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OCEAN ACCOUNTS PARTNERSHIP

FOR MALAYSIA

FINAL REPORT

**“A Study on the Sustainability of Fisheries of the
Straits of Malacca”**

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By

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EXECUTIVE SUMMARY OF THE FINAL REPORT

1. Introduction

This Executive Summary considers the highlights of the Scoping Report, Design and Selection of the Pilot, Pilot Results and considers some decisions for the Future and Conclusions.

2. Summary of Scoping Report

An extensive scoping study was carried out in the national implementation of SDG 14, where the mission, vision, objectives, policies, strategies, action plans, concerns and priorities, laws, and governance structures of the various agencies responsible for ocean governance in Malaysia were considered. The Scoping Report was circulated to all the ocean-related stakeholders and deliberated at the First National Workshop on Ocean Accounts for Malaysia. Stakeholders for this Project were divided into data providers and data users. There is no ocean policy in Malaysia although there is a National Policy on Biological Diversity 2016-2025.

3. Activities undertaken in Implementing the Pilot

3.1 Design and Selection of the Topic for Pilot at the First National Workshop

Fifty-three stakeholders from 30 agencies attended the First National Workshop on Ocean Accounts for Malaysia, organized on 4th and 5th April 2019 at the DOSM where they reviewed, responded and considered the priorities for further development by the Pilot. Four topics were adopted from these broad challenges. These were focused on a Study of

- (1) The Living resources (Straits of Malacca);
- (2) Protecting the marine habitat (Peninsular Malaysia);
- (3) Ocean conservation (indicators); and
- (4) Klang Straits (land-based).

The topic '*Living Resources of the Straits of Malacca*' in terms of work to be done required the compilation of existing data for the area. The six-month output would require drawing up an Inventory of available data and the running of Test accounts for extent & conditions. It was a Proposal for an analytical project. It required a collaboration between DOSM and the State & local authority, Department of Forestry, Department of Fisheries, Ministry of Water, Land and Natural Resources (KATS), Marine Parks Division, Ministry of Agriculture and Agro-based Industry (MOA), Fisheries Development Board of Malaysia (LKIM), Malaysian Institute of Maritime Affairs (MIMA), Local universities such as the University of Malaya (UM) and the

National University of Malaysia (Local universities), the Department of Minerals and Geoscience, the National Hydraulic Institute of Malaysia (NAHRIM) and the Drainage and Irrigation Department (DID). This topic got 22 votes.

For the topic ‘Protecting marine habitat (Peninsular Malaysia)’ the work to be done included getting data on Fish catch/stock, Ship movement and Mapping unprotected resources. The six-month output would require an Initial map of unprotected reserves, Test accounts for extent & aquatic resources and Assessment of pressures. It required a collaboration between the DOSM and Marine Parks Division, Department of Fisheries and Marine Department, the Department of Environment (DOE), State and local authority, and the Drainage and Irrigation Department. The priority accorded was one vote. This topic addressed concerns in living resources in the ecosystem of the coastal stretch of Terengganu in line with SDG 14 in the east coast of Peninsular Malaysia and port and fisheries activities in the area of the Klang valley (from the sea to river) as there were port activities contributions to marine pollution with impact on mangroves and fisheries.

The topic ‘Ocean Conservation (indicators)’ required work to be done on the water quality, CO₂ emissions, and land-based pollution. The six-month output required an Agreement on indicators, Mapping of spatial data, and Test accounts for conditions. It required a collaboration between DOSM and DOE, KATS, Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), DOA, and the Marine Department. The priority accorded was seven votes. This topic was concerned about the depletion of fish stocks and oil and gas resources; coral reefs; tourism and enhanced livelihood of the local communities.

The final topic ‘Klang Straits (land based)’ in Peninsular Malaysia required work to be done in two areas:

- (1) Distinguish land-based activities; and
- (2) Estimate pollutants.

