Chapter 10

The way forward – where the Nansen Programme should focus in future

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"The third *Nansen* and a new programme phase are expected to play a pivotal role in realizing ocean economies in developing countries."

Abstract

Increasingly, it is recognized that oceans can be vital components of economic growth. They are influential in regulating climate, sustaining ecosystems and abundant marine resources, and supporting the livelihoods of people around the world. Their importance has given rise to a global "blue economy" initiative, in which continued economic growth and the sustainable use of ocean and coastal resources are closely coupled. Within this context, the launch of a third RV *Dr Fridtjof Nansen* and a new EAF-Nansen Programme phase in 2017 were important events, because they are expected to play a pivotal role in realizing ocean economies in developing countries. In the Western Indian Ocean region, fast-growing economies and increasing coastal populations rely on the ocean as an essential source of food security, economic activity and livelihoods. Nearshore fisheries are dominated by local small-scale operations, whereas industrial fleets, many of foreign origin, harvest tunas and related species in offshore waters. Offshore oil and gas exploration continues to increase. To a large extent, the use of marine resources remains uncoordinated and weakly regulated, with signs of overexploitation and degradation of coastal habitats. The preceding chapters of this book dealt with the contributions of the Nansen Programme to understanding the physical oceanographic processes in the region, ocean productivity, and the distribution and abundance of fisheries resources. The progress in strengthening scientific capacity, policy development and the implementation of fisheries management strategies was also evaluated. Chapter 10 now looks towards the future, where the objectives of the new EAF-Nansen Programme will be to investigate the potential of fisheries resources; understand the ecological impacts of oil and gas activities, and land-based pollution; and measure the impacts of climate change on coastal and marine resources. In combination, these objectives are geared towards promoting an ocean (or "blue") economy, using mechanisms such as ecosystem-based management, marine spatial planning and regional collaboration.

Previous page: Ocean, people and fishing boats in Zanzibar – towards a sustainable future. © Shutterstock.com/damn12.

10.1 Introduction

Whereas the first nine chapters of this book focussed on four decades of marine research and discoveries contributed by the Nansen Programme, Chapter 10 looks to the future. The chapter is well-timed, because it comes at the beginning of a new programme phase (EAF-Nansen Programme) entitled "Supporting the application of the Ecosystem Approach to Fisheries management, considering climate and pollution impacts". The new programme agreement was signed in Oslo, Norway, on 24 March 2017 (Figure 10.1). Also in 2017, the third RV *Dr Fridtjof Nansen* was commissioned, to replace the older second vessel, thus increasing the scientific reach and capacity of the programme (Figure 10.2).

These changes at strategic and operational levels coincide with a turbulent period in the history of sustainable use of natural resources, where the combined effects of climate change and overexploitation are becoming manifest. An effective response to these existential threats is long overdue. The role that the EAF-Nansen Programme with its flagship research vessel can play in the developing world, and particularly in the Western Indian Ocean, is examined.

The Science Plan of the new EAF-Nansen Programme (FAO, 2017) outlines three priority research areas:

- Fisheries resources, distribution, abundance and structure; and dynamics of key bycatch species;
- Understanding the impacts of oil and gas activities, and land-based pollution, including marine debris and microplastics;
- Measuring the impacts of climate change on coastal and marine resources, including the use of long-term monitoring systems.

In combination, the three priority areas are expected to promote an ocean (or "blue") economy, using mechanisms such as ecosystem-based management, marine spatial planning and regional collaboration.

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Figure 10.1 Signing ceremony of the new EAF-Nansen Programme agreement on 24 March 2017. Present are (L-R), FAO Assistant Director General for Fisheries, Director General of FAO, Assistant Director General of Norad, Norwegian Minister of Foreign Affairs and the Managing Director of the Institute of Marine Research.

In Chapter 10, the regional socio-ecological milieu within which the new EAF-Nansen Programme will have to operate is shown, to highlight important socio-economic and ecological stressors. Global and regional processes to advance sustainable development in the oceans provide a fundamental grounding for the role of the EAF-Nansen Programme in developing countries. Hence, key processes and their potential influences are listed. Preceding chapters have identified specific knowledge gaps that still exist in the Western Indian Ocean arena. Ways in which the gaps can be addressed by future *Nansen* surveys, or through the broader EAF-Nansen Programme, are recommended.

