Climate change impacts and adaptation

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Ocean Acidification: A hidden risk to sustainable development in the Western Indian Ocean

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Summary

Ocean acidification (OA) is a profound change in ocean chemistry due to anthropogenic carbon dioxide (CO_2) emissions. The ocean represents 72 per cent of the Earth's surface and contains about 99 per cent of the available surface water. In response to the accumulation of CO_2 in the atmosphere, the ocean is currently absorbing about one-third of anthropogenic emissions (Gruber and others, 2019). This absorption rate is increasing as more CO_2 is emitted to the atmosphere via natural and anthropogenic pathways. The chemical dissolution of CO_2 in seawater is changing the carbonate chemistry of the ocean's surface, a phenomenon known as ocean acidification (OA). The ocean's average acidity has already increased by 30 per cent. Biogeochemical models based on the IPCC's business-as-usual CO_2 emissions scenario project a further decrease of average open ocean pH, leading to the acidity of up to 150 per cent higher than today (Doney and others, 2009). This rate of change is nearly ten times faster than anything observed within the past 50 million years, thus outpacing the ocean's capacity to restore oceanic pH and carbonate chemistry in the near future. Without rapid science-based action, the consequences of OA on marine species, ecosystems, associated services and peoples depending on them will be dramatic. A large body of evidence, based on paleo, laboratory and field observations, clearly demonstrates that OA will have strong negative impacts on many marine species and ecosystems. For example, up to 50 per cent of all tested marine animals, including many seafood species, are negatively impacted when exposed to near-future OA conditions (Wittmann and Pörtner 2013). OA already has a negative impact on some marine-related industries. For example, OA had a negative impact on the US Pacific Northwest oyster industry with an estimated US$110 000 000 cost, along with associated socio-economic impacts, direct or indirect, on 3 200 employees in the sector (Ekstrom and others, 2015). Addressing and minimising the negative impacts of OA requires urgent actions, combining mitigation (reduction of CO_2 emissions) and adaptation (Gattuso and others, 2015) which require local and regional data to efficiently inform the development and implementation of locally adapted solutions and the policy process.

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Background

OA will have consequences for the WIO region. Although OA is a global problem, it has cascading implications for regional and local ecological and socio-economic systems and, potentially, human health. Most marine species and ecosystems are likely to be impacted by the chemical changes associated with OA as more CO_2 is available for photosynthesis. Under low pH, organisms have to increase their energy investment to maintain pH homeostasis in their body and cells. This cost is particularly high in calcifying organisms that need to create high pH environments to precipitate calcium carbonate for their shells and skeletons. As a direct consequence, calcifying organisms facing OA are at risk, including reef corals (high biodiversity hotspots prized by tourists and essential to artisanal fisheries), deep corals (an essential resource for biodiversity and a potential biochemical reservoir for the pharmaceutical industry), and most benthic species of commercial interest and shellfisheries. These habitats and species are also key features of some of the Ecologically and Biologically Significant Marine Areas (EBSAs) of the Southern Indian Ocean (Secretariat of the Convention on Biological Diversity, 2016). Consequently, a series of appropriate priority actions were identified during the OA workshop in Zanzibar in 2019 to be included in an Action Plan for the region for consideration by the Nairobi Convention (Laffoley and others, 2020).

OA is now recognised as a major threat by the international community and is linked to various global initiatives such as the Paris Agreement on climate change and the CBD post-2020 Global Biodiversity Framework discussions. OA is also one of the targets of the Sustainable Development Goals (SDG 14.3, which calls for nations to minimise and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels). Furthermore, the Global Ocean Acidification Observing Network (GOA-ON), a network of 750 scientists and resource managers from 100 countries, sets guidelines for monitoring and assessing OA and provides a data portal for viewing where data is collected around the world. GOA-ON is supported by multiple organisations such as the IOC-UNESCO, IAEA-OA-ICC, NOAA OAP, and IOCCP. GOA-ON has already started establishing the technical and human capacity for OA measurement, including in the WIO.