The six-month output would be an Inventory of available data; Integration of scientific data; and Test accounts for water emissions, wastewater, and solid waste. It required a collaboration between DOSM and the DOE, Ministry of Water, Land and Natural Resources (KATS), Marine Department, DID, Port Authorities, NAHRIM, DOA, Forestry, UM and MIMA. The priority accorded was 12 votes. This proposal was concerned about the marine region which provides major ecosystem services to the Klang valley. Ports, invasive alien species, fisheries and aquaculture, indigenous population dependent on fisheries, land-based sources of marine pollution, mudflats and mangroves were considered in this topic.

The topic “Living Resources of the Straits of Malacca” garnered the most votes. However, it was not finalized by the DOSM. This topic was selected because it reflected on all SDG 14 targets, directly and indirectly. There were challenges to mangroves, coral reefs, mud flats along the Straits of Malacca. The impact of climate change and erosion, pollution and oil spills from ship collisions on these habitats in the Straits were considered. It was felt that the way forward was to increase the number and size of the marine protected areas, regulate mangroves and coral reef protection and enhance safety of navigation. For the Straits of Malacca, there was existing data on fish production (capture fisheries), fish price, a vessel list and vessel movements. There were also records of increase in fish stock, an increase in fishermen’s livelihoods, and guarantee of food security for consumption.

In conclusion, the First Workshop deliberated on the stressors on the oceans surrounding Malaysia and its resources. Only one topic would be confirmed for the Pilot: it was an important case study as it would be a prototype to conduct many more studies in the future, given the many issues and topics of concern.

3.2 Activities undertaken to refine the Pilot

The activities undertaken in refining and implementing the Pilot focused on the Establishment of a Working Group, Research, Consultation, Data collection, Integration, Mapping Analysis, Accounting, and Valuation. Considerations of data availability and time constraints, as this Pilot was the first effort of its kind in Malaysia, prompted several robust administrative and scientific meetings where a number of high-level and working groups were established and a specialist scientific team called the UM Team was constituted for this purpose. The Working Group (WG) comprised the High-Level Group of Stakeholders, the DOSM personnel and the UM Team. The High-Level Group (HLG) for the System of Environmental-Economic Accounting (SEEA) of Ocean Accounts in Malaysia took place on 2nd July and it was chaired by the Chief Statistician YBhg. Dato’ Sri Dr. Mohd Uzir Mahidin. On 23 July 2019 (Tuesday), the Small Working Group (SWG) met at DOSM for the first time. The SWG comprised the Department of Fisheries, Department of Environment, Plan Malaysia, Marine Department, Remote Sensing Agency, Forestry Department, the UM Team, DOSM and the Centre for National Geospatial Data. The UM Team comprised Professor Azizan Abu Samah, Dr Rizman Idid, Dr Wee Cheah, Dr Loh Kar Hoe, Dr Illyani Ibrahim, Dr Jillian Ooi, Dr Sahadev Sharma and Professor Mary George. The DOSM sought departmental approvals for the release of data upon agreement of the Pilot topic. Finally, there was an analysis and examination of the data presented and experimental results obtained at the Second National Workshop on Ocean Accounts for Malaysia held on 17 October 2019. The stakeholders adopted the results. The

Malaysian Pilot was presented at the Global Ocean Accounts Partnership, 12-16 November 2019.

4. The Pilot

4.1 Research Question

The research question focussed on food security risk under climate variability. The approach we took was from the ocean to land. Most of the other works are from land to ocean. So the Malaysian study is in the reverse.

4.2 Methodology

The study focused on fish landings in the west coast of Peninsular Malaysia in the Straits of Malacca from 1998 to 2017. Fish landings data were obtained by extracting data from the fisheries report published annually by the Department of Fisheries, Malaysia. Three major drivers that have an impact on fisheries in the Straits of Malacca were identified:

- (1) Sea surface temperature (SST),
- (2) chlorophyll a (Chl) concentration (indication of primary production) and
- (3) total suspended matters (TSM, indication of river runoffs i.e. nutrient input).

SST data were obtained from the National Oceanic and Atmospheric Administration (NOAA) Optimum Interpolated SST (OISST) product, Chl data from the European Space Agency (ESA) Ocean Colour Climate Change Initiative (OC-CCI) product, and TSM from ESA's MERIS satellite sensor.