10.2 Socio-economic and ecological setting

A current conservative estimate of the economic value of goods and services provided by coastal and marine environments of the Western Indian Ocean is US$ 20.8 billion annually (Obura *et al.*, 2017). This value, also referred to as "annual gross marine product", is calculated in a similar way to the annual gross domestic product (GDP)

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Figure 10.2 The third RV *Dr Fridtjof Nansen*, commissioned in 2017.

of a country. The gross marine product is derived from direct outputs from the ocean (such as fisheries), services supported by the ocean (for instance, marine tourism), and adjacent benefits associated with the coastlines, such as carbon sequestration. Coastal and marine tourism accounts for 69 percent (US$ 14.3 billion) of the gross marine product, followed by carbon sequestration (14 percent; US$ 2.9 billion) and fisheries (9 percent; US$ 1.9 billion). Of the US$ 1.9 billion contributed by fisheries, 87 percent originates from industrial fisheries and 13 percent from artisanal and small-scale fisheries. The Indian Ocean supports the second largest tuna fishery in the world, after the Pacific Ocean, and 70–80 percent of Indian Ocean tuna are caught in the Western Indian Ocean – around 850 000 tonnes per annum, valued at over US$ 1.3 billion (Obura *et al*., 2017).

Livelihood activities of coastal communities have undergone major change in recent decades, as a result of population growth, policy measures, global economic expansion and markets, resource condition and poverty. Artisanal/small-scale fisheries remain the main source of livelihood in many coastal communities. Other activities include tourism, agriculture, subsistence forestry, mariculture, small-scale mining (stone and sand quarrying, lime and salt production), trading, livestock husbandry, and trade in handicrafts. More formal employment, such as in industrial fisheries, or in the oil and gas or shipping and ports industries (UNEP-Nairobi Convention and WIOMSA, 2015) has also taken root. The recent successful exploration of oil and gas increases the potential for social and economic growth, but maintaining a delicate balance between environmental management and economic pursuits will be critical in the near future (UNEP-Nairobi Convention and WIOMSA, 2015).

The Western Indian Ocean is considered a distinct subdivision of the tropical Indo-West Pacific biogeographic region (Sheppard, 1987, 2000) with productive coastal habitats and a rich biodiversity, but low biomass of individual species.

Until recently, the region was relatively unknown, and less heavily impacted than many other ocean basins (Halpern *et al*., 2008; Stojanovic and Farmer, 2013). Rapid economic growth in recent decades, and concomitant increases in coastal populations, fishing, shipping, oil and gas exploitation, agriculture and urbanization have escalated environmental impacts, and are eroding the resource base. Hence ocean-dependent communities in the region often face economic hardship – including food insecurity (UNEP-Nairobi Convention and WIOMSA, 2015).

In addition to institutional weaknesses, management processes are often hamstrung because of the lack of reliable information. In several cases, environmental or fisheries management strategies have been adopted, but cannot be implemented because of a lack of basic information. Investment in research remains low, and collaboration between research institutions and management authorities is inadequate. Novel and integrated legal and management solutions to existing problems are required; these can be facilitated by the experience brought by partners, such as the EAF-Nansen Programme.

10.3 Global and regional processes towards sustainable development in oceans

The global discourse on the state of the environment places increasing emphasis on the sustainable use of ocean and coastal resources, in what has become known as the "blue economy" or "sustainable ocean economy". This is manifest in an increasing number of formal processes, at global, regional and national levels, aimed at sustainable development in oceans. These processes guide strategic thinking within the EAF-Nansen Programme, and are essential to the understanding of its role in the Western Indian Ocean over the next decades.

In September 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development with 17 Sustainable Development Goals (SDGs) and 169 underlying targets. SDG 14 – "*to conserve and sustainably use the oceans, seas and marine resources for sustainable development*" – confirms the importance of conservation and sustainable use of the coastal and marine resources for long-term economic growth, food security and poverty alleviation. It further provides impetus to the development of solutions to cross-sector threats, such as the impacts of the fisheries sector on the conservation of biodiversity.

The Paris Agreement of December 2015 is grounded in the UN Framework Convention on Climate Change (UNFCCC), and aims to strengthen the global response to climate change. It recognizes the importance of oceans within the Preamble and in the Agreement itself, under the banner of Ecosystem Integrity. Articles 4 and 5 exhort parties to promote sustainable management, and in article 7.7.b, parties are invited to strengthen climate science, including research, systematic observation, and early warning systems.