Advances in the WIO

Local and regional data are needed to develop and implement adaptation solutions. Research over the last fifteen years has led to a better understanding of OA's chemical and biological aspects and, in turn, the potential socio-economic effects on the global scale (Hall-Spencer and Harvey 2019). This research also demonstrated that biological response is highly dependent on local conditions (Vargas and others, 2017). The ocean's chemistry varies tremendously between regions and over time (days, seasons, etc.). This is particularly true in the coastal zones where other processes such as currents, biology or pollution play a key role. Understanding and forecasting the future impacts of OA requires understanding the local chemical conditions (monitoring) and consequences of changing carbonate chemistry on local species and ecosystems (biological experimentations and field observations). It is not possible to simply extrapolate data from one region to another.

The house is on fire- OA research should be prioritised toward short-term solutions. There is an urgency in developing and implementing mitigation and adaptation solutions to address OA, which strongly rely on the evaluation of the regional societal needs (eg key ocean services and industries threatened by OA), identification and collection of the needed data (eg monitoring at the relevant Spatio-temporal scale and understanding of biological impacts and their complexity regarding ecological interactions, multiple stressors, evolution). This co-design approach aligns with the UN Decade for the Ocean call to develop the "science we need for the ocean we want". The framework for building multi-national ocean governance exists in the WIO region and is facilitated by the UN SDGs, the UNEP Regional Seas Framework, and the Work Programme of the Nairobi Convention (2018-2022; main activity 39l, "Building capacities and partnerships to address the impacts of ocean acidification, including scientific cooperation at the national and regional levels." under the Assessments and Capacity Development section, but also activities 39a and j).

Ocean acidification research in the WIO is in its infancy. The monitoring of OA in the Indian Ocean lags far behind other oceans if data coverage of CO_2 partial pressure (pCO_2) in surface waters is used to indicate the intensity of the scientific effort (Figure 1). These gaps in data collection have led to serious underestimation and high variability of the contribution of the Indian Ocean to the global sink of anthropogenic CO_2 (ie 21±10%; Gruber and others 2019). Better data would allow characterisation of OA' hot spots' where more research and protection efforts could be directed.