4.3 Analysis and Finding

Overall, fish landings in the west coast of Malaysia Peninsular increased 31.1% from 1998 (551,183 metric tonnes) to 2017 (723,543 metric tonnes). Annual fish landings reached its peak in 2016. Seasonally, fish landings were high in summer and low in winter. On the contrary, Chl concentrations were high in winter and low in summer in response to low SST in winter and high in summer. Overall, Chl concentrations increased 17% and SST reduced 1.29°C. A drop of almost 70% of mangrove area was observed from 1995 to 2017 in the west coast of Peninsular Malaysia. In contrast, land-use for aquaculture and built-up area increased > 200% and 100%, respectively. Among the fish species, only anchovy appears to be sensitive to land-use change.

5. Future plans

The UM Team and DOSM are also considering implementing a similar pilot in the South China Sea. This Pilot brought statisticians, scientists and policy persons together for the first time under its umbrella. The experimental results of the Pilot endorse the impact of the climate on food security and primary productivity. As fisheries is under the purview of the agricultural division of the FAO, a joint workshop for a Food Balance Sheet (FBS) has been confirmed in DOSM by FAO where more than 20 agencies will be involved, on 25 - 29 November 2019 in Malaysia. The FBS is yet to be available in Malaysia. However, the national data is provided by DOSM, Ministry of Health and Ministry of Agriculture and Agro-Based Industry to FAO for the preparation of FBS Malaysia. It is currently being administered by the Ministry of Agriculture and Agro-Based Industry and the DOSM is going to spearhead the project on food security.

FINAL REPORT

1. Introduction

The Final Report of the Ocean Accounts Project for Malaysia highlights the importance of ocean accounts for Malaysia, the main features of the Scoping Report in relation to the Design and Selection of the topic for the Pilot, the Pilot Results and considers some decisions for the Future and Conclusions as was presented at the Global Oceans Dialogue, Sydney, 12-16 November 2019. Before I proceed any further, Malaysia would like to express its gratitude to UNESCAP and University of New South Wales for the great opportunity to share the experimental test results of our study entitled “A Study on the Sustainable Fisheries of the Straits of Malacca.” The Malaysian delegates who attended the event were Mrs Zakiah of the DOSM, Mr Ismail of DOSM, Mrs Khazlita of DOF, Mr Husni of MESTECC and members of the University of Malaya Specialist Team comprising Professor Dato’ Dr Azizan Abu Samah, Dr Wee Cheah and Professor Dr Mary George.

2. Malaysia

Malaysia is located in South-eastern Asia. The State attained independence on 31 August 1957 from the British Commonwealth of Nations. Malaysia comprises of a peninsula bordering Thailand to the north, Indonesia to the west and Singapore to the south and the northern one-third of the island of Borneo, bordering Indonesia, and Brunei. Malaysia has a tropical climate and two major monsoon seasons annually, the southwest monsoon from May to September and the northeast monsoon from November to February. The oceans are important to Malaysia as she borders the Straits of Malacca and Singapore, the Johore Straits, the South China Sea and the Sulu-Sulawesi Seas. Malaysia is a State Party to the 1982 Law of the Sea Convention (LOSC) since 14 October 1996. The Preamble to the 1982 LOSC states that the problems of ocean space are interrelated and need to be considered as a whole. Part XII of the 1982 LOSC on Protection of the Marine Environment refers to the sustainable development of the oceans by controlling marine pollution from a variety of sources and through cooperation and collaboration amongst States. The LOSC permits Malaysia to claim a 12 nm territorial sea, a 200 nm exclusive economic zone and a 200 nm continental shelf. The total length of the coastline is said to be 4,675 km, of which

- Peninsular Malaysia has 2,068 km; and
- East Malaysia has 2,607 km.

Recently in March 2019, our Prime Minister, Tun Dr Mahathir Mohamad, prioritized the need for Malaysia to be ‘a true maritime nation.’

