specifically aims at transferring the necessary knowledge and skills required for each participant of the project to be able to regenerate a coral fragment into a coral nursery for eventual transplantation out onto the reefs.

In an era where the use of fossil fuel is being constantly criticised, the search for cheaper and viable energy sources for the Republic of Mauritius is of utmost importance. And so, scientists at the Institute have developed the project '*Marine renewable energy resource assessment of Mauritius: Theoretical approach and electricity generation*' aimed at looking at the feasibility of extracting marine energy and its potential for providing enough power to run a building. Maps showing the most promising areas of harvesting wave energy for electricity generation have been published by the team (Doorga et al., 2018).

Through these and the other ongoing projects, the MOI, as the technical arm of the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping, is geared towards the sustainable development of the Ocean Economy in Mauritius. Although much needs to be done to make the Ocean a profitable sector, we are already on a positive course.

Investments have to be poured not only into developing this sector, but also in building up the human resources qualified to take up such a challenge, all the while paying attention to the conservation of the unique and vulnerable marine biodiversity in the Republic of Mauritius.

This article is the second part of a three series article for the MOI newsletter, focusing on the Blue Economy, the Ocean Economy in Mauritius and their implications for Small Island Developing States.

Dr. N. Reetoo

Workshop on the use of bioinformatics tools for Genomics

Genomics is a field in molecular biology which study the complete set of genetic material present in an organism. With the advent of next generation sequencing (NGS) technology, high throughput data of the genome of different organisms are being generated. Genomics uses a combination of next generation sequencing dataset and bioinformatics to sequence, assemble and analyse the function of genomes.

Mr Sarvanen Curpen attended a training workshop on "Bioinformatics tools for analysis of genomic dataset" which was held at the University of Mauritius (UoM) from 25 – 29 March 2019. The workshop was organised by UoM in collaboration with H3ABioNet. During the workshop, hands-on training was given on the fundamental techniques required for processing and interpreting of NGS data files of the genome. The workshop also gave an overview on how to query for DNA variants present in the genome which could lead to an indication of the functional property of an organism.

The techniques acquired during the training workshop can be applied to analyse microbial DNA dataset for novel enzymatic properties which may have potential application in the field of marine biotechnology. Furthermore, analysis of genomics dataset can also be used in hatchery-based selective breeding of aquacultured organisms.

Mr. S. Curpen

Workshop on Preparation of a Biosecurity Plan for the Agricultural Sector in Mauritius

On the 16th of January 2019, Mr. P. Mussai, Research Scientist attended a one-day workshop jointly organized by the Ministry of Agro-Industry and Food Security and the Food and Agriculture Organisation of the United Nations. The workshop was on the preparation of a biosecurity plan for the agricultural sector in Mauritius, held at the Hennessy Park Hotel in Ebène. This workshop was also attended by other relevant stakeholders, private sector and the farming community. The biosecurity plan will ensure that appropriate measures are engaged so as to prevent the introduction, establishment and spread of pests and diseases, as well as invasive alien species.

Mr. P. Mussai

Working session on VNR/SDG-UN MISSION Validation workshop for Global Innovation Index for Mauritius

In September 2015, Mauritius adopted the 2030 Agenda for Sustainable Development: Transforming our world – ending poverty, protecting our planet and ensuring that all people enjoy peace and prosperity which is also referred to as the Sustainable Development Goals (SDGs). The SDGs charter is a global action plan which comprises 17 goals and 169 targets along with 232 indicators set by the United Nations General Assembly, to be reached by 2030. Each country is expected to submit their progress report through a Voluntary National Review (VNR) report with regard to the implementation of the SDGs. Mauritius took the commitment to present its first VNR in July 2019 at the High Level Development Forum of the United Nations Economic and Social Council in New York, and the Ministry of Foreign Affairs, Regional Integration and International Trade is leading in the preparation of the Mauritian VNR.

In this context, working sessions were held on the preparation of the VNR, wherein the MOI and other stakeholders were involved in the write up for SDG 14 which aims to conserve and sustainably manage the oceans, seas and marine resources.