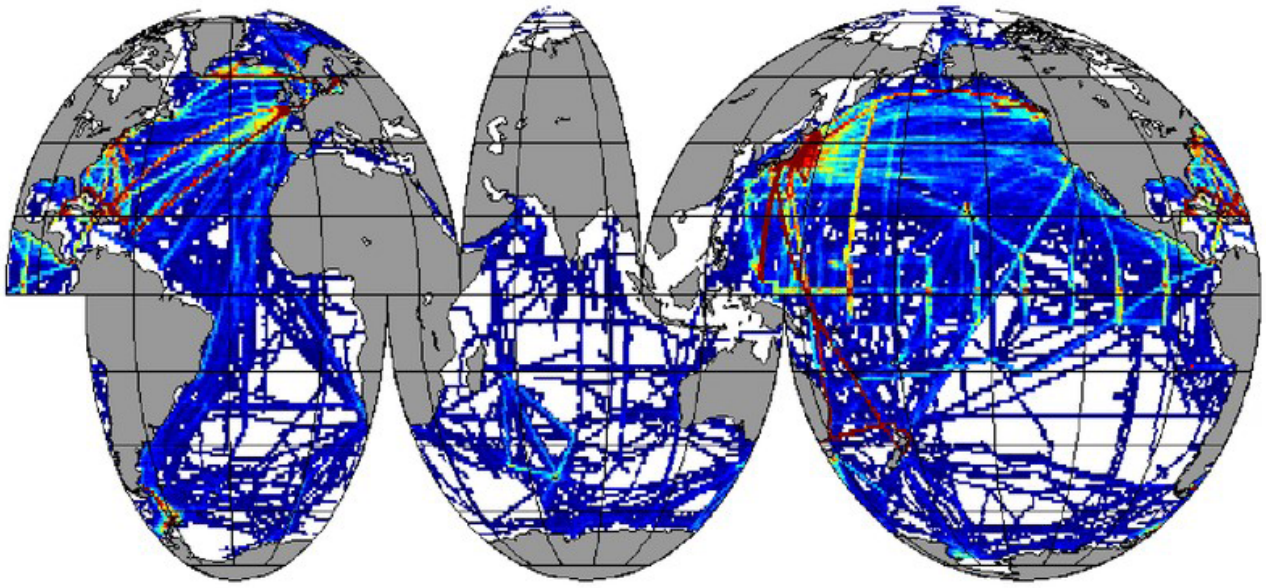

Figure 1. Historical inventory of global surface pCO_2 data used to illustrate the scientific effort towards monitoring OA. A large proportion of the central and western Indian Ocean (centre) has not been surveyed (Bakker and others, 2016).

Small-scale regional projects are already documenting the impacts of OA

For example, in the Mascarene region, at the eastern boundary of the WIO, surface pCO_2 was found in equilibrium with the atmosphere and surface pH in the expected range, around 8.1 (Harlay unpublished data; DFN2018406 EAF-Nansen cruise report). However, in vertical profiles of dissolved carbonate concentration, the 1 per cent aragonite saturation horizon (Ω_{Ara}=1), the chemical boundary below which seawater becomes corrosive to calcium carbonate used by many marine organisms to build their shells and skeletons, was at 750 m depth, 250 m above the previous observations, 23 years previously (ie the nine *R/V Knorr* expeditions in 1994-96). It is believed that this process will occur at an even faster rate in the future as CO_2 continues to increase in the atmosphere, leading to unfavourable environments for many key species as early as 2050. Investigations and experiments on OA's biological and ecological impacts are also being undertaken to focus on coastal ecosystems. For example, the juveniles of the fish *Argyrosomus japonicus* Dusky kob from South Africa were shown to be highly sensitive to near-future OA (Edworthy 2017). A critical reef-building coral (*Acropora austera*) in South Africa was also shown to exhibit a much slower growth in near-future OA conditions.

Regional and Global Outlook

The Nairobi Convention can critically assist with a highly needed strategic focus on OA in the WIO region. This paper is a new response to past COP decisions, CP.9/9 (Climate change adaptation and mitigation), to urge Contracting Parties to address the impact of OA, including through capacity development and the enhancement of scientific cooperation in partnership with research and academic institutions, regional monitoring and adaptation activities. Recently, WIOMSA, in partnership with IOC-UNESCO, IAEA-OA-ICC, and GOA-ON, supported six projects along the Eastern African Coast (Kenya, Mauritius, Mozambique, Seychelles, South Africa and Tanzania) to support OA observation systems in the field and the implementation of the SDG 14.3.1 indicator methodology. Further, the investigation of biological response to OA using laboratory-based experiments or a combination of both is being investigated as described in the East Africa OA White Paper (Ramessur and others, 2020).

The objectives of the Nairobi Convention can further support OA initiatives by:

- Supporting the development of a regional strategy for East Africa through regional workshops in the WIO region, bringing together scientists, policymakers and ocean users.
- Prioritising solution-oriented OA research to help countries achieve SDG target 14.3, which minimises OA's impacts.
- Creating a community of practice in the WIO focused on OA and other stressors of the marine environment.

- Developing and implementing mitigation and adaptation solutions to address and minimise the impacts of OA.

Conclusions and recommendations on ocean acidification in the WIO.

Take-home message – Ocean Acidification (OA) is a quantifiable and ongoing global process resulting from CO_2 emissions. Our understanding of the regional ecological and socio-economic consequences of OA in the WIO is limited. This knowledge is needed for the development and implementation of solutions. It will be enhanced by investigating and linking ocean and coastal carbonate chemistry with biological responses and the consequences for marine ecosystem services. This requires local and regional data and prioritisation of science towards solutions. WIO scientists are not currently empowered to address the issue of OA. We ask policymakers to recognise the threat posed by OA and for political support for further development, expansion, and enhancement of this area of research in the region, for example, through international research programmes, grants, and researchers' mobility frameworks.