To achieve this BIG picture, the nation needs to, amongst other initiatives:

1. Continue to track progress towards Sustainable Development Goal 14, alongside other SD Goals.
2. Establish an Ocean Accounts Partnership to bring together relevant government agencies, expert institutions and regional and international partners to integrate information from across scientific domains, policy frameworks and institutions to monitor progress on SDG 14.
3. Improve cross-sectoral policies that optimize the sustainable use of the ocean while minimizing the risk of ecological collapse and natural disasters.
4. Discard the former *laissez-faire* approach, speak with ‘one voice’ and adopt a responsible stewardship of the oceans and fulfil international obligations assumed by the nation.
5. Continue to honour the commitment to UNESCAP Resolution 73/5.
6. Continue to monitor Malaysia’s 11th Five-Year Development Plan.
7. Demonstrate benefits of ocean accounting in national and international fora building on existing work with Malaysia.
8. Build Capacity.
9. Set priorities.
10. Compile and analyse data.
11. Enhance partnerships among the Government of Malaysia and regional and international stakeholders.

The plausible concerns under SDG 14 are unsustainable fisheries, loss of mangroves, and marine pollution including oil pollution resulting in poor marine water quality in the Straits of Malacca. There are more than 30 stakeholders spread over many agencies and they are narrowed down to 12 as the most directly relevant and very important Ministries/agencies.

2.1 Stakeholders

The stakeholders for this Project were divided into data providers and data users.

Some examples of Data providers are:

- Ministry of Economic Affairs, Department of Statistics Malaysia (MEA, DOSM)
- Ministry of Water, Land and Natural Resources (KATS – translation into Malay)
- Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC)
- Ministry of Agriculture and Agro-based Industry (MOA)
- Fisheries Development Board Malaysia
- Department of Fisheries, and of Survey and Mapping
- Department of Environment – Water and Marine Division and the Environmental Quality Monitoring Programme

Some examples of Data users are:

- Prime Minister’s Department
- Ministry of Economic Affairs

- Ministry of Water, Land and Natural Resources
- Ministry of Energy, Science, Technology, Environment and Climate Change
- Ministry of Agriculture and Agro-based Industry
- University of Malaya
- Malaysian Institute of Maritime Affairs
- Government agencies, and universities

2.2 Initiatives

Though there is no ocean policy in Malaysia, there is a National Policy on Biological Diversity 2016-2025. Three targets are highlighted here:

Target 4: By 2025, our production forests, agriculture production and fisheries are managed and harvested sustainably. (KATS (formerly Ministry of Natural Resources and Environment), MOA)

Target 6: By 2025, at least 10% of coastal and marine areas, are conserved through a representative system of protected areas and other effective area-based conservation measures (KATS (MNRE)).

Target 7: By 2025, vulnerable ecosystems and habitats, coral reefs and seagrass beds, are adequately protected and restored. (KATS (MNRE), MOA)
Formerly, this responsibility lay with the MNRE.

2.3 Reasons for engagement with the Pilot

It was decided to engage in the Pilot Study, in order,

- To support the needs of Malaysia for integrated statistics to support integrated policies;
- To leverage on the Department of Statistics Malaysia's (DOSM) leadership to form a core working group; and
- To leverage on ESCAP's experience in implementing SEEA to support the Government of Malaysia in implementing SDG 14 and establish a national Ocean Accounts Platform and to support the development of a national work plan to strengthen statistics on oceans, and provide technical assistance on the compilation of Ocean Accounts.

2.4 Expected Outcomes of the Pilot

The expected outcomes were that the Pilot study would enhance Malaysia's capacity to develop and support integrated policies to sustainably manage the ocean, in line with SDG 14.

Over the short-term this was expected to identify overlaps, gaps and inconsistencies, if any, in policies and data.

Over the longer term, it was expected to improve the efficiency of data collection and the coherence of analysis to better report on and monitor these policies.

3. Scoping Report

An extensive scoping study of all the multi-stakeholders was carried out in the national implementation of SDG 14, where the mission, vision, objectives, policies, strategies, action plans, concerns and priorities, and laws, and governance structures of the various agencies responsible for ocean governance in Malaysia were considered. There are approximately 31 agencies/ministries involved in ocean-related matters in Malaysia. The Scoping Report was circulated to all the ocean-related stakeholders and deliberated at the First National Workshop on Ocean Accounts for Malaysia to deliberate on a suitable topic for the Pilot. This is considered below.