Mrs. A. Audit-Manna

WIOMSA Ocean Acidification (OA) Workshop



In May 2018, WIOMSA (Western Indian Ocean Marine Science Association) in partnership with the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), the IAEA Ocean Acidification International Coordination Centre (OA-ICC) and the Global Ocean Acidification Observing Network (GOA-ON), made a call for proposals for establishing ocean acidification observation systems in the field from institutions in the WIO region. In 2019, only one platform is known to regularly provide ocean acidification data for the whole region, and so the objective was to obtain baseline data for the carbonate system in the Western Indian Ocean and to document the ongoing ocean acidification along the coast.

Six projects in six countries were selected – Kenya, Mauritius, Mozambique, Tanzania, Seychelles, South Africa. The Mauritius Oceanography Institute in collaboration with the University of Mauritius successfully submitted a joint research proposal that was selected for financial support. In this context, Dr. Yashvin Neehaul, in his capacity of Principal Investigator was convened to a regional meeting from the 12th to the 14th of February 2019 in Mombasa, Kenya.

The workshop was a platform to network with scientists in the region with the same interest and background on the investigation of climate change and Ocean Acidification. Furthermore, the scientific forum worked on the regional targets to enhance the understanding of ocean acidification.

Dr. Y. Neehaul

Networking event: Supporting research and innovation through the collaborative research and innovation schemes

The purpose was to enable individuals, enterprises, industry and R&D institutions to propose innovative, collaborative research and development projects / ideas in order to boost creativity and innovation. These could be sustained through intellectual property rights, towards applications made for the grant of Patents or registration of Industrial Designs. All stakeholders participated actively and shared their ideas or current projects being undertaken.

Mr. V. Bhantoo

Inception Workshop & 1st meeting of the Global Project Task Force of the GEF-UNDP-IMO Glofouling Partnerships project

The GloFouling Partnerships is a project to address the transfer of harmful aquatic species through biofouling in some of the developing regions of the world. Launched in December 2018, the GEF-UNDP-IMO GloFouling Project, will drive actions to implement the IMO Guidelines for the control and management of ships' biofouling and deliver essential contributions to the 2030 Agenda for Sustainable Development. These guidelines provide for a globally-consistent approach on how biofouling should be controlled and managed to minimize the transfer of invasive aquatic species through ships' hulls. Additionally, the project will also provide for the development of best practices and standards towards improved biofouling management in other ocean industries. Representatives from the 12 Lead Partnering Countries (LPCs); namely Mauritius, Brazil, Ecuador, Fiji, Indonesia, Jordan, Madagascar, Mexico, Peru, the Philippines, Sri Lanka and Tonga, along with four regional organizations, the IOC-UNESCO and numerous strategic partners attended its first Global Project Task Force meeting. This five-year GloFouling Partnerships project was lead-off at a global workshop at IMO Headquarters in London, UK, in an event from the 18th to 20th of March 2019.

Mr. P. Mussai



Lead Partnering Countries (Adapted from IMO: GloFouling Partnerships Project)

Geographical Information Systems National Training Workshop

The Mauritius Oceanography Institute (MOI) and the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping in collaboration with the Western Indian Ocean Marine Science Association (WIOMSA) organised a national training workshop on Geographic Information Systems (GIS) from the 14th to the 18th of January 2019 at the MOI. Supported by WIOMSA, the training course was delivered by Dr. Joseph Maina, a WIOMSA Trainer and a Spatial Information Scientist based at Macquarie University (MQU) in Sydney, Australia and Mr. Will Farebrother from MQU.

An Opening Ceremony was held on Monday 14th January 2019 at 09 30 hours with welcoming remarks by Dr. Ruby Moothien Pillay, Director of MOI followed by the official opening of the workshop by the Honourable Premdutt Koonjoo, Minister for Ocean Economy, Marine Resources, Fisheries and Shipping. Dr. Joseph Maina gave an overview of the workshop and the official ceremony ended with a group photo.