Promoting a national and regional solution-oriented research strategy – The only way to fully address OA is to reduce global CO_2 emissions (mitigation). However, as OA effects are already visible today on marine ecosystems and services, it is critical to implement adaptation strategies to avoid dramatic effects within the timeframe required for mitigation (Gattuso and others, 2015). Adaptation strategies include protection of ecosystems (eg, marine protected areas, reduction of other environmental stressors), repair of damaged ecosystems (eg, restoration programmes) as well as adaptation (eg, change in aquaculture practices). Identification of local priorities should be based on local needs, availability of solutions and ease of implementation. This approach, involving scientists and ocean users, would prioritise data gaps and research needs.

Communication and Mitigation – Outreach and educational programmes must involve a concerted effort to communicate OA and its threat to the public. Special attention should be given to training and capacity development at the political-decision making level, to people with influence, national administrations and NGOs. The United Nations Policy Brief on OA as a platform can be used so that National Action Plans can be formulated, regional and local policies developed, and general awareness of OA promoted. There must be a regional commitment to climate change mitigation, via the Paris Agreement, with a view for national implementation of emission reduction strategies and adaptation plans relevant to the WIO marine environment.

Research and Adaptation – The development and implementation of efficient adaptation strategies to minimise the impact of OA directly depend on scientific understanding and many knowledge gaps remain in the WIO region. OA research can be expensive and remains inaccessible to most coastal communities worldwide and in the WIO. Thus, there is an immediate need for funding research, knowledge sharing and transfer, and capacity development. Depending on the local needs and gaps in data, research will include: (i) short-term high-resolution chemical monitoring aimed at capturing the present natural variability experienced by key marine ecosystems (*weather*); (ii) long-term chemical monitoring to feed regional and international databases and help modellers refine their carbonate budgets and OA projections at the regional scale in the WIO; (iii) biological monitoring as well as laboratory and field experiments aimed at understanding the mechanisms behind how key marine species and ecosystems respond to OA and other key environmental drivers. This is particularly important considering that many habitats and organisms that form the base of the food chain in the region and support large fisheries are biogenic accretors particularly vulnerable to OA. The economic impact of OA on fisheries and tourism is likely to be substantial and may include loss of profits and employment and may even lead to loss of coastal infrastructure due to decreased storm protection facilitated by reefs because of OA. The impact of OA needs to be considered in planning socio-economic activities that form part of the regional ocean economy as it poses a hidden risk for sustainable development.

Technical recommendations

The Secretariat working with WIOMSA and other partners support the development of a regional strategy for capacity building bringing together scientists, policymakers and ocean users. The Secretariat working with partners must establish a community of practice in the WIO focused on OA.

Policy recommendations

We call upon the Contracting Parties to develop and implement mitigation and adaptation solutions to address and minimise the impacts of OA as part of their broader climate-change intervention strategies.

Our recommendation should also include prioritising solution-oriented OA research to help their countries achieve SDG target 14.3, which aims at minimising the impacts of OA.

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COVID-19 and the future of Ocean Sustainability: supporting adaptation to post-COVID changes in the Western Indian Ocean

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Summary

The COVID-19 pandemic is generating significant changes for the future of the ocean. Here, we summarise the findings of a participatory process that brought together 25 diverse stakeholders from across the globe, including WIO participants, to understand those changes and identify their strategic implications.We focussed on the short term and long-term impacts of COVID-19 on seven areas that are key to ocean sustainability: healthy, sustainable ecosystems; community resilience and sustainable livelihoods; inclusive, sustainable economies; equality and equity; effective governance; climate change adaptation and mitigation; and awareness and understanding. It identifies how, in the short term, the medical response and associated lockdowns are impacting these seven key areas. The report also looks at how three priority long term impacts areas, including widespread economic recessions; increasing digitalization; and changes to data and research, might impact ocean sustainability. It also reveals that these impacts may be positive or negative depending on different alleviating and exacerbating factors.From these impacts, alleviators and exacerbators, we identified six areas for strategic action to shift the balance of impacts, particularly in the long term, towards positive outcomes and away from negative ones. These six areas emphasize the opportunity COVID provides: to select inclusive, equitable and sustainable options over inequitable and unsustainable options in all actions; to leverage the inevitable digitalization towards positive outcomes; to embrace interconnectivity and complexity; to leverage the unique global event to support shifts in mindsets towards long term solutions; to reduce compounding ecosystem pressures and threats particularly that affect the most vulnerable people, and to build resilience at all levels – across social and ecological domains.