4. The Pilot

4.1 Design and Selection of the Pilot

Fifty-three participants from 31 stakeholder agencies attended the First National Workshop on Ocean Accounts for Malaysia, organized on 4th and 5th April 2019 at the DOSM where they reviewed, responded and considered the priorities for further development by the Pilot. Four topics were adopted from these broad challenges. These were focused on (1) A Study of the Living Resources (Straits of Malacca); (2) Protecting the Marine Habitat (Peninsular Malaysia); (3) Ocean Conservation (Indicators); and (4) Klang Straits (land-based). Votes were cast by the attendees to determine which topic would be accorded the highest priority.

The topic '*Living Resources of the Straits of Malacca*' in terms of work to be done required the compilation of existing data for the area. The six-month output would require drawing up an Inventory of available data and the running of Test accounts for extent & conditions. It was a Proposal for an analytical project. It required a collaboration between DOSM and the State and local authority, Department of Forestry, Department of Fisheries, Ministry of Water, Land and Natural Resources (KATS), Marine Parks Division, Ministry of Agriculture and Agro-based Industry (MOA), Fisheries Development Board of Malaysia (LKIM (Malay)), Malaysian Institute of Maritime Affairs (MIMA), Local universities such as the University of Malaya (UM) and the National University of Malaysia (Local univs.), the Department of Minerals and Geoscience, the National Hydraulic Institute of Malaysia (NAHRIM) and the Drainage and Irrigation Department (DID). This topic got 22 votes.

For the topic 'Protecting marine habitat (Peninsular Malaysia)' the work to be done included getting data on Fish catch/stock, Ship movement and Mapping unprotected resources. The six-month output would require an Initial map of unprotected reserves, Test accounts for

extent and aquatic resources and Assessment of pressures. It required a collaboration between the DOSM and Marine Parks Division, Fisheries and Marine Departments, the Department of Environment (DOE), State and local authority, and the Drainage and Irrigation Department. The priority accorded was one vote. This topic addressed concerns in living resources in the ecosystem of the coastal stretch of Terengganu in line with SDG 14 in the east coast of Peninsular Malaysia and port and fisheries activities in the area of the Klang valley (from the sea to river) as there were port activity contributions to marine pollution with impact on mangroves and fisheries.

The topic ‘Ocean Conservation (Indicators)’ required work to be done on the water quality, CO₂ emissions, and land-based pollution. The six-month output required an Agreement on indicators, Mapping of spatial data, and Test accounts for conditions. It required a collaboration between DOSM and DOE, KATS, Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), DOA, and the Marine Department. The priority accorded was seven votes. This topic was concerned about the depletion of fish stocks and oil and gas resources; coral reefs; tourism and enhanced livelihood of the local communities.

The final topic ‘Klang Straits (Land-based)’ in Peninsular Malaysia required work to be done in two areas: (1) To distinguish land-based activities; and (2) To estimate pollutants. The six-month output would be an Inventory of available data; Integration of scientific data; and Test accounts for water emissions, wastewater, and solid waste. It required a collaboration between DOSM and the DOE, Ministry of Water, Land and Natural Resources (KATS), Marine Department, DID, Port Authorities, NAHRIM, DOA, Department of Forestry, UM and MIMA. The priority accorded was 12 votes. This proposal was concerned about the marine region which provides major ecosystem services to the Klang valley. Ports, invasive alien species, fisheries and aquaculture, indigenous population dependent on fisheries, land-based sources of marine pollution, mudflats and mangroves were considered in this topic.

The topic “Living Resources of the Straits of Malacca” garnered the most votes. However, it was not finalized by the DOSM. This topic was selected because it reflected on all SDG 14 targets, directly and indirectly. There were challenges to mangroves, coral reefs, and mud flats along the Straits of Malacca. The impact of climate change and erosion, pollution and oil spills from ship collisions on these habitats in the Straits were considered. It was felt that the way forward was to increase the number and size of the marine protected areas, regulate mangroves and coral reef protection and enhance safety of navigation. For the Straits of Malacca, there was existing data on fish production (capture fisheries), fish price, a vessel list and vessel movements. There were also records of increase in fish stock, an increase in fishermen’s livelihoods, and guarantee of food security for consumption.