In 2012, the African Union (AU) approved Africa's Integrated Maritime (AIM) Strategy – 2050 (African Union, 2012), thus recognizing the vast potential for wealth creation of the continent's inland waters, oceans and seas. The 2050 AIM Strategy proposes Marine Spatial Planning as a mechanism to balance competing sector-based interests, and that a blue economy is implemented. This was followed in 2014 by the Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (PFRS) (African Union, 2014).

FAO launched the Blue Growth Initiative (BGI) in 2013, based on the blue economy concept that emerged from the Rio+20 Conference in 2012 and on the Code of Conduct for Responsible Fisheries (FAO, 1995). The BGI aims to restore the potential of oceans and wetlands by introducing sustainable approaches to reconciling economic growth and food security.

The First Global Integrated Marine Assessment (World Ocean Assessment) was accepted by the UN General Assembly in January 2016 (www.worldoceanassessment.org). It provides a scientific

basis for dealing with ocean issues, and is targeted at governments and intergovernmental processes. It reinforces the science-policy interface and establishes a basis for future assessments.

The Regional State of the Coast Report for the Western Indian Ocean (UNEP-Nairobi Convention and WIOMSA, 2015) was launched during the 8th Conference of the Parties (COP) of the Nairobi Convention in June 2015. It reported on the economic potential of the Western Indian Ocean, and the consequential demand for marine ecosystem goods and services. It also provided a summary for policy makers (UNEP-Nairobi Convention and WIOMSA, 2016). The report highlights the increasing human population, pace and scale of environmental changes, and opportunities to avoid serious degradation. It presents exploratory scenarios and policy analyses to assist with decision-making. Key recommendations were to: increase levels of funding for marine research; expand the knowledge of resources, their environment and social aspects of exploitation; invest in human capacity development; promote equitable access and benefit sharing; and to adopt a blue economy.

At national level, Seychelles has adopted the blue economy concept, Mauritius is investing in ocean economy, South Africa relies on its Operation Phakisa to unlock its ocean economy, and Kenya now has a State Department of Fisheries and Blue Economy, under the Ministry of Agriculture, Livestock, Fisheries and Blue Economy.

The global, regional and national processes have similar higher level priorities in common, all of which provide strategic guidance to the nascent new EAF-Nansen Programme phase in the Western Indian Ocean. Key guidelines that emerge from these processes, and that can inform the EAF-Nansen Programme, revolve primarily around potential benefits inherent in a blue economy. In a blue economy, benefits are derived in an environmentally responsible and sustainable manner. It is suggested that this important emerging theme of "blue economy" represents the fourth component of the overall Science Plan with the following guidelines:

- Greater emphasis on the sustainable use of ocean and coastal resources, through promotion of sustainable ocean economy (or blue economy);
- Use of ecosystem-based management and marine spatial planning as mechanisms to support blue economy; and
- Establishment of comprehensive monitoring schemes for the marine environment.

10.4 Knowledge gaps and the future role of the EAF-Nansen Programme

In the preceding chapters, specific knowledge gaps which could potentially be filled by a future EAF-Nansen Programme, have been identified. Here we list the most important of these, and suggest ways in which they can be approached by the programme. The gaps and recommendations below are specific to the individual disciplines addressed in each preceding chapter, but in practice they can often best be resolved in an integrated way, by conducting multidisciplinary surveys.

Physical oceanography

Knowledge gap:
Backlog in analysis of oceanographic data (discussed in Chapter 4)
Large quantities of oceanographic data have been collected with advanced on-board sensory equipment and satellite imagery during past *Nansen* surveys (especially after 2007), and the amount of data collected will likely increase in future surveys. Given the past scarcity of manpower to analyze the data, much of the data have been (and will be) stored, without further detailed analysis.

Suggestions for future work:
a) Detailed exploration of the archived *Nansen* data, to investigate oceanographic processes that remain enigmatic – for instance, the Southeast Madagascar Current retroflection, or the Mozambican coastal counter-currents;
b) More targeted sampling of oceanographic features of interest during future surveys;

c) Use of "Big Data" technologies able to handle data of vast size and high complexity (Chen and Zhang, 2014).

Ocean productivity

- ***Knowledge gap:***
  Absence of plankton indicators of environmental change (discussed in Chapter 5)
  Plankton are model organisms for monitoring ecosystem health, biodiversity and environmental variation in the marine environment, because they respond rapidly to environmental stressors. A plankton monitoring programme, to provide a suite of plankton indicators for marine environmental management issues, is suggested. Potential applications might include: climate change (for example, distributional shifts and range expansions of plankton populations), ocean acidification (impacts on calcifying species), eutrophication (algal blooms and consequential "dead zones" of bloom decay), productivity supporting fisheries (plankton hotspots, fish dependence on biomass, composition and timing of their plankton prey), invasive species (invertebrates via their planktonic stages), ecosystem health (harmful/toxic algal blooms, marine pathogens) and biodiversity (community changes, unusual species records).