Pathways to a more sustainable future will involve transitioning responses to short term impacts into long term actions and responses, promoting factors that alleviate impacts and transforming factors that exacerbate impacts. Recommendations for implementation in the WIO include:

- Incorporate scenario or 'future thinking' approaches into project development and adapting to COVID-19 to strengthen and take advantage of alleviators and avoid or reduce the influence of exacerbators;
- Identify how one or more of the strategic interventions can be mainstreamed into COVID-recovery and other projects and processes;
- Support dialogues and consultations at relevant levels (local, national, regional) for WIO participants to explore and define their experience of COVID-19 and its implications for their lives and work.

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Background

The COVID-19 pandemic has transformed human activity from the scale of the globe down to individuals, including across Western Indian Ocean (WIO) countries. While prior pandemics have had higher mortality figures, and events such as wars and natural disasters have transformed the policies and actions of countries across the planet, no other pandemic, nor any other pressure, has changed peoples' behaviour so foundationally across all these scales.

People stopped travelling, with perhaps the greatest impact on a core sector for WIO countries - the tourism and travel industry. At the same time, fisheries were affected by labour shortages, broken value chains, and collapsed processing industries. Maritime transport has faced a severe disruption, with 40 per cent of ports having seen a 25 per cent decline in throughputs. Many seafarers were unable to resume their merchant shipping services. Offshore energy, including renewable operations, representing vital contributions to the

Figure 1. A) As the COVID lockdown extended in June-August 2020, support programmes were put in place by many NGOs and civil society groups, donating basic provisions to fishing and other coastal communities. B) Returning to fieldwork and community engagement required adhering to guidelines such as wearing masks and limited participants in more open spaces (Credit: D Obura)