Table 1: List of Topics

Topic	Work to be done	6-month output	DOSM and...	Priority
Living resources (Straits of Malacca)	<ul style="list-style-type: none"> • Compile existing data for the area 	<ul style="list-style-type: none"> • Inventory of available data • Test accounts for extent & conditions • Proposal for analytical project 	State & local authority, Forestry, DOF, KATS, Marine Parks, MOA, LKIM, MIMA, Local univ., Minerals and Geoscience, NAHRIM, DID	22
Protecting marine habitat (2) (P.M'sia)	<ul style="list-style-type: none"> • Fish catch/stock • Ship movement • Mapping unprotected resources (tbd) 	<ul style="list-style-type: none"> • Initial map of unprotected res. • Test accounts for extent & aquatic resources. • Assessment of pressures 	Marine Parks, Fisheries and Marine Dept, DOE, State and local authority, DID,	1
Ocean conservation (indicators)	<ul style="list-style-type: none"> • water quality, CO2 • land-based pollution 	<ul style="list-style-type: none"> • Agreement on indicators • Mapping of spatial data • Test accounts for conditions 	DOE, KATS, MESTECC, DOA, Marine Dept.	7
Klang Straits (land-based)	Distinguish land-based activities and estimate pollutants	<ul style="list-style-type: none"> • Inventory of available data • Integration of scientific data • Test accounts for water emissions, wastewater, solid waste 	DOE, KATS, Marine Dept, DID, Port Authorities, NAHRIM, DOA, Forestry, UM, MIMA	12

In conclusion, the First Workshop deliberated on the stressors on the ocean surrounding Malaysia and its resources. Only one topic would be confirmed for the Pilot: it was an important case study that would be a prototype to conduct many more studies in the future, given the many issues and topics of concern. The DOSM accepted the broad topic of “Living Resources of the Straits of Malacca” but emphasized the need to fine-tune the topic.

4.2 Meetings and Second National Workshop to refine the Pilot

In the next few steps, the topic “Living Resources of the Straits of Malacca” was fine-tuned to “Sustainable Fisheries of the Straits of Malacca.” This was done through a number of high-level robust administrative meetings, and scientific discussions with the most directly relevant stakeholders held by DOSM. In summary, the activities undertaken in refining and implementing the pilot focused on the Establishment of a Working Group, Research, Consultation, Data Collection, Integration, Mapping Analysis, Accounting, and Valuation. Considerations of data availability and time constraints, as this Pilot was the first effort of

its kind in Malaysia, prompted the robust administrative and scientific meetings where various high-level and working groups were established. Besides, high-level and working groups that were established, a specialist scientific team called the UM Team was constituted for this purpose. The UM Team comprised Professor Dato' Dr. Azizan Abu Samah, Dr. Rizman Idid, Dr. Wee Cheah, Dr. Loh Kar Hoe, Dr. Illyani Ibrahim, Dr. Jillian Ooi, Dr. Sahadev Sharma and Professor Mary George. As the UM Team required data to conduct the Pilot Study on Sustainable Fisheries in the Straits of Malacca, it was necessary to seek and obtain departmental approvals for the release of data.

More specifically, the Working Group (WG) comprised the High-Level Group of Stakeholders, the DOSM personnel and the UM Team. The High-Level Group (HLG) for the System of Environmental-Economic Accounting (SEEA) of Ocean Accounts in Malaysia took place on 2nd July and it was chaired by the Chief Statistician YBhg. Dato' Sri Dr. Mohd Uzir Mahidin. It was decided to embark on "A Study on the Sustainability of Fisheries in the Straits of Malacca." On 23 July 2019 (Tuesday), the Small Working Group (SWG) met at the DOSM for the first time. The SWG comprised the Department of Fisheries, Department of Environment, Plan Malaysia, Marine Department, Remote Sensing Agency, Forestry Department, the UM Team, the DOSM and the Centre for National Geospatial Data. The DOSM sought departmental approvals for the release of data upon agreement of the Pilot topic. Finally, the UM Team using a mixture of national and international datasets presented the analysis and experimental results at the Second National Workshop on Ocean Accounts for Malaysia held on 17th October 2019, at the Institute of Ocean and Earth Sciences, University of Malaya (see Appendix 1). The stakeholders adopted the results and it was highlighted that the Malaysian Pilot would be presented at the Global Ocean Accounts Partnership, 12-16 November 2019.