- ***Suggestions for future work:***
  a) The EAF-Nansen Programme could assist with a coordinated monitoring programme by including previously sampled transects when revisiting an area. Such a programme would require close collaboration with local partners who would continue regular monitoring during periods when the *Nansen* is elsewhere; b) The *Nansen* can tow a Continuous Plankton Recorder (CPR) during long transits. Such a programme would require access to a centre with expertise in the enumeration and identification of CPR-collected plankton, which is currently lacking in the region.

Pelagic resources

- ***Knowledge gap:***
  Ecology and abundance of migrating small pelagic fishes (discussed in Chapter 6)
  Small pelagic fish stocks are most likely to be transboundary resources, which require regional scale surveys designed to identify seasonal migration and distribution patterns, and to define individual fish stocks. To date, surveys have mainly been restricted to narrow geographical ranges, to fall within country borders. Shelf areas shallower than 20 m depth have been under-sampled, because of vessel safety – a potential bias when assessing the fisheries potential of migratory species. Biomass estimates for the northern part of the Western Indian Ocean date from the 1970s and 1980s, and may not reflect recent biomass levels.

- ***Suggestions for future work:***
  a) The *Nansen* undertakes regional scale surveys designed to identify migrations, abundance and distribution patterns of small pelagic fishes, and to define individual fish stocks; b) The *Nansen* undertakes surveys to generate up-to-date biomass estimates and species composition indices of pelagic fish resources in the Somali Coast and East Africa Coastal Current (EACC) subregions – when the security situation in the area improves; c) A subsampling technique for nearshore waters (5–20 m depth) is developed – potentially in collaboration with regional partners.

Demersal resources

- ***Knowledge gap:***
  Spatio-temporal gaps in trawl data (discussed in Chapter 7)
  Demersal trawl surveys have been conducted mainly at national level, without consideration for an overall regional design. Hence the long-term database is permeated with spatio-temporal gaps, for which no trawl data exist for long periods (up to 17 years) and large areas (Somali Coast, EACC, Madagascar). The unbalanced nature of the database restricts the potential for generating long-term abundance indices. In addition, few trawls have been conducted

shallower than 20 m depth or indeed on the continental slope > 200 m. Other untrawlable areas also remain under-sampled. Although few past surveys specifically covered demersal fish biodiversity, Everett *et al*. (2015) noted the existence of a large quantity of stored trawl data (>1 500 trawls), which apart from Bianchi (1992), have not yet been analyzed in detail.

- ***Suggestions for future work:***
  a) The *Nansen* undertakes demersal trawl sampling according to a survey design developed to improve the spatio-temporal distribution of data at a regional level. Greater coverage is suggested for areas that have not been surveyed recently; b) A subsampling technique for nearshore waters (5–20 m depth) is to be developed; c) Surveys of untrawlable areas are increased, using methods other than trawling; d) Data-mining to study patterns in biodiversity and to verify ecozones (see Spalding *et al*., 2007) is done – these can be used to refine the spatial survey design in the future, for example, by basing survey design on ecozones instead of national boundaries.

Impact on science, capacity development, policy and fishery management

- ***Knowledge gap:***
  Limited use of Nansen data and inefficient transfer into policy and management (discussed in Chapter 8)
  The limited use of data collected during *Nansen* surveys may be attributed to a lack of capacity for data analysis and interpretation in the Western Indian Ocean region – especially in fields related to fisheries resource use. While the cruise reports provide timely scientific information, their format is not geared towards advising policy-makers or managers. Hence the new information is not incorporated into policy formulation or management in an efficient way.

- ***Suggestions for future work:***
  a) Encourage the use of data collected during past *Nansen* surveys. For example, funding of postgraduate research at local universities, based on analysis of stored *Nansen* data, and co-supervised by local and IMR scientists, would address several issues – such as use of data and development of regional scientific capacity; b) Improve the access to cruise reports and *Nansen* data within the Western Indian Ocean region, thereby encouraging their use; c) Generate specific fisheries management / policy advice reports – designed to efficiently convey scientific information to decision-makers at national and regional levels; d) Strengthen ties with regional fisheries management bodies, as a mechanism to increase uptake of management / policy advice at regional level.