Invitees to the Opening Ceremony included officials from the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping and Board Members. The 5 day workshop was attended by thirty participants from MOI, the Environment and Sustainable Development Division of the Ministry of Social Security, National Solidarity, and Environment and Sustainable Development, the Fisheries Department as well as Fisheries Training and Extension Centre (FITEC) of the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping, the Ministry of Housing and Lands, the Continental Shelf, Maritime Zone Administration and Exploration (CSMZAE), the Mauritius Meteorological Services, the University of Mauritius. The Participants ranged from those who used GIS regularly, to those who had never heard or had any experience with GIS or Spatial Analyses prior to the workshop.

The aim of this training workshop introduced the concepts and application of Geographic Information Systems with conceptual and practical sessions for the analysis of spatial information using the ESRI ArcGIS suite of applications. The course provided a basic introduction to GIS including spatial data structures and sources, spatial tools, spatial data display and query, map generation, and basic spatial analysis using ArcGIS software.

The course consisted of short lectures interspersed with many hands-on exercises. The hands-on five day event covered core skills on applying GIS including the principals of GIS, and the exploration of data from a variety of sources. During the first three days of the training workshop, the GIS basics and foundational principals were introduced in a series of lectures, case studies and hands on practical exercises. During Day 3, participants were also introduced to data capture methods, including in the use of the latest technology of drones. Mr. Farebrother gave a lecture on the use of drones, their application, different types, costs, and drone-data processing techniques, before showcasing a typical drone mission by flying the drone within MOI premises.

During day 3, participants were also introduced to using GIS modelling and using GIS for decision support. Participants were then tasked to come up with a research questions in their respective areas of interest. A total of 10 projects were defined, and on days 4 and 5 participants proceeded with executing those projects with the help of the training team. As each of the projects required specific data, the IT team was at hand to download the required datasets, which participants proceeded to use for their projects. Some of the participants also used their own datasets. Participants engaged in diverse projects, topics ranged from identifying plastics pollution hotspots around Mauritius to vulnerability of coral reefs and identifying potential upwelling sites.

During the last day, a talk on "Aligning Marine Spatial Conservation Priorities with functional connectivity across maritime jurisdictions" by Dr. Joseph Maina was held in the Conference Room. Furthermore, the participants presented the results of their respective projects to fellow participants and other MOI staff. The quality of the presentations as well as the satisfaction by the participants were a clear demonstration that workshop objectives had been achieved and that the National GIS workshop was a successful event. The participants were given a certificate of participation at the end of the workshop.

Ms. R. Boyjoonauth



Speech by MOI Director



Speech by Minister

Training and Working session photos



Biofouling Project - First consultancy visit and team mobilisation

Mauritius coastal ecosystems and marine-based industries are particularly vulnerable to impacts of invasive aquatic species (IAS). International shipping, through the discharge of ballast water and hull biofouling have long been recognized as the main vectors contributing to the transfer and spread of marine IAS into new regions.

In order to address the transfer of harmful aquatic species through biofouling, the then Ministry of Ocean Economy, Marine Resources, Fisheries, Shipping and Outer Islands (Shipping Division) entered into an agreement with the MOI in 2016 to undertake the project Ships' Biofouling in Port Louis harbour.

Over the course of its duration, the project aims at developing a Biofouling Risk Assessment and Decision Support Tool (BRADS) that will be supplemented by a survey of ships for biofouling flora and fauna. In addition, a hydrodynamical and chemical fate model to demonstrate marine pollutant dispersion in the Port area will be developed as well the determination of butyltin and inorganic components of Port sediments.