Two Global Cohorts of Participants

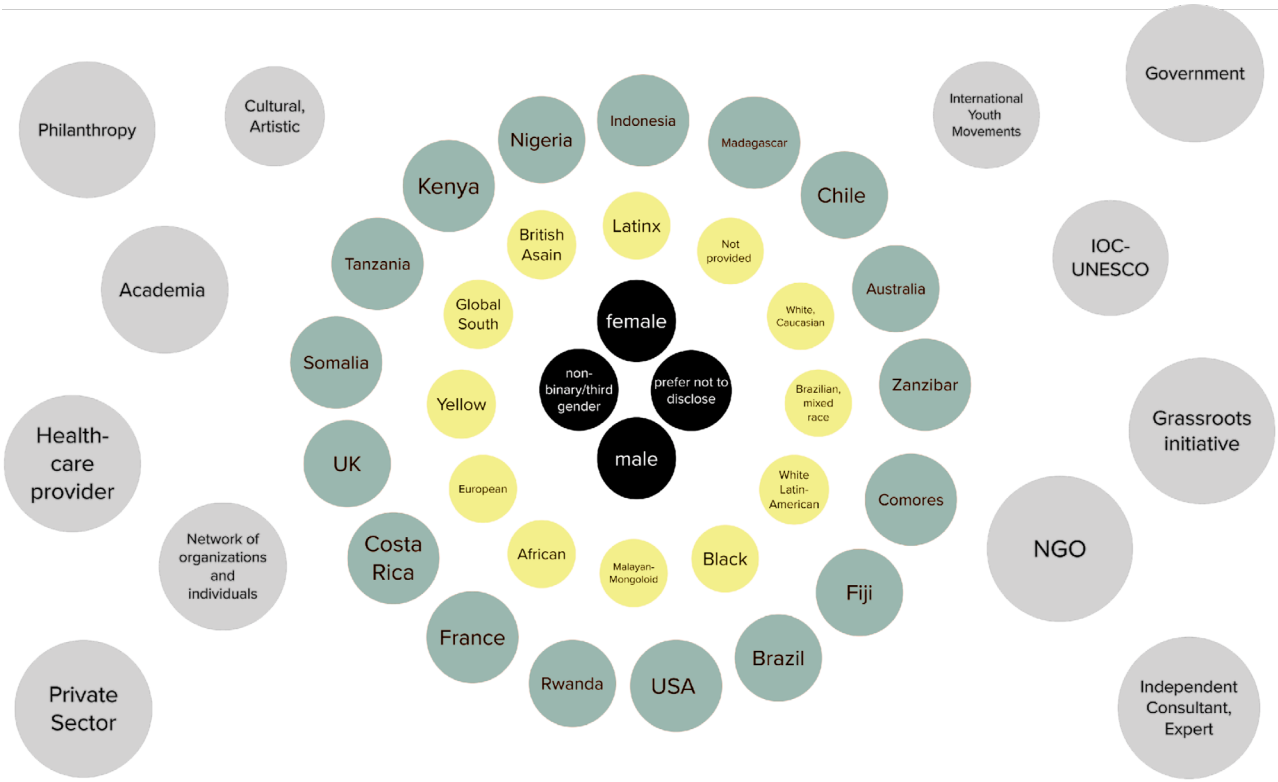

Figure 2. Representation of participants in the COVID-19 lab process by gender (inner, black), ethnicity (yellow), country (orange) and profession (grey).

global economy and supply chains, faced challenges to conducting personnel changeovers and could not get specialized personnel on offshore platforms to undergo routine safety inspections and maintenance checks. Vast amounts of data and research on ocean energy exploration have also been disrupted.

The impact of COVID-19 in individual sectors of human activity are multiple, and studies are emerging documenting how it has affected coastal societies and communities, such as small-scale fishing (Bennett and others, 2020) and coastal cities (Kithiia and others, 2020).

The uncertainties of a pandemic on this scale make it almost impossible for entities from countries to sub-national governments to businesses, communities, and even families to plan for their future. Will people be able to travel in one month, or three months, or one year? Travel restrictions persisted for 18 months, coming and going with new infection waves. Will schools reopen, then close again? Will jobs be available once people can go back to work? How can people interact as they are used to – shaking hands, meeting across a table or in a traditional ceremony, in sports and cultural events, in politics and religious gatherings?

Post COVID-19 resilience and recovery measures are needed across the planet (Büscher and others, 2021). For regions such as the WIO, recovery will depend on our ability to engage sustainable approaches towards local, national, regional and multilateral development cooperation. So building back better in terms of blue recovery will depend on our resolve to revitalize tourism and travel, fisheries, maritime transport, ocean renewable energy sectors. This should incorporate strategies that cut across multiple sectors and countries of the region in a holistic, "source to sea" approach. Governments, NGOs, businesses and other stakeholders all need to do their part to reduce marine pollution at source while protecting and restoring coastal and marine ecosystems and to create alternative livelihoods and business opportunities derived from the ocean spaces; develop or modernize port and coastal infrastructure; engage sustainable fisheries, aquaculture, tourism and maritime industry;

Table 1. Ocean sustainability areas and the alleviators (factors that reduce impacts) and exacerbators (factors that intensify impacts) that affect them, identified by lab participants.