Synthesis of results of the Nansen Programme

- ***Knowledge gap:***
  Inadequate regional infrastructure and expertise to sustain projects when the Nansen is not available (discussed in Chapter 9)
  The broad-based approach used by the Nansen Programme – to assist with collecting offshore data, encourage capacity development through training, and support policy implementation and fisheries management – is now well-established in the Western Indian Ocean, showing clear and enduring gains. However, there remains a shortfall in the region's institutions and individual scientists, to successfully continue and sustain the programme's longer-term projects without infrastructure support, for example, when the *Nansen* is deployed outside the Western Indian Ocean.

- ***Suggestions for future work:***
  a) Identify specific regional nodes and projects that can be supported over a longer term, especially in the absence of the *Nansen*. For example, a plankton monitoring programme in a specific area would require local infrastructure and expertise to conduct regular sampling, and to develop and monitor indicators. Logistically, sampling sites should therefore be located close to existing research facilities, with access to vessels (even smaller vessels) and the appropriate sampling gear; b) Longer-term collaborative projects between regional- and Norwegian scientists should benefit both parties – through

a transfer of scientific expertise to regional scientists, and a deeper understanding, by the Norwegian scientists, of the cultural and logistical challenges faced by their Western Indian Ocean contemporaries.

These suggestions should feed into the regional planning processes, such as that initiated in Durban (EAF-Nansen Project meeting, FAO, 2016). This meeting identified priority areas including:

- the identification of new resources to be exploited, especially deep-sea and small pelagics;
- assessment of exploited resources and examining possible connectivity between different populations;
- understanding enrichment processes such as upwelling and riverine nutrients and their variability and drivers, especially in relation to climate change;
- habitat characterization and setting baselines in areas where oil/gas exploitation is being planned.

10.5 Conclusion

The new EAF-Nansen Programme presents an exciting suite of activities, informed by emerging needs, pressing priorities and outstanding knowledge gaps, all of which adhere to the four themes of the envisaged Science Plan:

1. Fisheries resources
2. Impact of human activities
3. Climate change
4. Blue Economy

This makes the Programme well-positioned to contribute to research on any of the ten themes of the World Ocean Assessment: climate change, over-exploitation, food security, biodiversity, increased use of ocean space, pollution, cumulative impacts, inequalities in benefit distribution, management of human impacts, and delays in implementing known solutions.

Our review of the previous phases of the Nansen Programme identified some survey data limitations, mainly associated with uneven geographical coverage, temporal discontinuity, and undersampling of shallow, deep and untrawlable habitats. However, suggestions to redress the spatio-temporal imbalance of past surveys by developing techniques to sample shallow and rocky areas, and to set up baselines for long-term monitoring, should be approached in collaboration with local and regional institutions.

The limited use of past Nansen data in policy and management may be attributed to a regional lack of capacity for data analysis and interpretation. Scientific capacity can be enhanced through targeted interventions, such as building synergies between the EAF-Nansen Programme and universities in the region. Both partners could gain from such a network, in which the Nansen data gets used for applied research, while simultaneously, scientific capacity is developed at a post-graduate level.

It is increasingly recognized that sustained dialogue between scientists and policy makers is more effective than the traditional pipelines of just sending technical reports or publications to policy-makers and managers. A dialogue platform to strengthen the links between science, policy and action was proposed at the Eighth Conference of the Parties to the Nairobi Convention (Seychelles, June 2015). Further, the Southwest Indian Ocean Fisheries Commission (SWIOFC) provides a high-level forum for member countries to cooperatively decide on regional fisheries policy, management and research. The EAF-Nansen Programme could use the SWIOFC platform and structures more effectively to disseminate information and advice, including facilitation of data analysis, assessment and reporting.

Ecosystem-based marine spatial planning is recognized as an essential component for the implementation of a blue economy in the Western Indian Ocean. The EAF-Nansen Programme can contribute to the integrated ecosystem assessment process, as the basis for establishing sustainable

governance of ocean-based activities. Global indicators to assist countries in measuring progress towards achieving SDGs will depend on the ability to efficiently collect data, monitor targets and measure progress.

The EAF-Nansen Programme can assist partners in setting up baselines and tracking progress. Partnerships with governments, fisheries research and management authorities, regional and international organisations, and non-governmental organizations have played a key role in the successes of the EAF-Nansen Programme to date. These partnerships need to be maintained and expanded, where possible, to ensure that the projected outcomes of the programme are achieved. ■

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