4.3 UM Team

The Pilot was led by globally renowned scientist Professor Dato' Dr. Azizan Abu Samah, the Principal Investigator.

Following are the distribution of tasks of the team members.

Dr. Rizman Idid: Analysis and interpretation of fisheries data such as fish landings, number of vessels, vessel type, and landings by species.

Dr. Wee Cheah: Analysis and interpretation of satellite data of sea surface temperature, Chl concentration, total suspended matters and fisheries data.

Dr. Loh Kar Hoe: Analysis and interpretation of fisheries data such as fish landings, number of vessels, vessel type, and landings by species.

Dr. Illyani Ibrahim: Analysis and interpretation of changes in land-use data obtained from Landsat satellites.

Dr. Jilian Ooi and Dr. Sahadev Sharma: Interpretation and advice on mangrove habitats.

4.4 Research Question

The research question focused on the trends in fish landings in the west coast of Peninsular Malaysia over a 20-year period from 1998 to 2017. Factors contributing to fluctuation in fish landings such as number of vessels and gear, type of vessel and gear, sea surface temperature, chlorophyll a (Chl) concentration and changes in land use were investigated.

4.5 Methodology

Fish landings data from 1998 to 2017 were obtained from the annual fisheries reports published by the Department of Fisheries Malaysia. The annual fisheries reports were downloaded from the website of the Department of Fisheries. Tables on fish landings and related information in the fisheries report were first converted from PDF format to Microsoft Excel[®]. Extracted data include fish landings, number and type of licensed vessels (e.g. categorised by engine capacity 0-4.9 Gross register tonnage (GRT), 5-9.9 GRT, 10-14.9 GRT, etc., and inboard- and outboard-powered vessel types), number and type of fish gears, and type of fishes.

All fisheries related data comprise of total number or values for each state in the west coast of Peninsular Malaysia i.e. Perlis, Kedah, Penang, Perak, Selangor, Negeri Sembilan, Malacca, and the west coast of Johor. Three environmental parameters that are expected to have an impact on fisheries in the Straits of Malacca were identified: (1) Sea surface temperature (SST), (2) Chl concentration (indication of primary production) and (3) total suspended matters (TSM, indication of river runoffs i.e. nutrient input). The SST data were obtained from the National Oceanic and Atmospheric Administration (NOAA) Optimum Interpolated SST (OISST) product, Chl data from the European Space Agency (ESA) Ocean Colour Climate Change Initiative (OC-CCI) product, and TSM from ESA's MERIS satellite sensor. Information on land-use changes along the 5-km coastline band in the west coast of Peninsular Malaysia were identified based on the images captured by the Landsat satellites provided by the United States Geological Survey. Land-use changes were identified for years 1995, 2006 and 2017.

4.6 Analysis and Finding

Overall, fish landings in the west coast of Malaysia Peninsular increased 31.1% from 1998 (551,183 metric tonnes) to 2017 (723,543 metric tonnes). Annual fish landings reached its peak in 2016 (813,758 metric tonnes). Seasonally, fish landings were high in summer and low in winter. The increase in fish landings may have been attributed to the total number of licensed vessels and type of fishing gears used. Among the various licensed vessels, only the outboard powered vessels showed a marked increase in number from 2006 (11,434 vessels) to 2017 (15,563 vessels), whereas the number of inboard powered vessels remained constant for the last 20 years (average = 7552 vessels). Similarly, among the licensed fishing gears, the number of licensed drift/gill nets increased 147.78% (11,344 number licenses) from 2002

to 2014 but the number of licensed trawl nets have generally remained constant. Total fish landings from anchovy purse seines have decreased from 2008 onwards. Among the fish species, only anchovy appears to be sensitive to land-use change. Although the normalized fish landings per vessel showed a decreasing trend (-58.97%) from 5.376 metric tonnes/ vessel in 2005 to 2.206 metric tonnes/ vessel in 2014 in West Coast Peninsular Malaysia, the normalized fish landings for inboard powered vessels appear to increase (135.73%) from 4.31 metric tonnes/ vessel in 1999 to 10.16 metric tonnes/ vessel in 2017.