Ocean sustainability areas	Alleviators	Exacerbators
• Healthy, sustainable ecosystems • Community resilience and sustainable livelihoods • Inclusive, sustainable economies • Equality and equity • Effective governance • Climate Change Adaptation and Mitigation • Awareness and understanding	• Cooperation • Effective governance • Empowered and supported local communities • Strategic use of the disruption • Funding • Inspired youth leaders • Improving equity • Increasing equality	• Tendency towards business as usual • Unsupportive political environments • Siloed thinking and action • Climate change impacts • Reduced focus on climate change and environment • Degraded quality of international negotiations and other governance dialogues • Poor capacity in key actors

enhance ocean-related energy sources, and integrate waste management

The United Nations has adopted ocean governance and sustainable development processes as part of its Sustainable Development Goals (SDGs). In particular, SDG 14 commits to "Conserve and sustainably use the oceans, seas, and marine resources for sustainable development". The COVID-19 pandemic, affecting SDG 3 on "good health and wellbeing", impacted all other domains of the SDGs, raising calls for a "One Health" approach to resolving it (Häsler and others, 2020; Ruckert and others, 2020) and applicable to understanding its impacts on achieving SDG 14.

To facilitate this multi-sectoral and multi-stakeholder engagement, we need fora to meet to consider all these challenges and identify pathways to move forward in their context. Further, there is a need for joint action at the regional level in the WIO to align coastal and marine responses to the COVID-19 pandemic and harmonize approaches to tackle shared challenges.

This Sustainable Oceans Lab event was convened as a first step to bring together 25 diverse stakeholders from across the globe (figure 2) in a rapid online process to engage together to develop a systems-level analysis of the short and long-term implications of the COVID-19 crisis (CORDIO and Reos Partners, 2020). Learning from these findings, we may identify mechanisms for regionally-focused events to do the same, to support better from COVID-19 concerning Western Indian Ocean sustainability.

Advances

The lab looked at the short-term impacts of COVID-19 – both the medical response and the lockdowns – on seven key areas of ocean sustainability (Table 1). A surprise to participants was that impacts may have both a positive face and a negative face, and which of

Table 2. Long term sustainability areas identified by lab participants and how they may evolve through positive and negative scenarios into the future.

	Positive scenario	Negative scenario
Economic recession	**Regrow and Adapt** – the hardships of the COVID-19 response inspire people to look beyond economic growth to focus on a more holistic view of wellbeing and equity among people.	**Withdraw and Protect** – the hardships of the COVID-19 response lock-in tendencies towards 'business as usual', siloed thinking, and narrow political approaches.
Increasing digitalization	**Connecting Worlds** – many months spent online to give people greater hunger for an emotional and physical connection with nature and with one another.	**Digital Divide** – as people lose contact with nature and each other, their links erode misinformation increases, and decision-making disconnects from reality.
Changes to data and research	**Discovery** – this "real-world experiment" teaches people surprising connections and opportunities, unlocking new approaches, inspiration, learning and cooperation to "build forward better".	**Closing Down** – the stoppages in research, monitoring and data collection lead to data gaps and difficulty restarting them after lockdowns. Research and new thinking are blocked, and people close down into their comfort zones, impeding progress.

these dominates could depend on a range of 'alleviators' (emphasizing the positive) and 'exacerbators' (emphasizing the negative).

In the long term, participants emphasized how three key responses - widespread economic recession, increasing digitalization, and changes to data and research, might affect the ocean sustainability areas (Table 2). Scenarios highlighting positive versus negative pathways in each of these domains illustrate this:

COVID-19 has changed the landscape of strategic interventions that can help to advance ocean sustainability and achieve SDG 14. Further, actions to achieve sustainability and SDG14 can play a key role in supporting recovery and rebuilding from COVID-19. The lab identified six major areas for strategic action (figure 3) that would help actors on the ground, including communities, governments, businesses, NGOs, researchers, and others. Particularly when working together across their diverse perspectives, backgrounds and interests, identify how to turn negatives into positives – to avoid and transform the 'bad' scenarios' and create 'good' scenarios and pathways in the specific context they may be in.