During the current implementation phase of the project, a first team mobilization was conducted from the 13-15th March 2019, with the active participation of MOI, the project consultants and staff from key stakeholders namely Shipping Division, Mauritius Ports Authority and National Coast Guard. The 3 days multi-stakeholder working session were held at the Mauritius Maritime Training Academy (MMTA) and Mauritius Ports Authority (MPA). The discussions were focused on:

- Hull sampling protocol
- BRADS
- Hydrodynamic model



Figure 1: Multi-stakeholder discussion session at the MPA, Capitainerie Building



Figure 1: Training session at the MMTA amphitheatre

Moreover, field work was undertaken in the port area whereby baseline data related to water quality, sediment butyltin concentration and hydrodynamical exchange processes were collected using different oceanographic instruments. Captured data will then be used for the development of an integrated hydrodynamic and chemical fate model.



Figure 3: Filtration and labeling of collected seawater samples



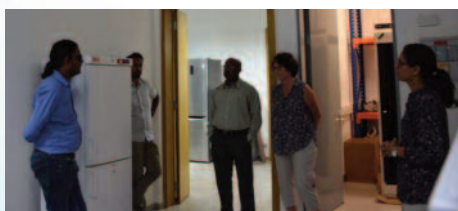
Figure 1: Mooring of ADCP

Mr. K. Ramdhony, Mrs. R. Sooroojebally & Mr. P. Mussai

Scientific Visit of Prof Christine Erbe from Curtin University

Professor Christine Erbe is the Director of the Centre for Marine Science & Technology at the Curtin University, Perth, Western Australia. She holds an M.Sc. in Physics from the University of Dortmund, Germany and a Ph.D. in Geophysics from the University of British Columbia, Canada. In view of potential avenues for collaboration, a meeting was held with the Director of MOI and Mr. Javed Iqbal Mosaheb, Principal Research Scientist to discuss about collaboration opportunities followed by a site visit whereby she met with the scientists to understand more about the various projects undertaken by MOI.

Ms. R. Boyjoonauth



Visit of laboratories and departments

Semester at Sea Student Visit

Semester at Sea (SAS) is a multi-country study-abroad program emphasizing global comparative study founded in 1963, now managed by the Institute for Shipboard Education in Fort Collins, Colorado, USA. Colorado State University is the current academic sponsor for the program while the program itself is run on the cruise ship MV World Odyssey. During the cruise ship call in Mauritius students are brought to experience and discover the social, cultural, economic, artistic, ecological and environmental facets of the destination.

In that context, some 60 international students visited the research facilities of the MOI on Monday the 11th of March 2019 with Ms. Sara Karen Arlin, Director of Academic Programs, Institute for Shipboard Education as part of the "Tropical Sustainability: Coral Reefs & Marine Ecosystems" Programme. As part of the visit, the accent was on the various research projects undertaken at the MOI for the sustainable development of the ocean economy in line with Government's Vision 2030.

Ms. R. Boyjoonauth

Career Education Program in Secondary Schools – Industrial Visit of Students of France Boyer DeLa Giroday SSS Girls

On Friday the 15th of March 2019, around 30 students of France Boyer De La Giroday SSS Girls visited the MOI in the context of a Career Education Programme in Secondary Schools organised by the Ministry of Education and Human Resources, Tertiary Education and Scientific Research.

The main aim of the visit was to apprise the students of the research activities undertaken at the MOI as well as to guide, counsel and advise students on educational as training possibilities and employment opportunities in oceanography. Dr. Manvendra Singh, Research Scientist welcomed the students and gave a description on the role and functions of the MOI as the technical of the Government. Mrs. Khishma Modoosoodun-Nicolas, Associate Research Scientist, then made a presentation on the research projects of the Institute and career prospects in oceanography. This was followed by a guided tour in the different laboratories with an in-depth description by the MOI scientists.



Visit of MOI Laboratories Facilities

Scientific Visit of the Korea Institute of Ocean Science and Technology (KIOST)

On Thursday the 18th of April 2019, the MOI received the visit of scientists from the Korea Institute of Ocean Science and Technology (KIOST). Taekeun Rho, a Korean scientist made a presentation about the R/V ISABU expedition in the MOI Conference Room in the presence of the MOI scientific staff followed by discussions for future collaboration in Indian Ocean Study.



Visit of MOI Laboratories Facilities