Seasonal trend of sea surface temperature (SST) in the Straits of Malacca were also high in summer and low in winter. The SST was observed to be sensitive to climatic phenomenon such as *El Nino*. During the strong *El Nino* years in 1998, 2010, and 2016, SST were anomaly high reaching beyond 30.5°C. A reversed trend was observed in Chl concentrations in which extremely low Chl concentrations were observed during the strong *El Nino* years. Seasonally, Chl concentrations were high in winter and low in summer in response to low SST in winter and high in summer. The reverse relationship between SST and Chl is statistically significant with a r value of -0.58 ($p < 0.0001$).

Over the 20-year study period, Chl concentrations increased 17% and SST reduced 1.29°C. On the other hand, a significant positive correlation was observed between TSM and Chl ($r = 0.35$, $p < 0.001$). Overall, no significant correlation was observed between fish landings and Chl concentrations. This is because fish landings are usually high in summer whereas high concentrations of Chl are usually observed in winter. The discrepancy may be due to a few factors such as a time lag between availability of food source and time required for fishes to grow and the number of days that a fisherman spent at sea are subjected to weather and vessel conditions, as well as maturity season of different fish species. In addition, fish landings data do not contain the information of the actual fish catch nor the location of fish stock.

It was observed, based on Landsat satellite images, that land-use changes along the 5-km stretch of the coastline showed a drop of almost 70% of mangrove area from 1995 to 2017 in the west coast of Peninsular Malaysia. In contrast, land-use for aquaculture and built-up area increased > 200% and 100%, respectively. Among the fish species, only anchovy appears to be sensitive to land-use change. Among the fish species, only fish landings in anchovy appear to follow the trend of coverage in mangrove areas. These findings show that the overall total fish landings in the west coast of Peninsular Malaysia are more sensitive to climatic changes such as warming and fluctuations in atmospheric and ocean conditions. In contrast, only selected fish species that rely on coastal habitats such as mangrove are sensitive to coastal changes.

5. Future plans and Conclusions

The UM Team and the DOSM are also considering implementing a similar pilot in the South China Sea. This Pilot brought statisticians, scientists and policy persons together for the first time under its umbrella. The experimental results of the Pilot endorse the impact of the climate on food security and primary productivity. As fisheries is under the purview of the agricultural division of the FAO, a joint workshop for a Food Balance Sheet (FBS) has been confirmed to be held in DOSM by the FAO where more than 20 agencies will be involved, on 25 - 29 November 2019 in Malaysia. The FBS is yet to be available in Malaysia. However, the national data is provided by DOSM, Ministry of Health and Ministry of Agriculture and Agro-Based Industry to FAO for the preparation of the FBS Malaysia. It is currently being administered by the Ministry of Agriculture and Agro-Based Industry and the DOSM is going to spearhead the project on food security.

APPENDIX: THE SECOND NATIONAL WORKSHOP, 17TH OCTOBER 2019

This Appendix contains the Programme and Presentations made by the UM Team during the Second National Workshop, held at the Institute of Ocean and Earth Sciences, University of Malaya

No.	Item	Tab
1	Conference Programme	A
2	“Reminder and Update on Ocean Accounts” by Michael Bordt	B
3	“Data availability and mapping classification feasibility on Ocean Accounts -from an ecosystem aspect” by Lyutong Cai	C
4	“General Overview” by Prof. Datin Dr. Mary George	D
5	“Fisheries in the West Coast of Peninsular Malaysia” by Dr. Mohammed Rizman Idid	E
6	“Primary productivity & Environmental Parameters in the Straits of Malacca” by Dr. Cheah Wee	F
7	“Land use in the West Coast of Peninsular Malaysia” by Dr. Illyani Ibrahim	G
8	“Living Resources of the Straits of Malacca: Fisheries” by Prof. Dato’ Dr. Azizan Abu Samah (not included here as submitted in the Final Report).	-