Outlook to regional and global processes

In the WIO region context, ocean governance is linked to all relevant national, regional and international regulatory frameworks (Momanyi, 2015). These include, but are not limited, to the UN Convention on the Law of the Sea; the Convention on Biological Diversity; the International Convention for the Prevention of Marine Pollution from Ships (MARPOL); The United Nations Fish Stocks Agreement; The Food and Agriculture Organisation (FAO) Code of Conduct of Responsible Fisheries; the South-West Indian Ocean Fisheries Commission (SWIOFC); the Agreement of the Indian Ocean Tuna Commission (IOTC); and the Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported, and Unregulated Fishing.

The Nairobi Convention aims to address and mitigate environmental degradation activities that harm marine life, undermine coastal communities, and negatively affect human health in the western Indian Ocean region. These threats make it more important than ever for governments in the region to work together to strengthen the protection of the ocean through policy interactions, technical cooperation, science and research – and hence the core importance of the Nairobi Convention for post-COVID recovery in the WIO. Western Indian Ocean countries, through the support of the Nairobi Convention, made a variety of commitments under SDG 14 in the UN Oceans Conference in 2017 and are likely to play a prominent role in the second Oceans Conference to be co-hosted by Kenya and Portugal in June 2022.

Relevance to the Nairobi Convention and its Work programme

Applying these strategic approaches will support achieving SDG 14 and SDG 3 to improve resilience to the ongoing and future impacts of COVID-19 and broader health and other diverse threats experienced in the future. The threat from COVID-19 was not anticipated except in specialized health sectors before December 2019. As a result, the Nairobi Convention's Work Programme for 2018-2022 does not explicitly reference health aspects relative to the pandemic. However, general areas of building capacity and resilience to cope with multiple and diverse threats, including climate change, are relevant and a core part of the Work Programme:

- Paragraph 31 (b) To support countries in their commitment to the attainment of the 2030

Figure 3. Strategic interventions to 'build forward better' from Covid-19 for ocean sustainability (adapted from CORDIO and Reos Partners, 2020).

Agenda and the Sustainable Development Goals, in particular through Goal 14, to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

- Paragraph 24 on building partnerships by implementing catalytic activities under programmes and projects supported by members of the Consortium for the Conservation of Coastal and Marine Ecosystems in the Western Indian Ocean and other non-governmental organizations.
- Under Information and awareness, paragraph 45 (k) Convening science-policy dialogues for scientists, policymakers, and decision-makers civil society and the private sector, in collaboration with partners, to provide knowledge and generate approaches to tackling current and emerging threats.

Recommendations

Recommendations from the 'COVID-19 and the future of Ocean Sustainability' process provide tangible guidance to 'build back better' from the challenges of the pandemic and across other major threats and challenges. This is a particular challenge when projects may already have predetermined actions and log frames that may not be able to address new realities post-COVID. The following approaches or actions can be adopted to alleviate this, which we call technical recommendations because of their practical application in project and discussion processes.

Technical recommendations

- Incorporate scenario or 'future thinking' approaches into project development to adapt to COVID-19. To do this, consider how to **take advantage of and strengthen alleviators** – which help generate positive actions and outcomes, such as cooperation, empowered communities, inspired youth leaders – while **avoiding and reducing the influence of exacerbators** – which reinforce and worsen negative actions and outcomes, such as unsupportive political environments, siloed thinking and tendency towards business as usual – to create positive outcomes to help deliver favourable outcomes.
- Identify how one or more of the **strategic interventions can be mainstreamed** into COVID-recovery and other projects and processes:
  - Ensure inclusive, blue, sustainable approaches
  - Build resilience of people and ecosystems to withstand future shocks
  - Embrace interconnectivity and complexity
  - Leverage digitalization to enhance activities, outputs and outcomes
  - Reduce ecosystem pressures and threats
  - Support shifts in mindsets to promote positive and reduce negative scenarios.
- **Support dialogues and consultations** at relevant levels (local, national, regional) for WIO participants to explore and define their experience of COVID-19 and its implications for their lives and work. This may occur through ongoing or new projects, joining the Sustainable Oceans Lab (www.sustainableoceanslab.org) or initiating similar processes in the region. Other examples of scenario processes to foster more effective and contextualized actions include the WIO Futures Scenarios (www.wiofutures.org).

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